The Payment System

Design, Management, and Supervision

Edited by
Bruce J. Summers

International Monetary Fund

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Foreword

The International Monetary Fund has been providing technical assistance in central banking for many years. Recently, the massive structural changes that have been occurring in many economies in transition have greatly increased the demand for technical assistance in all areas, including central banking. In response to this challenge, and at the request of major central banks, the IMF has provided and coordinated central banking technical assistance to the states of the former Soviet Union and the Baltic States with the support of a number of cooperating central banks and other international organizations. This book on payment systems is a product of this joint endeavor.

Improvements in the payment system have been a top priority among central banking reforms for those countries moving away from centrally planned economies. Because in the previous regimes the payment system played a very different role from that played in market economies, transforming the old system to an efficient, reliable, and safe one was essential. This transformation has been crucial both to facilitate monetary management through market-oriented monetary instruments and to provide an efficient payment service to the financial system and the real sector. The importance of payment system reforms for monetary management and financial market development has motivated the IMF to work closely with cooperating central banks to provide technical assistance on payment systems and to coordinate these efforts with other international institutions. Such cooperation and coordination has been important because of the magnitude of the structural changes needed; the importance of consistency in changes within the payment system and with other central banking reforms; and the interdisciplinary nature of payment system reforms involving accounting, technology, monetary policy, and regulatory policy.

This book illustrates the support and cooperation that the IMF has received from cooperating central banks and other international organizations in assisting the countries in transition. The IMF is pleased to publish this book. It should bring to a broader range of practitioners a valuable presentation of the conceptual framework for payments and the analytic review of many practical issues of concern to transition economies, drawing on international experience.

Michel Camdessus
Managing Director
International Monetary Fund

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Foreword

The payment system is an essential part of the financial infrastructure in a market economy, where the organization and operation of the monetary, banking, and payment systems are determined largely by the needs of the markets, with official oversight to ensure stability and safety. Development of the financial infrastructure, including reform of the payment system, is a top priority in formerly socialist economies making the transition to the market system, including the economies of the countries emerging from the breakup of the former Soviet Union.

Over the past few years, the Group of Ten and other central banks have been providing technical assistance to the nascent central banks of the states of the former Soviet Union to assist them in reforming their financial systems, with a major emphasis on developing well-functioning payment systems. A significant part of this assistance has been organized under the aegis of the International Monetary Fund in cooperation with other international organizations. A major element of the technical assistance has been training, including operational exposure to the principles and practice of commercial and central banking in a market system.

In September 1992, the Federal Reserve jointly sponsored with the International Monetary Fund, the Organization for Economic Cooperation and Development, the Bank for International Settlements, and other central banks a two-week training program on the payment system for central bankers from the states of the former Soviet Union. The training program was organized by Bruce J. Summers, editor of this volume, who was then serving as Deputy Director of the Federal Reserve Board's Division of Reserve Bank Operations and Payment Systems.

The training program provided both the conceptual foundation for understanding payment systems in developed market economies and practical, hands-on exposure to payment system operations. Central bankers from around the world, with many years of diversified experience in payment system issues, conducted a series of seminars on payment system concepts and practices. These seminars were hosted by the Bank for International Settlements and the Federal Reserve System. Participants in the seminars visited central and commercial bank payment system operations in Zurich, Frankfurt, and New York.

This book is based on the lectures prepared for the training program. It is being published in English and Russian to broaden its accessibility. A complete range of topics is treated in a highly integrated and analytical fashion, and special emphasis is given to the design and operation of

large-value payment systems. The result is a valuable and distinctive analytical contribution to the literature that will be of interest to students of the payment system in both developed and emerging market economies. It is hoped that this volume will make a practical contribution to the design and management of payment systems, increase understanding of the relationship between the operation of the payment system and monetary policy, and further develop an appreciation for appropriate supervisory arrangements to ensure payment system stability and safety.

Alan Greenspan
Chairman, Board of Governors
Federal Reserve System of the
United States

Acknowledgments

This book was inspired by the personal experiences of the contributors in providing technical assistance on the payment system to the central banks of the countries emerging from the former Soviet Union. This technical assistance has been truly international, carried out by central bankers from around the world and coordinated by the International Monetary Fund. The book is an extension of this cooperation and is made possible by the collective endeavors of the contributors. Their efforts as teachers made the September 1992 training program possible, and their subsequent conversion of their lectures into articles made this book possible. I am grateful to all of them for finding time in their busy schedules to help make the book a reality. The views expressed by the authors are their own and should not be attributed to the institutions with which they are affiliated.

The September 1992 training program was a formidable undertaking requiring a great deal of advance preparation. V. Sundararajan, Deputy Director of the Monetary and Exchange Affairs Department of the International Monetary Fund, supported the original idea for the training program and encouraged the initiative. The Organization for Economic Cooperation and Development generously provided funding for the travel expenses of the central bankers from the former Soviet Union for whom the training program was organized. My colleagues at the Federal Reserve Board, especially Edwin M. Truman and Charles J. Siegman, Director and Senior Associate Director, respectively, of the Division of International Finance, were very generous and helpful in providing guidance and insight with respect to the planning for and organization of the training program. Further, Clyde H. Farnsworth, Jr., Director of the Board's Division of Reserve Bank Operations and Payment Systems, was most generous in accommodating the adjustments to my schedule and responsibilities necessitated by the demands of putting the program together. Jeffrey C. Marquardt and Nalini T. Rogers, my colleagues in the Division of Reserve Bank Operations and Payment Systems, worked closely with me in designing the training program and executing the many details necessary to make it a success. Their cheerful and dependable support was indispensable.

Special acknowledgment is due to Hans J. Blommestein of the Organization for Economic Cooperation and Development, who originally suggested that the lectures be turned into a book. Elin Knotter of the External

Relations Department of the International Monetary Fund edited the book for publication and directed it through production, which was ably carried out by the IMF Graphics Section.

BRUCE J. SUMMERS

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1

The Payment System in a Market Economy

Bruce J. Summers

The papers contained in this book address a broad range of policy issues and issues of practical implementation that arise in the design, management, and supervision of the payment system in a market economy. The payment system, which consists of the set of rules, institutions, and technical mechanisms for the transfer of money, is an integral part of the monetary system in such an economy. As such, the safe and efficient operation of the payment system is of concern to both market participants and public officials, especially central bankers. The perspective on payment systems provided in this book is that of central banking and is given by a group of people whose range of experience spans payment system operations in their own developed market economies as well as the emerging market economies of the states of the former Soviet Union and the Baltics.

In recent years, the issues related to payment system design, management, and supervision considered in this book have been at the forefront of public policy discussions in developed economies in Asia, Europe, and North America. Payment system issues have also received attention in connection with the transformation of former centrally planned, or socialist, economies into market economies, especially the economies of Central and Eastern Europe and the former Soviet Union. Experience in market reform has taught that the existence of a payment system that is responsive to the needs of individuals and businesses for safe and efficient funds transfers is an important part of the infrastructure needed to introduce a market economy successfully. In particular, a well-functioning payment system plays a crucial role in the development of interbank money markets and securities markets.

This introductory chapter describes the nature of transactions in a market economy and the use of money and credit through the payment system to facilitate transactions. It identifies key principles that underlie payment systems in market economies, regardless of their stage of development, and the unresolved issues that arise in connection with the payment system in both modern market economies and former socialist economies. Finally, it reviews the specific case of the former Soviet Union,

showing how these principles and issues manifested themselves during 1992 and 1993 in the transition of a major part of the world economy to the market model.

Transactions and Payment in a Market Economy

In a market economy, many transactions take place each day at the initiative of a large number of economic actors. In a market economy with a modern financial system, purchases of goods and services, including financial instruments, are paid for using money, either in the form of currency or deposits held in banks, and may involve the use of credit. Many participants in a market economy, including individuals, businesses in the real sector, and especially those dealing in the financial markets, face uncertainty regarding the timing of their payment receipts and expenditures. These uncertainties are related to a variety of factors, including the promptness with which parties that owe funds initiate payment, the choice of instrument used to make payment and the performance that type of instrument can deliver in terms of timeliness and processing efficiency, and the number of intermediaries involved in the payment stream. Further, the availability and cost of credit used by payors to bridge temporary shortfalls in their money balances can affect the overall efficiency and certainty of the payment system. Finally, well-developed markets tend to be less bound by geographic limitations and may be global in scope. Timeliness and certainty of payment can therefore be influenced by factors such as the different time zone locations of payors and payees and differences in hours of operation of national payment systems.

Participants in a market economy will enter into contracts that require payment for goods and services at specific times. Except where the suppliers of goods and services are willing to extend trade credit, they will require timely payment by a means that gives them immediate use of funds. Because of the uncertainty regarding the timing of receipts and expenditures and because many market transactions depend on payment by cash or the equivalent of cash, all economic actors will hold an inventory of currency or bank deposits to meet their contractual obligations.

It is inefficient, however, for every participant in the economy to hold a large enough inventory of currency or bank deposits to meet its obligations for payments under all possible outcomes entailing the timing of receipts against expenditures. It is probably more efficient for economic actors in the real sector to use payment services provided by credit-granting entities like banks, which are willing to extend credit to cover timing gaps between receipts and expenditures. For their part, banks must be ready at all times to honor payment orders for their customers. Banks themselves may experience gaps in the timing of their receipts and

expenditures, however, and will therefore rely on the interbank markets, and to some extent central banks, to provide short-term funding to meet their interbank settlement obligations.

Payment System Principles and Issues

As noted, the authors of the chapters contained in this book have extensive experience in matters relating to their national payment systems. They have also worked as donors of technical assistance, providing the benefit of their expertise to counterparts in former socialist economies making the transition to the market system. Such experience has led to the identification of certain basic principles that govern payment system design and policy in both types of economies. Further, and equally interesting, commercial and central bankers who share responsibility for building the financial systems of the emerging market economies have had to confront and make decisions fairly early in the reform process about a number of design issues that have not yet been finally resolved in many developed financial systems.

Experience in the technical assistance area has resulted in a large degree of acceptance among both donors and recipients of technical assistance of certain underlying assumptions and principles that can serve as building blocks in the development of modern payment systems. These principles are discussed in the next section. At the same time, a number of the issues that arise during the transition from a socialist to a market economy---especially regarding payment system design---cannot automatically be answered by turning to the developed market model for guidance. These issues are also discussed further below.

Common Principles

The first general principle is that a payment system that relies on fiat money as a store value and medium of exchange must enjoy price stability if an effective and efficient payment system based on the national currency is to develop. High rates of inflation render a currency virtually useless as a store of value and medium of exchange. Accordingly, and especially when a developing payment system has not yet achieved the level of technical performance that allows for highly reliable and timely processing of payment instructions, the public will seek ways to avoid using the national currency and payment system, especially deposit money in banks.

If the rate of inflation is high and it takes days or weeks to process payments, a particularly heavy cost is added to conducting transactions in

the economy. Economic actors will quickly turn to alternative means of payment, which might entail falling back on less efficient payment methods, such as currency, barter, or reliance on foreign currencies. Use of currency will guarantee certainty and finality of payment and, although awkward for large-value transactions, might be used to achieve more timely payment than the deposit money system. Barter and the use of foreign currencies provide ways of completely avoiding reliance on the domestic unit of value. Although use of currency, barter, and foreign currency are likely to be a costly means of paying for a broad range of transactions, their use is still relatively attractive if their cost is less than the inflation cost implicit in the use of domestic bank deposits.

A second general principle is that a nation's monetary regime, which defines the terms and conditions under which deposit money held in commercial banks and the central bank can be used, plays a major part in determining the choice of design for the payment system. As discussed in Chapters 2, 3, and 4, the relative attractiveness of clearing through a correspondent banking network versus clearinghouses and of relying on net versus gross payment will be heavily influenced by factors such as the level of reserves that commercial banks have to hold with the central bank, the assets that are eligible to meet reserve requirements, and whether reserve balances earn interest. The choice of payment system design, in turn, will directly affect the risk management procedures that need to be employed in a particular system.

The third general principle is that the technical efficiency of the payment system (that is, the cost effectiveness and physical performance characteristics) influences the efficiency with which the stock of deposit money balances in banks is used and the degree of credit and liquidity risk and fraud risk carried by a particular payment system. Therefore, the technical efficiency of the payment system is closely intertwined with issues of choice of payment system design and management of payment system risk. As discussed in Chapters 4, 9, and 12, timing delays in handling payments resulting from reliance on different types of processing systems lead to different trade-offs regarding costs of operation and risk exposures. Moreover, coordination of the timing of the handling of payment instructions and accounting for these instructions by entering debits and credits into the accounts of the customers of banks, discussed in Chapter 10, can contribute considerably to the overall monetary efficiency of the payment system.

The fourth general principle is that the payment process in a modern economy centers around economic actors' management of their stocks of currency and bank deposits and their access to sources of credit that can be used to obtain money balances. Therefore, as discussed in Chapters 2 and 10, the payment system has developed as an apparatus through which cash balances are transferred and by which credit is extended. This

is true for payment services in virtually all types of markets, including retail markets involving individual consumers, the retail trade, wholesale, and manufacturing sectors, and especially the financial sector. Identifying and managing credit and liquidity risks is therefore an inherent part of the payment process, as discussed in Chapter 7. Grasping the significance of the credit-related aspects of payment system operations is one of the more difficult, but at the same time more important, priorities in developing a payment system.

The fifth general principle concerns the legal framework governing payment transactions. As discussed in Chapter 5 in connection with large-value credit transfer systems, the legal regime can contribute substantially to the certainty of payment and, therefore, to the overall risk inherent in the payment process. The laws and regulations upon which payment relationships are based are as important a building block as are the institutions and operational systems that enter into the development of a modern payment infrastructure.

The sixth general principle is that, like many other financial components of an economic system, the payment system has public good characteristics that require a certain amount of official oversight and supervision. Self-regulation of payment institutions, such as clearing organizations organized and operated by banks, is an important element of the supervisory apparatus. At the same time, however, and as discussed in Chapter 11, an essential and important role exists for official supervision or oversight that in most countries is discharged by the central bank. As with the legal framework governing payment relationships, the supervisory "rules of the game" should be clearly stated and promulgated so they they are recognized by all major payment system participants. This will contribute significantly to the regulatory efficiency of the payment process.

Finally, it is universally accepted that final interbank settlement is best accomplished by the transfer of balances held in accounts with the central bank. The central bank is the logical final settlement authority because of its unique status as an institution that does not pose credit or liquidity risks to its account holders. Moreover, because of the role of reserve requirements in the monetary regimes of most countries, it is efficient for commercial banks to rely on accounts and balances held with the central bank to satisfy their interbank payment obligations. Chapters 2 and 3 describe the clearing and settlement system as an inverted pyramid, with the central bank at the apex. A complex set of payment transactions flowing through the economy ultimately achieve final settlement through the transfer of central bank balances between commercial banks. As described in Chapter 6, the real-time gross settlement approach is increasingly viewed as the most effective design for achieving final interbank settlement in central bank money.

Although the above principles are virtually universal for payment systems in countries at different stages of development according to the market model, at least three issues faced by newly developing payment systems have not yet been fully resolved in "mature" systems. The first issue concerns the appropriate division of labor between the central bank and the commercial banking system regarding operation of the payment system. It is clear that commercial banks should be responsible for providing account services to the general public and for the specialized payment services that accompany these account relationships. But it is less clear how active the central bank should be in providing interbank payment services, which may entail handling many individual payment transactions that enter the banking system and must then be cleared and settled on an interbank basis. Similarly, it is not completely clear what the role of the central bank should be regarding operation of the various components of the physical infrastructure of the payment system.

In fact, a variety of different models exist—most of which work quite well within their national contexts—that suggest different approaches to sharing the division of labor in the payment system between the commercial banking system and the central bank. As discussed in Chapter 11, these models range from the case of the United Kingdom, where the central bank currently plays a relatively small operational role, to that of the United States, where the Federal Reserve plays a large role.

The conditions under which the central bank participates in payment system operations may also vary considerably. For example, while the Federal Reserve plays a large operational role in the U.S. payment system as a provider of interbank payment services, these services are priced to recover their full cost of production, including variable, fixed, and imputed costs. In this way, market forces are relied upon to determine the most efficient mix of involvement in the market for payment services by the central bank and commercial banks. In some other countries, however, central bank operational services are subsidized, and the central bank's role in the payment system is treated more like a public good. The growing trend, however, seems to be toward some type of pricing of central bank payment services because of the benefits of relying on market mechanisms to determine efficient amounts and patterns of usage of payment services, a subject that is discussed in Chapter 9. Perhaps the best overall guidance that can be given to those responsible for payment system development in former socialist economies is that each country must carefully weigh its own circumstances in choosing a model that accommodates its needs. The right model will surely be influenced, to a large degree, by each country's own historical circumstances.

A second major issue concerns reliance on real-time gross settlement versus net settlement—particularly for large-value interbank payments. In developed financial and payment systems, a major contemporary question

is the degree of reliance on multilateral netting systems and the appropriate controls that such systems must employ to ensure their integrity. Controls permitting management of the credit and liquidity risks inherent in multilateral netting, described in Chapters 3 and 7, are not without cost, however. There may be differences in view between commercial and central bankers regarding the appropriate level of risk controls needed and, accordingly, the costs that multilateral netting systems should be willing to bear in relation to the risk reduction achieved. As noted earlier, the best that can be said at present is that final settlement for interbank obligations—including those arising in connection with participation in netting systems—should be achieved through the transfer of central bank money, preferably with same-day settlement. As technical systems become more sophisticated and cost efficient, and particularly as financial markets develop, the trade-offs between real-time gross settlement and multilateral net settlement must be carefully considered.

Finally, choices have to be made about the resilience of the operational infrastructures supporting the payment system, as discussed in Chapter 12. Significant dependencies are developed as newer and more sophisticated technologies are introduced into the payment process. Maintaining the levels of operational understanding and backup in automation systems needed to ensure that the payment system can continue to operate even in the face of unanticipated disruptions such as those caused by technical failures in key computer systems, natural disasters, or even civil disorder is expensive. But because the payment system plays such a key role in a modern economy, a fragile operational infrastructure cannot be tolerated. The question of how large an investment should be made in backup systems to ensure the appropriate amount of resilience is still outstanding.

Payment System Reform in the Former Soviet Union[1]

Since 1992, major efforts have been made to reform the banking systems of the countries emerging from the former Soviet Union to meet the requirements of a market economy. Reform of the payment system has been a top priority in these countries. Their financial and payment systems, like those of the former socialist economies of countries in Central and Eastern Europe, were organized, until recently, on essentially the same central planning model. In particular, their banking systems were

[1]This discussion is based on a presentation made by the author at the Bank for International Settlements on November 7, 1993.

based on "monobanks," in which the central bank played a dominant role in all aspects of banking, including the operation of the payment system. Money itself played a limited role in the economy. Central planning in conjunction with the monobank model is the starting point of payment system reform in the economies of the former Soviet Union. The sections below review progress in payment system reform in the former Soviet Union through 1993 and highlight opportunities for continuing that reform.

Recent Progress

When technical assistance work began in late 1991, the payment apparatus in the former Soviet Union consisted of cash exchange in the retail economy and a deposit money transfer system based on payment orders (credit instruments) and payment demand orders (debit instruments) in the enterprise sector. Individuals could also pay for some services received through the state, such as housing and utilities, using preauthorized transfers through accounts held at Sberbank, the state savings bank.

The payment systems inherited from the former central planning system and supported by Gosbank—the state bank of the former U.S.S.R.—were unsuited to a market economy. Under the socialist model, economic relationships were determined by central planners. The payment system, and indeed the entire banking system, essentially played an accounting role: maintaining a financial record of centrally planned economic activity. This payment apparatus was not, and did not have to be, particularly reliable or efficient. Timeliness of financial flows was also not essential because the ability to pay in a timely manner was not a factor in establishing economic relationships. Moreover, because payment was guaranteed under the central planning system, counterparties in trade transactions had no need to be concerned about payment system risks. Finally, because the transaction costs associated with the payment process were not shouldered by economic actors as an expense to be managed, there were no direct incentives to motivate efficient payment system operations.

After the introduction of market reforms in the early 1990s, difficulties in making payments had a negative impact on the performance of local markets and the interstate markets linking Russia to the other countries of the former Soviet Union, whose trade patterns were tightly related. The local currency payment systems almost collapsed under the stress of inflation. Dislocations in the transportation sector led to disruptions in the exchange of payment instruments between processing centers operated by the central banks of the former Soviet Union. Faced with this deterio-

rating predicament, many businesses turned to cash, barter, or the use of hard currencies to meet their payment needs.

A large buildup in interenterprise arrears, or trade credits granted between businesses, also occurred. Mechanically, these arrears arose because sellers could order funds transfers from the buyers' banks using an instrument known as a payment demand order, a debit payment instrument. Whereas buyers were at least nominally allowed time to decide whether to honor the "request for payment" represented by such an order, funds transfers were in fact often largely automatic if the buyer's bank agreed to honor that order. Banks refused to honor payment demand orders sent to their illiquid customers by transferring funds on behalf of these customers, and instead large arrears were recorded between enterprises. Thus, it was the illiquidity of buyers—combined with the sellers' willingness to continue delivering goods without receiving timely payment—that led to the arrears. This occurred in an environment of moral hazard, as it was expected that the government would support bankrupt enterprises by guaranteeing their creditworthiness.

In response to the problem with interenterprise arrears, in the summer of 1992 the central banks of the former Soviet Union prohibited the use of payment demand orders for most transactions. Almost all interenterprise payments using deposit money are now made through payment orders, that is, credit transfers that are initiated by the payor of funds. The stock of arrears was reduced through a program of payment netting among enterprises and government loans to allow net payment obligations to be met.

Although the operation of the payment system was not the principal cause of corporate illiquidity and the buildup of interenterprise arrears, inefficiencies in those systems in the countries of the former Soviet Union exacerbated liquidity difficulties throughout the economies of these countries. In particular, inefficient handling of payment orders and inappropriate accounting practices caused large amounts of central bank credit float in these banking systems.[2] As discussed in Chapter 10, credit float is the balance sheet result of debiting (with a credit transaction like a payment order) the bank account of the entity originating the payment before the offsetting credit is made to the account of the entity receiving the payment.

Central bank credit float decreases the balances of the commercial banking system with the central bank, thus lowering commercial bank reserves. This situation is ironic, as the central banks of the countries of the former Soviet Union, on the one hand, have followed accounting practices for payments that result in credit float and at the same time have

[2]See Bruce J. Summers, "The Developing Payment System in Russia," *Payment Systems Worldwide*, Summer 1993.

been concerned about the illiquidity of the financial system. The latter has been addressed by a continuing and liberal policy of providing credit directly to selected commercial banks for specific purposes. Thus, while central bank operational practices have resulted in a generalized removal of liquidity from the economy through the payment system, the central banks have directed liquidity back into the economy on a highly specific basis to selected economic sectors and enterprises. Accordingly, the central banks have become major financial intermediaries.

Improvements in the payment systems of these countries since 1992 have led to a reduction in credit float and increased the certainty and timeliness of payments. In the Russian Federation, for example, credit float is estimated to have been reduced by about half during 1993, from 30 percent to 15 percent of base money (that is, the stock of currency in circulation plus balances held by commercial banks with the central bank). Also, the monthly variation in float was reduced considerably in 1993 compared with 1992.

More timely and assured processing of payments and reductions in float were accomplished mainly through relatively inexpensive improvements in the physical apparatus for handling payments, especially the improved transportation of payment instruments. In smaller countries, such as Belarus and the Baltics, with only one, or just a few, central bank processing centers, time delays have been cut significantly, and payment instruments can now be processed relatively quickly. In larger countries, such as the Russian Federation, Kazakhstan, and Ukraine, with their much larger geographic area and many processing centers, interterritorial transactions are now more timely, but can still take days if not weeks to process. Within territories that share the same processing center, paper transactions can be handled very quickly, and even overnight.

But the monetary accounting practices of the central banks of the states of the former Soviet Union have not been changed to incorporate techniques routinely used in developed banking systems to minimize bank float, such as availability schedules. As described in Chapter 10, availability schedules are used to synchronize, on average, the accounting performed on both sides of payment transactions to minimize float.

The operational difficulties described above arose in connection with the national clearing systems managed by the central banks and with accounting practices for payments settled through accounts held with the central banks. These practical problems have led to substantial interest in forming privately operated clearing systems in a number of countries. Where this has occurred, they have relieved operational pressures on the central banks' clearing systems and contributed to more timely and reliable payment. The growing interest in private clearing systems, however, has progressed in fits and starts, partly because of official discouragement by some central banks. Official restrictions on private clearing persist in

some countries, where the central banks require all payments (including interbank payments and even payments between branches of the same bank) to be cleared through the official clearing system.

Private banks in some countries are gravitating toward a banker's bank model of interbank clearing rather than the traditional clearing organization model. Private banks are recognizing that they need to rely on interbank credit specifically to facilitate payments. Short-term funding to help meet interbank payment obligations cannot readily be obtained from the central banks of the countries of the former Soviet Union and, further, interbank money markets have not developed to the point where they can efficiently meet the banking system's liquidity needs. The central banks seem to be approaching the authorization of banker's bank arrangements with caution, partly because these institutions have, at least until recently, completely escaped regulatory oversight. The banker's banks, although essentially deposit-taking and credit-granting institutions like commercial banks—but with a specialized clearing and settlement role—have not been classified as commercial banks. Recent banking regulation in the Russian Federation, however, stipulates that banker's banks must comply with the same financial regulations, promulgated by the central bank, that apply to commercial banks.

A major concern is that private clearing arrangements, whether in the form of banker's banks or traditional clearinghouses, do not generally envision use of central bank accounts and balances for settlement of netted interbank settlement obligations. The private banks view their clearinghouses as an opportunity to disconnect entirely from the central bank, including for interbank settlement—an attitude that is encouraged by the persistent problems with the clearing systems operated by the central banks. In short, the interbank market appears to be willing to trade finality of payment in central bank money for greater speed and certainty in the clearing process.

In the initial phase of payment system modernization, payment systems serving enterprises and the interbank market have been accentuated, with relatively little attention paid to providing individuals and households with payment alternatives to cash, although planning has begun on giro systems in Lithuania and Latvia. A number of the new commercial banks are introducing modern payment services to their retail customers, with credit card services proving particularly popular. Several Russian commercial banks, including the quasi-public Sberbank, are taking the lead in importing technologically sophisticated consumer payment services, including on-line authorization systems for credit cards. To develop the banking system as a primary means of mobilizing savings and investment, better ways must be found to allow people to transfer their deposit and investment balances. Moreover, the development of the retail sector will be limited unless more efficient means of payment are introduced.

Future Opportunities

It is clear that important reforms have begun in the payment systems of the countries of the former Soviet Union. These reforms include operational improvements in the existing clearing systems operated by central banks, resulting in reductions in credit float and the start-up of private clearing organizations. Other important aspects of payment system reform have also been identified, including improvements to the reserve maintenance regime, consolidation of account relationships with the central banks and pricing of payment services they provide, and the establishment of large-value transfer systems.

Reform of the reserve accounting regime to rationalize use of central bank accounts for clearing and settlement is a high priority. Virtually all of the central banks of the countries of the former Soviet Union require that each private bank maintain two accounts: a reserve account and a correspondent, or clearing account. Balances in the reserve account are frozen, and required reserves are not available to fund payments. Consequently, a large amount of liquidity is withdrawn from the banking system as a result of the design of the reserve accounting system. The correspondent account is used to settle payments and is usually generously funded by banks to take account of the uncertainties regarding the timing of the clearing process and the costs imposed by the central banks on overdrafts. In fact, commercial banks have been holding excess reserves equal to about 60 percent of their deposits.[3]

One way of addressing this problem is to merge the reserve and correspondent accounts and implement a reserve-averaging procedure. This strategy is common in the monetary regimes of modern financial systems and would allow commercial banks to manage actively all of their liquid balances held with the central bank. Alternatively, the dual account arrangement could continue, and intraday overdrafts, up to a limit, could be permitted in correspondent accounts. The central banks would control their risks by setting the limit that each bank could have—equal to that bank's balance held in the reserve account. Essentially, overdrafts in correspondent accounts (both intraday and overnight) would be fully collateralized by required reserve balances. These possibilities are discussed in Chapter 4.

A related issue is that reserve and correspondent accounts are held with the central banks of the states of the former Soviet Union on a highly decentralized basis. Every branch of every bank holds separate accounts with the local office of the central bank. In the Russian Federation, cur-

[3]V. Sundararajan and Gabriel Sensenbrenner, "Linkages Between Payment System Reforms and Monetary Policy—The Recent Experience in the Russian Federation and Other Newly Independent States," paper presented at the Sixth Central Banking Seminar of the International Monetary Fund, March 1–10, 1993.

rently over one thousand local central bank offices hold accounts for commercial banks. This decentralized account structure fragments the banking system and discourages efficient management by private banks of their liquid balances. Consolidation of the geographically dispersed accounts into one, or at most a few, accounts would also facilitate more efficient clearing. Account consolidation, however, would require significant changes in the way private banks organize their financial management and accounting systems and substantial investments in automation systems, including telecommunications, to permit consolidation.

It is important to define the appropriate division of responsibilities between the central banks on the one hand and the private sector on the other with regard to the operation of the payment system. The central banks need to embrace fully their roles as ultimate settlement authority for interbank transactions and as supervisor of the payment system. The supervisory role needs to be institutionalized so that objective decision making is not influenced by the central bank's proprietary interest in performing payment operations. A closely related point is that central bank payment services that are now free should be priced. So long as these services continue to be free, they will be overused, and competition from private providers of payment services will be stifled.

Implementing large-value transfer systems to support the development of interbank markets is another priority in the countries of the former Soviet Union. These large-value transfer systems do not need to be sophisticated and expensive. They can be based initially on identification of "large-value" transfers early in the payment stream and expedited handling, even for paper-based instruments. This approach is being followed in the Russian Federation. The large-value transfer system will help reduce credit float, thereby increasing the liquidity of the banking system and economy generally. It is a necessary condition to the establishment of an efficient interbank funds market and, as noted below, a market for government securities.

A small number of countries, including the Russian Federation and the Kyrgyz Republic, have implemented book-entry securities clearing systems to handle new issues and secondary market trading of their countries' government securities. Such systems need to be developed promptly in virtually all countries that are issuing their own currencies. In the Russian Federation, a delivery-versus-payment system for Russian Government securities based on prepayment for securities has been organized outside the central bank by a private clearinghouse with the approval of the central bank. In the Kyrgyz Republic, the system is operated by the National Bank of Kyrgyzstan. Clearly, the basis now exists for implementing such systems widely, and each country should develop a delivery-versus-payment system that supports final payment for purchases of government securities in central bank money.

Conclusions

The payment system in a modern market economy is a specialized apparatus that the banking system is well-suited to provide. Experience has shown that there are common principles underlying the operation of both developed and developing market-based payment systems. They include the importance of low inflation in the domestic currency, the need for clarity in the monetary regime and legal framework, accommodation of the cash and credit management needs of economic actors, a sound technical infrastructure, sound supervision, and reliance on central bank money to achieve final interbank settlement. Outstanding issues remain, including the appropriate division of labor between the central bank and commercial banks in the operation of the interbank payment system, reliance on real-time versus gross settlement for large-value interbank transactions, and the extent of the investment needed to back up critical operational components of the payment system.

The countries of the former Soviet Union are well on their way to reforming their payment systems along the lines of a market model; considerable work remains to be done, however. Key choices focus on some of the issues summarized above. The design decisions that are made and the way these decisions are implemented will play an important part in these countries' transition to market-style economies.

2

Banking and the Payment System

Hans J. Blommestein and Bruce J. Summers[1]

A modern market economy depends on an effective and efficient payment system. Indeed, the efficiency of transactions in a market economy is to a large extent determined by the efficiency of the payment system. Key elements of the payment system are provided through services supplied by banks and through the infrastructure of the banking system—the central bank plus commercial banks. Accordingly, to understand how a modern payment system functions, it is necessary to understand the role played by banks as providers of payment services and the role of the banking system as a whole.

This chapter describes the structure and organization of the banking system in terms of its relationship to the payment system in a market economy. It describes the role of banks as providers of payment services and analyzes the interbank account relationships that permit a complex payment system to operate efficiently. It describes the role of the central bank in interbank settlement, discusses the interplay between the payment system and the money market, and presents a conceptual model of the payment and settlement system.

Bank Payment Services

A modern market economy is often described as having a two-tier banking structure. Under a two-tier banking structure, commercial banks provide services to the nonbank public, including nonbank financial firms, as well as to other commercial banks. The central bank, in turn, provides services to commercial banks and issues bank notes and coins (currency). The core services that banks provide are deposits (bank liabilities) and loans (bank assets). Of course, in accepting deposits, banks must maintain accounts for their customers.

[1]The authors appreciate comments on an earlier draft of this chapter by R. Alton Gilbert and Anatoli Kuprianov, of the Federal Reserve Banks of St. Louis and Richmond, respectively.

Directly related to the deposit, loan, and associated account services that banks provide to their customers are payment services. Bank payment services must be competitive vis-à-vis currency supplied by the central bank, which means that bank customers must find advantages to using bank deposit money rather than currency for at least some of their transactions. To be competitive vis-à-vis currency for purposes of payment, bank deposit money must meet two conditions. First, banks must provide transfer facilities for moving deposit money from account to account that are attractive to their customers. Attributes of an attractive funds transfer service include reliability, speed, low cost, and the provision of good records of transactions. Second, banks must provide conversion facilities that readily allow their customers to make and receive payments using bank deposit money in a variety of forms that are readily convertible with each other and with currency.

In fact, noncash payments account for the largest share of the total value of payments in a modern economy. In the United States, for example, noncash payments are estimated to account for nearly 100 percent of the value of all transactions. The public's demand for noncash payment services is satisfied in a competitive setting by the commercial banking system, which offers a wide variety of payment instruments to the public. Every economic actor depends on the payment system both to originate and to receive payments. Banks therefore strive to meet the needs of their customers both as originators and as receivers of payments. Not all customers are alike, and consequently banks must develop specialized business and marketing strategies for payment services, deciding whether they will compete in a limited segment of the market for payment services or attempt to offer a wide array of services. The most basic distinction between market segments in payments, as well as other banking services, is wholesale versus retail. The payment needs of the wholesale and retail markets, and the services devised by banks to meet those needs, are treated in Chapters 6 and 8, respectively.

Above all, a user of payment services expects to have convertibility among the different types of payment instruments that circulate among banks. An account holder who is the payee in a transaction will want to be able to receive payments into his bank account regardless of the choice of instrument made by the originator of the payment. For example, a payee may at any time receive payment in the form of a paper draft or an electronic giro, and may be asked to participate in an automatic debit program—all or any of which he will want to do to facilitate speedy and reliable payment. Consequently, a minimum condition for a bank to participate as a provider of payment services is that the bank must be prepared to receive virtually any type of payment instrument on behalf of its customers.

It has also become common, in both the retail and wholesale market segments, for banks to offer credit services as a direct extension of their

account and payment services. Especially for wholesale customers, and then particularly for wholesale customers that are active buyers and sellers of financial instruments, commodities, or other contracts giving rise to large payments, synchronization of inflows to and outflows from transaction accounts becomes difficult. These kinds of customers require working capital to fund their payments when expected receipts are late, and banks normally provide the type of working capital necessary to meet the needs of entities whose transactions accounts go into deficit. Within the last decade intraday credit has become a more important service that banks provide as a natural extension of the payment services they offer.

Depending on the nature of the payment business that a bank chooses to be in, its role in interbank settlement can be relatively larger or smaller. For example, as discussed in Chapter 10, a bank that is targeting primarily retail business will likely end up handling large numbers of smaller-value transactions on behalf of its retail clients. A bank competing in this market segment will probably augment the usual array of retail credit services with demand deposit account overdraft facilities to help retail clients better manage their liquidity.

A bank that is targeting primarily wholesale business will face a different type of demand for payment services. In particular, the volume, and especially the value, of transfers through the accounts that businesses hold with banks are likely to be much higher than those held for retail clients. Moreover, business customers are likely to be more demanding with respect to the bank's performance as a provider of services. For example, as discussed in Chapter 10, businesses often require current information on their account balances to assist in their cash management. Such information may be needed early each day, and perhaps several times during the day, and, to be timely, will have to be delivered electronically. Also, overdraft services provided through these accounts will likely play an important role in meeting the working capital needs of businesses.

Financial firms that are active participants in the money and capital markets such as brokers and dealers have extremely specialized payments requirements. In particular, the business of these firms results in rapid turnover of account balances because of the very large-value transfers that they make and receive during a normal business day. Banks offering services to these types of firms are in the most specialized payments business.

Interbank Account Relationships

As noted above, a variety of payment instruments are available to the public for transferring deposit balances held in banks. Regardless of the particular type of instrument used, whether it is a credit or debit

instrument, and whether it is in paper or electronic form, the purpose is the same—to effect a transfer of bank balances. If a payment order involves the transfer of balances between accounts held at the same bank, the transaction is referred to as an "on us" transaction or a "book transfer." If it involves the transfer of balances between accounts held at different banks, however, a more complex, interbank transfer comes into play.

In providing payment services, banks act as financial intermediaries. When a nonbank economic actor originates a payment to another nonbanking entity using bank deposit money, the bank of the originator of the payment and the bank of the receiver of the payment become parties to the transaction. For efficiency, originating banks may accumulate many smaller payments originated by their customers that are destined for counterparties holding accounts at another bank and send the individual payment instructions with one settlement total that satisfies the interbank claim. Alternatively, banks may participate in netting schemes by which interbank claims resulting from their own and their customer payments are offset, either bilaterally or multilaterally. With netting, the interbank settlement resulting from customer payments bears little resemblance to the size of the underlying transactions. By agreeing to handle their customers' payment transactions, banks intermediate by assuming interbank payment and settlement obligations.

Interbank settlement obligations arising from customer payments can be settled in three basic ways. First, banks can exchange currency to discharge their interbank obligations. Although legally permissible, frequent handling of large amounts of bank notes and coins is inefficient and risky and is rarely used as a method of interbank settlement. Second, banks can settle with each other by transferring ownership of funds they hold in bilateral accounts. Third, banks can settle with each other by transferring ownership of balances in accounts they hold with a third party, either another commercial bank or the central bank. The structure of interbank account relationships that supports settlement of interbank obligations in the second and third methods is described below.

The account that one bank holds with another bank is referred to using two different names, depending on whether the reference is made from the standpoint of the bank providing the account service or the bank using the account service, although it is the same account. Say that bank X is the bank that uses the account service of another bank and owns the balances maintained in that account. Say that bank Y is the bank that provides the account service and is therefore the bank on whose books the account is maintained. For the bank using the account service (bank X), the account is known as the nostro account and bank X is the nostro bank. For the bank providing the account service (bank Y), the account is the vostro account and bank Y is the vostro bank. In some countries, vostro banks are referred to as correspondent banks and nostro banks as respondent banks.

The nostro bank owns the funds held in its nostro account and alone controls the disposition of those funds. Only the nostro bank can order funds transfers from its account. In this sense, the vostro bank is simply the administrator of payment orders made by the nostro bank.

The vostro bank, however, establishes the terms and conditions under which the nostro account can be used. For example, the vostro bank will specify the level of service it will provide, including the timeliness and accuracy with which it processes deposits to and withdrawals from the account. It will also establish a fee schedule governing the payment services it provides and may set minimum balance requirements. Finally, and most important, the vostro bank will exercise control over the amount of credit it extends to the nostro bank through the account by limiting the amount of overdrafts it will permit, either intraday or overnight.

An example of how interbank settlement takes place using the mutual accounts that commercial banks hold with one another is illustrated in Table 1. The notation used is as follows:

DD_x = customer demand deposits held with bank X;
DD_y = customer demand deposits held with bank Y;
VD_x = the vostro deposit that bank Y holds for bank X;
VD_y = the vostro deposit that bank X holds for bank Y;
ND_x = bank Y's nostro deposit held with bank X;
ND_y = bank X's nostro deposit held with bank Y;
OA_y = other assets on bank Y's balance sheet;
OA_x = other assets on bank X's balance sheet;
OL_y = other liabilities on bank Y's balance sheet;
OL_x = other liabilities on bank X's balance sheet;
$TA_{x \text{ or } y}$ = total assets for the respective banks; and
$TL_{x \text{ or } y}$ = total liabilities for the respective banks.

In this simplified example, the entire commercial banking system consists of two commercial banks, whose initial balance sheets are shown in Part 1 of Table 1. There is no central bank nor are there required reserves. In this system, the total deposits of the bank and nonbank public equal

$$DD_x + DD_y + VD_y + VD_x.$$

Some simple identities hold:

$$TA_x = TL_x;\ TA_y = TL_y;\ ND_y = VD_x;\ ND_x = VD_y.$$

Assume that the customers holding deposit accounts at banks X and Y engage in transactions that are paid for using deposit money held with the commercial banks. For simplicity, assume that the transactions between customers of the two banks on any given settlement day result in a net transfer of deposits from the customers of bank Y to the customers of bank X equal to four monetary units.

Table 1. Effects on Bank Balance Sheets of Settling Payments—Two Commercial Banks

I. Initial Balance Sheets

BANK X		BANK Y	
ND_y	DD_x	ND_x	DD_y
OA_x	VD_y	OA_y	VD_x
	OL_x		OL_y
TA_x	TL_x	TA_y	TL_y

II. Effects of Transactions on Balance Sheets

A				B				C			
BANK X		BANK Y		BANK X		BANK Y		BANK X		BANK Y	
$ND_y + 4$	$DD_x + 4$	ND_x	$DD_y - 4$	ND_y	$DD_x + 4$	$ND_x - 4$	$DD_y - 4$	ND_y	$DD_x + 4$	ND_x	$DD_y - 4$
OA_x	VD_y	OA_y	$VD_x + 4$	OA_y	$VD_y - 4$	OA_y	VD_x	$OA_y + 4$	VD_y	$OA_y - 4$	VD_x
	OL_x		OL_y		OL_y		OL_y		OL_x		OL_y
$TA_x + 4$	$TL_x + 4$	TA_y	TL_y	TA_x	TA_x	$TA_y - 4$	$TL_y - 4$	$TA_x + 4$	$TL_x + 4$	$TA_y - 4$	$TL_y - 4$

Interbank settlement using nostro and vostro accounts and effects on the banking system's balance sheet are illustrated in Part II of Table 1. The example is based on the theory that commercial banks establish limits on the amounts they are willing to hold in their mutual accounts with each other. These limits are determined, in part, by interbank risk assessments, as the nostro bank assumes some credit risk from holding deposits with a counterparty vostro bank. In addition, however, nostro banks are profit maximizers and will seek the highest possible rate of return on investments, consistent with their need to hold clearing and settlement accounts. Nostro banks will therefore attempt to optimize the amount of reciprocal balances they hold, allocating the largest part of their portfolios to other assets including loans and securities.

Panel A of Part II of Table 1 illustrates the effect of a transfer of four monetary units' worth of deposits from the customers of bank Y to the customers of bank X (DD_y is decremented, whereas DD_x is incremented, by four monetary units). Where bank X is willing to accept payment from bank Y in the form of an increase in its vostro account, bank X's nostro deposit asset and bank Y's vostro deposit liability are each increased by four monetary units ($VD_x + 4 = ND_y + 4$). The total assets and liabilities of bank Y do not change, but those of bank X increase by four. Essentially, bank X has made a loan to bank Y and there is a total increase in the banking system's resources of four monetary units.

Panel B of Part II illustrates a case in which bank X is unwilling to increase its vostro deposits with bank Y. The alternative form of settlement illustrated is a reduction of bank Y's nostro debit with bank X ($ND_x - 4 = VD_y - 4$). Bank X's unwillingness to increase its nostro deposit with bank Y and bank Y's unwillingness, or inability, to transfer other liquid assets from OA_y to bank X has the result of reducing the banking system's total resources by four monetary units.

Panel C illustrates the case in which bank Y settles its interbank obligation with bank X for the transfer of four monetary units of customer deposits by a shift in other assets. For example, bank Y may simply pay bank X in cash, which reduces bank Y's total resources by four monetary units, increases bank X's total resources by four monetary units, and leaves the resources of the total banking system unchanged.

In practice, some vostro banks become highly specialized in the role they perform and therefore strongly influence the operation of interbank settlements and the money market. The importance of vostro banks in the money market is directly related to their dominant position in the payment system. In addition, however, the role of the central bank in the interbank payment process and the central bank's policies on the minimum reserve requirements it establishes and the payment credit it grants are key determinants of money market conditions. The role of the central bank in the interbank payment system and the interplay between the

central bank and vostro banks that determine money market conditions is addressed below.

Role of the Central Bank in Interbank Settlement

In a complex banking system with many participants, it is inefficient for banks to establish large numbers of bilateral relationships and to hold many nostro accounts. Maintaining nostro accounts can be expensive, as the vostro banks will assess fees for the account and payment services they provide. More important, however, nostro accounts can absorb large amounts of liquidity when nostro banks try to maintain the precautionary balances needed to settle obligations and to meet minimum balance requirements established by vostro banks. Accordingly, there is a finite limit to the number of nostro accounts that banks will want to hold, which stimulates competition among the vostro banks.

However, every bank must be prepared to satisfy its customers' needs to send money to or receive money from any other economic actor holding an account at any other bank in the system. This calls for a specialized, central institution that provides account services to virtually the entire banking system. This, of course, is an important role of the central bank.

In the banking vernacular introduced earlier, commercial banks hold nostro accounts with the central bank. The central bank, however, does not hold nostro accounts with commercial banks, at least not with respect to its domestic currency.[2] The central bank is a very important vostro bank because it holds accounts for almost the whole banking industry.

The nostro accounts that commercial banks hold with the central bank can be used to make interbank payments using "central bank money." Payment using central bank money is a unique form of payment, because such payments result in a claim on an institution that cannot fail and that, because of its money creation powers, will never suffer a shortage of liquidity. Consequently, recipients of payments in the form of central bank money assume no counterparty credit or liquidity risk. Moreover, payments made with instruments issued by the central bank are completely convertible, because all banks hold accounts directly with the central bank that they use to settle interbank payments or with vostro banks that themselves use central bank payment services.

The central bank establishes terms and conditions for the vostro accounts it provides. Balances held in central bank vostro accounts are almost always noninterest bearing. Further, many central banks establish

[2]Central banks in different countries maintain account relationships with each other. Further, central banks may also hold balances with commercial banks overseas in connection with the management of their foreign currency reserves.

minimum reserve requirements that commercial banks must meet, at least in part, by maintaining balances in their nostro accounts with the central bank. Central banks may also charge explicit fees for their payment services. Further, central banks can provide liquidity to individual commercial banks by granting central bank credit, which contributes significantly to the efficiency of a nation's payment system and is an important element in determining conditions in the domestic money market. By using central bank credit when liquidity is tight, commercial banks can ensure completion of payments on schedule. In a modern payment system, central bank daylight credit is especially important as a source of intraday working capital to banks. Short-term "daylight loans" to banks by the central bank, if not repaid by the end of the day, become overnight loans. Thus, there is a direct connection between a central bank's providing intraday credit and the management of its Lombard facility.

In a generalized model of the banking system, commercial banks that hold nostro accounts with the central bank should be divided into two groups—those that are eligible to use central bank credit and those that are not. In some countries, for example, certain classes of banking institutions, such as savings banks or bank-like institutions that are not required to hold reserves, may not be granted direct access to central bank credit. In any event, central bank credit to banks with access to this source of liquidity will be rationed, either by price or administratively.

Table 2 illustrates an example of the effects on balance sheets of the central bank and two commercial banks as a result of customer transactions. The notation is the same as that used in Table 1, with the following additions:

BL = loans by the central bank to commercial banks;
CC = currency and coin liabilities of the central bank;
GS = government securities investments of the central bank;
RA_x = reserve account balances held by bank X with the central bank; and
RA_y = reserve account balances held by bank Y with the central bank.

The nonbank public's payment transactions are the same in this example as in Table 1 for a banking system consisting only of two commercial banks.

Part I of Table 2 shows the initial balance sheets of the central bank and commercial banks X and Y. In this example the central bank acts as a vostro bank and the two commercial banks hold nostro accounts RA_x and RA_y, respectively, with the central bank. The central bank also makes loans to commercial banks and does so directly by creating an asset BL.

Panel A of Part II illustrates the case in which bank Y settles its interbank obligation to bank X associated with the transfer of four monetary units of deposits from bank Y's customers to bank X's customers. The

Table 2. Effects on Bank Balance Sheets of Settling Payments—Central Bank and Two Commercial Banks

I. Initial Balance Sheets

CENTRAL BANK

GS	RA_x
BL	RA_y
	CC
TA	TL

BANK X		BANK Y	
RA_x	DD_x	RA_y	DD_y
OA_x	OL_x	OA_y	OL_y
TA_x	TL_x	TA_y	TA_y

II. Effects of Transactions on Balance Sheets

A

CENTRAL BANK

GS	$RA_x + 4$
BL	$RA_y - 4$
	CC
TA	TL

B

CENTRAL BANK

GS	$RA_x + 4$
BL + 4	RA_y
	CC
TA + 4	TL + 4

BANK X		BANK Y	
$RA_x + 4$	$DD_x + 4$	$RA_y - 4$	$DD_y - 4$
OA_x	OL_x	OA_y	OL_y
$TA_x + 4$	$TL_x + 4$	$TA_y - 4$	$TL_y - 4$

BANK X		BANK Y	
RA + 4	$DD_x + 4$	RA_y	$DD_y - 4$
OA	OL	OA	$BL_y + 4$
		OL	
$TA_x + 4$	$TL_x + 4$	TA_y	TL_y

liability sides of the commercial banks' balance sheets are affected by the now familiar decline in DD_y and the increase in DD_x. To settle the customer payments, bank Y orders a transfer from its central bank nostro account, RA_y, to the central bank nostro account of RA_x. In this case, there is no change in the banking system's total resources, as bank Y transfers an existing asset to bank X. The effect is virtually identical to that explained earlier when bank Y paid bank X, using cash, as shown in Panel C of Part II of Table 1.

Panel B of Part II of Table 2 shows the effects of using the central bank for interbank settlements when bank Y has insufficient funds in its central bank nostro account to meet its interbank settlement obligation to bank X. In this case, bank Y must borrow from the central bank in the amount of

the settlement obligation, resulting in a new liability for bank Y, $BL_y + 4$. By agreeing to make the loan and transfer the proceeds to bank X, the central bank creates additional loan assets and would increase total reserves by four monetary units, unless it undertook an offsetting open market sale of assets of equivalent value. The banking system's total reserves now equal $RA_y + (RA_x + 4)$.

The Payment System and the Money Market

The interplay between the central bank's credit policies and those of commercial vostro banks determines money market conditions. An example might help illustrate this point.

Suppose that two banks, A and B, both hold nostro accounts with the central bank. As a result of its customers' payment activity, bank A faces a deficit in its nostro account, or at least is unable to keep its balance at the level necessary to satisfy its minimum reserve requirement. Bank B, however, holds excess reserves in its account, above the amount needed for settlement and to meet reserve requirements. Banks A and B can enter into a mutually beneficial loan of reserve balances if B charges A a lower rate of interest on an overnight loan than would the central bank. The interest rate charged by B will be between the rate it earns on its excess reserves (zero) and the rate charged by the central bank for overnight loans. Or, if the central bank sets the Lombard rate administratively and rations credit, B will charge a rate that is not high enough to induce A to overcome its reluctance to approach the central bank for a loan.

The situation with intraday funds is different because in most countries there is no market for intraday credit. In principle, however, intraday markets should operate like overnight markets, with reserves being allocated between banks' nostro accounts with the central bank depending on conditions of supply and demand.[3]

Whereas overnight central bank credit is well understood, intraday credit is a fairly modern phenomenon that has resulted from the emergence of new kinds of markets characterized by very high volumes and values of transactions that must be settled quickly. Examples include the markets for government securities, other financial instruments, and financial derivatives. Participants in these markets find it difficult to synchronize incoming

[3]An intraday market does exist in Japan for funds that settle at the three designated settlement times in the Bank of Japan Financial Network System (BOJ-NET)—a designated-time net settlement system. The Federal Reserve began charging explicit interest for intraday overdrafts in April 1994, a measure that could stimulate the development of a private market of some type for intraday funds in the United States.

and outgoing payments and therefore have a special need for bank intraday credit.[4]

As in other kinds of markets, participants in the high-value securities markets rely heavily on bank services to meet their payment needs. Activity in these markets therefore gives rise to interbank payments that have special characteristics, such as rapid settlement. Because a given security may be traded several times on the same day, the payments associated with each trade must settle within that day. The special settlement requirements of the high-value financial markets have greatly increased the value of intraday, interbank transfers and have led to very rapid turnover in the reserve balances that commercial banks keep with the central bank. To cite but one example, in the United States, the ratio of average daily payments settled on the books of the 12 Federal Reserve Banks to average daily reserve balances maintained has increased dramatically, from only about 1 in 1960 to over 30 in 1985, and over 60 by 1992. This rapid turnover in balances held in central bank nostro accounts explains the dramatic increase in intraday credit and the emergence of intraday credit as a major bank management issue.

Increasingly, the method used by central banks to supply interbank payment and settlement services while controlling their own risk is through large-value transfer systems. Although, as discussed in Chapter 6, these systems can be designed in different ways, the tendency is toward gross, real-time systems that provide final settlement. Such systems are flexible enough to support many types of interbank payment needs, including intraday or immediate settlement for financial market deals and settlement obligations resulting from netting performed by specialized clearing organizations.

A bank's payment system operations directly influence how it manages its cash position. Cash management is defined as those operations undertaken to regulate and control the assets a bank holds to make payment. The cash position of a bank is defined as the sum of three major items: (1) the balances in the bank's nostro account held with the central bank; (2) the balances in the bank's nostro accounts held with other commercial banks; and (3) the bank's holdings of domestic bank notes and coins. The objective of cash management is to keep the optimum amount of cash. The cash balance should be enough to satisfy the settlement obligations that arise from the payment behavior of the bank's clients and minimum balance requirements that may be set by the vostro banks, but not more than is needed for these purposes. In general, because cash is a sterile asset, cash managers will strive to keep on hand only what is absolutely necessary.

[4]David L. Mengle, David B. Humphrey, and Bruce J. Summers, "Intraday Credit: Risk, Value, and Pricing," *Economic Review*, Federal Reserve Bank of Richmond (January/February 1987).

Any surplus cash will be channeled to the money market. The major determinants of the cash positions that banks maintain are the volume and price conditions imposed by vostro banks, especially the central bank. The operation of a large-value transfer system is the primary channel through which central banks provide intraday credit. In this connection, and as discussed in Chapter 4, the conditions surrounding the demand for and supply of intraday credit have direct implications for short-term interest rate determination, including not only intraday rates but also the overnight rate. Accordingly, use of central bank accounts and credit to meet settlement obligations in connection with payment activity can have direct implications for interest rate determination in the overnight and 24-hour markets.

Payment System Hierarchy

The foregoing discussion suggests a payment system hierarchy that has been described as an "inverted pyramid."[5] At the top of the inverted pyramid is the broad base of economic actors whose daily activity in the market economy gives rise to payment obligations. This base consists of individuals who use retail payment services provided by banks, and a variety of business enterprises in the goods and services industries. The next level includes very specialized firms, such as brokers and dealers, involved in the money, capital, and commodities markets, which also rely on bank payment services.

All of the economic actors in the base of the inverted pyramid have one thing in common: they incur payment obligations and rely on banks for the services that allow them to discharge those obligations. But they may, either knowingly or unknowingly, rely on some type of clearing organization to clear and settle their transactions through the banking system. In any event, by using banks' services, their economic activity, in turn, leads to the banks' assuming interbank settlement obligations.

As described earlier, interbank settlement can occur between the commercial banks themselves, using nostro and vostro accounts, shown in the next narrower level of the pyramid. Finally, at the very pinnacle, is the central bank. The central bank holds accounts for virtually every commercial banking institution and serves as the ultimate settlement authority because it provides final interbank settlement in central bank money. Final settlement in central bank money is usually effected using a large-value transfer system operated by the central bank.

[5]See E. Gerald Corrigan, "Perspectives on Payment System Risk Reduction," in *The U.S. Payment System: Efficiency, Risk and the Role of the Federal Reserve*, ed. by David B. Humphrey (Boston: Kluwer Academic Publishers, 1990).

Conclusions

The banking system, consisting of commercial banks and the central bank, is the instrumentality through which payments are made in a developed market economy. Commercial banks provide settlement accounts and the liquidity needed to meet their customers' needs in making payments. Interbank settlement occurs through interbank account relationships, and of special significance in this regard are the nostro accounts that commercial banks hold with the central bank. It is through these nostro accounts that commercial banks achieve final settlement using central bank money. The operation by the central bank of a real-time gross settlement system for making large-value payments is the chief operational mechanism for effecting interbank settlement in central bank money.

3

Operational and Financial Structure of the Payment System

Paul Van den Bergh[1]

This chapter describes the operational and financial structure of a modern payment system. It provides a general structure of the payment system that builds onto the payment system hierarchy explained in Chapter 2, focuses on the interbank payment system, which lies at the heart of the payment process, and uses a simple numerical example to explain the key concepts of gross and net settlement.

General Structure of the Payment System

The payment system consists of the set of arrangements for discharging obligations assumed by economic actors whenever they acquire real or financial resources. In nonbarter economies, such obligations are discharged by transferring the title of ownership of a set of assets that, by virtue of their wide acceptability, are known as "money." Historically, money assets have taken the form of commodities (for example, gold or silver) or various types of IOU (I owe you) issued by government entities, financial firms, or private persons, which, in principle, could be redeemed in commodity money. In practice in modern financial systems, the set of money assets is more narrow, consisting of claims on the government (coin), the central bank (bank notes or bank reserves), or other depository institutions (bank deposits). These types of assets represent pure "fiat money," which means that they are not convertible into gold or other commodities. Fiat money is acceptable as a medium of exchange when the public has confidence in this form of money.

Included in the payment system are the mechanisms by which "fiat money" is transferred among economic actors when they settle their own payment obligations or when they act as intermediaries for third parties by providing payment services. These mechanisms include the institutions

[1]This chapter is based on earlier joint work with C.E.V. Borio of the Bank for International Settlements.

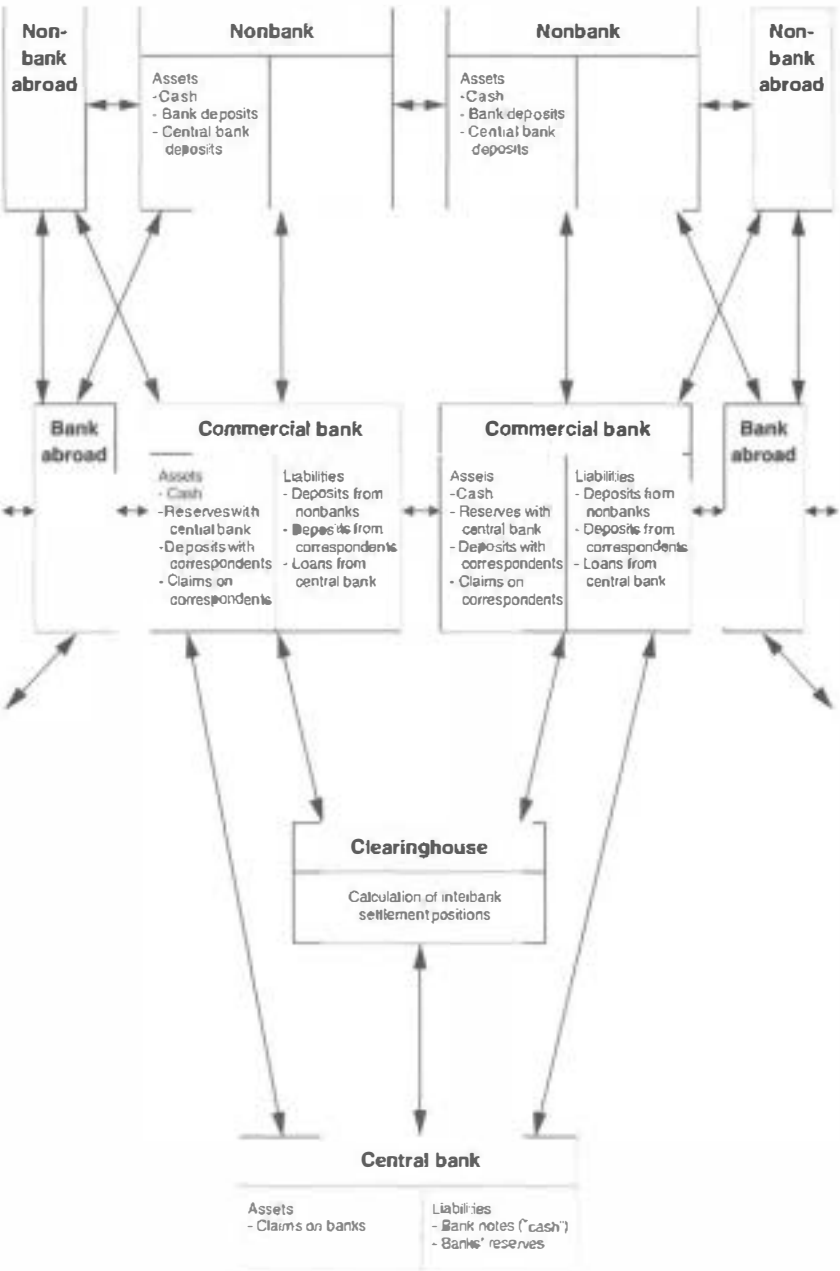
providing payment services, the various instruments used to convey payment instructions, the means of transferring those instructions (including communications channels), and the contractual relationships between the parties concerned.

Chart 1 illustrates the relationships and linkages between the major participants in the payment system. It is based on the payment system hierarchy and account relationships described in Chapter 2. The major payment system participants include nonbanks, commercial banks, clearinghouses, and the central bank. Funds transferred include (1) liabilities of the central bank held by the nonbank public (bank notes); (2) commercial bank deposits held with the central bank (commercial banks' reserve balances); (3) liabilities of banks vis-à-vis the nonbank public (bank deposits); and (4) liabilities of banks to other banks (correspondent bank deposits). Linkages to counterparties overseas and overseas banks are also shown to illustrate international commercial banking connections.

The most traditional and direct means of transferring funds between nonbanks is through the use of cash (bank notes). When cash is used to discharge an obligation, for instance, to buy a newspaper at a kiosk, payment is made directly and immediately for each individual transaction: in other words, settlement is gross and takes place in "real time." In contrast, the transfer of ownership of deposit money in banks must take place by book-entry on the accounts of the issuing institutions, that is, the central bank or commercial banks. In this case, an economic actor instructs a bank to transfer funds from its account ("the payor") to the account of another economic actor ("the payee"). A lag usually occurs between the time the payment instruction is issued and the time the actual book-entry transfer of deposits takes place, signifying settlement of the payment. When the payor and payee hold accounts with different banks, the execution of a payment order requires the payor's bank to transfer funds to the payee's bank, giving rise to an interbank transfer. Thus, payments involving deposit money give rise to a chain of instructions and book-entries. A single payment can consist of a number of related transfers of funds.

Interbank funds transfers are transfers of funds in which the banks are in the role of payor and payee. Such transfers originate either when banks send payments to one another in response to payments between their customers or when they discharge obligations they have incurred with one another, for example, in money market transactions. Three main methods are used for these transfers. The first method consists of the crediting and debiting of interbank payments to nostro and vostro accounts held bilaterally between banks. In this case, the banks will agree to adjust any large imbalances that may accumulate on their accounts through periodic transfers to or from another institution (cover payments), or an interbank loan. The second method involves crediting and

Chart 1. Payment System Participants, Message Flows, and Funds Transferred



debiting accounts held with a third party correspondent bank. The third method involves debiting and crediting accounts that the banks hold at the central bank, which is a specialized banker's bank.

Every single underlying transaction, involving either the customer of a bank or transactions made by banks for their own account, can be carried out by making a corresponding interbank funds transfer. In this case, interbank settlement is on a gross basis. Alternatively, individual payment obligations can be made subject to mutual offset in a netting arrangement, with settlement of net obligations occurring at the end of a designated settlement period. In the case of netting, individual payment instructions are processed and book-entry records are updated to reflect the underlying payment transactions. The interbank exchange of funds to settle all the underlying transactions, however, is on a net basis.

Funds transfers may take the form of credit or debit transfers. In a credit transfer (also called a giro instruction in some cases), the payor instructs the bank to transfer his funds to the payee. In contrast, in a debit transfer (for example, using a check), the payment is initiated by the payee, who instructs the bank to transfer the payor's funds, usually after prior authorization by the payor.[2] With regard to the technology used to make payment instructions, funds transfers can be classified in terms of the form taken by the instructions and the advices of delivery (paper or paperless) and, in electronic payments, by the transmission channels used (telephone, telex, or computer-to-computer telecommunications).

Financial systems in modern market economies offer economic actors a variety of ways to make payments. Economic actors can select the instrument that best suits their needs with respect to speed of execution, transaction cost, and the local customs or legal arrangements governing payment obligations. Small-value retail transactions, for instance, can be settled using cash, checks, credit cards, debit cards, or credit transfers, each of which may involve manual operations, telephone, mail, or magnetic media.[3] Businesses will most likely present bulk giro instructions or direct debit orders to their banks on magnetic media such as tapes and diskettes, or by the electronic transfer of computer files. For large-value payments in which timing is critical, such as those associated with trading in financial instruments, more sophisticated electronic funds transfer systems will normally be used, although in some countries traditional manual instruments such as checks drawn on commercial banks or on the central bank are still used.

As with domestic payment arrangements, cross-border payments involve a variety of payment intermediaries, instruments, legal forms, and

[2]Other terms used to characterize the difference between the two types of payment instructions are "credit push" and "debit pull."

[3]These forms of retail payments are described in more detail in Chapter 8.

communications channels. An added complexity is that more than one geographical area or political jurisdiction is involved in international payments and, as well, such payments may include multiple currencies. Nonresident banks participate in domestic interbank funds transfer systems either indirectly through correspondent banks or directly through their subsidiaries chartered in the host country in which the payment is to be made, or through their branch offices located in the host country. These subsidiaries or branches may themselves hold accounts with the host country central bank.

In terms of Chart 1, cross-border payment system arrangements entail linkages at the level of nonbanks and banks in different countries, but not at the level of the clearinghouse or the central bank. Accordingly, payments in any particular currency tend to be executed through banks chartered and located in the country of issue or through the subsidiaries or branches of foreign banks located in the country of issue. Economic actors may, in principle, be able to use foreign currency accounts with a bank abroad to make their payments in that country. It is more likely that they will rely on the international payment services offered by their home country banks, which will, in turn, make use of their own branches, subsidiaries, or correspondent banking relationships, to execute cross-border transactions.

The structure of the payment system shown in Chart 1 can be described as an inverted pyramid. This structure is fundamental to the banking and financial systems in modern market economies. It reflects a high degree of specialization and sophistication and highlights the special role of banks in providing payment services. Banks are equipped to play the role of payment intermediaries because they hold the settlement accounts of those engaged in economic activity.

There are good reasons why nonbank economic agents find it useful to accept claims on commercial banks as a settlement medium. These claims are liquid in that they can be transferred almost immediately at par. Moreover, their credit quality is generally easier to monitor compared with that of claims on nonbank institutions. Also, given the crucial role of banks in the financial system, a sophisticated public safety net has been developed to protect the economy from the potential adverse effects of the failure of a particular bank or group of banks. As described in Chapter 11, this safety net includes deposit insurance schemes, banking supervision, and central bank liquidity support facilities.

Banks also play a key role as payment intermediaries because they can provide credit services in addition to pure payment services. By offering such credit services to their clients (and to one another), payment obligations can be discharged even though the payor may not have the funds immediately available when the payment is due. In essence, banks provide the liquidity to allow the payment process to run smoothly. The

importance of the link between money transfer services and liquidity facilities is clearly seen in the capital markets, where many nonbank participants rely heavily on bank credit facilities during the day and overnight to effect the time-critical payments related to the settlement of securities transactions.

The inverted pyramid structure also emphasizes the central bank's crucial role in the payment system and more generally in the banking system. Since central bank reserves are intrinsically default free, banks normally prefer to settle their interbank payment obligations through the transfer of such claims. Even if these reserves do not bear interest, banks will always want to hold a minimum amount of reserves with the central bank to meet their interbank settlement needs. Given the general acceptability of deposits held with the central bank for interbank funds transfers and because the central bank is a monopoly provider of this type of money, the central bank is able to set the conditions under which it will make these reserves available to the banking system, thereby providing it with a key tool to conduct monetary policy. It also allows the central bank to play a stabilizing role in the interbank money market, such as when the commercial banking system's demand for bank reserves suddenly rises in periods of financial stress (the so-called lender of last resort function of central banks).

Interbank Funds Transfer Arrangements

As mentioned above, the execution of nonbanks' payment orders will often entail a chain of payment messages and book-entries by various intermediaries, especially when the counterparties do not hold accounts at the same bank. The characteristics of these chains of messages and funds transfers depend on a variety of factors, including the degree of concentration in the banking system. High concentration reduces the likelihood that customer transfers will involve shifts of deposits between different banks. Banking concentration is determined by the number of banks in a country, the dominance of large institutions as measured by market share, and the geographical areas within which different banks operate.

Another factor affecting the chain of payment instructions may be the existence of different types of banking institutions, such as commercial, savings, or cooperative banks, which provide payment services to their customers and may set up interbank funds transfer systems within their own groups. Intragroup settlement may then occur through correspondent account relationships, often through a central group institution acting as a bankers' bank for its members.[4]

[4]The services of such central institutions may not only include clearing and settlement services but also the provision of credit facilities, investment services, and the like.

Some geographic segmentation in interbank funds transfer arrangements may exist, typically in the form of local or regional clearinghouses. This stems from the potential cost advantages of processing transactions in the area in which they occur. Thus, banks operating on a nationwide basis may clear and settle a large portion of their payments directly through local facilities. Geographic segmentation and local or regional clearing are common where the technology used involves the physical exchange of payment instructions, either on paper or magnetic media.

As suggested above, an important factor influencing the operation of the interbank funds transfer system is the use of information technology. Electronic processing and telecommunications, for example, have enabled the introduction of continuous or real-time gross settlement systems that transfer funds among centralized accounts at the central bank. In many modern financial systems, automation has led to greater specialization in payment systems, such as large- and small-value payments. Today, paper and automated clearinghouses (ACH) generally process the bulk of small-value payments related to commercial and retail transactions. In addition, in almost every country there is now at least one large-value electronic interbank transfer system, providing same-day settlement and finality for interbank and wholesale payments. The role of technology in the payment system is described more fully in Chapter 12.

With respect to the operational characteristics of interbank funds transfer systems, a distinction can also be made between batch and real-time systems. A batch system involves the transmission or processing of a group of funds transfer instructions at a single point in time. Manual clearinghouses operate in batch mode. Automated clearinghouses typically receive and send bulk payment instructions via magnetic media or telecommunications and will process the payments on computers at a particular time during the day.

In a real-time system, the transmission and processing of payment instructions takes place payment-by-payment at the time each payment is initiated. Information pertaining to incoming and outgoing instructions is thus available continuously. Modern telecommunication and computing facilities are required for real-time processing, which although typically used in gross settlement systems, may also be used in net settlement systems.

In cross-border payments, the chain of messages and book-entries involves a complex, multinational network of banks active in their respective domestic payment systems that provide specialized clearing services. Banks involved in executing cross-border payments are linked by a series of communication networks that carry funds transfer instructions through the respective domestic payment systems. The networks may be operated by the post, telegraph, and telecommunications authorities or by banks themselves (proprietary networks), central banks, or other suppliers of telecommunications services. Among the private message carriers, the

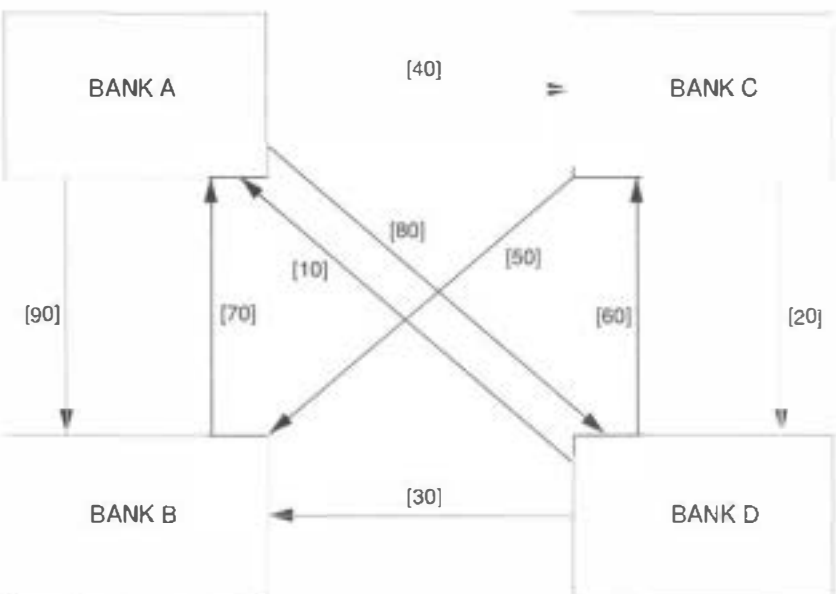
Society for Worldwide Interbank Financial Telecommunication (SWIFT), which is a specialized cooperative company owned by banks, is the system most widely used to convey cross-border payment instructions.

Gross and Net Settlement

As noted above, the interbank funds transfers relating to payment instructions can be settled individually on a gross basis. To reduce the need to hold large balances in the settlement medium for settlement purposes, especially deposits at the central bank, and to help manage interbank risks associated with settlement, banks rely on netting arrangements.

In netting, banks send information related to individual payments to a single location, the so-called clearinghouse. The banks participating in the

Chart 2. Example of Interbank Funds Transfer System with Gross Settlement

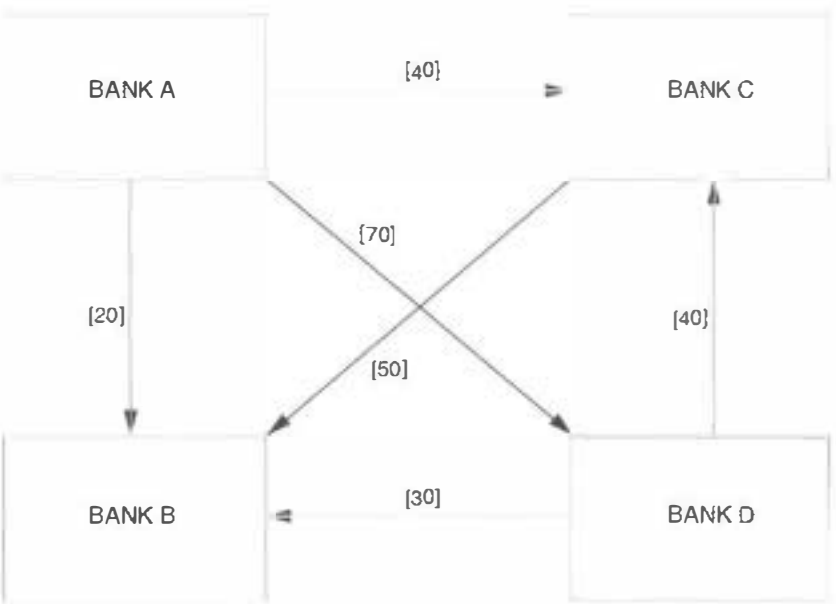


Number of potential interbank communication channels:	6
Number of interbank payment messages exchanged:	9
Number of actual interbank funds transfers:	9
Value of actual funds transfers made by banks:	450

clearinghouse agree not to settle for each individual payment immediately through interbank funds transfers, but to let their claims and obligations accumulate over a certain period (called the clearing cycle) and to offset incoming and outgoing payments. Banks then transfer only the value of their net obligation to the clearinghouse at a designated settlement time at the end of the clearing cycle. Settlement typically takes place at the end of the day on the books of a settlement bank, normally the central bank. But it can also take place one or even more business days after the calculation of the net positions. Further, it is possible to settle net obligations through nostro accounts held with a commercial bank.

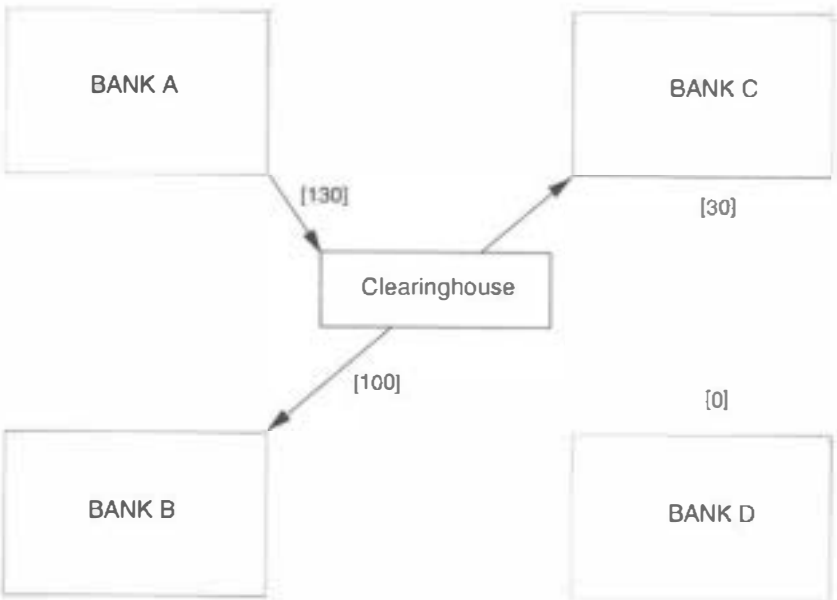
Charts 2–4 illustrate the different financial effects of gross, bilateral net, and multilateral net settlement, respectively. The examples are simple but the effects of netting that are demonstrated are quite realistic. Chart 2 shows that with gross settlement payment messages are exchanged

Chart 3. Example of Interbank Funds Transfer System with Bilateral Net Settlement



Number of potential interbank communication channels:	6
Number of interbank payment messages exchanged:	9
Number of actual interbank funds transfers:	6
Value of actual funds transfers made by banks:	250

Chart 4. Example of Interbank Funds Transfer System with Multilateral Net Settlement



Number of potential interbank communication channels:	4
Number of interbank payment messages exchanged:	9
Number of actual interbank funds transfers:	3
Value of actual funds transfers made by banks:	130

between each pair of banks, resulting in a relatively large number of communications channels (six in the case of the four banks shown). Banks settle each and every payment individually through funds transfers. In the nine interbank payments exchanged, nine interbank funds transfers are actually made with a total value of 450 units of account. If settlement takes place on reciprocal correspondent accounts, each bank needs to hold an account with each other bank.

The example of bilateral net settlement in Chart 3 shows that little has changed in terms of the total number of communications channels potentially needed. Since in this case the banks offset their bilateral obligations resulting from the various instructions sent to and received from one another, the total value of actual settlements made is significantly reduced, to 250 units of account. The banking system's need for settlement balances is thus reduced by almost half.

Table 1. Bookkeeping Record of Multilateral Net Settlement System for Credit Transfers

I. Gross Payments Among Banks Before Netting

Bank sending payment	Bank receiving payment				Sum of obligations
	A	B	C	D	
A	—	90	40	80	210
B	70	—	0	0	70
C	0	50	—	20	70
D	10	30	60	—	100
Sum of claims	80	170	100	100	450

II. Net Claim (+) or Obligation (-) of Each Bank with Clearinghouse

Bank	A	B	C	D	Net net
Total	–130	100	30	0	0

Source: Based on George R. Juncker, Bruce J. Summers, and Florence M. Young, "A Primer on the Settlement of Payments in the United States," *Federal Reserve Bulletin*, Vol. 77 (November 1991), p. 852.

A further reduction in the value of actual settlements is achieved through multilateral netting, as shown in Chart 4. In this case, the number of communications channels is significantly reduced (to four), since each bank needs only to open a communications line with the central clearinghouse. Banks in a multilateral net debit position cover their obligations by transferring settlement funds to an account held with the settlement bank, say, the central bank. The clearinghouse may act as agent for the participants in the netting by monitoring the settlement account and ordering transfers to the banks in a multilateral net credit position, once all net debit obligations are paid. In the example, the total value of funds transferred by the banks is 130, which again represents a saving of close to 50 percent in the settlement medium required compared with bilateral netting. Experience with multilateral netting has shown that the total value of the settlement may be reduced by as much as 90 percent from the case of gross settlement.

Table 1 shows the bookkeeping record of the clearinghouse for the example explained in Charts 2–4. As can be seen, the total sum of the payment obligations of all the banks is equal to the total sum of claims on all the banks (450 units of account). In other words, the sum of all multilateral net debit positions in a netting arrangement is always equal to the sum of all the multilateral net credit positions. This bookkeeping record is

used in Chapter 7 to illustrate the problems encountered when one of the participants in a net debit position fails to meet its obligation to pay funds at settlement.

Conclusions

A modern payment system is a complex apparatus whose functioning depends on the interaction of operational and financial design features. The operational and financial structure of the payment system is very much a matter of choice, with different designs available to meet the needs of different types of transactions arising in the economy. Regardless of the general design, banks are always at the core of the settlement process because interbank transfers of funds—especially transfers of deposits held with the central bank—provide settlement for underlying payments. Two basic designs are available: gross and net settlement. Netting is an important tool used by banks to increase the efficiency of their settlement operations and to control interbank settlement risk, although the effects of netting on settlement risk need to be defined and controlled fully.

4

Monetary Issues and Payment System Design

Jeffrey C. Marquardt

An important banking issue for many developing countries is whether to install an electronic interbank funds transfer system. A further issue concerns the type of system that offers the best design from the standpoint of users of the system as well as the public at large. Indeed, these issues are relevant in a number of developed countries. The central banks of the European Union, for example, recently published a report on the minimum common features that are desirable for domestic payment systems, with an important emphasis on the features of large-value interbank systems.[1]

This chapter focuses on the interrelationship of monetary issues and the design of large-value payment systems. It discusses the monetary rationale for installing an electronic interbank funds transfer system and deals with the influence of central bank monetary regulations and procedures on the incentives to support the installation and use of real-time gross settlement and multilateral net settlement systems.

Modern designs for such automated systems involve the electronic sending and receiving of payment messages between banks. These payment messages can be either for the benefit of the banks themselves or for the benefit of bank customers. Both types of designs also typically require settlement of the payment messages on the same day that payment messages are sent and received (same-day settlement) in central bank balances—central bank money—held in sight accounts at a central bank.[2]

The design of the real-time gross settlement system embodies the principle that payments are settled one at a time by debiting and crediting the sending and receiving banks' money balances, respectively, in accounts at

[1]See Working Group on EC Payment Systems, *Report to the Committee of Governors of the Central Banks of the Member Countries of the European Economic Community on Minimum Common Features for Domestic Payment Systems* (November 1993).

[2]Some large-value transfer systems provide for settlement in commercial bank balances. Such arrangements for large-scale interbank funds transfer systems raise important issues of systemic risk, which are discussed in other chapters in this book. There are also examples of electronic interbank funds transfer systems that settle the day after payment messages are sent and received.

a central bank. The concept behind this procedure is that a transfer of central bank money representing the settlement of each payment is unconditional and irrevocable when it is made, thus satisfying the obligation of the sending bank to make the payment. As discussed in Chapter 6, Fedwire, the Swiss Interbank Clearing System, and The Bank of Japan's real-time gross settlement service provided through BOJ-NET are examples of such systems. In practice, technical issues or cost considerations may limit the ability of a central bank to perform the real-time accounting necessary to permit real-time transfers of central bank money, which leads to minor technical variations on the real-time gross settlement principle.[3]

Multilateral netting systems embody a fundamentally different principle than gross settlement in real time. Electronic messages are exchanged between participants in these systems, possibly in real time. These messages reflect obligations to pay central bank money at a periodic settlement time, such as the end of a banking day, subject to mutual offset among members of the netting arrangement. Under clearinghouse rules and procedures, settlement obligations are calculated from the multilateral net value of payment messages sent to and received from participants in the system. Participants that are in a multilateral net debit position at settlement time, generally at the end of the banking day, settle their obligation by paying central bank money, in some cases using a real-time gross settlement system. The Clearing House Interbank Payments System (CHIPS) in the United States and the Clearing House Automated Payment System (CHAPS) in the United Kingdom are examples of multilateral netting systems. In some countries, such as Japan and the United States, both real-time gross settlement and multilateral net settlement systems are in operation.

Monetary Rationale for Large-Value Transfer Systems

Automated large-value interbank funds transfer systems are generally regarded as a key component of the infrastructure in modern financial markets. A major function of these systems is to speed up dramatically the communication, processing, and settlement of large-value payments. This infrastructure, in turn, has the potential to produce a number of long-term benefits for monetary arrangements in most countries.

[3]For example, the complete set of accounts held at the central bank might be updated once a day, but with real-time logging and control of real-time gross settlement funds transfers. Special central bank subaccounts might also be established for such a real-time gross settlement system, with real-time accounting performed for the subaccounts, but not for the entire set of accounts held at the central bank. The important feature of a real-time gross settlement system from a financial perspective is that irrevocable, unconditional funds are given to the bank receiving a payment message.

One simple but important benefit is the linking together of regional centers of commerce and finance. Automated large-value systems with same-day settlement permit the transfer of funds between regions on a same-day basis, reducing or eliminating the need for interregional transfers of large-value paper payment instruments, which may entail long delays in clearing with attendant risks and financial float (see Chapter 10). A reduction in clearing delays, as well as a reduction in the uncertainty about settlement times, will tend to strengthen financial linkages among regions in a country and to equalize short-term money market rates across regions.

From a macroeconomic perspective, an automated large-value interbank payment system may greatly facilitate the establishment of short-term money markets that reflect nationwide monetary conditions at a particular time. Such markets, in turn, provide more accurate information about the current state of nationwide monetary conditions. In addition, monetary policy changes implemented in one city or region will tend to spread rapidly and influence nationwide monetary conditions.

At the microeconomic level, the installation of automated large-value transfer systems can enhance the liquidity both of interbank money markets and of individual banking organizations. Rapid and low-cost payment systems, particularly those with same-day settlement, allow the timely and low-cost settlement of trading in interbank loans, deposits, or other contracts for money.[4] By lowering the direct and indirect costs of settlement, such systems can be expected to increase the incentives for market development. Liquid markets, in turn, tend to reduce the reliance of the banking sector on the central bank for liquidity and to promote market-oriented reserve management practices by banks. The result is likely to increase the liquidity adjustment capabilities, and thus the liquidity, of individual banking organizations.

In addition, a more liquid interbank money market may provide added flexibility for the conduct of central bank monetary operations. For a variety of reasons, a central bank may wish to adopt market-oriented procedures for increasing or decreasing the aggregate supply of central bank money to an economy. A liquid interbank money market may provide either a readily available market in which central bank operations can be conducted directly and with precision, or a market in which the banking system can adjust reserve positions rapidly in response to such operations conducted in other financial markets.

The introduction of automated payment systems may lead to and be accompanied by changes in the demand for central bank balances. Such systems, combined with significant automation capabilities at commercial

[4]Improvements in interbank funds transfer systems may also help stimulate the development of improved methods for clearing and settling various types of securities.

banks using the system, may permit a given daily value of payments to be cleared and settled with a much smaller stock of central bank money than was needed previously. Depending on a number of factors, the demand for central bank money to be held overnight by the banking system may decline from levels that prevailed before the automated system was introduced. Thus, some short-term adjustments in monetary forecasting and central bank procedures may be needed as major improvements in interbank funds transfer systems are introduced.

Monetary Incentives for Choosing Among Large-Value Transfer Systems

The remainder of this chapter discusses the monetary incentives for the private banking sector to prefer either real-time gross settlement or multilateral net settlement systems, assuming the choice has been made to install at least one interbank funds transfer system in an economy. It does not address the issue of who makes the decision to install such a system.

If it is assumed that both a real-time gross settlement and a multilateral net settlement system would be constructed to use central bank money for settling payments, the monetary incentives to use one system or another depend largely on the cost of obtaining the relevant type of central bank money for settlements. Further, since multilateral net settlement systems settle payments on a multilateral net basis at the end of a banking day instead of sequentially in real time, these systems can generally be expected to require less central bank money to settle a given value of payments than a real-time gross settlement system. Thus, the higher the relevant measure of the cost of using central bank money to settle payments, the greater the monetary incentive for commercial bank holders of central bank money to install and use multilateral net settlement systems rather than real-time gross settlement systems.

The incremental or marginal cost of central bank money is the most relevant factor for choosing between interbank funds transfer systems, because the added expense of participating in a system that utilizes incrementally larger amounts of central bank money for a given group of payments will depend on the (estimated) incremental amount of central bank money to be used, multiplied by the (estimated) incremental cost of obtaining that money.

The standard concept for measuring the incremental or marginal cost of central bank money, which is adopted here, is the concept of "opportunity cost." This concept recognizes that central banks typically do not pay interest on money balances held with them. Further, if interest was paid, the rate would probably be below market rates. Thus, the opportunity cost of holding central bank money is the (risk-adjusted) rate of

interest forgone by holding non-interest-bearing balances at a central bank. In other words, the opportunity cost is the market rate of interest that could be earned on these funds if they were invested in financial assets of approximately equal liquidity and risk. Although it may be difficult to calculate this opportunity cost precisely, the concept is straightforward. The opportunity cost is usually approximated in economies with liquid interbank markets by the rate of interest paid on investments in overnight interbank deposits or related instruments.

For payment systems that feature same-day settlement, the relevant opportunity cost is the cost of the central bank money used by these payment systems for settlement. Further, the relevant opportunity cost for settling payments using a real-time gross settlement system that operates during the banking day is the opportunity cost of obtaining central bank money *during* the day to settle payments. This intraday opportunity cost may differ substantially from the opportunity cost of central bank balances on an overnight basis.

In a market-oriented analysis, opportunity cost will be determined by the demand for central bank money in relation to supply. This demand must be analyzed separately for both settlement systems. For a multilateral net settlement system, the sum of all multilateral net settlement positions (positive and negative) is equal to zero, since the total amount of money to be paid by participants equals the total amount to be received.[5] Thus, the net aggregate demand for central bank money to be used at settlement is zero, except where settlement debits and credits are not posted simultaneously to central bank accounts. In this case, debtors typically pay central bank money, for example, into a settlement account maintained at the central bank, before creditors receive funds. This procedure generates a temporary additional net demand for balances.[6] To compare the incremental monetary costs of both systems, the issue of the relative demand for money that arises in each type of system can be addressed in terms of the extent to which a real-time gross settlement system increases the demand for central bank money in comparison with the relatively low demand associated with multilateral net settlement systems.

The actual demand for central bank money generated by the installation of a real-time gross settlement system will depend on factors such as the value and timing of the flow of large-value interbank payments. The potential size and timing of these flows is essentially an empirical issue

[5]However, there are still flows of central bank money from participants in a net debtor position at settlement to those in a net creditor position.

[6]In CHIPS, at settlement net debtors must pay central bank money representing their settlement obligations into a settlement account at the Federal Reserve before net creditors are paid from the account via Fedwire funds transfers.

that must be addressed for specific economies and proposed payment systems.

The supply of central bank money, however, particularly during the banking day, is under the control of the central bank. Central bank monetary regulations and credit policies will have significant effects on supply, and hence on the opportunity cost of central bank money during the day. Supply policies may even be designed to produce particular levels of, or to place bounds on, the intraday opportunity cost of balances that are independent of the level of demand. Indeed, a supply policy of reducing the intraday opportunity cost of central bank money to approximately zero by accommodating all demand (without charge) would presumably eliminate this cost as an influence on the choice between real-time gross settlement and multilateral net settlement systems.

Monetary Regulations

At least three central bank monetary regulations will influence the level of balances of central bank money held overnight by commercial banks. These regulations include (1) the level of reserve requirements, if any, applied to commercial bank liabilities; (2) the instruments in which such required reserves may be held; and (3) the rate of interest, if any, paid on balances of central bank money. If any monetary regulations increase overnight sight balances held at a central bank, these balances are a potential source of supply of central bank money for use in settling payments during the day. Whether a central bank permits these balances to be used in this manner can be viewed as part of the central bank's supply policy.

First, reserve requirements may generate substantial levels of holdings of central bank money on an overnight basis.[7] If a central bank permits these required balances to be used to settle payments, and the balances are large in relation to the value of payments to be settled, the opportunity cost to the banking sector of using central bank money to settle payments may be quite low, even zero. On the other hand, if reserve requirements are low, the opportunity cost of holding additional amounts of central bank money solely to settle payments during the day may approach, or equal, the level of interest rates in an overnight interbank market for central bank money.[8]

[7]The level of overnight balances can be viewed as the outcome of both a regulatory demand for overnight balances by commercial banks and the supply of balances by the central bank that is a function of the implementation of monetary policy.

[8]If an intraday interbank funds market, or intraday central bank credit, are sources of supply of money for settling payments, the rates, terms, and conditions for use of funds from these sources will have an important effect on, and may well significantly lower, the opportunity cost of obtaining incremental balances of central bank money for settling payments. This issue is discussed below.

Reserve requirements may change over time with possible effects on payment systems. For example, the lowering of reserve requirements may increase the opportunity cost of holding central bank money to settle payments. Lower reserve requirements in turn may increase incentives to install and/or use multilateral net settlement systems to economize on such central bank money.

Second, the instruments in which required reserves may be held will influence the monetary balances available for settling payments. In some countries, commercial banks are permitted to count the currency they hold toward their required reserves. For a number of reasons, however, currency is not a useful asset for settling payments processed by automated systems. Deposit money in the form of electronic records is much more practical for these purposes. Thus, reserve requirement regimes that favor large holdings of currency will not reduce the opportunity cost of central bank money used for settling payments as much as regimes that favor large holdings of (sight) deposit money at the central bank.

Banks can be required to hold reserves in segregated accounts that cannot be used for payment. Such arrangements may be imposed as prudential measures to ensure that funds will be available in all circumstances to meet customer withdrawals. More typically, such arrangements are designed indirectly to tax banking organizations and finance government debt, in which central banks invest the segregated funds. Lacking the transferability needed to serve as a monetary asset for interbank settlement, such reserves are virtually useless for payment purposes on a day-to-day basis. Thus, frozen reserves do not reduce the opportunity cost of central bank money for settling payments and can be viewed as increasing that opportunity cost relative to a regime in which these reserves can be used for settlement.[9]

Third, the rate of interest paid on central bank money will have important effects on the opportunity cost of these balances. For example, if interest is paid on reserves held overnight, the (overnight) demand for this money would be expected to be higher than if no interest were paid. Larger holdings of central bank money overnight would increase the stock of balances that could be used for settling payments, assuming a central bank makes these funds available to banks during the day.[10] A larger supply of balances, other things equal, implies a lower opportunity cost of using central bank money for settlement.

[9]In theory, government tax and financing objectives can be met by requiring balances to be held overnight in segregated accounts, while allowing these funds to be used for making payments during the business day.

[10]Interest-bearing central bank securities or term deposits may be examples of instruments that central banks would not consider to be available for settling payments. These instruments are sometimes issued for monetary policy or exchange management purposes.

Typically, however, no interest is paid on central bank money. Accordingly, balances held overnight at the central bank will be an unattractive investment relative to short-term investments that pay a return. In general, the lower the interest rate paid on central bank money relative to rates paid on alternative bank investments, particularly highly liquid investments, the higher the opportunity cost of holding central bank money. Further, the higher the inflation rate in a country, the greater will be the opportunity cost, since market interest rates on alternative investments would likely include an inflation premium that a central bank would be unlikely to pay. If a central bank does not pay interest, the entire inflation premium contained in market rates would be part of the opportunity cost of holding central bank balances.

Other central bank procedures may also affect the opportunity cost of using central bank money for settlements. This section has described the key role played by policies and procedures that govern whether overnight balances are available for settling payments during the day. A further issue is whether central bank accounts and procedures are structured in a way that enables banks to consolidate and use their holdings of central bank money during the day to settle payments. If banks hold multiple accounts with a central bank and cannot readily consolidate funds, the opportunity cost of using central bank money for settlement may be higher than it would be otherwise.

Central Bank Credit Facilities

Central bank credit facilities may be significant sources of supply of central bank money and have important effects on opportunity costs. These credit facilities can be categorized for payment system analysis as overnight and longer-term facilities, or as intraday facilities. Some intraday facilities are explicitly overdraft facilities, whereas others are implicit arrangements that are a by-product of traditional end-of-day central bank accounting procedures.

Explicit overnight and longer-term credit facilities are designed to provide central bank money to the borrowing institution on an interday basis. These arrangements affect the opportunity cost of using central bank money for settling payments in at least three ways. First, there is normally an explicit interest charge for credit. This charge may be set at a premium over interbank market rates or at a discount, depending on central bank procedures. Second, the terms for providing credit are important. Borrowing from the central bank within certain limits may be considered a right or a privilege and may be subject to varying degrees of administrative encouragement or discouragement by the central bank. Explicit administrative rationing, including the setting of quotas, is employed by some central

banks. Collateral is also typically required. These nonprice aspects of credit essentially raise or lower the combined explicit and implicit charge for obtaining central bank money.

In the case of collateral, interest earned on the collateral may be passed on to the bank that owns the securities or other assets posted as collateral. Any assumed increase in the cost of obtaining central bank money owing to the need to post collateral for a loan results from the possibility that pledging the collateral for a loan entails some economic cost to the pledging bank. Whether such costs exist will depend on the specific type of collateral and the circumstances involved.

Third, the timing of borrowing and repayment of central bank credit can affect the use of credit facilities for settling payments. In some countries, potential account overdrafts at a central bank resulting from real-time gross settlement or other payment system activity may be covered automatically by extensions of central bank credit, if sufficient collateral is posted and credit lines are available. Lombard facilities have operated historically in this manner. In theory, payment-related credit can be extended throughout the day, with final end-of-day positions reflecting the actual overnight loan to be "booked" by the central bank. If the (overnight) central bank interest rate is applied only to net end-of-day credit, substantial amounts of intraday balances may be obtained at a very low, or zero, interest rate.

To use a specific example, the Federal Reserve's discount window clearly distinguishes between intraday and overnight lending. Discount window loans are normally made at the end of the business day for a 24-hour period, in part, to avoid confusion between intraday and overnight lending that might result from the type of end-of-day overdraft banking described above. Further, in an environment where intraday credit and money balances may have value, and intraday interest rates may exist, the central bank rate for a 24-hour loan provides a clear yardstick against which to evaluate combinations of overnight and intraday interest rates.

Another timing dimension of central bank credit facilities is the minimum time for which a loan may be obtained. For example, if loans must be taken out for periods longer than one day, borrowing to finance adverse payment flows on one day that are reversed on the next will have to be invested for the remainder of the term of the borrowing from the central bank or remain idle. In such a case, restrictions placed on central bank borrowing may add to the opportunity cost of obtaining central bank money to settle payments.

Central bank intraday credit facilities should also be thought of as having traditional dimensions such as rates, duration, and other terms. To date, only the Federal Reserve has adopted a program to charge for intraday central bank credit, which began in April 1994. Other central banks either do not provide explicit intraday credit, provide it but do not charge,

or provide it implicitly through the operation of their accounting or payment systems.

If quantitative limits, or other conditions, are placed on the use of intraday credit, including collateralization requirements, the implicit cost of the credit will tend to rise. Similarly, the greater the flexibility to borrow and repay during the day, the lower the implicit cost of daylight credit and the associated opportunity cost of the central bank money created by central bank lending.

As discussed in Chapter 10, float can also be a major source of increases or decreases in central bank credit. Central bank money can be provided to or withdrawn from the financial system when float is generated by the operation of central bank payment mechanisms, either on an intraday or interday basis with attendant consequences for the opportunity cost of using central bank money to settle payments. Central bank float may be priced and may be subject to nonprice terms, with attendant implications for the opportunity cost of central bank money.

Policy Influences on Payment System Choice and Use

Table 1 sets out the impact of the factors discussed in the last two sections on the opportunity cost of central bank money and on the private sector's incentives to install and use real-time gross settlement or multilateral net settlement systems. A plus sign indicates an increase in the opportunity cost of central bank money used to settle payments and an increase in the incentive for banks to prefer the indicated payment system. A minus sign indicates a decrease in the opportunity cost of central bank money and a decrease in the incentive to prefer the indicated system. As discussed in previous sections, since real-time gross settlement systems tend to use central bank money more intensively than do netting systems, a higher opportunity cost of money for settling payments (+) will be associated with a reduced incentive (-) to prefer real-time gross settlement systems and an increased incentive (+) to prefer multilateral net settlement systems, and vice versa.

As shown in Table 1, the major monetary and credit regulations and policies affecting the choice of payment systems are (1) reserve requirements; (2) the mix of instruments provided for holding reserves; (3) the payment of interest on central bank balances; and (4) the granting of intraday central bank credit with no or limited interest charged. Collateral requirements are also included in the table for reference.

Overall, if required reserves are sufficiently large and can be used to settle payments, they will lower the opportunity cost of using central bank money for settlement, increase the incentive to install and use a real-time

Table 1. Impact of Regulatory and Credit Policies on the Opportunity Cost of Central Bank Money and Choices Between Payment Systems[1]

Regulatory Policy	Impact on Opportunity Cost	Monetary Incentive to Install or Use	
		Real-time gross	Multilateral netting
Reserve requirements	–	+	–
Instruments for holding reserves			
Currency	+	–	+
Interest-bearing securities	+	–	+
Blocked accounts	+	–	+
Interest paid on central bank money	–	+	–
Intraday central bank credit facilities (no or limited interest)	–	+	–
Collateral requirements for central bank credit	0/+	0/–	0/+

[1]Plus sign indicates an increase in the opportunity cost or increase in incentive; a minus sign indicates a decrease in the opportunity cost or decrease in incentive; and zero indicates no impact on opportunity cost or change in incentive.

gross settlement system, and reduce the incentive to install and use a multilateral net settlement system. On the other hand, if required reserves are sufficiently low in relation to the daily value of payments, they will raise the opportunity cost of using central bank money for payment system purposes and decrease the incentive to use real-time gross settlement systems.

As noted above, central bank policies regarding instruments that are eligible for use to meet reserve requirements will also affect choices between payment systems. As suggested in Table 1, when currency and interest-bearing assets are eligible for meeting reserve requirements, the opportunity cost of using central bank money to settle payments increases. The payment of interest on sight balances would tend to have the opposite effect.

Finally, if central banks provide intraday central bank money to the banking sector at either a zero or nominal fee, through, for example, daylight credit facilities, the opportunity cost of intraday central bank money will be lower. In turn, the cost of using a real-time gross settlement system that requires intraday central bank money for settling payments would be reduced relative to when no intraday credit is provided. Collateral requirements would have either a negligible or positive effect on the opportunity cost of central bank money, depending on the costs of pledging the collateral.

Conclusions

There are monetary advantages to a country's banking and financial systems from having a large-value interbank funds transfer system. Differing monetary incentives may affect choices between real-time gross settlement and multilateral net settlement systems. Multilateral net settlement systems tend to economize on the use of central bank money relative to real-time gross settlement systems, essentially by substituting explicit or implicit interbank intraday credit, extended through netting, for central bank money. Further, an economy's monetary regulations and procedures can raise or lower the opportunity cost of holding and using central bank money to settle payments through effects on the supply of such balances relative to demand. The incentives represented by this opportunity cost can lead the private banking sector to prefer the establishment of multilateral net settlement systems, which economize on central bank money, compared with real-time gross settlement systems.

The monetary incentives experienced by the commercial banking sector, however, may not, and perhaps should not, be the decisive factor in the final decision on installation and use of interbank funds transfer systems. The commercial banking sector, the central bank, and other authorities must also consider issues relating to the stability of the payment system, particularly during times of financial stress. Other issues involving payment system risk, technology, and access to the payment system will also need to be addressed. Nonetheless, money and credit issues have an important influence on the incentive for choosing one type of system over another, and often influence the discussion and analysis of the merits of different types of large-value payment systems.

5

Legal Foundations of Large-Value Transfer Systems

Raj Bhala

Overview

This chapter describes and explains the interaction between the main pillars of law that should govern large-value credit transfer systems. It does so by focusing on the essence of the U.S. legal regime governing such systems.[1] The chapter will be useful to readers who are concerned with the development of laws for funds transfers in other countries and will serve as a point of departure for the future work and study of the lawyer, banker, or scholar.

The substance of the U.S. legal regime governing large-value credit transfer systems can be grasped by understanding five legal rules. Although these are not the only rules in U.S. funds transfer law, and some may contend that there are other equally or even more essential statutory provisions, distilling the law into five rules certainly yields much of the essence. The economic and policy justifications for choosing these five legal rules are beyond the scope of this chapter.[2] To appreciate the rules, the terminology of funds transfer law must be mastered and the applicable terms used in the context of a typical funds transfer. (The terms "funds

[1]This is not to imply that Article 4A of the Uniform Commercial Code (U.C.C.) is the sole paragon or heuristic device. Indeed, the recently approved United Nations Model Law on International Credit Transfers is available for national legislatures to enact in whole or in part. U.N. GAOR, 47th Sess., Supp. No. 17, at Annex 1 p. 48, U.N. Doc. A/47/17 (1992). For a discussion of the Model Law, see E. Patrikis, T. Baxter, and R. Bhala, *Wire Transfers* Parts III and V (1993).

[2]For theoretical discussions of funds transfer law, see R. Bhala, "The Inverted Pyramid of Wire Transfer Law," 82 *Kentucky Law Journal* 347 (1993) and "Paying for the Deal: An Analysis of Wire Transfer Law and International Financial Market Interest Groups," 42 *Kansas Law Review* No. 3 (1994). See also F. Leary, Jr. and P. Fry, "A Systems Approach to Payment Modes: Moving Toward a New Payments Code," 16 *U.C.C.L.J.* 283 (1984); and H. Scott, "Corporate Wire Transfers and the Uniform New Payments Code," 83 *Columbia L.R.* 1664 (1983). For a microeconomic analysis of loss allocation rules in consumer payments transactions, see R. Cooter and E. Rubin, "A Theory of Loss Allocation for Consumer Payments, 66 *Texas Law Review* 63 (1987) (hereinafter, "Cooter and Rubin") and H. Scott, "The Risk Fixers," 91 *Harv. L.R.* 737 (1978.) For this analysis in the funds transfers context, see Judge Richard Posner's opinion in *Evra Corp. v. Swiss Bank Corp.* 673 F.2d 951 (7th Cir.), cert. denied, 459 U.S. 1017 (1982).

transfers" and "credit transfers" are used interchangeably, as are the terms "funds transfer systems" and "large-value credit transfer systems."[3])

The five rules are set forth in Article 4A of the Uniform Commercial Code (U.C.C.), the principal law in the United States governing funds transfers.[4] They are (1) a scope rule to differentiate the parties and payment instructions that are included in the law from those that are not; (2) a trigger event to indicate the moment when the rights and obligations of a party to a funds transfer are manifest; (3) a receiver finality rule to establish when credit to an account is irrevocable; (4) a money-back guarantee to cover situations where a funds transfer is not completed, coupled with a discharge rule for cases where the transfer is completed; and (5) an anti-fraud rule to allocate liability for fraudulent payments instructions.

Context

A necessary (but not sufficient) condition for a thorough discussion of large-value credit transfers is a treatment of U.C.C. Article 4A. Whether these transfers are a popular means of payment from the point of view of individual transactors, and whether they are conducted in a safe and sound manner from the point of view of bank supervisors are issues that necessarily involve the law. Funds transfer law should serve the interests of the commercial parties that look to large-value credit transfer systems to settle their payment obligations and in particular should facilitate growth in domestic and international transactions. Ill-conceived funds transfer rules, or a legal void, can retard the growth and development of large-value credit transfer systems. In turn, the underlying transactions that generate payments obligations may be hampered.

Large-value credit transfers are of enormous importance. As described in Chapter 6, for example, over 80 percent of the dollars transferred in the United States are sent over large-dollar electronic funds transfer networks.

[3]"Funds transfers" are defined in U.C.C. Section 4A-104(a), and a "funds transfers system" in Section 4A-105(a) (5).

[4]The version cited here is the 1989 Official Text with Comments approved by the American Law Institute and National Conference of Commissioners on Uniform State Laws (NCCUSL). States have been quick to incorporate Article 4A into their Uniform Commercial Codes, with over 40 states enacting the statute in less than three years. Information on state enactment is provided by NCCUSL. Regulation J, which governs Fedwire, essentially incorporates this version of Article 4A by reference, with some modifications and additions. Regulation J is codified at 12 C.F.R. Part 210 subpart B (1992). Similarly, the New York Clearing House has selected New York's version of Article 4A as the law applicable to the Clearing House Interbank Payments System (CHIPS). In addition, relevant additional provisions are set forth in Federal Reserve Bank operating circulars and the CHIPS rules. For a discussion of Regulation J and Operating Circular No. 8 and of the CHIPS rules, see Wire Transfers cited in footnote 1 above.

Every day in the United States, roughly two trillion U.S. dollars are transferred by means of Fedwire and CHIPS. Depending on the structure of the laws governing funds transfers, potential users and providers of funds transfer services may find these services either more or less attractive.[5]

With so much money transferred by wire each day, and with the average value of each transfer so high, the potential for large losses is great. Thus, commercial parties making and receiving such payments require a clear, comprehensible, and sensible legal regime to answer two basic questions. First, how should a funds transfer normally work? Second, what happens if a mishap occurs? There is a third public policy issue of particular concern to central bankers, namely, systemic risk—how can this risk be minimized and contained?

Hypothetical Case

A discussion of the five key rules of U.C.C. Article 4A is aided by reference to a hypothetical funds transfer. Consider the following:[6]

(1) An automobile manufacturer buys steel worth $100,000 from a steel company to make vehicles. The steel company delivers the steel to the automobile manufacturer, and the manufacturer now seeks to pay the company for the steel by funds transfer.

(2) The manufacturer and steel company hold their accounts at different banks.

(3) The manufacturer instructs its bank to pay $100,000 to the steel company. The instruction contains the name and account number of the steel company and the name and identifying number of the steel company's bank.

(4) The automobile manufacturer's bank complies with the instruction of its customer by further instructing a second bank to pay $100,000 to the steel company. This second instruction again contains the relevant information about the steel company and its bank.

(5) The second bank also complies with the instruction it received. It further instructs the bank at which the steel company has an account to pay $100,000 to the steel company.

[5]See, for example, the discussion of transactions costs in Cooter and Rubin, 67–68 cited above in footnote 2.

[6]A payments obligation to be discharged by a funds transfer can arise from virtually any sort of underlying contractual relationship between the buyer-payor and seller-payee. While the underlying contractual obligation in this hypothesis involves goods, in reality financial transactions generate the bulk of funds transfers. Most large-value funds transfer activity is associated with securities and foreign exchange trading. See "The Inverted Pyramid" cited in footnote 2 above, and Bank for International Settlements, *Payment Systems in Eleven Developed Countries* (Basle: Bank for International Settlements, 3rd ed., 1989), p. 215.

(6) The steel company's bank complies with the third instruction and pays the company.

This hypothetical transaction is represented in Chart 1. The chronological steps in the transaction are indicated by numbers in parentheses. The defined terms of U.C.C. Article 4A are used, highlighted, and explained in detail below.

Each of these parties, and the actions each undertakes, has a specific legal label in U.C.C. Article 4A. Applying the correct labels is the first step in the process of distilling Article 4A to its essential ingredients. Each payment instruction is a "payment order" if it meets the requirements of the definition of that term. This term is critical in defining the scope of the law.[7]

The automobile manufacturer is the "originator" of the funds transfer, that is, "the sender of the first payment order in a funds transfer."[8] The bank at which the automobile manufacturer maintains an account and to which the first payment order is addressed is the "originator's bank."[9] The steel company is the "beneficiary" of the originator's payment order.[10] Also, it is the beneficiary of each payment order issued in the funds transfer chain that implements the originator's order, that is, the payment order issued by the originator's bank and the second bank. The "beneficiary" is simply "the person to be paid by the beneficiary's bank."[11] The bank at which the steel company maintains its account and to which funds are credited is the "beneficiary's bank."[12] This term is reserved for "the bank identified in a payment order in which an account of the beneficiary is to be credited pursuant to the order or which otherwise is to make payment to the beneficiary if the order does not provide for payment to an account."[13] The second bank is the "intermediary bank" in that it is "a receiving bank other than the originator's bank or the beneficiary's bank."[14]

The terms "sender" and "receiving bank" are generic: a sender is "the person giving the instruction to the receiving bank" and the receiving bank is "the bank to which the sender's instruction is addressed."[15] The automobile manufacturer (the originator), the bank of the automobile

[7]See below, part IV.A.

[8]U.C.C. Section 4A-104(c).

[9]U.C.C. Section 4A-104(d). There is no requirement in this definition, or elsewhere in Article 4A, that the originator have a pre-existing account relationship with the originator's bank.

[10]U.C.C. Section 4A-103(a)(2).

[11]U.C.C. Section 4A-103(a)(3).

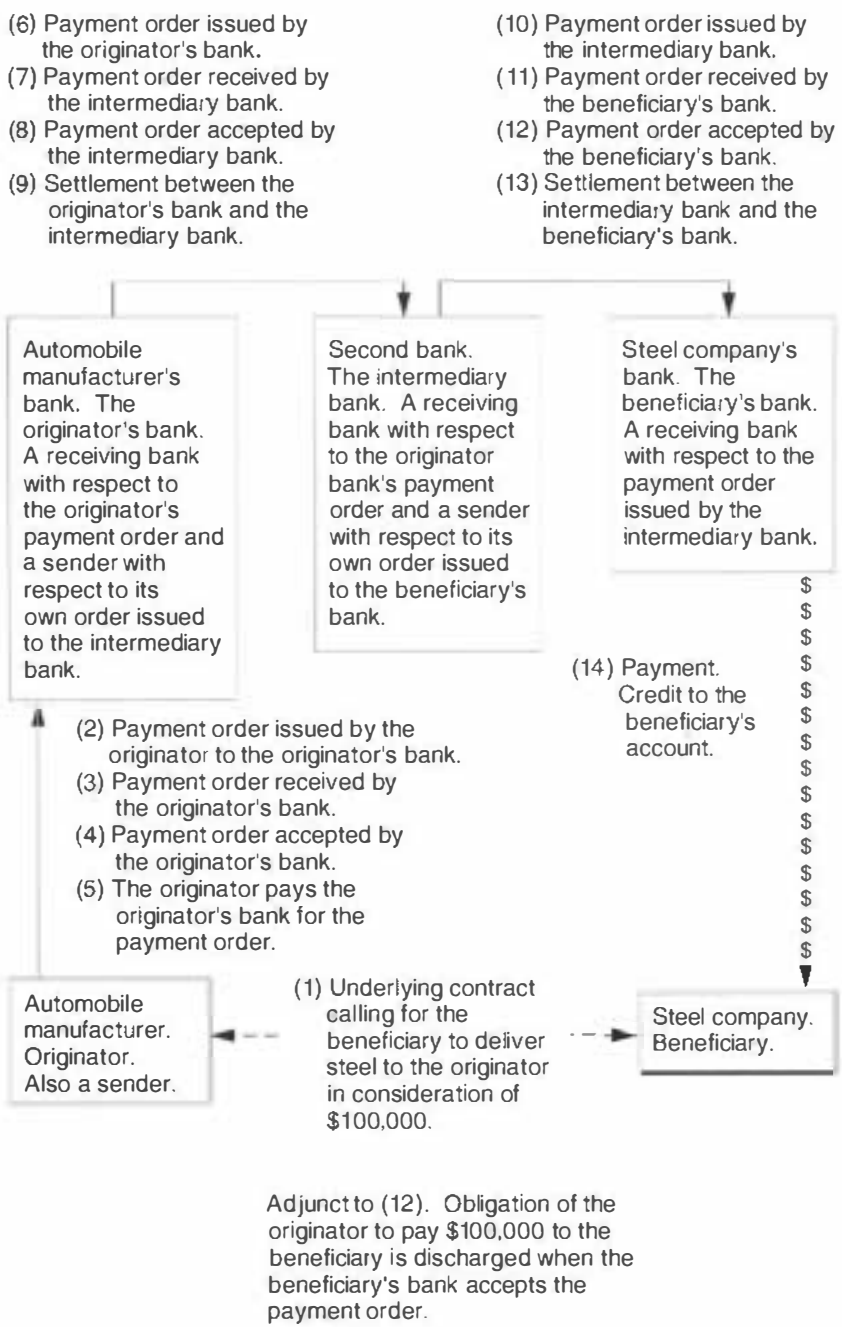
[12]U.C.C. Section 4A-103(a)(3). Here too, there is no requirement of a pre-existing account relationship.

[13]U.C.C. Section 4A-103(a)(3).

[14]U.C.C. Section 4A-104(b).

[15]U.C.C. Section 4A-103(a)(4)-(5).

Chart 1. Hypothetical Example of a Funds Transfer



manufacturer (the originator's bank), and the second bank (the intermediary bank) are all senders. The originator's bank, intermediary bank, and beneficiary's bank (the steel company's bank) are receiving banks.

The "funds transfer" is the entire "series of transactions, beginning with the originator's payment order, made for the purpose of making payment to the beneficiary of the order."[16] It includes the payment orders issued by the originator's bank and the intermediary bank, because these are "intended to carry out the originator's payment order."[17] The funds transfer "is *completed* by acceptance by the beneficiary's bank of a payment order for the benefit of the beneficiary of the originator's payment order."[18]

The sale of steel by the steel company to the automobile manufacturer is the underlying contract between the beneficiary and originator of the funds transfer. Under the terms of the contract, the originator has a $100,000 payment obligation, and the originator begins the funds transfer for the purpose of *discharging* this obligation.[19]

The concept of discharge is tricky in two senses. First, its legal importance is not always clearly understood. The crucial point is that until the funds transfer is completed, which occurs when the beneficiary's bank accepts a payment order for the beneficiary, the originator is legally liable on this obligation—it is not discharged.[20] The originator's obligation to pay the beneficiary based on the contract for steel is not discharged until the beneficiary's bank accepts a payment order for the benefit of the beneficiary. Thereafter, the originator cannot be sued by the beneficiary for breach of contract on the grounds of nonpayment.

Second, seemingly synonymous uses of the terms "payment obligation" (or "payment"), "settlement obligation" (or "settlement"), and "discharge" sometimes generate confusion. In the funds transfer context, the underlying payment obligation refers to the obligation of the originator to pay the beneficiary. This obligation arises from the underlying contractual obligation between those two parties. When the obligation is satisfied, it is said to be legally discharged. Each sender whose payment order is accepted by a receiving bank has a payment obligation to that bank, namely, to pay for the accepted order. The terms "settlement" and "settlement obligation" refer to an interbank payment obligation that arises from the acceptance of a payment order. That is, they refer to the payment obligation as between a sending and receiving bank. However, these interpretations are based more on customary and trade usage than on specific sections of Article 4A.[21]

[16] U.C.C. Section 4A-104(a).
[17] *Id.*
[18] *Id.*
[19] U.C.C. Section 4A-406(b).
[20] U.C.C. Sections 4A-104(a) and 4A-406(a)-(b).
[21] *Wire Transfers*, 72–73 cited in footnote 1 above.

Each receiving bank has a decision to make when it receives a payment order: should it *accept* or *reject* the order? The receiving bank is not obligated to accept an order.[22] A receiving bank other than the beneficiary's bank (i.e., the originator's bank and intermediary bank) accepts a payment order by executing the order.[23] "Execution" means that the bank "issues a payment order intended to carry out the payment order received by the bank."[24] Thus, the originator's bank accepts the payment order of the originator by issuing an order that conforms with the instructions set forth in the order of the originator. Similarly, the intermediary bank accepts the payment order of the originator's bank by issuing a conforming order designed to implement the originator bank's order.

A beneficiary's bank, however, does not accept a payment order by execution.[25] Rather, the beneficiary's bank, if it accepts the order, is required to pay the beneficiary the amount of the order.[26]

A receiving bank's decision to accept or reject a payment order is partly a credit judgment: if the order is accepted, then the sender must *pay* for the order (e.g., the originator must pay $100,000 to the originator's bank if the bank accepts the originator's order, the originator's bank must pay $100,000 to the intermediary bank if the intermediary bank accepts the originator's bank's order, and so forth).[27] The credit issue arises where a sender does not currently have funds in its account with the receiving bank sufficient to pay for the payment order. The receiving bank may, in

[22]U.C.C. Section 4A-209 and official comment 3. The receiving bank is free to enter into an account agreement with its sender-customer specifying that the bank will accept all payment orders issued by that customer. In this instance, the bank cannot reject the order. In addition, a receiving bank is unable to reject a payment order transmitted through Fedwire, because one of the ways in which a receiving bank accepts a payment order is obtaining payment from its sender. U.C.C. Section 4A-209(b)(2). With a funds transfer through Fedwire, the payment order and payment (the instruction and value) move simultaneously from sender to originator. *Wire Transfers*, 174 cited above in footnote 1.

[23]U.C.C. Section 4A-209(a).

[24]U.C.C. Section 4A-301(a).

[25]*Id.*

[26]U.C.C. Section 4A-404(a). While this duty is plainly sensible, the liability for failing to perform it is unique in the statute. Failure to pay the beneficiary the amount of an accepted order is the only instance where the statute expressly provides for consequential damages, though the bank has a defense that it had a "reasonable doubt" as to the entitlement of the beneficiary to payment. *See infra* part note 6a and related text. With respect to other duties imposed on receiving banks, liability for consequential damages is precluded unless such banks expressly agree to assume this liability in writing with their sender-customers. See U.C.C. Section 4A-305. The liability rules of U.C.C. Article 4A are not treated in this chapter. However, they are relevant not only for those involved in the development of funds transfer law in other countries but also for those giving or seeking practical legal advice. See Note, "Cancellation of Wire Transfers Under Article 4A of the Uniform Commercial Code: *Delbrueck & Co. v. Manufacturers Hanover Trust Co.* Revisited," 70 *Texas L.R.* 739 (1992); E. Patrikis, T. Baxter, and R. Bhala, "Article 4A: The New Law of Funds Transfers and the Role of Counsel," 23 *U.C.C.L.J.* 219 (1991); and T. Baxter and R. Bhala, "Proper and Improper Execution of Payment Orders," 45 *Bus. Law.* 1447 (1990).

[27]U.C.C. Section 4A-402(b)-(c).

its discretion, grant the sender an overdraft. But any receiving bank, including a Federal Reserve Bank, may charge interest to the sender for the amount and duration of the overdraft.[28]

If the bank entitled to payment is a receiving bank other than the beneficiary's bank (i.e., the originator's bank or an intermediary bank), the obligation to pay arises upon acceptance but does not mature until the *execution date*. That is, payment is not due until the day on which it is proper for the receiving bank to execute the order.[29] Generally, the execution date is the day the order is received.[30] This is referred to as "same-day execution," which means that the receiving bank executes the order on the day it is received from the sender. On or before that day, the sender must pay for the order.[31] Payment by a sender to a receiving bank for a payment order issued by the former and accepted by the latter may be made by a number of means. These include receipt of final settlement on the books of a central bank or through a funds transfer system (which may involve bilateral or multilateral netting), a credit to an account of the receiving bank with the sender, or a debit to an account of the sender with the receiving bank.[32] (See the discussion of nostro and vostro accounts in Chapter 2).

If the bank entitled to payment is the beneficiary's bank, then again the obligation to pay arises upon acceptance by that bank. Here, however, the sender (in the hypothetical, the intermediary bank) need not pay the beneficiary's bank until the *payment date*. That is the date on which the amount of the payment order accepted by the beneficiary's bank is payable to the beneficiary.[33] Typically, it is the date of receipt.[34] The beneficiary's bank can pay the beneficiary by crediting its account.[35] The beneficiary is paid as a matter of law when it "is notified of the right to withdraw the credit," or funds "are otherwise made available to the beneficiary," or the bank lawfully applies the credit to a debt of the beneficiary."[36]

[28]"Modification of the Payments System Risk Reduction Program: Daylight Overdraft Pricing," 57 *Fed. Reg.* 47084 (Oct. 14, 1992) and "Modification of the Payments System Risk Reduction Program: Measurement of Daylight Overdrafts," 57 *Fed. Reg.* 47093 (Oct. 14, 1992).

[29]U.C.C. Section 4A-301(b). Receiving banks are free to establish cut-off times for the receipt of payment orders. *See* Section 4A-106.

[30] *Id.*

[31]In the hypothetical transaction, assume that the originator issues its payment order on day 1 and the originator's bank receives it on that day. Assuming that the originator does not specifically instruct the originator's bank to execute on a future day, the bank will execute it on day 1. The execution is, therefore, on the same day as the day of receipt (day 1), and payment from the originator to the originator's bank is due on or before that day.

[32]U.C.C. Section 4A-403(a).

[33]U.C.C. Section 4A-401.

[34] *Id.*

[35]U.C.C. Section 4A-405(a).

[36] *Id.*

Discussion

Scope Rule

What is the scope of application of the law? How does a party seeking to send funds electronically know whether the transmission is a funds transfer governed by applicable funds transfer law? Who is included and who is excluded? These questions are answered in Article 4A by referring to the definition of "payment order." *If an instruction is not a "payment order," then Article 4A is not applicable.* The term "payment order" means

> an instruction of a sender to a *receiving bank*, transmitted orally, electronically, or in writing, to pay, or to cause another bank to pay, a *fixed or determinable* amount of money to a beneficiary, if:
>
> (i) the instruction *does not state a condition* to payment to the beneficiary other than time of payment,
>
> (ii) the receiving bank is to be *reimbursed* by debiting an account of, or otherwise receiving payment from, the sender, and
>
> (iii) the instruction is transmitted by the sender *directly* to the receiving bank or to an agent, funds-transfer system, or communication for transmittal to the receiving bank.[37]

There are five salient features of this definition. First, the instruction must be issued to a "bank." While any person can be a "sender," only a "bank" can be a "receiving bank."[38] A "bank" is "a person engaged in the business of banking and includes a savings bank, savings and loan association, credit union, and trust company."[39] This definition is flexible, applying to a variety of financial institutions that offer account services. Thus, the scope of application is potentially wide.

Second, the amount of the instruction must be "fixed or determinable." In most cases, the application of this requirement is straightforward. In the hypothetical, the $100,000 amount is "fixed."

Third, the definition of "payment order" requires that the instruction contain no condition other than time of payment.[40] If the automobile manufacturer's instruction to its bank said "pay $100,000 on day 10 if you receive delivery of shipping documents pertaining to the purchased steel," then the requirement would not be satisfied. Only the statement

[37]U.C.C. Section 4A-103(a)(1) (emphasis supplied).

[38]U.C.C. Section 4A-103(a)(4)-(5). "Person" is used throughout the definition sections of U.C.C. Article 4A but not defined therein. Therefore, the U.C.C. Article 1 definition would apply. U.C.C. Section 1-105(d). Under Article 1, a "'person' includes an individual or an organization." U.C.C. Section 1-201(30).

[39]U.C.C. Section 4A-105(a)(2).

[40]U.C.C. Section 4A-103(a)(1)(i).

regarding day 10 is permissible; the statement regarding presentation of documents to the bank is a condition other than time of payment. If both statements are included in the instruction, then it is not a "payment order" and Article 4A is inapplicable.

The fourth requirement concerns payment for the payment instruction. A receiving bank that receives a payment instruction from its sender must be reimbursed by debiting an account of, or otherwise receiving payment from, the sender.[41] Credit transfers are included, but all electronic funds transfers that are debit transfers are excluded.[42] In the hypothetical, if the originator's bank is reimbursed for the automobile company's payment order by debiting an account of the company, this requirement is met.

The way in which this result is obtained raises the important distinction between a credit and debit transfer. "In a credit transfer the instruction to pay is given by the person making payment. In a debit transfer the instruction to pay is given by the person receiving payment."[43] The classic example of a debit transfer involves a check or other negotiable instrument.[44] In a check transaction, a debtor (the drawer of the check) gives authority to the creditor (the payee of the check) to draw on the debtor's account that is maintained at the payor bank (also called the drawee).[45] The authority is given by drawing the check and transferring the check to the payee. In turn, the payee issues the instruction to pay to the payor bank when it deposits the check.[46] That is, the payee (not the drawer) issues the instruction by depositing the check in the depositary bank (at which the payee maintains an account), and the check is presented to the payor bank through the check collection process.[47] Assuming the payor bank honors the check, it is reimbursed by the debtor, not the person giving the instruction (the payee).[48] "Article 4A is limited to transactions in which the account to be debited by the receiving bank is that of the person in whose name the instruction is given."[49] In sum, in a funds transfer the payor (originator) issues the instruction (payment order) to the paying bank (originator's bank) and reimburses that bank. In a check transaction the payee issues the instruction (the check) and the paying bank (payor bank) is reimbursed by the drawer of the check.

[41] U.C.C. Section 4A-103(a)(1)(ii).

[42] U.C.C. Section 4A-103(a)(1)(ii) official comment 4.

[43] *Id.* See also U.C.C. Article 4A Prefatory Note, p. 11.

[44] Negotiable instruments are governed by U.C.C. Articles 3 and 4. U.C.C. Sections 3-102 and 4-102.

[45] U.C.C. Sections 3-102(1)(d) (the "drawer" is a secondary party on the check, whereas the payor bank becomes primarily liable upon accepting the check); 3-302 ("payee" may be a holder in due course), and 4-105(b) (definition of "payor bank").

[46] U.C.C. Section 3-102(1)(a) (definition of "issue").

[47] U.C.C. Section 4-105(a) (definition of "depositary bank").

[48] U.C.C. Section 4A-104 official comment 4.

[49] *Id.*

Finally, to qualify as a payment order, an instruction must be transmitted directly by the sender to the receiving bank (or its agent, funds transfer system, or communication system for subsequent transmission to the receiving bank).[50] In the hypothetical, each instruction is directly transmitted from sender to receiving bank. This requirement serves to exclude from Article 4A payments made by means of a check or credit card, for example.[51]

Assume that the parties know that Article 4A applies to their transfer. Does it apply to the entire transfer, from the originator to the beneficiary? This is the issue of "end-to-end" coverage. Generally speaking, U.C.C. Article 4A is intended to apply end-to-end.[52] The rules of a funds transfer system ensure such coverage. For example, if the funds transfer is through Fedwire, then whether remote parties,—i.e., those that are not in privity with a Federal Reserve Bank—are bound by Article IVa depends on whether they had prior notice that (1) Fedwire might be used and (2) the applicable law governing Fedwire is Regulation J.[53] Privity means that the parties send payment orders directly to or receive orders directly from a Reserve Bank.[54] These requirements presumably avoid the unwarranted extension of Regulation J or the extraterritorial application thereof in inappropriate situations.[55]

Trigger Event

At what point are the rights and obligations of a party to a funds transfer triggered? In other words, when does the party gain certain legal entitlements, and when is it legally "on the hook" to perform certain duties? The answer is provided in Article 4A by the concept of acceptance.

"*Rights and obligations under Article 4A arise as the result of acceptance of a payment order by the bank to which the order is addressed.*"[56] Only when a receiving bank accepts a payment order issued by its sender are the rights and obligations of the receiving bank and sender triggered.

As the hypothetical suggests, acceptance is bifurcated according to the class of receiving bank. A receiving bank other than the beneficiary's bank, in the example, the originator's bank and the intermediary bank (the automobile manufacturer's bank and the second bank, respectively)

[50]U.C.C. Section 4A-103(a)(1)(iii).
[51]U.C.C. Section 4A-103(a)(1) official comment 5.
[52]U.C.C. Prefatory Note, iii and Section 4A-507(c).
[53]12 C.F.R. Section 210.25(b)(2)(v) (1993).
[54]12 C.F.R. Section 210.25(b)(2)(ii)-(iii) (1993).
[55]See 12 C.F.R. subpt. B, app. A comment (a) to Section 210.25 (1993).
[56]U.C.C. Article 4A Prefatory Note p. iv (emphasis supplied). See also Section 4A-209 (regarding acceptance of a payment order) and official comment 1 thereto ("[a]cceptance of the payment order imposes an obligation on the receiving bank to the sender if the receiving bank is not the beneficiary's bank, or to the beneficiary if the receiving bank is the beneficiary's bank.")

can accept a payment order only by executing the order. "Execution" means the issuance of a payment order that conforms with the terms of the order received from the sender.[57]

In contrast, a beneficiary's bank is responsible for crediting the account of the beneficiary (or otherwise lawfully applying funds received on behalf of the beneficiary). There are essentially three acts that constitute "acceptance" by a beneficiary's bank: (1) payment by the beneficiary's bank to the beneficiary; (2) notification from the beneficiary's bank to the beneficiary that a payment order has been received; or (3) receipt of payment by the beneficiary's bank from the sender that issued the payment order to the beneficiary's bank.[58] Acceptance occurs at the earliest of these times. The first two acts involve the "downstream" relationship between the beneficiary's bank and its customer, the beneficiary.[59] The third act involves the "upstream" relationship between the beneficiary's bank and its sender.[60]

What rights and obligations are triggered upon acceptance of a payment order? Again, there is bifurcation. The basic duty of a sender whose payment order is accepted by a receiving bank is to pay the receiving bank for the order. Conversely, the basic right of the receiving bank is to be paid for the accepted order. While this right-duty set is triggered upon acceptance, it does not mature until the execution date.[61] In addition, the sender has a right to have its payment order, upon acceptance, executed at the right time, in the right amount, and to the right place.[62] This is a trinity of rights which, from the receiving bank's perspective, constitutes a trinity of duties.

[57]U.C.C. Sections 4A-209(a) and 4A-301(a).

[58]U.C.C. Section 4A-209(b). This list is incomplete because there is a fourth manner of acceptance. A beneficiary's bank can do nothing with the payment order received and wait until the opening of the next funds-transfer business day. In other words, the beneficiary's bank can defer acceptance overnight (and, therefore, defer payment to the beneficiary). The incentive to do this is to "buy time" to see whether the sender will pay for the order. (Delaying acceptance is not possible if the beneficiary's bank has been paid by its sender, because that payment is by definition a form of acceptance.) U.C.C. Section 4A-209(b)(3) and official comment 5. See also Section 4A-405 official comment 2. Of course, this method of acceptance is unavailable if the funds transfer is through a system like Fedwire, because the payment order and payment are received simultaneously.

[59]Payment by a beneficiary's bank to a beneficiary is governed by U.C.C. Section 4A-405, which is discussed below in the context of the receiver finality rule.

[60]Payment by a sender to a receiving bank is covered in U.C.C. Section 4A-403.

[61]U.C.C. Section 4A-402(c). Note that if the receiving bank is the beneficiary's bank, then the obligation of the sender to pay matures on the payment date, which is the date the order is payable by the beneficiary's bank to the beneficiary. Thus, the beneficiary's bank is afforded the legal protection of being entitled to payment from its sender no later than the time it must pay its customer, i.e., it need not have paid out before receiving interbank settlement. U.C.C. Section 4A-402(b).

[62]U.C.C. Section 4A-302(a).

The right-duty set pertaining to the beneficiary's bank and the beneficiary is straightforward. Upon acceptance of a payment order, the beneficiary's bank has an obligation to pay the order, and the beneficiary has a right to be paid.[63] These mature on the payment date, which typically is the day the order is received by the beneficiary's bank.[64]

Receiver Finality

When does a beneficiary know that it has received "good funds"? If the steel company receives a $100,000 credit to its account, is the credit provisional (revocable), on the one hand, or final on the other hand? If the credit is revocable, then the steel company cannot commit the $100,000 to other uses (for example to pay its bills, pay dividends, invest in new projects, and the like). The steel company's bank (the beneficiary's bank) might demand that the $100,000 be returned if the bank does not finally receive payment from the intermediary bank.

Once a beneficiary's bank has paid the beneficiary, it has thereby satisfied the obligation to pay the beneficiary that arises from its acceptance of a payment order on behalf of the beneficiary. The payment is *final*.[65] The payment for the funds transfer cannot be recovered by the beneficiary's bank. This is the receiver finality rule. Even the beneficiary's right to withdraw a credit (that is, even if the beneficiary's account has been credited but the beneficiary has not withdrawn the credit) cannot be revoked.

The receiver finality rule is subject to one important exception.[66] Consider a major settlement failure in a funds transfer system that nets payment obligations on a multilateral (or net-net) basis and has a loss-sharing arrangement among participants in the system to handle a settlement failure by one or more participants.[67] If a beneficiary's bank accepts a payment order but the multilateral netting system fails to complete settlement in spite of the operation of the loss-sharing scheme, the acceptance is nullified and the beneficiary's bank can recover funds from the beneficiary.[68] In this unwind scenario, the funds transfer is not completed, the originator is not discharged on its underlying obligation to the beneficiary, and each sender is excused from its obligation to pay for its payment order. This exception to the receiver finality rule supports the development of loss-sharing agreements and other methods to achieve finality on

[63]U.C.C. Section 4A-404(a).
[64]U.C.C. Section 4A-401.
[65]U.C.C. Section 4A-405(c).
[66]An additional exception, not treated here, pertains to funds transfers involving automated clearing houses. See U.C.C. Section 4A-405(d).
[67]U.C.C. Section 4A-405(e). The classic example of such a system is CHIPS.
[68]*Id.*

privately operated funds transfer systems that rely on netting. The unwind exception is a "last resort escape" from potentially expensive settlement guarantees that remaining (and presumably solvent) participants in the funds transfer system might be unable to meet. Only by accounting for the potential trade-off between settlement guarantees and finality can the law promote netting systems designed to offer their users finality on a routine basis.

The receiver finality rule is constrained when the beneficiary's bank (having accepted a payment order) has a "reasonable doubt concerning the right of the beneficiary to payment."[69] But the beneficiary's bank risks incurring liability for consequential damages as a result of its nonpayment if the beneficiary demands payment, the bank has notice of "particular circumstances that will give rise to consequential damages as a result of nonpayment," and it is shown that the bank lacked reasonable doubt.[70] This is the only instance in Article 4A where consequential damages are a remedy provided by the statute, without a written agreement between parties that calls for consequential damages.[71]

Interloper Fraud Rule

Modern day electronic pirates abound. A fraudsperson (also called an interloper) claiming to be an official of the automobile manufacturer could send a payment order to the automobile manufacturer's bank instructing that $100,000 be paid to an account #10017 at the Bank of Credit and Commerce International (BCCI) in the Grand Cayman Islands. How is the automobile manufacturer's bank to determine whether the payment order is really that of its customer, the automobile manufacturer? If the bank executes the order and debits the automobile manufacturer's account for $100,000, is the bank obliged to recredit the account when it is discovered that the payment order was not authentic? What if the payment order is issued by an employee or agent of the automobile manufacturer that has access to its bank account information?

U.C.C. Article 4A addresses the interloper fraud problem through the concept of a "security procedure" and rules based on the existence or nonexistence of such a security procedure.

A security procedure is the generic term for a device or method (whether an electronic message authentication or other computer algorithm, code words, telephone call-back, or the like) for "verifying that a

[69] U.C.C. Section 4A-404(a).

[70] *Id.*

[71] U.C.C. Section 4A-305(c)-(d) (consequential damages for late or improper execution of a payment order or failure to execute a payment order are not recoverable unless agreed to expressly in writing by the receiving bank).

payment order is that of the customer . . ."[72] The Article 4A rules are summarized as follows:

> In a large percentage of cases, the payment order of the originator of the funds transfer is transmitted electronically to the originator's bank. In these cases it may not be possible for the bank to know whether the electronic message has been authorized by its customer. To ensure that no unauthorized person is transmitting messages to the bank, the normal practice is to establish security procedures that usually involve the use of codes or identifying words. If the bank accepts a payment order that purports to be that of its customer after verifying its authenticity by complying with a *security procedure agreed to by the customer and the bank*, the customer is bound to pay the order even if it was not authorized. But there is an important limitation on this rule. The bank is entitled to payment in the case of an unauthorized order only if the court finds that the security procedure was a *commercially reasonable* method of providing security against unauthorized payment orders. The customer can also avoid liability if it can prove that the unauthorized order was *not initiated by an employee or other agent* of the customer having access to confidential security information or by a person who obtained that information from a source controlled by the customer. . . . If the bank accepts an unauthorized payment order without verifying it in compliance with a security procedure, the loss falls on the bank.[73]

Three analytical steps are apparent from the summary: the agreement; commercial reasonability; and the "not an insider" defense.

First, has a security procedure been established pursuant to an agreement between the sender and receiving bank? If no procedure exists, then interloper fraud issues are resolved under non-U.C.C. Article 4A principles, specifically, the law of agency.[74] Thus, if no security procedure exists between the automobile manufacturer and its bank, whether the payment order issued by the fraudsperson was authorized by the automobile manufacturer will be determined under applicable agency law principles.

A security procedure, in theory, is not unilaterally imposed by one party or the other, but rather results from negotiations culminating in a written account agreement. To be sure, many customers are likely to have a standard-form contract specifying a particular procedure presented to them by their banks. Assuming that a security procedure has been agreed to by the bank and its customer, the next step is to consider whether that procedure is "commercially reasonable."

"Commercial reasonability" is a question of law, not fact. The judge's discretion is limited by U.C.C. Article 4A, which sets out criteria for

[72]U.C.C. Section 4A-201.

[73]U.C.C. Article 4A Prefatory Note p. vii (emphasis supplied). The rules are set forth at Sections 4A-201 through 4A-204.

[74]U.C.C. Section 4A-202(a).

evaluating whether a security procedure is commercially reasonable in a case at bar: "the wishes of the customer expressed to the bank, the circumstances of the customer known to the bank, including the size, type and frequency of payment orders normally issued by the customer to the bank, alternative security procedures offered to the customer, and security procedures in general use by customers and receiving banks similarly situated."[75]

To avoid liability, the originator's bank in the hypothetical must prove that the security procedure it agreed to with its customer is commercially reasonable. In addition, the bank must show that it accepted the payment order in "good faith" and in compliance with the procedure.[76] Acting in good faith and following the security procedure are matters for a trier of fact.

In the hypothetical funds transfer, suppose the originator argues that the $100,000 issued in its name and accepted by the originator's bank was unauthorized, and the ensuing $100,000 debit to its account should be reversed. The automobile manufacturer's bank proves to a judge that the security procedure in operation between it and the automobile manufacturer by which the payment order was verified was commercially reasonable. The bank also proves to the trier of fact that it acted in good faith in accepting the order and in compliance with the procedure. Has the purported originator, the innocent customer of the bank, lost the case? Not necessarily, because of the "not an insider" defense.

The suspect payment order may have been issued by a person who was not an employee or agent of the automobile manufacturer, and who did not gain access to the manufacturer's bank account information through someone controlled by the manufacturer. In other words, the fraudsperson may not have been an "insider" of the automobile manufacturer or someone close to an insider. If the "innocent" automobile manufacturer proves these facts, then the automobile manufacturer's bank cannot retain payment for the payment order. The burden of proof has shifted: the automobile manufacturer's bank has the burden on the matters of a security procedure agreement, commercial reasonability, and good faith and compliance; but the customer purporting to be a victim of fraud has the burden of the "not an insider" defense.[77]

There is no comparative negligence analysis or sharing of liability in this legal scheme. The purported sender/innocent customer (the

[75]U.C.C. Section 4A-202(c). Note that a security procedure can be deemed commercially reasonable, and this presents bank counsel with a useful negotiating tactic. See E. Patrikis, T. Baxter, and R. Bhala, "Article 4A: The New Law of Funds Transfers and the Role of Counsel," 23 *U.C.C.L.J.* 219, 235-236 (1991).

[76]U.C.C. Section 4A-202(b). "Good faith" is defined in Section 4A-105(a)(6) as "honesty in fact and the observance of reasonable commercial standards of fair dealing."

[77]U.C.C. Sections 4A-202 and 4A-203.

automobile manufacturer) bears the full $100,000 loss (in that its account is not recredited) if (1) the bank proves that it acted in good faith and complied with a commercially reasonable security procedure and (2) the customer cannot meet the innocent customer defense requirements.

Money-Back Guarantee and Discharge

In the hypothetical funds transfer, what rights does each sender (the originator, originator's bank, and intermediary bank) have if the funds transfer is not completed? (A funds transfer is complete when the beneficiary's bank accepts a payment order for the benefit of the beneficiary of the originator's order.)[78] For example, is the automobile manufacturer entitled to a refund of $100,000, or must it commence litigation against some downstream party to recover the funds? What rights do the automobile manufacturer's bank and the second bank have in the event of noncompletion? More fundamentally, when is a funds transfer complete? Does completion have an effect on the underlying contractual obligation of the automobile manufacturer to pay $100,000 to the steel company?

A money-back guarantee rule ensures that the originator of a funds transfer, and each subsequent sender of a payment order in the funds transfer chain, obtains its money back if the transfer is not completed. A funds transfer is said to be completed when the *beneficiary's bank accepts* a payment order on behalf of the beneficiary.[79] If the transfer is not completed, then each sender of a payment order in the funds transfer chain is *entitled to a refund* of the principal amount of the payment order, plus any accrued interest.[80] If the transfer is completed, then the originator's underlying contractual obligation to the beneficiary is *discharged*.[81]

In the hypothetical funds transfer, as soon as the steel company's bank accepts the payment order issued by the second bank, the funds transfer is complete and the automobile manufacturer is discharged on its underlying obligation to pay $100,000 to the steel company. In the event of noncompletion, each sender—the automobile manufacturer, the automobile manufacturer's bank, and the second bank—is entitled to a refund of any amount it paid for its payment order, plus interest.[82]

The money-back guarantee may not be varied by an agreement between the sender and receiving bank.[83] However, the rule is subject to the

[78]U.C.C. Section 4A-104(a).

[79]*Id.*

[80]U.C.C. Section 4A-402(c)-(d).

[81]U.C.C. Section 4A-406(b).

[82]The rate of interest is determined in accordance with U.C.C. Section 4A-506. Unless otherwise agreed, it is the federal funds rate.

[83]U.C.C. Section 4A-402(f).

exception that a sender that selects a particular intermediary bank through which to route a funds transfer bears the risk of loss associated with the failure of that bank.[84]

Suppose the automobile manufacturer instructed its bank to route the $100,000 transfer through BCCI instead of the second bank, and the automobile manufacturer's bank complies with this instruction and debits its customer's account. Assume that BCCI is closed by banking supervisors. The closure occurs after BCCI accepts the payment order issued by the automobile manufacturer's bank and is paid for the order by that bank, but before the funds transfer is completed (before the steel company's bank accepts BCCI's order). The effective result of these facts is that the funds are "stuck" at BCCI. Then, the originator is not entitled to a re-credit of $100,000. The automobile manufacturer's bank can keep the $100,000, and the automobile manufacturer is subrogated to the right of its bank to claim against the receiver or trustee of BCCI's assets. In sum, the party (here, the originator) who designates the failed intermediary bank should and does bear the risk of adverse consequences of that choice.

Bank Failure

The consequences of bank failure on account holders depend in part on the time the failure occurs and on which bank in the funds transfer chain fails. In the above example, since BCCI fails before the funds transfer is complete, the risk of loss is assumed by the party that designated the use of the intermediary bank.

If BCCI fails after the transfer is complete, the beneficiary's bank must have accepted a payment order from BCCI, and the originator must have been discharged, before the failure, because of the definition of "completion" and the discharge rule.[85] Payment by the beneficiary's bank to the beneficiary is final because of the receiver finality rule.[86] Whether the beneficiary's bank was paid by BCCI for the order it received and accepted from BCCI before the beneficiary's bank paid the beneficiary depends on the facts of the case. If the beneficiary's bank accepts BCCI's order by paying the beneficiary before receiving settlement from BCCI, the beneficiary's bank assumes the risk of loss from a BCCI failure.[87]

[84]U.C.C. Section 4A-402(d).

[85]U.C.C. Sections 4A-104(a) and 4A-406, respectively.

[86]U.C.C. Section 4A-405(c).

[87]Under U.C.C. Section 4A-209(b)(1)(clause (i)), one way in which the beneficiary's bank can accept a payment order is by paying the beneficiary in accordance with Section 4A-405(a) or (b). Section 4A-405(a) concerns a credit to the beneficiary's account, and Section 4A-405(b) concerns payment by means other than a credit as determined by "principles of law that determine when an obligation is satisfied." The point is that the beneficiary's bank can pay the beneficiary before the bank has received settlement from its sender.

The above discussion prompts the question of what happens if BCCI remains solvent, hut the originator's bank or the beneficiary's bank fails. Consider first the case where the originator's bank fails before accepting the originator's payment order. Plainly, the funds transfer is not complete and the originator's obligation to pay $100,000 to the beneficiary is not discharged. Under U.C.C. Article 4A, because the originator's bank failed before acceptance, the duty of the originator to pay the originator's bank for its order never matured, hence the originator is not liable for the order it issued.[88]

If the originator's bank fails after accepting the order, the originator is obligated to pay for its order.[89] Assuming a same-day execution scenario, the originator's bank will have accepted the originator's payment order by issuing a conforming order, that is, by executing the originator's order, on the day it received the originator's order.[90] Under U.C.C. Article 4A, if BCCI accepts the order of the originator's hank, the originator's bank is liable to pay for its order.[91] Whether this liability is affected by applicable Federal bank regulatory provisions is beyond the scope of this chapter, but the issue raises potentially intriguing legal and policy issues.[92]

For example, the originator is not discharged until the beneficiary's hank accepts an order from BCCI, but suppose BCCI is unwilling to accept the order issued by the originator's bank until the originator's bank provides settlement for its order. In this instance, BCCI presumably is unwilling to assume the risk that the originator's bank fails after BCCI accepts the order hut before BCCI has been paid for the order. The originator will then bear that risk, because it may have paid the originator's hank for its payment order but not have been discharged on its underlying payment obligation to the beneficiary. If the originator's bank fails before discharge occurs, then the originator is liable to the beneficiary for $100,000 on the underlying contract and must claim against the originator's bank (or its receiver or liquidator) under the money-back guarantee (or perhaps other applicable law).[93] This might be justified on the ground that the originator is the party that selected the use of the originator's bank by maintaining an account at, and issuing a payment order to, that bank.

Consider the scenario in which the beneficiary's bank fails. If this occurs after acceptance, then the originator is discharged on its obligation.[94]

[88]U.C.C. Section 4A-402(c).

[89]*Id.*

[90]U.C.C. Sections 4A-209(a) and 4A-301.

[91]U.C.C. Article 4A-402(b).

[92]This scenario is perhaps more likely given the prompt corrective action rules implemented pursuant to the Federal Deposit Insurance Corporation Improvement Act of 1991, Pub. L. No. 102-242, section 131 (1991). See 12 C.F.R. Parts 208 and 263 (1993).

[93]U.C.C. Section 4A-402(c).

[94]U.C.C. Section 4A-406.

The beneficiary bears the risk of loss and must make a claim against the failed bank (or its receiver or liquidator). Again, this might be justifiable because the beneficiary is the party that designated to the originator in its underlying contract with the originator that payment should be made at the beneficiary's bank. If failure occurs before acceptance, the funds transfer is not complete. The originator (and each subsequent sender) is entitled to the money-back guarantee.[95] Presumably, the originator will pay the beneficiary through a funds transfer directed to a different beneficiary's bank (or through an alternative payments mechanism).

Summary

The legal foundations of the large-value credit transfer systems in the United States—Fedwire and CHIPS—are set forth in U.C.C. Article 4A. Among the many provisions in the statute, the five most noteworthy are articulated through precise terminology identifying each party to a funds transfer and the actions that each party undertakes.

Must the five rules exist in any funds transfer statute? To what extent can one generalize from the Article 4A experience? These questions deserve two levels of analysis. First, comparative legal research on the laws governing large-value credit transfer systems in other jurisdictions and on the new United Nations Model Law on International Credit Transfers is needed to identify the foundations of those laws. In other words, those laws need to be distilled. Second, theoretical debate, involving economic rationales and public policy goals, is required to determine the justifications for alternative statutory foundations.

Although these analyses have yet to be performed, one point of caution is appropriate: commercial law, including funds transfer law, is not immutable. It serves commercial parties and their transactions, but because both of these change over time, individual needs and systemic concerns vary as well. Accordingly, the legal foundations of Article 4A, or any other regime for large-value credit transfer systems, should be viewed as dynamic, not static.

[95]U.C.C. Section 4A-402(c).

6

Large-Value Transfer Systems

Akinari Horii and Bruce J. Summers

Large-value transfer systems supporting the interbank markets are the main arteries of a nation's payment system. The safe and efficient operation of the money and capital markets hinges upon the smooth functioning of these systems. Moreover, rapid and reliable settlement is essential for technical efficiency and innovation in financial markets. The safe and efficient operation of large-value transfer systems has a bearing not only on the markets they directly serve but on a nation's whole financial system. In addition, large-value transfer systems have an international role to play, as they, in combination, provide the ultimate settlement vehicle for important cross-border markets in multiple currencies. The international goods and financial markets depend critically on national large-value transfer systems to settle obligations in the currencies in which trading is conducted.

For these reasons, the design and operation of large-value transfer systems are major concerns for policymakers and banking practitioners. In developed market economies, attention has recently been focused on strengthening these systems. Establishing at least a rudimentary large-value payment capability is a priority in developing market economies because it is needed to support emerging financial markets and will help to create conditions for improved execution of monetary policy by the central bank.

This chapter makes some practical distinctions to help single out large-value transfer systems from among the plethora of payment mechanisms in use, and presents three general models of such systems that embody the basic distinctions among the major systems that are currently operational. It examines actual large-value transfer systems, including the Swiss Interbank Clearing System (SIC), Fedwire, The Bank of Japan Financial Network System (BOJ-NET), and the Clearing House Interbank Payments System (CHIPS), that illustrate the models. It identifies issues relating to the use of these systems for settlement of cross-border payments.

Distinctions Between Large-Value Transfer Systems

Different payment mechanisms can be distinguished by the businesses they support and the customers they serve, as reflected in the value of the

payments processed. As a result of the wide variation in the value of payments, payment mechanisms have become quite highly specialized. Although there is no clear-cut, quantitative demarcation between small- and large-value payments, some systems have specialized in handling payments that are typically very large.

In general, the interbank, securities, and business-to-business, or wholesale markets, give rise to payments whose large size and critical timing place them in the category of large-value payments. Participants in these markets naturally seek bank payment services and payment mechanisms that can meet their needs for reliability, security, accuracy, and timeliness. To meet these needs, specialized large-value transfer systems have evolved.

The average size of the payments handled by a system is a useful practical indicator of the system's uses. Table 1 shows, for 1992, the average size of funds transfers made over the four large-value transfer systems discussed in this chapter. Although there is generally no minimum size restriction on transfers over these systems, the typical transfer is a very large sum. For example, the average size of funds transfers over Fedwire and BOJ-NET are about $3 million and $33 million, respectively.

The cost of providing the superior levels of service required by the users of such systems is high compared with other systems that handle low values, in part owing to the greater security, reliability, and timeliness required in large-value payments. Accordingly, competitive pricing of payment services, together with the requirements placed by systems on their users to comply with minimum operational and security standards, have thus far limited the use of such systems for small-value transfers.

In addition to average transaction size, the total value of payments handled by a system during a normal business day is also a relevant indicator of the underlying purpose for which the system is used. Table 1 also shows the daily average value of funds transfers over the four systems treated here. The daily flows of funds over these systems is huge in relative terms as well, on average equaling the value of annual GDP every 2.6 and 2.8 days in Switzerland and Japan, respectively, and every 3.4 days in the United States for Fedwire and CHIPS combined.

Three Models of Large-Value Transfer Systems

The framework for analysis of payment systems presented in Chapter 3 introduced a number of concepts that are useful building blocks in constructing models of payment systems. Three general models of large-value transfer systems are developed here using the following concepts: (1) operator of the system, that is, the central bank or a private organization such as a clearinghouse; (2) type of settlement, that is, gross or net;

Table 1. Value of Funds Transfers Over Four Large-Value Transfer Systems, 1992

System	Average Transfer Size *(Million U.S. dollars)*	Daily Average Value of Transfers *(Billion U.S. dollars)*
Swiss Interbank Clearing System[1]	0.4	93.6
Fedwire	2.9	796.7
BOJ-NET (Designated-time net settlement)	33.4	1,198.7
Clearing House Interbank Payments System	6.1	941.7

[1]In contrast to other large-value transfer systems, SIC is used heavily to process smaller-value transactions.

and (3) credit facilities, in particular, whether the system provides intraday credit and whether operational controls are in place to help manage such credit extensions.

The first general model of a large-value transfer system is a gross settlement system operated by the central bank without intraday credit. As explained in Chapter 2, intraday loans have a duration shorter than one business day; say, a few minutes or hours. In a gross settlement system operated by the central bank, agreement to honor a payment order when the funds in the account of the paying bank are insufficient to settle the payment results in an extension of credit. This is so regardless of whether the paying bank would fully fund the payment before the end of the business day, that is, repay the intraday loan. In the general model where the central bank does not agree to provide credit, a payment order will be honored only if funds are on deposit at the time the payment order is made. Otherwise, the payment order is returned to the originator (rejected) or held until covering funds become available during the day (pended or queued). This type of system implies real-time computer processing and operational controls that permit the central bank to prevent use of intraday credit. An example of such a system is the Swiss Interbank Clearing System.

The second general model of a large-value transfer system is a gross settlement system operated by the central bank with intraday credit. In this model, the central bank will honor payment orders during the day even if an ordering bank's account does not contain sufficient funds to settle the transfer. Intraday credit is generally provided with the expectation that the covering funds will be deposited in the account before the

end of the business day. The central bank's willingness to extend intraday credit, however, is not unlimited. Financial and operational controls will be employed to govern the amount of intraday credit extended. An example of such a system is the Fedwire funds transfer system in the United States.

The third general model of a large-value transfer system is a deferred net settlement system. In such a system, settlement does not occur payment-by-payment, but at designated times during the day. Between—or at—designated settlement times, payments exchanged between banks are multilaterally netted, resulting in one net obligation for each net debtor bank that is due at settlement time.

Netting systems act to reduce, perhaps significantly, the intraday liquidity needed to settle large payments. In a netting system, these liquidity needs are met by the de facto extension of credit among participants in the system. However, this credit is extended by the originators and receivers of payments over the system, not by the operator of the system. Some deferred net settlement systems are operated by the central bank, whereas others are operated by the private sector. An example of the former type of system is BOJ-NET[1] in Japan. An example of a privately operated system is CHIPS in the United States.

The netting principles that underlie the operation of deferred net settlement systems are the same, regardless of whether the system operator is a central bank or a private entity. In the latter, day-to-day management of the system is in the hands of the private sector. Nonetheless, the central bank almost certainly will exercise some oversight of the privately operated system, for example, by examining its operations and reviewing and approving rule changes before they are made. An important characteristic of all deferred net settlement systems is that netted obligations arising from payment activity between deferred settlement times are finally settled by transferring balances held in accounts with the central bank, that is, final settlement is made in central bank money. For this reason alone, a central bank should be extremely confident about the appropriateness of the risk management controls that such systems employ before it grants use of its net settlement services. The minimum standards that have come into use for judging the adequacy of the design and operation of cross-border and multicurrency netting systems are the so-called six Lamfalussy standards published by the Bank for International Settlements, most of which are applicable to large-value netting schemes in general.[2]

[1]BOJ-NET also offers gross settlement without intraday credit.

[2]Bank for International Settlements, *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries*, prepared by the Committee on Interbank Netting Schemes chaired by M.A. Lamfalussy (Basle, November 1990).

Examples of Large-Value Transfer Systems

This section describes the operation of four large-value transfer systems that typify the models presented above. Table 2 is a profile of the four systems, which comprise SIC, Fedwire, BOJ-NET, and CHIPS. Table 2 is intended as a quick reference to show the basic features of these systems. The appendices to this book provide detailed descriptions of each of the four systems. The essential operating features of these four systems are described below using numerical examples.

Swiss Interbank Clearing System (SIC)

SIC is the best example of a gross settlement system providing final settlement in central bank money without any extension of intraday credit whatsoever. From its inception in 1987, it was designed as a no-overdraft system. It operates on the principle that all payment orders will be processed *only* if they can be fully funded from a bank's account held at the Swiss National Bank. If funding is not available, the payment order will be queued and held until covering funds become available, up to the end of the operating day. At the end of the operating day, payment orders in the queues are canceled.[3]

SIC operates virtually around the clock. The beginning of the SIC operating day is 18:00 Zurich time (17:00 GMT) on day t and the end of the operating day is 16:15 Zurich time (15:15 GMT) on day $t+1$. Payment orders can be originated throughout this period and are processed and settled virtually immediately if funds are available in the account of the originating bank.

Table 3 is a simple numerical example of how SIC functions. Assume an opening of business balance in the account of the bank of 10 monetary units. Assume further that the first transaction of the day is the receipt of a payment order equal to 20 monetary units. Because SIC is a gross settlement system, the bank's current account balance held at the Swiss National Bank is immediately increased to 30 monetary units. The second transaction is an order to pay 30. Because there are sufficient balances in the account at the Swiss National Bank, this payment order is accepted and settled immediately, reducing the current account balance with the Swiss National Bank to zero. The third transaction is an order to pay 10 monetary units. In this instance, the amount settled is zero, as the Swiss National Bank will not agree to process the transaction because there are insufficient funds in the account to settle the payment order. Instead, the

[3]Much of this section is based on Christian Vital, "Swiss Interbank Clearing—Further Experience With a Queuing Mechanism to Control Payment System Risk," a paper presented in April 1990 at a conference sponsored by the Institute for International Research.

Table 2. Summary Profile of Four Large-Value Transfer Systems

	Swiss Interbank Clearing System (SIC)	Fedwire	BOJ-NET Designated-Time Net Settlement[1]	Clearing House Interbank Payments System (CHIPS)
Type of system	Gross settlement system without central bank credit	Gross settlement system with central bank credit	Multilateral net settlement system without central bank credit	Privately operated multilateral net settlement system
Year started	1987	1918	1988	1970
Governing body	Swiss National Bank	Federal Reserve System	Bank of Japan	New York Clearing House
Operating day[2]	18:00 day *t* to 16:15 day *t*+1	8:30 to 18:30[3]	9:00 to 17:00	7:00 to 16:30
Settlement time(s)[2]	Continuous	Continuous	9:00; 13:00; 15:00; 17:00	Before 18:00
Number and type of participants as of year-end 1992	163 banks	11,435 banks	461 banks, securities firms, and money market brokers	20 settling banks and 119 nonsettling banks
Daily average transaction volume during 1992	250,000	280,000	36,000	150,000
When is payment settled finally and irrevocably on books of central bank?	When account of sending bank has been debited and account of receiving bank credited.	When payment order is accepted for processing.	At time designated by originating institution.	By 18:00.

What happens if there are not sufficient funds in originator's account at time of settlement?	Payment order is queued until sufficient funds have accumulated in sending participant's account. Payment orders in queue may be canceled at any time by sending participant. Payment orders remaining in queue at 16:15 are canceled automatically.	For institutions subject to real-time monitoring, account balance with Federal Reserve Bank is continuously monitored. If overdraft amount reaches a predefined cap, transaction is either rejected or pended until covering funds are received.	Sending participant borrows from Bank of Japan, subject to regular lending policy. In theory, netting can be unwound.	Settlement is guaranteed against failure of largest net debtor defaulting on its obligation by participants in arrangement and a loss sharing procedure is in place to back up guarantee.
Bilateral credit limits	None.	None.	None.	Each participant determines maximum amount it is willing to receive from each other participant.
Sender net debit caps	N/A	There is a limit to amount of daylight overdraft that is set as a multiple of capital according to a participant's self-assessment based on its creditworthiness and operational controls.	None.	There is a limit on what one participant may owe entire CHIPS system at any time of day equal to 5 percent of sum of bilateral limits assigned by other participants.

[1]BOJ-NET also offers a gross real-time settlement capability without credit, which operates in a manner similar to SIC.
[2]All times are local times.
[3]The Board of Governors of the Federal Reserve System has announced that Fedwire will open at 0:30 beginning in early 1997.

Table 3. Numerical Example of Operation of Swiss Interbank Clearing System

Transaction	Payment Orders	Settlement Amounts	Current Account Balance	Unsettled Balance (Net Receipt)
Opening of business	—	—	10	0
1.	Receive 20	Receive 20	30	0
2.	Pay 30	Pay 30	0	0
3.	Pay 10	0	0	−10
4.	Receive 20	Receive 20	20	0
		Pay 10	10	0

transaction is placed in queue, resulting in an unsettled balance of minus 10. Finally, the fourth and last transaction of the operating day is the receipt of 20 monetary units. The receipt of 20 monetary units is settled immediately and results in a positive account balance of 20, which triggers release of the one payment order in the queue and elimination of the unsettled balance of 10. The end-of-day result of this activity is a current account balance of 10 and an unsettled balance of zero.

As described in Appendix 1, the SIC system is designed to process as many payment orders as possible following the "first-in, first-out" principle. The amount of funds held in the account of the originating institution must be sufficient to cover the payment that is at the head of the queue of unfunded payment orders, should such a queue exist. If there are unsettled balances outstanding at the end of the SIC business day, the payments in the queue will be purged, and the institution will be forced to resubmit the orders on the following day. An institution is, however, permitted to manage the payment orders held in its SIC queue by canceling orders in the queue, which would advance other payment orders to the head of the queue.[4] A new feature will become available in 1994 that allows participants to attach a priority to a payment order. Processing will then be governed by the principle "by priority level and first-in, first-out for a given priority level."

One important feature of SIC is that the institution designated as the intended receiver is notified of the amount of pending receipts. Further notification is received when a payment order is settled. In the numerical

[4]Cancellation before the first cutoff time of 3:00 p.m. can be done by the sending bank unilaterally. After the first cutoff time, cancellation requires the consent of the receiving bank. Otherwise, the sender will be charged a penalty equivalent to 5 percentage points over the prevailing market rate.

example discussed above, therefore, the intended receiving institution is informed of the amount of the third transaction, an order to pay 10, at the time the order is made. Only after the fourth transaction of the day, however, does the receiving institution receive funds and notification that the payment order is settled. Perhaps as important, institutions can use a real-time inquiry feature to monitor the current status of all payment messages.

Fedwire

Table 4 illustrates the operation of Fedwire, the gross settlement system operated by the Federal Reserve Banks since 1918. Fedwire began as a simple telegraph system that was used to transfer balances between accounts held at Federal Reserve Banks. Settlement is final when the Federal Reserve Bank holding the account of the originating institution agrees to process a payment order. The Federal Reserve permits daylight overdrafts over Fedwire, within limits. As described in Appendix 2, institutions are expected to perform a self-assessment of their creditworthiness and operational capabilities and to establish a Fedwire cap, which is based on a multiple of their tier 1 capital, if they have overdrafts that are large in relation to their capital.

The normal Fedwire operating day is 8:30 to 18:30 New York time (13:30 to 23:30 GMT). Fedwire is sometimes opened earlier than 8:30 or closed later than 18:30 to meet special needs. For example, Fedwire has been opened earlier than 8:30 in response to unusually volatile financial market conditions resulting in large price swings and consequently unusually large settlement obligations on the part of market participants. By

Table 4. Numerical Example of Operation of Fedwire Funds Transfer System1

Transaction	Payment Orders	Settlement Amounts	Current Account Balance	Unsettled Balance (Net Receipt)
Opening of business	—	—	10	0
1.	Receive 20	Receive 20	30	0
2.	Pay 30	Pay 30	0	0
3.	Pay 10	Pay 10	−10	0
4.	Receive 20	Receive 20	10	
5.	Pay25	0	10	−25
6.	Receive 5	Receive 5	−10	0

1Sender debit cap equals 12.

opening Fedwire early, the Federal Reserve has given the settlement banks for the financial exchanges the ability to transfer early in the morning payments that represent settlement obligations of their members. Such settlement obligations might arise, for example, in connection with end-of-day variation margin calls on the futures exchanges. Early opening of Fedwire permits settlement of such end-of-day obligations before the beginning of trading on the subsequent day. Further, there have been extensions to the Fedwire operating day to give more time for CHIPS to settle. In addition, Fedwire operating hours can be extended if a participant with a large value of transfers has operating problems that result in its needing a longer operating day to make its payments.

In the numerical example illustrated in Table 4, the opening of business balance held at the Federal Reserve Bank is again 10 monetary units. The first transaction is the receipt of a Fedwire transfer of 20 monetary units, which is immediately settled and reflected in the account balance at the Federal Reserve Bank, which is increased to 30. The second transaction of the Fedwire day is a payment order of 30, which draws the account balance down to zero.

This example assumes that the originating bank's debit cap is 12 monetary units. Consequently, the third transaction of the day, which is a payment order of 10, is processed by the Federal Reserve and settled immediately, even though this payment order results in a negative account balance of minus 10. The cap is not binding because the amount of the payment order does not exceed the debit cap. By agreeing to process the payment order, the Federal Reserve essentially agrees to lend intraday funds to the bank originating the payment so that the transaction can be settled.

The fourth transaction of the day is the receipt of 20 monetary units, which rebuilds the account balance to 10 and extinguishes the intraday loan. The fifth transaction of the day is a payment order of 25. In this case, the positive current balance in the Federal Reserve Bank account (10 monetary units) combined with the institution's cap (12 monetary units) results in total capacity of 22 monetary units, an amount insufficient to settle the transaction, which is valued at 25 monetary units. Assuming, for the moment, that the Federal Reserve Bank monitors the institution in real time, the transaction will not be settled but will either be (a) rejected back to the sender or (b) pended for subsequent processing once the account is funded. Because the payment order of 25 cannot be funded, unsettled balances in the system (assuming that the transaction is pended) equal minus 25 monetary units.

Finally, the Fedwire day ends with the sixth transaction, which is the receipt of 5 monetary units. The positive account balance increases to 15, which, combined with the cap, increases capacity to 27 monetary units, an amount sufficient to fund the pended transaction of 25 even though the

result is a negative balance of minus 2. If the Fedwire day ends and the institution's balance is negative, as in this example, the implication is that the institution was unable to raise funds in the market to meet its Fedwire payment obligations for the day. The institution must then obtain a discount window loan from the Federal Reserve to bring its account into balance.

The Board of Governors of the Federal Reserve System has decided to price intraday overdrafts incurred by depository institutions using Fedwire. Pricing of intraday overdrafts is an extremely complex subject and raises a host of legal, operational, and monetary control issues.[5] Pricing became effective in April 1994.

The operation of SIC and Fedwire highlights an important contrast between systems that do and do not provide credit. In particular, a "no-overdraft" system like SIC imposes tighter liquidity management constraints on banks than does Fedwire, through which the central bank provides intraday credit. Banks and other financial market participants that place a premium on timely settlement are likely to describe a no-overdraft system as being less efficient than a system like Fedwire, which permits intraday overdrafts. Their intraday credit needs cannot currently be efficiently met except through the payment mechanism they use. In short, the SIC system does not "lubricate" the payment system with intraday credit, and consequently many transactions are queued. In contrast, the Federal Reserve has historically been a generous provider of intraday credit over Fedwire, and Fedwire caps have historically not been binding.

Although Fedwire may be more efficient in terms of the timeliness of settlement for interbank transactions, this enhanced efficiency comes at a cost. The cost takes the form of the increased credit risk absorbed by the Federal Reserve in operating Fedwire. Moreover, because the abundant intraday credit has been provided free, banks have overused intraday overdrafts provided by the Federal Reserve, resulting in the absorption by the central bank of a certain amount of credit risk that should more appropriately be shouldered by the private sector.

BOJ-NET

The Bank of Japan is somewhat special among central bank operators of large-value transfer systems because it supports two distinctively different systems, both operating under the name BOJ-NET. On the one hand, BOJ-NET offers, like SIC, a gross real-time settlement service without intraday

[5]For an analysis of these issues, see the attachments to the Federal Reserve press release dated October 7, 1992.

overdrafts. BOJ-NET is, however, different from SIC in that, if sufficient funds are not available in the account to settle the obligation, the payment order is automatically rejected, rather than queued.

The gross, real-time, no-overdraft service provided over BOJ-NET is not heavily used in comparison with the other services provided by the Bank of Japan. More heavily used by banks and other financial firms holding accounts at the Bank of Japan is the BOJ-NET designated-time net settlement system, which is estimated to handle 50 times the transfer volume that the gross real-time BOJ-NET system handles.

The BOJ-NET designated-time net settlement system accepts payment orders between 9:00 and 17:00 Tokyo time (00:00 to 8:00 GMT) for same-day settlement. The cutoff time for postdated transactions is 17:20. Although settlement obligations are calculated based on multilateral netting, in strict legal terms this BOJ-NET service is a designated-time gross settlement. Each payment order originated before or during the settlement day can be designated to settle at one of four designated settlement times during the day, namely, 9:00, 13:00, or 15:00 or 17:00. Table 5 is a numerical example illustrating the operation of this system.

Assume again that an institution, this time using the BOJ-NET designated-time settlement, has an opening of business balance in its account at the Bank of Japan of 10 monetary units. The first transaction of the day is the receipt of 20 monetary units and, because this is a designated-time system, the amount settled is zero—the account balance remains unchanged at 10, and total unsettled balances increase from zero to 20 monetary units. Next, assume that a payment order valued at 30 is originated. Again, there are no changes in the account balance, there is no final settlement associated with the transaction, but the unsettled net balance of the institution in question falls to minus 10 monetary units. The process is repeated for a payment order of 10 with the unsettled net balance falling further to minus 20 monetary units. Finally, the last transaction before the designated settlement time is the receipt of a payment valued at 25 monetary units, which increases the net unsettled balance to 5. Accordingly, at the designated settlement time, the total net amount to be settled for the institution is 5, which increases its balance in the settlement account of the Bank of Japan to 15, while unsettled balances fall to zero.

There are no formal procedures currently in place for the BOJ-NET designated-time net settlement system to address an institution's inability to meet its settlement obligation. The Bank of Japan has discretion to provide the institution in question with credit or to delete the institution's payment orders from the settlement. Although this room for discretion gives the central bank flexibility in forestalling systemic disruption of financial markets, it may invite moral hazard among participating institutions if central bank credits are expected to be granted easily.

Table 5. Numerical Example of Operations of BOJ-NET Designated-Time Net Settlement System

Transaction	Payment Orders	Settlement Amounts	Current Account Balance[1]	Unsettled Balance (Net Receipt)
Opening of business	—	—	10	0
1.	Receive 20	0	10	20
2.	Pay 30	0	10	−10
3.	Pay 10	0	10	−20
4.	Receive 25	0	10	5
Designated settlement time		5	15	0

[1]Balance held in the settlement account at the Bank of Japan.

Clearing House Interbank Payments System (CHIPS)

The Clearing House Interbank Payments System is operated by the New York Clearing House and processes primarily international payments. The numerical example shown in Table 5 could apply to CHIPS, as CHIPS operates under a netting arrangement similar to the BOJ-NET designated-time net settlement system. CHIPS differs from BOJ-NET in that there is one end-of-day settlement, not a series of designated settlement times during the day. Moreover, CHIPS is a privately operated payment system in which final settlement is achieved by funds transfers on Fedwire. CHIPS operations are governed by a set of risk controls that have been adopted by its members.[6] In particular, as summarized in Table 2 and described more fully in Appendix 4, CHIPS participants have adopted a system of bilateral credit limits and sender net debit caps that limit both individual participant exposure and the entire system's vulnerability to credit risk.

Under CHIPS bilateral credit limits, each participant establishes the maximum net amount it is willing to receive from another participant and this limit is enforced automatically, in real time, by the CHIPS computer system. Further, there is a sender net debit cap in place that limits the amount that any one participant can owe to the entire CHIPS system. Each participant's sender net debit cap is equal to 5 percent of the sum of the bilateral credit limits established by each of its counterparties in CHIPS. Essentially, then, participants are able to limit their exposures bilaterally

[6]See New York Clearing House Association, *CHIPS Settlement Finality Rules and Documents*, April 1990.

to participants they judge to be in questionable financial condition and, in the process, the entire CHIPS system's exposure to that participant is limited.

All CHIPS participants agree to participate in a scheme for guaranteeing the daily settlement, if a participant with a large settlement obligation ever fails to meet that obligation. The settlement guarantee is combined with a loss-sharing arrangement to govern the distribution of the burden of funding a failure to settle among the members of CHIPS. CHIPS maintains significant liquidity to permit the mobilization of cash on very short notice to allow the system to settle in a timely fashion if a participant unexpectedly fails to meet its net debit obligation. As described in Appendix 4, the liquidity arrangements include a pool of U.S. Government securities collateral held in escrow at the Federal Reserve Bank of New York.

Cross-Border Large-Value Payments

As noted earlier, domestic large-value transfer systems are often used in the interbank markets to settle the local currency component of cross-border, multicurrency transactions. The value of such transactions is substantial, reflecting growing internationalization in the goods and financial markets. In fact, the largest cross-border financial flows in the world result from trading in the international interbank markets, the largest of which is the foreign exchange market.

Settlement of payment obligations that arise in these cross-border markets depends substantively on the international correspondent banking system. Correspondent banks provide the clearing, settlement, and credit services necessary to allow payments to be made efficiently. The correspondent banks, in turn, rely on either book transfers or domestic large-value transfer systems to settle their interbank obligations arising in such markets.

A special type of risk that must be managed by banks settling cross-border obligations is the temporal risk arising when the two sides of a settlement are separated in time owing to international time-zone differences. A mechanism for the simultaneous final settlement of interbank money positions in different currencies using large-value transfer systems does not currently exist for every currency pair. For example, time-zone differences and the current differences in the hours of operation of domestic large-value transfer systems and domestic money markets introduce temporal risk in the settlement of the three most important currency pairs on the foreign exchange markets---the U.S. dollar/deutsche mark, U.S. dollar/yen, and U.S. dollar/pound sterling.[7]

[7]See Bank for International Settlements, *Central Bank Survey of Foreign Exchange Market Activity in April 1992* (Basle, March 1993).

Several private arrangements to improve settlement particularly in the foreign exchange markets have been initiated. In the foreign exchange markets, two different groups of bankers, one in Europe and the other in North America, have explored establishing multilateral netting arrangements on behalf of their members. These arrangements are the Exchange Clearing House Organization and MultiNet, respectively. Their objective is to design and implement safe and efficient final settlement capabilities for foreign exchange dealing by attempting to synchronize their multicurrency settlements across time zones to the extent possible.[8] At least one other service offered by a private bank is designed to support simultaneous settlement in multiple currencies through the exchange of shares in a mutual fund that is invested in highly liquid government securities.[9]

It is likely that the participants in any cross-border, multicurrency multilateral settlements that are established will wish to rely on domestic large-value transfer systems to achieve final settlement. Participants in such arrangements may also wish to achieve greater simultaneity in the settlement of their respective positions in various currencies. As long as there are needs in the market for settlement arrangements to reduce cross-border settlement risks, large-value transfer systems will over time likely provide such services.

Conclusions

A rich variety of large-value transfer systems exist that serve developed financial markets around the world. The operation of these systems can entail risks both for the participants transferring funds and for the operators of the systems. These risks must be allocated and controlled so that the participants in the systems and the system operators are reasonably protected. At the same time, when the systems are based on multilateral netting and result in a mutualization of risk, risk control mechanisms must be in place to protect against adverse systemic consequences for the financial system at large. These systems can be expected to continue to adapt over time to changing market needs, including the needs of cross-border markets for safer multicurrency settlement.

There is a trade-off between efficiency and risk in the design and operation of large-value transfer systems. At one extreme, a gross settlement system that does not provide for intraday credit to participants minimizes the concentration of credit risk in the large-value transfer system itself, but

[8]Peter B. Smith, "Foreign-Exchange Netting Needed to Reduce Enormous Exposures," *Financier*, Vol. 15 (January 1991), pp. 22–24.

[9]See "A Fund-Shifting System That's Open All Night," *New York Times*, November 27, 1992, p. D12.

at the same time may severely constrain the flexibility with which payments can be made. Such a system is more likely to result in delayed payments or the accumulation by banks of large, probably sterile clearing balances. At the other extreme, a gross payment mechanism that provides liberal quantities of credit, either through the central bank or implicitly through a multilateral netting arrangement, brings significant risks both for participants and for the financial system. The models presented here highlight some of the trade-offs between the two different approaches and the types of controls that have been employed to protect against risk.

In the end, no single model of a large-value transfer system is necessarily best for a particular situation. More than one large-value transfer system can serve the same economy, meeting the needs of different types of markets and customer requirements. In the United States, for example, Fedwire and CHIPS operate side by side and have, over time, adapted to meet the varying requirements of the U.S. and international financial systems. Similarly, in Japan, there is a clearing system for yen settlement for foreign exchange and cross-border transactions—the foreign exchange yen settlement system (FEYSS)—as well as BOJ-NET. The FEYSS and CHIPS netting systems, however, depend critically on the final payment capabilities of the Bank of Japan and the Federal Reserve, respectively. A mix of public and private arrangements may represent the optimal solution to the needs of participants in markets that give rise to demands for large-value transfer services.

7

Payment System Risk and Risk Management

Paul Van den Bergh and John M. Veale[1]

Financial transactions generate a range of risks for counterparties that undertake them, their bankers and other intermediaries that process the transactions, and central banks through which final interbank settlement occurs. These risks are greatest in large-value interbank funds and securities transfer systems that support trading in financial markets. It is in these markets in particular that interrelationships between counterparties create the potential that disturbances in payment flows will have wider repercussions for the financial system and the economy as a whole.

This chapter describes and analyzes the risks borne by participants in payment systems. It outlines the basic steps and the types of risks that can arise in a financial transaction and shows how an intermediary providing payment services also takes on risks. It explains systemic risk, describes the risks that arise in netting arrangements, and deals with control of risk in net settlement and real-time gross settlement systems.

Risks in Financial Transactions

A transaction leading to a payment is typically a contract calling for an exchange between two parties. As illustrated in Chart 1, one leg of the exchange is the payment itself, while the other leg can be the delivery of a good or service. The delivery leg may also consist of a transfer of funds, for example, when the contract involves a foreign exchange transaction. Each exchange therefore involves risks both for the counterparties (X and Y in Chart 1) and for any intermediaries taking part in the payment.

The counterparties face two fundamental types of risk:

- Credit risk is the risk that participants in the transaction will not be paid for an outstanding claim. These participants include the counterparties themselves, the issuer of the settlement medium, and, if

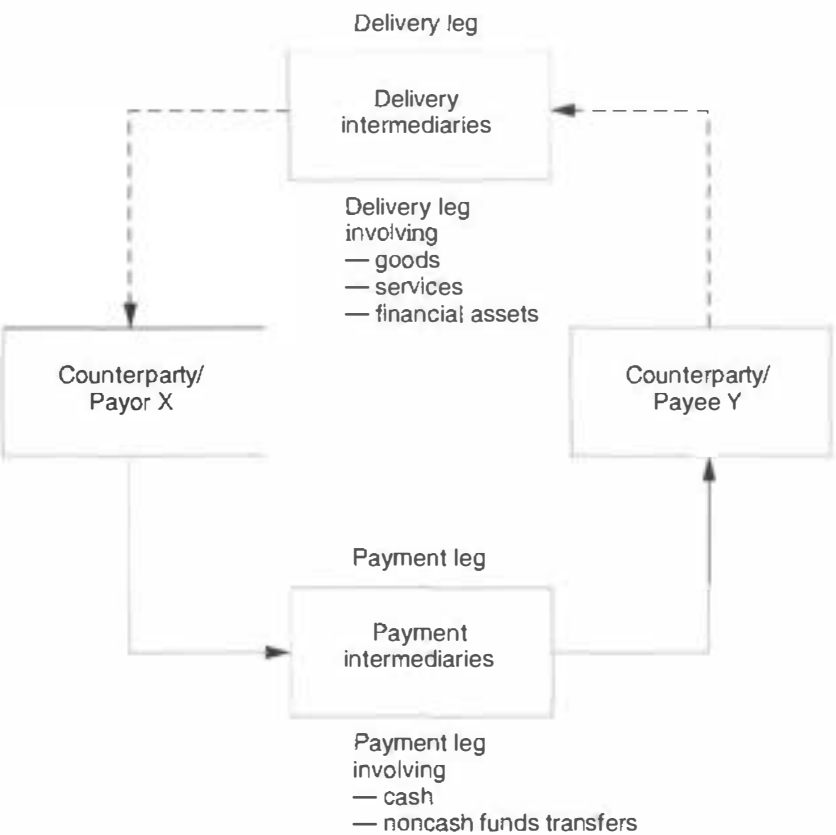
[1]This chapter draws in part on a paper by C.E.V. Borio and P. Van den Bergh, "The Nature and Management of Payment System Risks: An International Perspective," *BIS Economic Papers*, No. 36 (1993).

any, intermediaries involved in the delivery of goods, services, etc. Credit risk typically arises when one of the participants becomes insolvent.

- Liquidity risk is the risk that the counterparty that owes funds will not be able to meet its payment obligation on time, thus adversely affecting the expected liquidity position of the recipient of funds at the time the funds are due.

The distinction between credit and liquidity risk is important. Credit risk entails the probability of a loss of principal and implies the possibility of associated liquidity risk. Liquidity risk principally entails a cashflow shortfall. The distinction may, however, not always be clear in practice. Indeed, liquidity shortfalls may be costly, forcing the party expecting a payment to engage in relatively expensive borrowing or unprofitable

Chart 1. Structure of Exchanges



asset sales. If the liquidity shortfall is very serious, an induced default on other contracts, or even bankruptcy, may result. Cashflow shortfalls may thus be an important cause of credit risk. Whereas a liquidity shortfall in an exchange may arise because of a technical failure in the payment system, it can also stem from the credit loss associated with the unexpected bankruptcy of a counterparty.

Credit and liquidity risk can arise because of settlement lags, nonsynchronous settlement, or default by the issuer of the settlement medium. Moreover, a lag between the time a trade is agreed and settlement takes place creates the risk that the transaction may not take place at the time agreed owing to the failure of one of the parties to perform. For example, the transaction may be canceled or one of the two parties could default. One of the two parties would therefore suffer a loss if the terms at which it could replicate the transaction in the market moved against it in the intervening period, leading to an increase in the replacement cost of the transaction. In Chart 1, for example, suppose that counterparty Y sold a security to X and went bankrupt before the agreed settlement date, which is likely to be a number of days after the trade date. Counterparty X would then incur a loss if it had to purchase the security from another market participant at a higher price. In general, the longer the delay in settlement following the trade, the more likely it is that price changes may occur and thus the larger would be the potential replacement cost risk.

When the exchange of monetary value and the delivery of the good or service are not synchronous, the party performing its obligation first runs the risk that the counterparty may never perform its obligation. The nondefaulting party may receive only part or none of the value specified in the contract, thereby suffering a loss. This form of credit risk is known as principal risk. Again in Chart 1, suppose counterparty X purchased a security from Y and paid for it on the settlement date but before taking delivery. If Y were to default before delivering the security, X would lose the entire amount of its payment. Foreign exchange transactions in which the two payment legs are settled in different time zones are particularly vulnerable to this risk, commonly referred to as Herstatt risk. Herstatt risk is explored more fully in the appendix to this chapter.

Even if settlement is synchronous, the counterparty receiving payment would still be exposed to credit and liquidity risk if the issuer of the settlement medium is subject to default. As discussed in Chapter 2, although cash and central bank balances are free of this form of default risk, the liabilities of other payment intermediaries, such as commercial banks, typically are not.

It may be useful to illustrate these concepts with a simple example of a transaction involving cash. When an obligation is discharged using cash, for example, when a newspaper is purchased at a kiosk, settlement is immediate and simultaneous and occurs at the time of the transaction.

There is no settlement lag involved with respect to either the delivery of the newspaper or the payment. The exchange is fully synchronous. In more technical jargon, it can be said that the transaction is settled on a delivery-versus-payment (DVP) basis. Moreover, assuming there is confidence in the issuer of the bank notes (and the notes are not counterfeit), there is no default risk associated with the settlement medium. While cash payments may appear rudimentary, they actually combine essential features that are either absent or mimicked only with considerable difficulty in more sophisticated noncash payments, including interbank funds transfer systems.

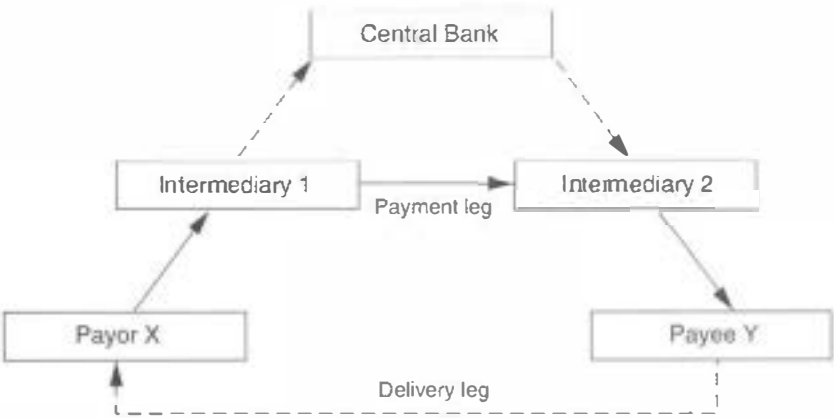
Risks Faced by Intermediaries

The risks faced by payment intermediaries—commercial banks, other financial institutions, and the central bank—are analogous to those faced by the ultimate counterparties to the exchange. As shown in Chart 2, each intermediary is engaged in a type of exchange as a result of receiving funds on behalf of, and making funds available to, counterparties. As a result, intermediaries face liquidity risk whenever they do not receive funds on time but make funds available to the intended beneficiary in the transaction. Intermediaries face credit risks when the settlement of the transfer is not synchronous. This will occur if they make funds available to the next link in the payment chain (including the ultimate beneficiary) before receiving funds from the previous link (including the ultimate payor). Finally, intermediaries assume credit risk when accepting a risky settlement medium.

While time lags are a major source of payment system risk, other factors are also important. One is a payor's ability to revoke payment or delivery orders before their execution or to make such orders conditional on a particular set of conditions. For example, a bank may credit a beneficiary's account, and even allow the beneficiary to use the funds, on the condition that it receives the funds from the payor's bank through an interbank funds transfer system. Similarly, participants in an interbank funds transfer system may retain the right to revoke individual transfers before a designated cut-off time. Or, the rules of a net settlement system may make all payment orders conditional on final settlement of participants' multilateral net positions at the end of the day.

A final payment denotes a funds transfer that is irrevocable and unconditional, giving rise to the notion of finality. Only when a payment is final can an institution receiving the funds dispose of them knowing for certain that they are its to spend. If a payment is conditional, an intermediary that acts on incoming funds or that allows its customer to act on incoming funds before final settlement will be exposed to a credit risk. Pressures to

Chart 2. Risks in Intermediated Payments
(Credit transfer)



Credit (principal) risk

X vis-à-vis Y: transfer funds before receipt of item
Y vis-à-vis X: transfer item before receipt of funds
1 vis-à-vis X: transfer funds to 2 without availability of funds in X's account
2 vis-à-vis 1: transfer funds to Y without availability of funds in 1's account or before receipt of final funds from X on its central bank account
central bank vis-à-vis 1: transfer funds to 2 without availability of funds in 1's account

Liquidity risk

1 vis-à-vis X: if X does not make funds available at time expected
2 vis-à-vis 1: if 1 does not make funds available at time expected
Y vis-à-vis 2: if 2 does not make funds available at time expected

treat conditional payments as final for purposes of access to funds can be great, especially in securities and foreign exchange markets where turnover is high.

Systemic Risk

The previous section outlined the credit and liquidity risks that intermediaries face if counterparties fail to meet their payment or delivery obligations in a transaction. Central banks are concerned not so much with the risks involved in individual transactions or single institutions, but rather with systemic risk. Systemic risk is the risk that credit or liquidity problems

incurred by one institution, or a small number of institutions, lead to similar difficulties for others.

The mechanism through which systemic risk manifests itself can be described as follows. One intermediary may be unable to settle, or face difficulty in settling, payments ordered by its customers. As soon as counterparties in financial markets sense the difficulties, they will move quickly to protect their own positions. Difficulties in determining the underlying creditworthiness of the troubled intermediary may induce its counterparties to withdraw funds held on deposit and to refuse to pay out funds on its behalf. To increase its liquidity, the intermediary suffering the problem may be forced to sell assets at unfavorable prices, thereby incurring losses that could lead to its insolvency.

Financial linkages between payment institutions can spread credit and liquidity problems widely, as participants in a particular market may, in turn, find themselves short of funds or face a decline in the value of their assets as a result of the actions taken by the troubled intermediary. Increased uncertainty about the size and distribution of exposures may lead banks to limit the credit they provide to their clients and to one another precisely when the need for liquidity rises. As a result, disturbances in the payment system may have profound ramifications across the economy.

Payment arrangements represent the connective tissue of all financial and real economic activity in a modern market economy. The ability to complete transactions, and confidence in counterparties to do likewise, underpins the smooth functioning of the payment system. Inevitably, therefore, the payment system is a key channel for the transmission of shocks across institutions and markets. It is primarily the real costs associated with a systemic payment system crisis that explain public concern for the safety and soundness of the financial system in general, and the payment system in particular.

From this perspective, large-value interbank funds transfer systems, such as those described in Chapter 6, deserve special attention, given that they lie at the heart of the payment process. A key question is how such systems would cope with the possibility that a participating bank may fail to provide funds at settlement. This settlement risk can imply a large liquidity shortfall for the other system participants and it may also involve credit risk. The specific nature of this settlement risk depends on whether the interbank transfer system settles on a deferred net basis or on a real-time gross basis.

Risks in Net Settlement Systems

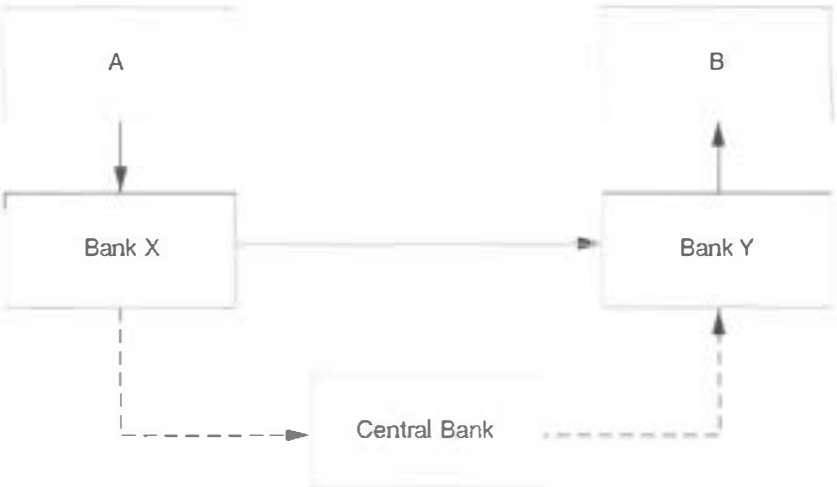
In netting arrangements, payment orders are exchanged during a designated clearing period and settled at the end of that period. The values of

all incoming and outgoing funds transfers are offset for each participant during the clearing period. Netting can be bilateral, involving pairs of counterparties, or multilateral, involving three or more netting participants. In multilateral netting, settlement can be organized on a decentralized or centralized basis. When decentralized, an agent calculates net positions and each participant pays funds to (net debtors) or receives funds from (net creditors) a central settlement account maintained by a settlement agent. When centralized, a clearing organization becomes a central counterparty and assumes responsibility for paying net creditors, receiving its funds from net debtors. Chapters 3 and 4 explain that netting systems reduce banks' need for settlement balances and thereby add to the efficiency of the payment system. As a result of netting, however, risk pressures are concentrated at the end of the clearing period. The credit risk involved in these systems results primarily from the presence of a settlement lag, that is, the time between the beginning of the exchange of payment orders and their final settlement.

Chart 3 is an illustration of how credit risks arise in bilateral netting. Because there are only two banks involved in this example, a central clearing agent is not needed. The two banks in question rely on the settlement services of the central bank to achieve final settlement of their bilaterally netted payments. Between the time that bank Y credits enterprise B's account and the time at which final interbank settlement occurs across nostro accounts at the central bank, bank Y has an exposure to bank X. By making the payment to enterprise B, bank Y has, in essence, extended credit to bank X. This occurs because bank Y credits enterprise B's account and allows enterprise B to use the funds before it is actually paid by bank X. If bank X is the net debtor at the end of the clearing period, settlement of its netted obligations will take place at the end of the period through a funds transfer from its nostro account at the central bank to the nostro account of bank Y.

In an interbank netting system with end-of-day final settlement, intraday credit is tacitly extended by a receiving bank that accepts and acts on a payment order knowing that it will not receive final funds until the end of the clearing period. Participants in bilateral netting can assess their counterparty credit risk directly. Multilateral netting involves three or more parties and leads to a mutualization of credit and liquidity risk, calling for more sophisticated risk management techniques. The mutualized obligations and claims are satisfied and made, respectively, through a clearing arrangement. It is through this clearing arrangement that risk controls must be implemented. If the payment order is in favor of the receiving bank's customer and the receiving bank is confident that the sending bank will ultimately settle for the transfer(s), it may make funds available to its customer(s) before settlement. Indeed, the rules of some netting arrangements explicitly require that banks receiving payment

Chart 3. Deferred Net Settlement System Operated by Private Sector



In the example, enterprise A instructs its bank, bank X, to pay enterprise B, which has an account at Bank Y. Bank X sends a message directly to bank Y, and bank Y credits enterprise B with funds that cannot be revoked. Enterprise B is free to withdraw the funds immediately (and is likely to do so, especially if it is trading in securities or foreign exchange markets). At the end of the clearing period, bank X and bank Y confirm their net settlement balances. Bank X can settle its net obligations by ordering a funds transfer from its nostro account at the central bank to the nostro account of bank Y.

orders credit their customers' accounts immediately. The receiving bank is then exposed to credit risk, because the customer may withdraw funds or retransfer them and, if settlement does not occur, the receiving bank will not have received payment from the sending bank.

The timely settlement of the underlying gross transactions that are included in a multilateral net settlement system depends on the ability of each participant in a net debit position to meet its obligation arising from the netting. The critical question is, what happens if a bank fails to meet its net debit obligation at the end of the day? There are two broad possibilities. First, if the central bank underwrites the settlement, it would make good on the obligation of the bank failing to settle. In agreeing to guarantee the settlement of a participant in a netting system, and thus averting an immediate liquidity crisis for other participants, the central bank may require other banks participating in the system to share in the

loss after the fact. Irrespective of how losses are subsequently borne, each day's settlement will take place and any potential crisis would be short circuited.

Second, the bank participants in the netting arrangement may themselves deal with any crisis caused by the failure of one of the members of the system to settle. In this case, the central bank does not stand ready to absorb losses and guarantee settlement. Rather, the banks participating in the multilateral netting system will rely on the contingency arrangements they have agreed upon to deal with a settlement failure. The design of a multilateral netting system, particularly arrangements in place to deal with a failure to settle by one or more participants, will determine how safe the system is.

One method for dealing with settlement failures is to unwind the settlement. This means that some or all of the underlying payments involving a participant that is unable to meet its settlement obligation are deleted from the netting, and the settlement positions of the remaining participants are recalculated. Such a procedure has the effect of reallocating liquidity pressures and potential losses from the failed bank to the remaining participants in the system. An unwind is generally considered to be an unsatisfactory method of dealing with the failure of a participant to settle its obligations, because participants that had been net creditors of the failed institution will be adversely affected when expected funds are not forthcoming. Unwinds are generally tolerated only for small-value net settlement arrangements where concerns about systemic risk are minimal.

An example of the repercussions of an unwind in a multilateral net settlement system is shown in Table 1. This example is based on the multilateral netting example shown in Table 1 of Chapter 3. In that example, the net claims (+) and obligations (–) of the participants were A(–130), B(+100), C(+30), D(0). Here, Table 1 shows the effects on the multilateral net positions of the other participants if bank A cannot settle its original net debit position of 130 and the settlement is unwound, that is, all transactions to and from bank A are eliminated from the settlement, resulting in a new set of net claims or obligations for the remaining banks. In the example, bank B's net credit position is reduced from 100 to 80 and bank C's position changes from a net credit of 30 to a net debit of –10. Bank D's position, which was originally zero, also turns into a net debit of –70. Thus, both banks C and D suddenly and unexpectedly find themselves with net debit obligations to fulfill. They will need to raise funds to meet their newly calculated obligations before settlement can occur. A bank unexpectedly facing a need for liquidity may have to compete for funds with others also suddenly having to raise liquidity. If either bank C or D were unable to fund the new net debit position following the unwind, then its transactions would, in turn, have to be deleted, possibly causing knock-on effects for other institutions. In this way, unwinds can

Table 1. Deletion of Bank A's Transactions from Multilateral Net Settlement System

I. Remaining Gross Payments Among Banks Before Netting

Bank sending payment	Bank receiving payment				Sum of obligations
	A	B	C	D	
A	—	—	—	—	—
B	—	—	0	0	0
C	—	50	—	20	70
D	—	30	60	—	90
Sum of claims	—	80	60	20	160

II. Recalculated Net Claim (+) or Obligation (-) of Each Bank with Clearinghouse

Bank	A	B	C	D	Net net
Total	—	80	–10	–70	0

Source: Based on George R. Juncker, Bruce J. Summers, and Florence M. Young, "A Primer on the Settlement of Payments in the United States," *Federal Reserve Bulletin*, Vol. 77 (November 1991), p. 852.

cause considerable disruption to the underlying flow of payments through the economy.

Simulation exercises have been conducted using actual transaction flows for multilateral net settlement systems to assess the likely extent of knock-on effects from undertaking an unwind following the failure of a single participant. Simulations performed using 1983 data for CHIPS, for example, suggested that the failure of a large netting participant to settle could result in close to half of all other participants in turn being unable to settle.[2] The results also indicated that the institutions affected by a failure to settle varied substantially depending on the particular day's data used for the simulation and that, because of the knock-on effects, banks not involved in transactions with the institution failing to settle could be adversely affected.

Results such as those described above underscore that unwinds can be a significant source of systemic risk. Because of systemic risk, both participants in net settlement systems and central banks have been working to develop arrangements that ensure that settlement can take place in the event of difficulties faced by participants in the arrangements. By putting

[2]David B. Humphrey, "Payments Finality and Risk of Settlement Failure," in *Technology and the Regulation of Financial Markets*, ed. by Anthony Saunders and Lawrence J. White (Lexington, Massachusetts: Lexington Books, 1986).

into place methods to guarantee settlement, the possibility of needing to resort to an unwind is reduced. The following section discusses some of the steps that have been taken to reduce the possibility of a settlement default and to limit the disruption if one should occur.

Controlling Risk in Net Settlement Systems

Disturbances in the settlement process can directly affect central banks as the ultimate providers of interbank settlement services, as lenders of last resort to the banking system, and in their conduct of monetary policy. Reflecting these concerns in 1990, the central banks of the Group of Ten countries established a set of minimum standards applicable to the design and operation of cross-border and multicurrency netting schemes, especially those handling large-value funds transfers. These standards apply equally to domestic interbank net settlement systems. The Lamfalussy standards (named after the chairman of the committee that developed them) are designed to control risk in netting schemes; they are set out in Table 2. It has become accepted that all large-value funds transfer systems should he moving to meet them. Accordingly, this section uses the Lamfalussy standards as a framework for analyzing the issues that need to be addressed if risk is to be controlled in deferred net settlement systems.

Any netting scheme needs to have a well-founded legal basis. When a netting scheme is legally binding, banks can he assured that their obligations are limited to the net amounts arising from the netting. Without a sound legal basis, a liquidator may be able to engage in "cherry-picking," insisting on the performance of obligations that favor the failed institution and defaulting on those that would disadvantage it. The result could leave counterparties faced with paying away gross obligations to the failed institution and not being paid in return. There are a numher of legal forms of netting schemes in use. One is netting by novation, under which each new transaction becomes part of a single contract capturing the running balances due to or from each party.

Institutions that participate in deferred net settlement systems should have a clear understanding of the financial risks to which they are exposed. In particular, they should understand that their liquidity obligations are concentrated at the end of the clearing cycle. Acting on this understanding, they should make adequate provisions to meet the highest possible obligation arising from their own trading and any contingent obligations they would be required to assume if another institution participating in the scheme was to fail.

The third, and potentially most complex, requirement is that netting schemes should have clearly defined procedures for limiting and managing credit and liquidity risks. An important means to limit risks is to restrict

Table 2. Minimum Standards for Design and Operation of Cross-Border and Multicurrency Netting and Settlement Schemes

I. Netting schemes should have a well-founded legal basis in all relevant jurisdictions.

II. Netting scheme participants should have a clear understanding of the impact of the particular scheme on each of the financial risks affected by the netting process.

III. Multilateral netting systems should have clearly defined procedures for the management of credit risks and liquidity risks that specify the respective responsibilities of the netting provider and the participants. These procedures should also ensure that all parties have both the incentives and the capabilities to manage and contain each of the risks they bear and that limits are placed on the maximum level of credit exposure that can be produced by each participant.

IV. Multilateral netting systems should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net debit position.

V. Multilateral netting systems should have objective and publicly disclosed criteria for admission, which permit fair and open access.

VI. All netting schemes should ensure the operational reliability of technical systems and the availability of backup facilities capable of completing daily processing requirements.

Source: *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries* (Basle: Bank for International Settlements, November 1990).

the duration of settlement exposures. Most large-value net settlement systems now settle on the same day. Same-day settlement lowers exposures by reducing the duration of the settlement delay and allows transactions for a given day to be finalized before the following day's trading begins. In particular, it reduces the likelihood of a disruption to the domestic payment system from events that occur overnight.

It is increasingly accepted that participants in multilateral netting systems should make bilateral credit assessments of other members to ensure that each participant accepts responsibility for its own exposures. By setting bilateral net credit limits, each participant establishes the maximum net amount of credit it is prepared to grant to each of its counterparties in the system and thus the maximum loss it is prepared to incur should that counterparty fail to settle. Also, there is an increasing emphasis on placing a limit on the total exposure that all members of a multilateral netting system may jointly assume vis-à-vis any one member. This requires the imposition of a sender net debit cap on each member. Setting such a cap ensures that the system can limit the total liquidity shortfall that might be caused by the failure of any single participant.

Even when the participants in a multilateral netting system have limited their total exposures to a single participant, it is important to have a clear plan to deal promptly with any liquidity and credit problems that might

occur. The fourth Lamfalussy standard requires that systems should be capable of ensuring the timely completion of daily settlement. It is not sufficient to limit the size of the liquidity shortfall; participants must be able to meet it so that settlement can proceed and the dangers of an unwind can be avoided. There will be no time for negotiating lines of credit or other sources of liquidity, or a loss-sharing agreement, once a crisis arises. Loss-sharing rules allocate losses on the basis of a preagreed formula, usually based on the amount of bilateral credit each "surviving bank" has granted to the defaulting bank.

Liquidity problems can still arise if contributions to the loss-sharing are made only *after* a crisis has arisen. This, of course, would be a very difficult time to raise liquidity and settlement could not occur if some banks were unable to meet their obligations under the loss-sharing rules. To avoid this problem, it is prudent to require that the participants in multilateral netting systems set aside and commit collateral as a condition of participation. If a participant in the settlement arrangement fails to meet its obligation, enough of the collateral lodged by the failed and all the surviving banks would be liquidated to pay the obligations of the failed bank. Although the surviving members would have to replenish the collateral, the immediate crisis would be forestalled. Chapter 6 describes how limits have been set and settlement underpinned by the establishment of a collateral pool for CHIPS.

The fifth standard emphasizes membership criteria. One way of reducing settlement risk in multilateral netting systems is through appropriate membership criteria. In particular, institutions that are financially strong are less likely to fail than are weaker institutions. Membership criteria will be more important for participation in large-value deferred net settlement systems than for real-time gross settlement systems (see below).

Finally, the Lamfalussy standards emphasize operational reliability. Since a technical failure involving computer systems can cause severe disruptions to liquidity flows, it is common that members be required to meet high operational standards, including having back-up systems that allow members to recover quickly from computer failures (see Chapter 12).

The Lamfalussy report emphasizes that any large-value netting scheme should be closely supervised by the appropriate central bank. This reflects central banks' broader objective of limiting systemic risks in payment systems and financial markets. In undertaking such supervision, however, central banks must be careful that their efforts to limit systemic risk do not actually encourage undesirable risk-taking by banks. In particular, banks will be less likely to control the riskiness of their behavior if they perceive that the central bank is willing to absorb risks. In other words, as the perceived likelihood of central bank support grows, market participants may engage in increasingly risky activities. This problem is known as moral hazard.

Multilateral net settlement systems may be particularly susceptible to moral hazard. The number of banks participating in such systems and the major disruption that an unwind of funds transfers could cause create pressure on the central bank to act to avert settlement failures. As a result, privately owned and operated multilateral net settlement systems may be designed without sufficient regard to the need for built-in mechanisms and incentives to control risks.

Two important points should be made about the translation of the Lamfalussy standards into operational and legal underpinnings, credit controls, and related banking practices. The Group of Ten central banks deliberately set out the standards in general terms, recognizing that designers of systems in particular countries would face and need to deal with a variety of legal requirements, financial structures, and long-established banking conventions. Close consultation will be needed between central and commercial banks to ensure that risk controls are optimal, meaning, in part, that they are not too costly. An appropriate degree of risk control is most likely to be achieved when it is realized from the start that efforts to contain risks in interbank settlement systems will benefit the entire financial system and the individual system participants.

The committee also emphasized that these standards should be seen as minimum standards and that practices should continue to be strengthened over time. Along these lines, a number of countries have decided that their existing deferred net settlement systems cannot be upgraded to a satisfactory level to serve as the mechanism for their time-critical large-value payments. They have instead turned to real-time gross settlement systems.

Controlling Risk in Real-Time Gross Settlement Systems

This section describes the type of settlement risk that can arise in the operation of a real-time gross settlement system and the means by which it can be controlled. The analysis and descriptions provided in Chapter 6 for specific types of real-time gross settlement systems are generalized here.

Real-time gross settlement systems may or may not provide intraday credit to facilitate the timely settlement of payments. When credit is not provided, as in the Swiss Interbank Clearing System (SIC), banks have to give a great deal of attention to managing their liquidity and payment flows if they are to make customer payments as requested. In well-developed banking systems with liquid money markets, banks can borrow from one another to replenish their accounts at the central bank. Such borrowing and lending typically takes place on an overnight basis. It is also possible, in theory, for banks to borrow and lend on an intraday basis, that is, for periods of up to a few hours. The need for an intraday

market depends on the alternative intraday funding facilities, such as a repo facility, that may be provided by the central bank. Intraday funds markets are not yet well developed, even in major financial centers.[3]

Managing liquidity through the interbank markets can be difficult when payment flows are volatile and unpredictable. From time to time, banks may find that they need to hold back outgoing payments while they await incoming payments to replenish the balances in their accounts at the central bank. The resulting queuing of payments can be disruptive to both the originators and the receivers of payments who may be counting on immediate, or at least very timely, settlement. Moreover, depending on the circumstances, and especially during periods of financial stress, the inability of a bank to make real-time payments without undue delay could raise doubts in the rest of the market about its liquidity.

To alleviate these potential pressures arising from a strict "no-overdrafts rule," some central banks operating gross settlement systems provide limited overdraft facilities to banks. Intraday overdraft facilities typically take the form of automatic advances when payments are made but funds are not on deposit. To protect itself from credit risk, the central bank may require that intraday borrowing be secured and limits may be placed on the maximum amount that can be borrowed. If it allows a bank to overdraw without collateral during the day, the central bank assumes credit risk.

Reliance on a real-time gross settlement system does not mean that systemic risk is absent in a financial system. Rather, a bank's obligations can accumulate during the day if it does not have the funds or credit capacity to make its payments. If this results in the delay of a large number and value of transfers, the initial impact could be similar to that resulting from a settlement failure. The main difference is that in deferred net settlement systems, counterparties may assume during the clearing period that payment orders will be settled and can be redeployed in the interim. Unless the netting system fully meets the Lamfalussy standards, settlement may not be assured. In a real-time gross settlement system, participants are under no such impression, since they cannot respend payments that have not been received. Nevertheless, the failure of a large bank to make its payments could have knock-on effects on others, including both other banks and their customers, possibly leading to payments gridlock with potential systemic consequences.

Conclusions

Financial institutions exchanging payment instructions face two key risks in the clearing and settlement process. Credit risk arises if one of the parties

[3]The funding alternatives described here are explained in more detail in Chapter 4, particularly in relation to a particular country's monetary regulations and procedures.

cannot meet its obligations; liquidity risk results from an unexpected delay in a party meeting its payment obligations. Both risks are particularly important in large-value funds transfer systems, which form the core of the payment system, because a significant liquidity shortfall may be quickly transmitted from one financial institution to another, a condition known as systemic risk. Systemic risk is of particular concern in large-value transfer systems that provide funds transfer facilities to the financial markets. In this environment, funds may be retransferred many times during a trading day, with parties assuming that each transfer is final. This assumption may not hold for a deferred net settlement system. If a participant in such a system is unable to settle and transactions have to be unwound, the knock-on effects to other participants, even those that have not traded with the failed participant, can be substantial.

For these reasons, central banks have taken a keen interest in improvements in the robustness of deferred net settlement systems and their ability to withstand shocks. In particular, they have sought to ensure that such systems can settle in a timely fashion, even if a member with a large net debit is unable to meet its obligation. The six so-called Lamfalussy standards are now widely accepted as the minimum standards that need to be met if risk is to be controlled in large-value deferred net settlement systems.

A number of countries that do not already have them are installing real-time gross settlement systems for large-value payments. Although financial risks are not eliminated in such systems, they are significantly changed and can be reduced compared with net settlement alternatives. In particular, the scope for the large-value payment network to transmit shocks throughout the financial system, so-called systemic risk, is markedly reduced.

APPENDIX

Risks in the Settlement of Foreign Exchange Transactions

The major risk in the settlement of foreign exchange transactions arises because each of the two legs of the transaction is settled across domestic large-value payment systems in different countries, often in different time zones. Whenever the two counterparties do not receive final funds denominated in each of the currencies at the same time, they expose themselves to both credit and liquidity risk. These risks can have serious systemic implications because foreign exchange transactions account for a large share of the value of payments in the major financial centers and because most of them are entered into by banks.

Foreign exchange settlement risk arises mainly because of differences in time zones and opening hours of interbank funds transfer systems across countries. There is currently no overlap at all in the operating hours of the funds transfer systems of the countries of the three most actively traded currencies—the U.S. dollar, the Japanese yen, and the deutsche mark. As settlement in each currency typically takes place in the country of issue, the counterparties to a transaction are thereby exposed to liquidity or credit risks.

Since most spot foreign exchange transactions settle two business days after the trade date, counterparties to trades run the risk that their counterparts will not be able to honor their commitments at the designated settlement time. Counterparties therefore are exposed to replacement cost risk, which, in foreign exchange transactions, can be considerable given the potential volatility of exchange rates.

More important, the party paying final funds first on the settlement date is exposed to principal risk, because it pays before the counterparty completes the other leg of the transaction. Should the counterparty default and fail to pay the second leg, the bank that paid away the first leg of the transaction may not be able to recover its funds.

The time lag can be particularly long in a yen/dollar transaction. Assuming that the counterparties obtain final funds only at the end of the opening hours of the interbank systems handling yen and U.S. dollars (typically FEYSS and CHIPS), the party paying out yen pays out the funds over 15 hours before receiving dollars. In a deutsche mark/U.S. dollar exchange, the time lag is still about 10 hours.

The risks raised by the asynchronous settlement of foreign exchange transactions were highlighted in July 1974, when Bankhaus Herstatt, a relatively small German bank very active in foreign exchange dealings, was ordered into liquidation by the German banking supervisory authorities, thereby suspending all payments. The suspension and related announcement took place after the closing of the interbank funds transfer system in Germany so that all of Herstatt's deutsche mark payments and receipts were made, but before its U.S. dollar obligations were to be settled on CHIPS. As a result of its failure, Herstatt did not complete payments to its counterparties in U.S. dollars and a number of them faced losses as a result of the asynchronous settlement of funds.

Although average exposures in 1974 were much smaller than at present, the Herstatt episode caused great disruption to the interbank clearing system in the United States and in particular to CHIPS. The disruption was related, in part, to declining confidence that spread to counterparties generally. Creditors did, in the end, receive partial compensation for the losses suffered, but the episode illustrated how uncertainty regarding the size, distribution, and resolution of exposures might lead to a broader financial crisis.

8

Small-Value Transfer Systems

Jürgen C. Pingitzer and Bruce J. Summers

If, as described in Chapter 6, large-value transfer systems are the main arteries of the payment system, then small-value transfer systems can be considered the complex network of veins connecting the entire economy. The efficient operation of a market economy depends on the availability of a smoothly functioning small-value transfer system that connects all economic agents, including individuals and businesses, is low in cost, reliable, and safe. Commercial banks and other specialized businesses provide small-value transfer services to the economy, and these services generally provide a range of choice to users of payment services.

Payment services are an essential element of the product mix provided by banks to their clients. Such services, however, are expensive to produce. Accordingly, there is today a major emphasis on the application of new technologies to the area of small-value transfer systems to increase cost efficiency. Further, as the world's economies become more integrated, compatibility among different small-value transfer systems across borders and currencies is also important.

This chapter describes the current status of small-value transfer systems in developed economies and discusses trends that are likely to influence these systems in the years ahead. It defines small-value transfer systems and describes the main types of small-value payment instruments. It identifies trends that will likely influence the future of such transfer systems.

Small-Value Transfer Systems Defined

Small-value transfer systems are defined as those systems that meet the payment needs of individuals and businesses for ordinary transactions in the economy. These systems support a variety of transactions, which might be generalized as being of two types—recurring and nonrecurring payments.

Recurring payments are those that are made regularly, often for fixed amounts. For example, an individual may regularly make fixed-value payments to businesses, such as for life insurance premiums, or variable payments, such as for utility bills. Similarly, businesses may regularly make fixed payments to individuals, such as for salaries and pensions.

Nonrecurring payments are payments for transactions that occur occasionally and for which the value varies from payment to payment. For example, individuals occasionally pay other individuals amounts that do not recur regularly, as in the case of gifts. Individuals also make large numbers of occasional payments in variable amounts to businesses for purchases of goods and services at the point of sale. In turn, businesses are responsible for a large number of intercorporate transactions related to their ongoing operations.

In addition, the public sector—for example, local and national governmental entities—makes and receives payments for a variety of both recurring and nonrecurring transactions involving individuals and businesses. One of the largest categories of recurring payments is salaries to public sector workers and the variety of social benefits paid by governments to citizens. Like businesses, government entities must also make a large number of nonrecurring payments to businesses in support of their regular operations.

A feature that particularly distinguishes small-value transfer systems from large-value transfer systems is their large number. Small-value transfer systems must be extremely versatile: they must be able to handle payments for a large variety of transactions. They must also have a large processing capacity to support the great volume of transactions that take place in a market economy each day. Unlike large-value transfer systems that provide services to a relatively small set of specialized market participants, small-value transfer systems support virtually every participant in the economy. Accordingly, there is a very large market for small-value transfer services, and product differentiation in a competitive environment has led to banks and others developing a variety of competing systems.

Although the average size of a payment processed through a small-value transfer system is typically quite small, some individual transactions could be substantial in size, since these systems support payments between corporations. In fact, "small-value" systems routinely handle individual transactions valued in the millions of dollars. The total value of all transactions processed through these systems daily, however, is quite small compared with the value processed through large-value transfer systems. Comparative data on the percent of the volume and value of cashless payments handled through small-value transfer systems are shown in Table 1 for Japan, Switzerland, and the United States (the three countries whose large-value transfer systems are discussed in Chapter 6).

Payment Instruments

In analyzing the variety of ways to make small-value payments, it is useful to distinguish between transactions made using cash and cashless methods.

Table 1. Percent of Volume and Value of Cashless Payments Handled by Large- and Small-Value Interbank Payment Systems, 1992

	Large-Value Systems		Small-Value Systems	
Country	Volume	Value	Volume	Value
Japan	0.1	75.7	99.9	24.3
Switzerland	47.9	99.9	52.1	0.1
United States	0.1	95.0	99.9	5.0

Source: Bank for International Settlements.

Cash Payments

Even in developed economies, cash (bank notes and coins) remains the most convenient method for making small-value payments, when payment is made at the point of sale. It is estimated that upward of 80 percent of all retail transactions are paid for in cash, although, of course, in terms of value the proportion is much less. The larger the amount of the transaction, the greater is the tendency to use a noncash or "cashless" instrument to make the payment.

Payment system trends in advanced market economies are affecting the use of cash in contradictory ways. On the one hand, the development of convenient, technologically advanced means for transferring money held in current accounts at banks has resulted in more intensive use of cashless payment services. On the other hand, technology has made it increasingly easy to access bank accounts for purposes of cash withdrawals. The use of automated teller machines (ATMs) and cash dispensers is now widespread in a number of countries and supports the use of cash for everyday transactions. Because transactions paid for in cash are not recorded through the banking system, a demand for this payment medium continues to exist for those transactions occurring in the underground economy.

Cashless Payments

Cashless payments are made using instruments by which current account balances held with banks are transferred. Until the last decade or so, legal prohibitions in many countries generally limited the ability of banks to pay explicit interest on current account balances. As a result, banks engaged in nonprice competition for the public's deposits, often by offering payment services below cost, sometimes even free of charge. In the last decade, however, laws have been liberalized, and banks are now

permitted to pay interest on current accounts in a number of countries, at least on current accounts held by individuals. Concurrently, there has been a trend toward explicit pricing of the payment services provided by banks. This is a rational development that should lead to greater efficiency in the use of bank payment services.

Table 2 shows the relative importance of different types of cashless payment instruments in ten industrial countries. These different instruments are briefly discussed below.

Check Payments

Checks are debit instruments in the form of written orders to pay a specified sum on demand when the instrument is presented to the issuing institution (the payor's bank). As shown in Table 2, the check is the most widely used cashless payment instrument in Canada, France, the United Kingdom, and especially the United States. Nonetheless, over the last decade, the rate of growth of payments by check has generally been slower than that for newer, more technologically advanced instruments.

Banks in some countries have increased the acceptability of checks by supplying their creditworthy customers with check guarantee cards. A check guarantee card provides assurance that any check accepted for payment will be honored up to a specified amount. The number of the guarantee card must be written on the reverse side of the check, and the payee has the duty to check the back of the card at the time the check is

Table 2. Percent of Volume of Cashless Payments Handled by Type of Instrument, 1992[1]

Country	Checks	Credit Transfers	Direct Debits	Payment Cards
Belgium	18.8	56.8	8.8	15.6
Canada	62.4	4.4	4.3	28.9
France	50.8	15.4	10.2	15.0
Germany	8.8	49.8	39.3	2.1
Italy	40.0	42.1	4.1	3.7
Netherlands	12.3	61.3	23.8	2.6
Sweden	8.9	77.7	4.6	8.8
Switzerland	4.4	81.3	2.5	11.8
United Kingdom	45.0	21.0	15.0	19.0
United States	80.5	1.8	0.9	16.8

Source: Bank for International Settlements.

[1]Some totals do not add to 100 percent owing to the existence of other types of instruments not captured in these categories.

accepted for payment. Accordingly, check guarantee cards are useful only at the point of sale.

Because checks are debit instruments and take the form of physical documents that take some time to clear, those paying by check enjoy the advantage of float. As discussed in Chapter 10, inefficient handling of debit instruments, such as checks, leads to increased debit float, which rewards the payor with what amounts to an interest-free loan, and tends to impair both the efficiency and safety of the payment system. Accordingly, paper debit instruments, such as checks, that take a long time to clear, are considered substandard from a payment system design perspective. As long as pricing of checks does not charge float costs to the writers of checks, there will be a perverse incentive for their continued use.

Substantial progress has been made in the standardization of checks, including their physical characteristics and information content, to facilitate efficient handling. Check processing is now highly automated and is based on the use of magnetic ink character recognition (MICR) technology in countries such as the United States and optical character recognition (OCR) in other countries.

Recently, check truncation has become more widespread. Truncation is a process by which physical check documents are stopped at the point of first deposit, or at some later point in the collection stream, and relevant information for collecting the check is captured and converted into electronic form. Like the traditional check collection process, check truncation requires a large amount of cooperation among banks. Check truncation is already widely practiced in a number of European countries, including Denmark, Finland, Germany, the Netherlands, and Spain. In the United States, truncation is still in its infancy.

In Europe, the Eurocheque system has been established to support acceptance of checks across national borders. Basically, the Eurocheque system makes it safer for merchants to accept checks by reducing the possibility that they will not be paid. The Eurocheque system is based on a uniform check instrument and a standard check guarantee card. The guarantee card may also serve as a cash withdrawal card for use at ATMs. When accepted in connection with a valid guarantee card, the bank issuing the check will guarantee payment on the check up to a fixed amount, equivalent to about 300 Swiss francs. The Eurocheque International organization, located in Brussels, is a private cooperative company whose shareholders are national banks and other associations of financial institutions from nearly 20 countries.

The Eurocheque system can be considered an open system, as banks, savings banks, cooperatives, and some postal authorities accept Eurocheques at their branches and all of them can become issuers. To establish a full international payment system, agreements have been introduced to harmonize clearing procedures among countries, most of which

operate one check processing center. In countries in which Eurocheque is accepted but in which no formal agreements exist, traditional correspondent bank clearing procedures are followed. To handle international transactions, the national Eurocheque systems are linked to the multinational data transmission network set up to handle authorizations, clearing, and settlement for credit cards.

Giro Payments

Giro payments, which may take the form of paper or paperless payments, are credit payments. Therefore, giro payments are payment orders, or credit transfers, made for the purpose of placing funds at the disposal of a beneficiary. As shown in Table 2, the giro is the dominant payment method in a number of European countries, including Belgium, Germany, Italy, the Netherlands, Sweden, and Switzerland. In many of these countries postal banks have provided payment facilities for decades, operating primarily through the post offices and making and receiving mostly low-value payments.

Giro payments can be used for both recurring and nonrecurring payments. With recurring payments, customers give their banks instructions to initiate credit transfers in a specific amount, to a specific payee, on a specific, recurring date. Such standing orders cover payments for household commitments, such as rent, mortgage, and utility bills, and personal commitments, such as life and automobile insurance. Businesses also use the giro system as an efficient means of making bulk payments, such as salaries.

A significant trend is the growing use of automated or fully electronic communications methods by customers of banks to make payment orders. Increasingly, corporate customers are communicating their payment orders using magnetic tape or telecommunications. Corporate customers without the needed electronic data processing equipment and banks' individual customers predominantly make payment orders in paper form, which frequently still have to be converted into machine-readable instructions. Some banks offer their customers home-banking services that may involve use of the telephone to make payments. Adequate electronic data security is an important element for these payment methods.

Direct Debit Payments

The direct debit is, next to the standing order-giro payment, the type of instrument best suited to automation. Direct debits, as shown in Table 2, are extremely popular in Germany and the Netherlands, and this payment method has made important inroads in a number of other countries. This payment method is widely used to simplify recurring payments

(subscriptions, rents, public utility bills, taxes, etc.). In general, direct debit is becoming a relatively important method of making payments.

Direct debits must be preauthorized by the payor, who authorizes his bank to debit his account upon instructions issued by the authorized payee. No further action is then required on the payor's part. As with giro transfers, businesses often submit automated files of payment information, containing direct debit instructions for recurring payments, such as the repayment of consumer loans. In addition, direct debits have become quite popular for intercorporate payments, including use for intracompany cash concentration, as described in Chapter 10. Further, when businesses use direct debit payment methods for trade payments, the direct debit payment message may be combined with invoice information in electronic data interchange (EDI) format.

Payment Cards

Payment cards include both credit and debit cards. Credit cards in particular have become a mainstream for making payments. A credit card indicates that its holder has been granted a line of credit enabling him or her to make purchases and/or to draw cash up to a prearranged amount. Interest is charged on the amount of the unpaid credit balance and cardholders are often charged an annual user fee. Debit cards enable the holder to make purchases and to charge those purchases directly to a current account at the bank issuing the card. The popularity of payment cards in different developed countries can be seen in Table 3.

Traditional payment cards contain a magnetic strip that allows for the automated capture of essential information about the cardholder. Newer technologies have been introduced in the so-called chip card, in which a microprocessor is embedded. Chip cards are much safer than traditional magnetic strip cards because of the sophisticated security features they offer and because they contain "on-board" information about the remaining authorized value associated with the card at any point in time. Acceptance of the chip card has been slow, however, as this technology is still relatively expensive, including the cost of the card itself. Moreover, as noted above with respect to the use of direct debit cards, this means of payment cuts down substantially on the float currently enjoyed through use of checks. Accordingly, other things being equal, this method of payment would not be attractive to consumers compared with the check.

Trends

Generally speaking, there is a continuing trend in the personal and the business sectors away from the use of cash toward use of cashless means of

Table 3. Number of Cards Outstanding Per One Thousand Inhabitants, 1992

Country	Cards with Cash Function	Cards with Debit/Credit	Cards with Check Guarantee Function	Retailers Cards
Belgium	774	785	457	91
Canada	1,158	486	...	4,537
France	368	365	3	350
Germany	...	484	393	37
Italy	240	235	38	...
Japan	2,018	1,681	...	398
Netherlands	830	99	117	...
Sweden	227	446	...	681
Switzerland	548	659	411	...
United Kingdom	1,175	874	768	190
United States	704	1,809	...	1,811

Source: Bank for International Settlements.

payment. This trend has been influenced by the increased use of accounts at banks. Nonetheless, in recent years, cash in circulation has not declined. This can be explained by the continued attractiveness of cash as a payment medium, the trend toward charging market-based fees for bank payment services, and, of course, any inflation embedded in an economy that drives up the cash "working balances" needed by consumers.

With respect to cashless payments, reliance on paper means of payment is declining in importance, although volumes are and will remain significant for some time. Plastic card transactions and automated payments are growing rapidly and will likely dominate the future of cashless payments.

Looking at the payment preferences of individuals, reliance on current accounts into which salaries are deposited directly is becoming more common. Although automated direct deposit has grown significantly in many developed countries, the rate of increase is slowing as saturation levels are being reached. The personal payment market will increasingly involve making payments predominantly by automated media (standing orders and direct debits) for regular payments and plastic cards (credit and debit cards) for nonrecurring payments. Cash will be obtained from current accounts through card access to ATMs.

Looking at the payment preferences of businesses, corporations are increasing their use of automated payments, particularly for making payments to and receiving payments from individuals. Also, there is a clear trend toward using automated means to pay other businesses. In many

countries, automated trade payments are being used more heavily. In particular, when companies make use of electronic data interchange (EDI) for ordering, stock control, and invoicing, the EDI loop can be closed by integrating the payment process. The impact of electronic point of sale payments on the business sector is also worthy of mention. Growth in the use of credit and debit cards has led to a situation in which many retail businesses are receiving payments electronically.

With respect to the future use of different payment instruments, checks are known to be widely used for spontaneous payments. If the goal is to reduce the volume of checks, it appears likely that debit cards will need to make a significant contribution. The same trend can be forecast for giro transfers, mainly with nonrecurring payments. The aggregate cost of handling paper transactions is enormous, and will remain so, notwithstanding heavy investment in imaging technology whereby paper documents are converted to digital information stored on computers, and check truncation.

The volume of plastic cards has grown strongly in the past through the increased holding and usage of credit and ATM cards. By the year 2000, however, even these dynamic increases are likely to be overshadowed by debit card growth. The potential for debit card transactions depends mainly on the deployment of electronic point of sale terminals. For this to occur, inexpensive and portable terminals will be needed.

Cash is a cheap and efficient payment medium for low-value payments. The large-scale displacement of low-value cash transactions by debit cards would likely not be efficient.

Conclusions

Small-value payment systems must be extremely versatile and able to handle large volumes of transactions. In recent years, the exchange of physical payment instruments in paper form has increasingly been replaced by the exchange of payment data in automated or electronic form. In some cases, payments are purely electronic from their point of origin, as in automated credit and debit transfers. In other cases, for example, check truncation, a payment may be in paper form at the beginning of its life but converted to electronic form at a later point in the processing stream. Improved processing methods have been adopted for paper payment instruments, and the process has been made much more efficient. Although the volume of paper payment items will begin to decline, a significant fall-off in volume will be protracted.

Over the past few years, attention has been focused particularly on the need for interoperability among payment systems. Until recently, almost all small-value, cross-border payments have been processed through correspondent banks. Now, banks and some specialized institutions have

developed proprietary systems suitable for handling small-value, cross-border payments at low cost. Thought is also being given to establishing linkages between national ACHs, which has been suggested by the European Commission.

Internationally, direct debits and payments made by cards are growing strongly. Plastic card fraud, however, is a particular problem that must be addressed, in part by using new security techniques.

9

Payment System Policy Issues and Analysis

Jeffrey C. Marquardt[1]

This chapter discusses major payment system policy issues that typically arise in both developed and developing countries. In addition, it introduces and applies analytical concepts from market-oriented economies that are regularly used by central banks to assess these issues.

The principal operational and financial goal of payment system policy is widely accepted to be the safe and efficient transfer of money. In the context of this chapter, the broad economic concept of efficiency includes the reliable, timely, and low-cost transfer of money. Auxiliary goals of payment system policy, which relate to the structure and operation of financial markets generally, are to promote liquid money markets that enhance the liquidity of the banking system and the nonbank public, to facilitate the conduct of monetary policy, and to promote open and competitive financial markets. This chapter analyzes these general goals and draws some lessons from the experiences of developed countries in formulating payment system policy. It describes institutional arrangements, including payment instruments and systems, that are typically provided by the banking system and introduces a set of attributes that often influence the selection of alternative methods of payment, along with concepts and potential policies relating to the economic efficiency of payment systems. It also discusses concepts and policies relating specifically to payment system risk and deals briefly with selected monetary and banking policy issues.

Institutional Arrangements

As described in Chapters 2 and 3, a variety of instruments, delivery and communications mechanisms, and banking arrangements are used in different countries to make payments. The fundamental objective of individ-

[1]The author wishes to thank Diana Hancock and Bruce Summers for helpful comments on this chapter.

uals, businesses, and governments when making payments and using payment systems is to transfer money to, or receive money from, others, usually to complete transactions or to satisfy other underlying obligations. Two major types of noncommodity money are used as means of payment for these purposes—monetary liabilities of central banks and of commercial banks.[2]

Monetary liabilities of central banks are typically in the form of either paper currency or balances in accounts at a central bank.[3] Paper currency is used as a means of payment by virtually all economic actors, whether individuals, businesses, or governments. Balances in accounts at a central bank are used by specific entities eligible and willing to hold such accounts, including commercial banks. Although monetary liabilities of commercial banks that can be used to make payments may include privately issued notes, in modern times these monetary liabilities consist mainly of balances held in sight deposit accounts. Virtually all adult individuals and institutions in market economies are free to hold commercial bank accounts for the purpose of making payments.

As discussed in Chapter 3, there are also different instruments, or types of payment messages, used for transferring both "central bank money" and "commercial bank money." The term "payment message" is used frequently in this chapter to cover a variety of paper instruments and electronic messages that by law, agreement, or custom are used to transfer balances from one account to another at a central or commercial bank. A practical distinction in payments policy discussions is between paper-based and paperless instruments or messages.

As noted above, an important paper instrument is currency, which both represents and is used to transfer central bank money. Paper instruments also include checks and paper payment orders, which can be used to transfer account balances between account holders at either a central or commercial bank. Paperless payments include electronic messages used to transfer deposit balances at central or commercial banks. The communications, processing, and settlement systems for these messages include real-time gross settlement systems, large-value netting systems, and a variety of electronic batch processing systems used principally for small-value payments.[4] These electronic systems can be used to process credit transfers, debit transfers, or both.

The delivery and clearing mechanisms for payment instruments or messages fall generally into one of four institutional forms from the point of

[2]In certain countries, the monetary liabilities of thrift or savings institutions may be used.

[3]Paper currency may also take the form of a liability of a country's treasury or another government entity. Coinage is also an important liability of either a central bank or another government body.

[4]See Chapters 6 and 8.

view of the banking system: (1) intrabank systems; (2) interbank correspondent arrangements; (3) interbank clearinghouse arrangements; and (4) central bank arrangements. Intrabank systems allow for the delivery and settlement of payment messages between two customers of the same bank, possibly involving accounts at different branches of the same bank. Interbank correspondent arrangements allow for the delivery of instruments or messages, along with settlement, between two or more banks that have accounts and banking arrangements in place with a single, common, correspondent bank. Correspondent arrangements play a key role in international payments but are also commonly used in large countries with many banks, such as the United States, for domestic payments. Interbank clearinghouse arrangements allow for the interbank delivery of instruments or messages and their settlement among three or more banks using the principles of multilateral clearing and net settlement. As illustrated in Chapter 2, central bank arrangements involve the central bank acting as a common correspondent to some or all of the banks in a banking system, for the purposes of clearing and settling payment instructions between banks.

Credit arrangements and ancillary banking facilities are also important to the construction and operation of a country's payment system. As shown in Chapter 2, in modern payment systems, intraday and overnight credit facilities are routinely used to finance payment system activity. Thus, both monetary deposits and credit arrangements, along with technical delivery and settlement systems for payment messages, should be considered an integral part of a nation's payment system.

Payment System Efficiency

Payment system policy is often divided into two categories, namely, policies that promote efficiency and policies that reduce risk. This division is helpful in narrowing the focus on specific efficiency or risk policies and will be used in this chapter. From the viewpoint of both designers and users of payment systems, however, this can be an arbitrary division that interferes with a full analysis of the trade-offs and alternatives that affect the design, choice, and use of various instruments and systems. Therefore, risk considerations and other variables that influence choices and the overall efficiency of payment systems are treated in an interrelated manner.

The analysis of payment system efficiency must take account of both users and suppliers of payment services. Efficiency for users implies that the benefits of using a particular payment instrument must outweigh its costs. These benefits and costs include not only explicit and implicit fees charged by banks or other providers of payment services but also the benefits and costs associated with various key attributes of different pay-

ment instruments, as discussed further below. Efficiency for suppliers of payment services implies that the benefits, including revenues, of providing particular payment instruments, clearing services, and settlement operations to users must outweigh the costs of providing the services, including a market-based return on investment.

In a competitive market for payment services, the presumption is that banks and other financial institutions will provide the variety of payment services that users want, and are willing to pay for, at prices that cover the costs of providing these services. The benefits will exceed the costs of utilizing a particular payment instrument to transfer money, from the standpoint of both the user and the supplier, at least on average. Nevertheless, experience has shown that public policy plays an important role in establishing the institutional framework within which payment services are provided, in acting as a stimulus to payment system efficiency, and in helping to reduce risks, particularly systemic risks.

Efficiency from Users' Standpoint (Demand Efficiency)

In a market economy, the users of payment services---demanders—will determine whether a particular payment instrument is used and, if so, to what degree. In general, because payment instruments are used to transfer money in exchange for goods and services, the resource costs and the efficiency of the means of payment in an economy may affect the levels of production and exchange of some or all goods and services. In developing economies, in particular, slow, unreliable, and costly means of payment may dampen business activity and retard the development of liquid financial markets. In economies with high inflation rates, slow and unreliable payment mechanisms can aggravate the implicit "inflationary tax" on the use of money in business activity.

It is also important to recognize that payment instruments are typically exchanged between two parties in payment for underlying transactions involving goods or services. Thus, a payment instrument must be accepted by both parties as a means of payment in a transaction, and possibly also by the banks involved. It is not sufficient for only one party to a transaction to find the instrument acceptable. For example, in retail purchases, both merchants and consumers must accept a particular type of payment order or currency in payment for ordinary goods. In dealings between nonfinancial businesses, different types of payment instruments may be acceptable and customary. In dealings between banks, particularly those involving large-scale interbank settlements for money market or other financial activities, large-value payment systems may be used.

Experience in developed countries suggests that users of payment services may consider a wide range of attributes when judging the expected costs and benefits of using particular payment instruments for particular

purposes. Some of the key attributes, in addition to fees, include the speed and predictability of settlement; the physical characteristics of the payment instrument, including paper or electronic forms; the complexity of using the instrument—an issue particularly when new mechanisms are introduced; and, perhaps, purely psychological qualities associated with an instrument. In addition, important risk attributes may include the susceptibility to loss by theft, fraud, error, or counterfeiting associated with a particular instrument. Further, the possibility of losses owing to default on the payment instrument by the payor or the payor's bank may influence choice of payment instrument. In evaluating the importance of these risks, users will necessarily take into account the effort and expense they would incur by taking security and other precautions to reduce risk to tolerable levels.

The opportunity cost of forgone interest from holding a stock of money such as currency may be important in some circumstances, as would the benefits or costs associated with float, in the collection or processing of paper or electronic instruments or messages. Privacy may be important to both businesses and individuals. The compatibility of certain payment instruments with consumer or business financial record-keeping systems and practices may also affect usage, particularly in new electronic payment systems.

The expected benefits or costs of the attributes of different instruments and associated communications and processing mechanisms may depend on factors such as the value of a payment, the distance over which payment is made, and other circumstances that are unique to each payment. For example, in face-to-face transactions, currency provides immediate and predictable settlement with a great deal of privacy accorded to the individuals completing the transactions. For these reasons, currency is often used for illegal as well as legal transactions, and as noted in Chapter 8, the overall movement to more automated and technologically sophisticated payment methods may be seriously affected by the perceived lack of privacy attached to such new methods.

In addition, for small-value payments the risks of loss as a result of fraud and error inherent in currency are negligible, and those from handling currency are manageable at reasonable cost. At the same time, the risk of loss from the theft of currency can be substantial, even for small-value payments. As payments increase in value, the bulk and weight of currency impose additional expected costs on users, even as bills of higher denomination are introduced. Thus, in general, businesses and banks find that the expected costs of using currency outweigh the expected benefits, particularly when making large payments over long distances.

On net, the costs associated with using currency may well have given rise over time to the widespread use of deposit money for payments. Even

with such use, however, different types of payment messages and processing systems may have different attributes with different benefits and costs to users. For example, in contrast to currency, electronic payments can offer speed and predictability even over long distances without physical inconvenience. On the other hand, the susceptibility of some electronic systems to fraud, error, or default may be significant. The degree of privacy of information associated with electronic systems will depend on the laws and official policies applicable to such systems as well as the operational safeguards contained in the systems.

Paper payment instruments, such as checks or bank drafts, may present either larger expected benefits or costs than currency or electronic payments. On the one hand, paper instruments may be made to the order of named individuals and present a lower risk of loss from theft than currency. Moreover, paper instruments, like electronic messages, may provide significant additional security benefits to users when coupled with the use of deposit accounts for holding money and settling payments. On the other hand, for face-to-face transactions involving relatively small values, the use of paper instruments may entail slower and less predictable settlement, and, therefore, larger expected costs for at least one party to the transaction, than the use of currency. Further, for large-value payments, paper documents may be significantly more costly and risky to use than electronic payment systems, particularly if large numbers of such payments are to be made routinely, as is typical in the interbank markets.

Two classic examples exist in the United States of payment instruments that were developed without sufficient attention to user costs and benefits associated with the attributes described above. In the late 1970s, a one-dollar coin was introduced in an effort to reduce the volume of one-dollar notes in circulation, and thereby reduce the resources devoted to providing one-dollar payment instruments to consumers and businesses. Either because the coin was easily confused with the commonly used 25-cent piece, or because of a strong psychological preference for one-dollar notes, the dollar coin was never accepted by the general public as the standard for one-dollar payments.

In the mid-1970s, predictions were made that electronic payments would quickly come to dominate the use of currency and checks for small-value retail payments in the United States. The Automated Clearinghouse mechanism for processing bulk electronic payments was put in place and a "cashless" society was predicted. Acceptance of this payment mechanism, however, was relatively slow for most of the 1970s and 1980s. Consumers and businesses did not readily adapt to the payment mechanism, and indeed, with the advent of electro-mechanical automated teller machines, the use of currency in the United States apparently increased during that time. Currently, the use of electronic point-of-sale

payment mechanisms is growing rapidly in the United States, albeit from a low initial level of usage.

The expected benefits and costs associated with important attributes of different payment instruments is likely to differ, depending upon variables such as payment value, distances over which payments are to be made, and the relative importance of recurring versus nonrecurring payments. Thus, in theory, as observed in practice, different payment instruments will be used by the same individuals or institutions, depending on the circumstances surrounding the particular payment. This use of multiple payment instruments in different circumstances, along with the specialization of payment systems, is fully consistent with the principle that payment systems should be efficient from the standpoint of users of such systems. Thus, the possibility of multiple instruments and systems should be part of the conceptual framework of designers of payment mechanisms.

Efficiency from Suppliers' Standpoint (Supply Efficiency)

Efficiency in the payment system also requires that payment services be produced and distributed efficiently by banks and other suppliers of such services. A particular concern for suppliers is that the real resources devoted to making payments, such as labor, capital, and technology, be deployed so that the benefits from using the resources are greater than or equal to their costs.

The analysis of supply efficiency can be somewhat complex because payment systems involve the provision of services by individual banks to nonbank customers as well as the interbank clearing and settlement process. Interbank clearing inherently involves one or more of the institutional forms of interbank activity described earlier—correspondent, clearinghouse, or central bank arrangements. Thus, the analysis of supply efficiency extends to all of these arrangements.

In general, individual banks in a market economy expect to recover the operating and capital costs of their activities, including a return on invested capital. This policy extends to the payment system activities of banks. In many countries, the experience is that banks competing with each other will attempt to reduce the costs of providing payment services as they attempt to increase the efficiency of their operations. These efforts often lead to the automation of traditional labor-intensive payment practices, when bank managements consider capital and automation technology to be relatively inexpensive compared with labor.

An important issue in developing countries is the extent to which state-of-the-art automation technology should be installed in individual banks and in the payment system generally. As suggested above, in developed countries, competitive pressures have led to the widespread application

of automation to payment processing, as payment volumes have increased and the capital costs of automation have fallen dramatically. Further, the automation of payment processing and accounting functions within commercial banks is often undertaken, in part, because it is closely related to the automation of general banking activities and the development of new services.

The same competitive pressures will influence banks in developing countries. The relative benefits of installing advanced automation equipment, however, should be analyzed in light of the particular characteristics of payment volumes, labor costs, and equipment costs in each country. For example, scarce capital and foreign exchange resources may raise the relative cost of installing advanced technology, with the possibility of diverting scarce financial resources from more highly valued commercial uses. Thus, recent experience in developed countries with payment system automation provides important information about choices but should not be viewed as an absolute indicator of the benefits of technology that must be followed regardless of cost.

As noted above, interbank clearing and settlement is a key feature of payment systems in economies with large numbers of banks. In principle, the installation and operation of interbank systems should economize on labor, capital, and technology resources, as would individual intrabank systems.

In correspondent banking, at least two situations are possible. First, a single bank may act as correspondent to two other banks, for example, bank A and bank B. In this case, the provision of interbank payment services to banks A and B involves processing transfers of funds between the accounts of A and B at the correspondent. Supply efficiency by the correspondent entails the efficient employment of capital, labor, and technology in providing services to customer banks such as A and B as well as to other customers.

Second, a series of correspondent banks may be involved in completing the interbank processing and settlement of a payment. If a payment is to be made by bank A to bank B, but these banks do not share a common correspondent, assume that they use two different correspondent banks, C and D. Banks C and D, in turn, have a common correspondent, E. In this example, bank E can be visualized as the top of a correspondent banking pyramid, with multiple layers of correspondent banks. Clearly, a large number of banks could become involved in the payment process as it operates through the correspondent banking system. Experience suggests that both benefits and costs are involved in complex correspondent banking arrangements. On the one hand, correspondent banks can provide an important service at relatively low cost by specializing in payment processing, particularly for relatively low-volume users of particular payment services. On the other hand, additional costs and other inefficiencies may

be associated with a relatively long clearing and settlement chain, including long and variable delays in completing payments. The process of returning payment items and resolving errors or other problems can also be extremely complex and lengthy. These problems result partly from the inefficiencies in making payments through the processing systems of different banks, which may include manual as well as automated message handling. In addition, as discussed in Chapter 10, individual banks in a payment chain may be tempted to slow down processing to obtain the benefits of one or two days' extra use of customer funds.

Large numbers of payments flowing between banks, particularly involving paper instruments, generate potentially large inefficiencies in interbank clearance and settlement. In such cases, clearinghouses are often introduced to speed interbank clearance and settlement, with savings both in processing costs and settlement resources. Clearinghouses typically introduce centralized processing and accounting procedures with strict operational deadlines applying to all members. The multilateral netting of the monetary value of payments is also typically introduced, and can reduce the value of settlement obligations by 50–90 percent.[5]

Central bank arrangements may have characteristics of either correspondent banking or clearinghouses, or both. In some countries, the central bank owns and/or administers interbank clearinghouses similar to those that are operated privately in other countries. Net settlements are conducted using balances in central bank accounts. In other countries, the central bank collects paper instruments and/or operates an electronic payment system that relies on the crediting and debiting of its account holders in a manner similar to a private correspondent, with the important exception that funds in central bank accounts are free of default risk. In still other countries, including the United States, the central bank may offer both types of interbank clearing and settlement procedures.

Both private clearinghouse and central bank arrangements can introduce important efficiencies into interbank clearing and settlement, although care needs to be taken in analyzing the benefits of these arrangements. For example, both clearinghouses and central banks may be able to exploit economies of scale and scope in clearing and settlement. Traditional economies of scale may exist in the communication, processing, clearing, and settlement of either electronic or paper-based payments. In this context, economies of scale mean that as processing volumes increase over a relevant range, marginal and average unit processing costs decline.

[5]Under multilateral netting procedures, each member of a clearinghouse group typically will pay or receive one net amount of money per clearing cycle, which represents the multilateral net value owed to, or to be received from, all other members with respect to the instruments cleared in that cycle. There are many variations on this basic theme. Multilateral netting is discussed further in Chapters 3 and 7.

Economies of scale may also exist in the sense of "network economies," in which the addition of participants to a clearinghouse or central bank arrangement reduces the marginal and average unit costs of communications and processing for the group as a whole. The concept of network economies covers efficiencies attributable to the identities of the additional participants who exchange payments with others in the clearing group, and not simply owing to an increase in processing volumes. In some cases, "financial network economies" may also exist in the sense that as members are added to a multilateral clearing group, the aggregate value of net credit extended within the clearing group may increase less than proportionately with the aggregate value of payments to be cleared and settled. Again, this effect is partly associated with the identities of added members, not simply that additional payments are to be cleared and settled.

Further economies of scale may exist with respect to interbank settlement if increases in the value of payments processed result in a less than proportional increase in the value of the settlement media, including central bank money, needed to conduct settlements. In all of the above situations, "supply efficiency" increases because interbank clearing and settlement can take place at lower unit costs than they would do otherwise.

Both clearinghouses and central banks may also experience so-called economies of scope, also known as "synergies," in interbank clearing and settlement. Economies of scope would be said to exist if payment communications and processing can be coupled with credit operations so that the marginal and average costs of providing the services jointly is less than the respective costs of providing them separately.[6] For example, it may be much less expensive to receive implicit credit through a multilateral clearing arrangement than to "prefund" settlement obligations on an ongoing basis throughout a daily clearing cycle, using a separate credit facility to raise the money to meet prefunding requirements. Economies of scope may also exist in the joining of settlement and processing operations in real-time gross settlement systems typically run by central banks.

Care needs to be taken in analyzing economies of scale and scope for at least three reasons. First, the presence or absence of economies of scale is essentially an empirical question for specific clearing technologies and organizations. For example, in the case of check clearing, the statistical evidence from Federal Reserve experience suggests that check clearing does not have such large economies of scale that to achieve an efficient use of clearing resources, all checks cleared on an interbank basis in the

[6]Credit extensions may be either explicit or implicit. Implicit credit extensions, for example, may take place through the multilateral netting of payments.

United States should be processed by a single check processor or, indeed, at a single processing site.[7] Even with electronic technologies, it should not automatically be assumed that the fixed costs of acquiring computers will create economies of scale so large that all payments should be processed by a single clearing organization or at a single computer center. Economies of scale, or the lack thereof, in communications technologies will have a bearing on the overall scale economies in interbank clearing, particularly of electronic payments.

Second, although clearinghouses and central banks may help to focus attention on promoting efficiency in interbank clearing operations, they may also at times face internally conflicting objectives. Private clearinghouses are likely to have multiple owners who have somewhat different objectives for the clearinghouse based on their differing commercial interests. Central banks may have multiple responsibilities that transcend payment activities and may, by law or custom, be responsive to a wide range of public policy objectives in administering payment services. As a result, both private clearinghouses and central banks may at times find it difficult to take "entrepreneurial steps" to increase efficiency in the interbank clearing process.

Third, major private clearinghouses that are important institutions for clearing payments may also be a focal point of credit and liquidity risk in the payment system. When payment and credit volumes are relatively large, systemic risks may arise that generate external "diseconomies" for institutions in the financial system. These diseconomies may offset, at least to some extent, the net benefits associated with economies of scale and scope. In such cases, as discussed below, key risk controls may be needed to manage or avoid risks. A full analysis of the efficiencies such clearinghouse arrangements offer to the financial markets, as well as to society generally, must take into account any major financial risks, along with the costs and results of installing and operating key risk controls.

Overall Efficiency in the Market for Payment Services

Overall efficiency in the market for payment services requires that both users and suppliers of payment services behave efficiently. Users will choose among payment instruments and methods based on the benefits and costs associated with the attributes of different payment methods. Suppliers will supply instruments, communications and delivery systems, and clearing and settlement systems to optimize the use of resources needed to handle payments.

[7]See P. Bauer and D. Hancock, "The Efficiency of the Federal Reserve in Providing Check Processing Services," *Journal of Banking and Finance*, Vol. 17 (April 1993), pp. 287–311.

The presumption is that over the long run, competition among the providers of banking and payment services is the most effective way to ensure that the services produced are wanted by their users, and that those services are produced at the lowest cost possible, at fees commensurate with the cost of production. Accordingly, central banks will want to promote competition in the provision of payment services. The starting point for such policies may be the recognition at the philosophical level that private banking organizations, clearing associations, and similar participants all have an important role to play in an efficient payment system. This role is to provide both the institutional framework for the payment system and, at times, to compete directly with the central bank and other official bodies that may participate in the operation of the payment system. As discussed further below, regulatory policies are available, when needed, to help limit risks in the payment system.

Policies to Stimulate Payment System Efficiency

There are at least five broad areas in which central banks, together with other public authorities, can stimulate improvements in payment system efficiency. These include the setting of standards, competition policy, legal policy, monetary regulations, and the provision of central bank services. Positive steps that can be taken in each of these areas are identified below.

Standards

In the area of standards, central banks and other authorities can encourage the use of, and even issue, in consultation with banks, payment instruments and electronic message formats. The setting of standards, however, inherently touches on the interests of banks and payment system users broadly, and should balance the needs of each group. Further, as explored earlier, different payment instruments will be used for different purposes. Thus, problems are likely to arise if attempts are made to design one payment instrument or system for all uses in a country.

Technical standards that allow efficient processing of instruments or messages are also very important. The adoption of common standards can greatly simplify and speed up processing. A uniform system for identifying and routing paper documents or electronic messages, for example, is vital for reducing mistakes and delays in processing.[8] Standard message formats are also very important for the automated processing of payments, particularly if multiple banks or payment systems are involved.

[8]The standardization of check sizes and the use of the "magnetic ink character recognition" (MICR) line on checks, which contains machine-readable routing and account information, was critical in automating check processing in the United States.

Competition Policy

In competition policy, the central bank and anti-monopoly authorities should encourage wide access to essential clearing arrangements. Clearinghouse arrangements, for example, may pose temptations to exclude competitors, which can affect the quality of, and charges for, interbank clearing services. Certainly, those that form clearinghouses may underwrite the costs and risks of such arrangements, with late entrants receiving benefits but not bearing a full share of costs. But there are creative mechanisms that can be used in many circumstances to help control such situations and their associated adverse incentives, if needed.

Financially weaker participants in clearinghouses may create systemic credit and liquidity risks for other members, particularly in multilateral netting. As discussed in Chapter 7, these risks can be controlled to some degree through risk management techniques set up to protect the clearinghouse and other participants. Although it will presumably be necessary to exclude some potential members from a clearinghouse because of the technical or financial risks they represent, clearinghouses should not be designed to rely on exclusionary practices as the chief means of risk control. Less restrictive means should be found, particularly for clearinghouses that are an essential part of the payment system.

A further issue is whether a country's thrift institutions and so-called near-banks should be excluded from direct participation in key clearing arrangements. This issue often generates frictions in both banking and political circles. From the standpoint of the provision of efficient payment services, it is not clear a priori why such institutions should be excluded from key payment arrangements, if they qualify for membership on other grounds.

Legal Policy

In the area of legal policy, the central bank and legislative authorities should strive to make payments law as clear as possible. The rights of parties involved in making and receiving payments, including intermediary banks, should provide a sound foundation for payment system design, risk management, and use. It may be particularly important to design both a statutory and regulatory framework that facilitates the automation of payments processing, to stimulate gains in payment system efficiency. The issue of legal risks is discussed further in the next section.

Monetary Regulations

With monetary regulations, central banks may need to consider the effects of reserve requirement rules and related regulations on the liquidity of banks and the use of central bank money for the settlement of

payments. For example, as discussed in Chapter 4, if required reserves must be held in segregated accounts and cannot be used to settle payments, the monetary costs of settlement may be increased substantially. This may unnecessarily increase the costs of providing payment services for a country's banking system, with no offsetting public policy benefits. The objective of all payment systems is the transfer of money balances; monetary regulations that interfere with the money transfer process, or increase its cost, will increase the costs to banks of supplying payment services and therefore to bank customers of using bank payment services.

Central Bank Services

Finally, in the broad area of central bank services, central banks have a number of choices on their degree and type of involvement in the payment system. As noted above, central banks may choose to operate interbank clearinghouse arrangements directly. They may also choose to provide correspondent banking services. As discussed in Chapters 6 and 11, a very important payment service that central banks can offer is a large-value interbank funds transfer system.

Another vital and unique service is net settlement. A cornerstone of interbank clearing and settlement, particularly involving clearinghouses, is settlement in central bank money. Funds held on deposit at central banks are free of default risk and are provided by a neutral, public institution. Moreover, when interbank money markets are used to adjust the reserves of the banking system, settlement in central bank money is necessary to effect desired adjustments of reserve positions. Thus, particularly if a central bank does not provide other payment services, net settlement is fundamental to the establishment of money markets for adjusting banking reserves.

When central banks offer payment services, one important policy, as discussed earlier regarding clearinghouses, is the degree of access permitted to services. The objective of an efficient payment system suggests a policy of wide access by banks or other institutions offering deposit-money accounts used for payment purposes. Along these lines, the Federal Reserve is required by law to provide access to standardized payment services on a nationwide basis to "depository institutions," including banks, thrift institutions, and U.S. branches and agencies of foreign banks.[9]

In theory, the market would ensure the efficient provision of clearing and settlement services through correspondent banking channels if access

[9]The term "depository institution" is defined in Section 19(b)(1)(A) of the Federal Reserve Act and is similar to the concept of deposit-taking financial institutions.

to central bank services were more limited. As noted above, however, there are potential frictions in correspondent banking arrangements, along with conflicting incentives regarding the provision of speedy clearing. Furthermore, since payment services and general banking services are often closely linked, smaller banks that face payment services with higher cost or lower quality obtained through the correspondent banking system, may be at a disadvantage in general banking markets vis-à-vis larger banks. This, in turn, may affect the degree of market concentration and economic efficiency in banking markets generally. Thus, direct access to central bank services may help significantly not only to speed up payments and reduce their cost but also to maintain a more competitive banking system.

When a central bank provides payment services, however, it must also be careful not to subsidize these services in a way that suppresses the development of efficient private clearing arrangements. For example, if the central bank provides payment services free, as some central banks in developed economies have done in the past, it is likely to attract a very large share of the interbank clearing business. If it processes payments inefficiently, the general efficiency of the payment system will be reduced, perhaps substantially.

To take the United States, before it began charging fees for its payment services in 1980, the Federal Reserve collected a large share of the checks written in the United States. Studies show that some Federal Reserve check processing centers processed too many checks in proportion to the clearing resources employed at the centers, driving up the unit cost of check processing beyond the economically efficient level. Following the imposition of fees for check processing, the total volume of checks processed by the Federal Reserve declined, and processing loads were more rationally distributed across processing sites, lowering processing costs per item and increasing efficiency.[10]

A further effect of charging cost-based fees for central bank payment services is that, if and when private sector alternatives exist to central bank clearing, significant incentives are created for managers of central bank payment operations to provide services efficiently. This effect should not be underestimated. For example, competition for business may provide the impetus for central banks to improve services and introduce new technologies earlier than they would do otherwise.

If a central bank does choose to recover the costs of providing its services through fees, what costs should be recovered? For example, should a central bank recover only the variable costs of providing pay-

[10]See David B. Humphrey, "Resource Use in Federal Reserve Check and ACH Operations After Pricing," *Journal of Bank Research*, Spring 1985, pp. 45–53.

ment services, or should it also recover fixed costs? If fixed costs are to be recovered, how are costs associated with a central bank's other functions to be separated from costs attributable to payment services? In general, carefully designed cost accounting systems are needed when production inputs such as buildings, computers, and other equipment are used both for processing payments and for processing other data. Another question is how much management time should be attributed to payment services when management has both policy and operational responsibilities.[11]

One principle is clear. Unless a central bank recovers at least its variable costs of providing payment services through fees, it will almost never be economical for private banks to compete with the central bank for interbank clearing business. Moreover, in theory, central banks should recover their capital costs, including a market-oriented rate of return on capital, along with imputed taxes, in setting fees. This type of cost recovery helps to ensure that resources at the central bank's disposal are put to the most valuable uses and to promote overall efficiency in the provision of payment services.

The appropriate level of central bank cost recovery for particular payment services has been discussed for a number of years in the United States and is currently under discussion in Europe.[12] The development of new payment systems or the availability of payment services in geographically distant places may somtimes argue for some level of subsidy. In the United States, the Monetary Control Act of 1980 recognized this possibility. The presumption, however, is that a central bank seeking to stimulate efficiency in the payment system would resist a policy of providing large-scale subsidies to all of its services. The Federal Reserve follows a general policy of recovering the full costs of providing payment services.[13]

An interesting issue is whether unique services such as those provided by large-value interbank payment systems that provide real-time settlement in central bank money should be subsidized. Such systems form the basic standard for final electronic interbank settlement and, in many cases, form the fundamental settlement infrastructure of interbank money markets. Such systems can also be crucial to the continuing liquidity and

[11]Further issues are whether and how to separate policy and operational functions to avoid any potential conflicts of interest between central bank policy formulation and market activities. These questions are explored in Chapter 11.

[12]For a discussion of cost recovery objectives in the European Union, see Working Group on EC Payment Systems, "Report to the Committee of Governors of the Central Banks of the Member States of the European Economic Community on Minimum Common Features for Domestic Payment Systems," November 1993, pp. 6 and 28 (Principle 9).

[13]For background material on the Federal Reserve's policy of recovering the costs of providing payment services and charging fees for priced services, see Section 11A of the Federal Reserve Act, "The Federal Reserve in the Payments System," and "Principles for Pricing of Federal Reserve Bank Services," Federal Reserve Regulatory Service, sections 7–128, ff. (March 1994).

stability of the financial system. Whether these systems should be subsidized because they provide broad public benefits, beyond those to the immediate users of such systems, is not a settled question.[14]

Payment System Risk

Another area of policy concern is payment system risk. This potentially embraces a wide range of risks that affect payment instruments, delivery and communications systems, clearing and settlement arrangements, and the monetary sector of an economy. Of special concern to central banks are risks that affect the banking and financial system as a whole—so-called systemic risks. In designing payment systems, attention must also be paid to the vulnerability of systems to various kinds of operational interruptions, illegal interference, and other potential disruptions to the flow of payments. This section highlights and discusses briefly some of these major risks. As noted above, in designing payment systems and formulating policy, these risks need to be placed within the context of policy objectives relating not only to risk but also to efficiency.

Nonfinancial risks in the payment system include counterfeiting, theft, fraud, and error. Further, since payment operations are increasingly automated, operational risks deserve special attention. Natural disasters, including floods, fires, and earthquakes, may affect payment operations through a variety of effects on the basic infrastructure of the payment system, including buildings, equipment, roads, and, importantly, electric power. Many of these risks are discussed in detail in Chapter 12.

Financial risks are also a principal concern in the payment system. Since the banking and payment systems are closely intertwined, the solvency and liquidity of individual banks and their customers can depend on the payment system practices and policies of financial institutions, as well as the supervisory and "safety net" policies of government authorities.

Risks of Human Interference and Error

The risks of improper human interference in the payment process through activities such as counterfeiting, theft, and fraud may be dealt with in many ways.[15] Indeed, there have been a number of highly publicized cases of fraud involving the payment systems of developing coun-

[14]The Federal Reserve does not subsidize the provision of Fedwire services.

[15]For the purposes of this chapter, the forgery of signatures on paper instruments and the unauthorized making of electronic payments using various computer-assisted techniques are variations on the theme of theft and fraud.

tries in the past few years. Prevention, detection, prosecution, and punishment are relied upon for protection against these risks. In cases where swift apprehension is not possible, however, the deterrence value of threatened prosecution and punishment may be quite low. Further, law enforcement authorities often note that theft or misapplication of money and securities through the payment system is the result of highly organized criminal activity.

The most important strategy for addressing counterfeiting, theft, and fraud is to take cost-effective steps to prevent them from occurring. Mechanisms to verify the identity and authority of the individuals signing paper instruments or initiating and receiving electronic payments are essential. Simple precautions can involve increasing the security of processing centers and communications channels used for payment information. Physical security of premises and machines is very important, as is the protection of data, both in storage and during transmission. Furthermore, security should not be limited to banks and processing centers but should extend to the premises and computers of users of payment services. These ideas are explored fully in Chapter 12.

When multiple parties are involved and paper instruments are used to make payments, it can become quite complex and costly to set up sophisticated mechanisms to prevent fraud. In both paper-based and electronic payment systems, added security features may slow payment processing and, possibly, settlement operations. Some security measures, particularly those involving central bank or government activities, may raise public concerns about the privacy of payment and financial data.

In a market-oriented economy, the costs of theft and fraud as well as the cost of security relied upon to prevent these activities will be borne largely by payment system users. At some point, of course, trade-offs involving costs and benefits, as well as privacy concerns, will determine how much security is economical. Nonetheless, to maintain confidence in the main payment systems for an economy, it is likely to be necessary to make significant investments in security.

Operational Error and Failure

A key issue in the design and maintenance of automated systems is the management of the risks of operational error and failure. Indeed, the integrity of payment system operations, during both normal and unusual processing conditions, is critical to the functioning of a modern financial system. The tolerance level of errors and failures may be key parameters in the design of systems. These issues are discussed more fully in Chapters 10 and 12.

When a payment instrument or message is handled by multiple communications and processing systems in a sequence of communications,

banking, and clearing organizations, failures at any one of a number of organizations can delay or misdirect a payment message. Thus, general policies on operational risks may need to consider a quite complex mix of organization types and processing risks.

An important policy decision with very practical cost effects concerns the type of arrangements that authorities will encourage to back up the primary processing elements in critical payment systems. A number of operational arrangements are possible, as discussed in Chapter 12. These arrangements are in the nature of an insurance policy. Unfortunately, until system failures actually occur—and they tend to occur rarely for well-designed and well-maintained systems—institutions may feel that investments in backup systems are a waste of money. Thus, it may be beneficial for a central bank to encourage attention to backup arrangements in the context of the long-term costs and benefits of investing in such arrangements.

Legal Risks

Uncertainty about laws and regulations can also be an important risk in the payment system. Clear payments law, typically embodied in statutes or regulations, can help bring certainty to the payment process and avoid general disruptions of payment activities because of concerns about the status of legal rights. For example, clear definitions of the rights of parties to a payment, clear requirements for creating payment instruments or messages, and a definition of rights and responsibilities in communications, clearing, and settlement are very important. The location of different operational, financial, and other risks goes along with the definition of rights and responsibilities.[16]

One interesting issue in the creation of payments law is whether the government should define the rights and responsibilities of all parties to payments (including those of correspondent and intermediary banks) or whether the authorities should permit the parties to individual payment transactions, along with their banking organizations and clearinghouses, to negotiate rights and responsibilities. On the one hand, market principles and the need for flexibility in financial and payment transactions may argue, in some cases, for individual negotiation. Clearinghouses, for example, have often adopted important rules affecting rights and responsibilities that are binding on their members, including rules covering sharing of financial losses. Correspondent banks "regulate" parts of their payment operations through private contracts. On the other hand, the legal definitions and standards for a unified, nationwide payment system would argue for uniform statutory or regulatory standards. To an impor-

[16]See Chapter 5 for a discussion of the legal foundations of large-value transfer systems.

tant degree, each country must deal with this issue in the context of its own standards for commercial and payments law, its general legal principles, and the practicality of different legal strategies.

In formulating payments law, it is necessary to balance the interests of a variety of participants in the payment system. For example, suppliers of payment services, including banks and clearing organizations, will want commercially reasonable laws and regulations that are not costly to comply with. End users of the payment system will presumably also want low-cost rules. Some end users, however, may also have an interest in relatively expensive consumer protection measures that entail high implementation costs. A balancing of interests is therefore necessary.

Both suppliers and end users of payment services may seek legal provisions that will allow risks or losses to be shifted to the other group. Again, some balancing of interests is likely to be necessary. Legal provisions that do not clearly allocate risks and leave the resolution of legal uncertainty until after payments have been initiated have little value. Indeed, in large-value payment systems, legal uncertainties can generate serious systemic risks for the financial system.

Although a full discussion of all types of law that touch on payments is beyond the scope of this chapter, many types of law may be relevant. For example, bankruptcy laws may determine whether a payment that has been made by one party, who subsequently goes bankrupt, to another party, can or cannot be reversed. A country's laws governing the bankruptcy of banks may have a profound effect on the status of payments that have been initiated but not finally settled before such a bankruptcy. In addition, general banking laws may govern the terms and conditions of accounts offered by banks, rights in deposit money, and the credit-granting process. In multicurrency and cross-border transactions, a host of laws governing foreign exchange and cross-border transactions may come into play and affect the process of making payments.

Perhaps the legal issue of overriding importance in the payment system concerns the definition of when a payment is final. Finality occurs at the time at which a payment is complete and cannot be reversed. Some payments, such as those made over the Fedwire funds transfer system in the United States (as described in Chapter 6), are final as they are being processed. Indeed, a Fedwire funds transfer is both irrevocable and unconditional between the depository institutions sending and receiving the transfer, so that a payment cannot be reversed even owing to mistake and error. (Such problems must be dealt with outside the Fedwire payment system by private negotiation.) Thus, when a depository institution receives a payment directly over Fedwire, it has received final payment in central bank money.[17] Other privately or publicly operated payment

[17]The legal framework of the Fedwire system is discussed more fully in Chapter 5.

systems, including large-value multilateral netting systems, may have less stringent finality rules than real-time gross settlement systems such as Fedwire. For example, there may be a period of time on some systems, during which checks, payment orders, or certain types of electronic payments may be returned, if the payments contain errors or are thought to be fraudulent. The terms of finality are also likely to differ between debit transfer systems and credit transfer systems, owing to the different operational nature of the two types of systems. All payment systems, however, define a time after which payments cannot be reversed.

Stringent finality rules do not come without cost. For example, if electronic funds transfers are final as they are processed, making a transfer is equivalent to making an irrevocable and unconditional delivery of cash. Indeed, an important reason why many payment systems do not adopt the rule that all payments are irrevocable and unconditional when they are processed is the added cost of arrangements that would be required to ensure the very high security and integrity of payments. At the same time, as discussed below, reliance on payment reversals, particularly same-day reversals, to manage financial risks in large-value interbank transfer systems would potentially entail very large systemic risks.

Credit, Liquidity, and Systemic Financial Risks

Credit risk enters payment system analysis because the operation of most payment systems involves extensions of credit, either explicitly or implicitly. Many central banks extend credit directly to commercial banks in connection with the provision of payment services. Commercial banks typically extend credit to one another in the course of payment operations, either as part of correspondent banking relationships or through clearinghouse arrangements. Moreover, banks also normally use money markets to borrow or lend reserves of central bank money that are gained or lost through payment, clearing, and settlement. Commercial banks also extend credit to their customers as part of normal commercial operations, of which one part is the handling of payments.

Credit risk is the "risk that a counterparty will not settle an obligation for full value, either when due or at any time thereafter."[18] In the payment system context, the focus is on the risk of default in the settlement of payment obligations, particularly in interbank settlements. There are, however, often credit risks at every stage of the payment process. Banks or bank customers that borrow funds in the payment process may be unable to repay those funds for reasons wholly unrelated to their payment activities. For example, the value of customer or bank assets held in the

[18]See the Glossary to *Payment Systems in the Group of Ten Countries* (Basle: Bank for International Settlements, December 1993), p. 536.

fonn of securities, commercial loans, or real estate may decline sufficiently to bankrupt the holder of the assets, who, in turn, may be a borrower of funds at some stage in the payment process. Thus, credit risk in the payment system may be closely intertwined with general credit risks in the banking and financial markets.

Liquidity risk is the "risk that a counterparty (or participant in a settlement system) will not settle an obligation for full value when due. Liquidity risk does not imply that a counterparty or participant is insolvent since it may be able to settle the required debit obligations at some unspecified time thereafter."[19] An important implication of liquidity risk for the payment system is that, although a participant in the payment system may hold insufficient central bank money to settle payments at a particular point in time, payments can be settled for full value given sufficient time to convert assets into central bank money. The same point is also true for settlement media other than central bank money. Liquidity risk contrasts with credit risk, since with credit risk, a default at settlement represents a loss that must ultimately be shared in some way by those that have dealt with the defaulting payment system participant.

Systemic risk is "the risk that the failure of one participant in a transfer [payment] system, or in the financial markets generally, to meet its required obligations will cause other participants or financial institutions to be unable to meet their obligations (including settlement obligations in a transfer system) when due. Such a failure may cause significant liquidity or credit problems and, as a result, might threaten the stability of financial markets."[20] Systemic risks can result from the extension of credit between banks in either the payment process or the interbank markets. Indeed, systemic risks in the financial markets are not confined to banks, but may include other major financial institutions. One particular fonn of systemic risk in private clearing arrangements is the risk that a settlement default by one participant in a clearing arrangement will trigger defaults by other participants.

As discussed in Chapter 11, central banks are concerned about credit, liquidity, and systemic risks in the banking and payment system from their perspective as supervisors of financial institutions, monetary authorities, and operators of payment systems. As supervisors, central banks are concerned about the credit and liquidity risks to the individual institutions they supervise. As monetary authorities, central banks are concerned about the demands for central bank money and credit, both in general and at specific times when important interbank settlements are conducted. As payment system operators, central banks are concerned about

[19]Ibid., p. 539.
[20]Ibid., p. 544.

providing efficient and low-risk payment services. In all three roles, central banks are concerned about the systemic stability of the payment and financial system and the important connections between various financial markets and the payment systems that provide the infrastructure for settling transactions in the financial markets. Thus, official payment system risk policies typically have their roots in the combination of functions performed by central banks.

Private Sector Clearing Arrangements

Central banks may directly supervise private sector clearinghouses, may provide money or credit to facilitate settlements by participants in these arrangements, and may be directly involved in settlements through net settlement or other services. Thus, central banks often have important public policy interests in the operation and management of clearinghouse arrangements for payment and other instruments, including securities. Policies toward private clearing arrangements are currently under review and development in a number of countries. An important issue is how extensive should be credit, liquidity, and systemic risk safeguards in relation to the risks presented by a particular system.

The organizers and members of private sector clearing arrangements also have concerns about risks to their participants, ultimate users, and to the viability of the arrangement itself. As noted above, one of the major systemic issues for a clearing arrangement is the possibility that one member not meeting its obligation on a given day may cause other members not to be able to settle their obligations, so-called knock-on effects. To reduce the risks of catastrophic failures involving many institutions, and to ensure the integrity of clearings and settlements short of catastrophic failure, clearinghouses should, and often do, adopt risk control procedures. These risk control procedures, which are described more fully in Chapter 7, may include membership standards; inspection programs; credit limits both on bilateral and multilateral positions; and loss-allocation procedures backed by pools of funds or collateral, committed bank lines of credit, and guarantees. Operational risks may be managed through operational requirements for membership, backup processing arrangements, and other techniques.

For central banks overseeing clearing arrangements, it is important to bear in mind that the greater a system's credit and liquidity safeguards, the greater is the probable cost to the private sector of establishing and using such facilities. In countries in which clearing arrangements fall into categories that lie on a spectrum from lowest to highest in systemic risk, it may be possible and desirable to give greater attention to, and to demand stronger risk controls and liquidity safeguards from, arrangements that present greater degrees of systemic risk. For example, small-value systems in which multilateral net positions are small in relation to each user's

assets, capital, and ability to finance settlement failures may require a somewhat lower degree of risk controls and liquidity safeguards than large-value payment netting systems. In contrast, large-value systems would ordinarily need to have the strongest controls.

In the past in many developed countries, clearing arrangements were not subject to requirements that explicit credit and liquidity risk management arrangements be in place. For example, clearing arrangements for checks or other paper instruments often allow these instruments to be returned to a bank attempting to collect the instrument through a clearinghouse if a bank on which an instrument is drawn is unable to settle the instrument. Credit risk, and even liquidity risk, is essentially managed by returning payments that cannot be settled.

This type of risk management system, which relies on the "reversing" or "unwinding" of payments, may be adequate to manage risks associated with clearing systems that process and settle relatively small values. Risk management based on unwinds, however, has sometimes been adopted by clearing arrangements for large-value payments, including electronic interbank funds transfer systems. In general, central banks have discouraged the use of reversals or unwind procedures as a method for managing credit and liquidity risks, particularly by electronic same-day settlement systems for large-value payments. First, such procedures have the potential to cause serious systemic liquidity problems in financial markets, if they are ever used. Second, settlement failures in clearing arrangements could occur as part of a larger financial crisis, and reversals could significantly amplify, through the payment system, a problem originating elsewhere. Third, a central bank may want to avoid any implication that it might provide the credit or liquidity necessary to avert the disruptive effects of a large-scale reversal of payments. Instead, central banks may insist that private sector participants in clearing arrangements directly take the necessary precautions to deal with credit and liquidity risk as part of the normal cost of operating a clearing system.

In the international setting, the central banks of the Group of Ten countries have developed a set of minimum common standards for "netting schemes," including clearing arrangements that rely on the principle of multilateral netting and settlement.[21] Moreover, the European Union central banks have endorsed similar minimum standards for domestic clearing arrangements in Europe that rely on multilateral netting.[22]

[21]See "Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries" (Lamfalussy Report) (Basle: Bank for International Settlements, November 1990), p. 5. These standards, which are shown in Table 2 of Chapter 7, also apply to foreign exchange contracts and certain other instruments traded "over-the-counter" in interbank markets.

[22]See Working Group on EC Payment Systems, "Report to the Committee of Governors of the Central Banks of the Member States of the European Economic Community on Minimum Common Features for Domestic Payment Systems," November 1993, p. 5 (Principle 5).

Among other things, these minimum standards require a clear definition of credit and liquidity risks in clearing arrangements, along with adequate credit and liquidity risk management systems. To avoid the systemic risks of multiple defaults in a clearing arrangement, the standards require that large-value systems be able to settle the single largest net debit position on the system in the event of a default. The standards also require other measures such as a strong legal foundation for netting systems, objective and public admission criteria, and reliable operational backup systems. Whereas policies toward domestic clearing arrangements may well depend on the particular circumstances in each country, the minimum standards provide an important starting point for analyzing risks in a wide range of netting systems as well as policies designed to manage these risks.

Correspondent Banking Arrangements

Correspondent banking arrangements may be as important, or even more important, than clearinghouse arrangements in the payment system in some countries. Specific payment system risk policies may or may not be aimed at these arrangements, depending on the country and the particular features of the arrangement. Operational and credit examinations conducted by bank supervisory authorities should cover key interbank settlement activities, along with other activities, as noted in Chapter 11.

Central Bank Payment Systems

One means of reducing credit and liquidity risks within the private sector is for a central bank to supply jointly payment services and supporting credit to the banking system. In the arena of large-value payment systems, some central banks provide multilateral netting systems, others provide real-time gross settlement systems, and some provide both. By offering credit with payment services, as amplified below, central banks tend to absorb credit and liquidity risk. Some central banks, of course, choose not to provide credit in connection with payment services, following a policy that places the private sector in the position of generating any credit needed to make payments. Even when a central bank does not provide credit in connection with its payments operations, however, it may monitor risks and be prepared to assist in liquidity management, in the event of potential settlement difficulties.

An emerging trend is for central banks to emphasize the advantages, from a risk perspective, of systems that provide for real-time gross settlement, particularly of large-value payments.[23] A central bank would at

[23]Ibid., p. 5 (Principle 4).

least provide real-time settlement for a payment system, and might well own and operate the entire system, depending on the country. As explained in Chapter 7, real-time gross settlement systems do not necessarily eliminate credit and liquidity risks. When central bank credit is granted in connection with real-time settlement systems, for example, risk is essentially transferred to the central bank, which must then adopt means to manage the risks. Real-time settlement systems, however, do have the crucial advantage of eliminating the possibility that if one bank in the financial system defaults on its payments at settlement, others will in turn default. Thus, real-time settlement systems can potentially help to reduce systemic risks associated with large-value payment systems.

Whether a netting system run by a central bank has less credit and liquidity risk than such a system run by private banks is an open question. For its own systems, a central bank may be in a more favorable position to insist that strong risk controls be adopted. A countervailing point, however, is that a clearinghouse run by a central bank may be regarded as fail-safe by participants, and there may be even less incentive than in private sector arrangements to agree to sound risk controls.

Central banks have designed specific tools to help manage the credit and liquidity risks in the payment systems they operate.[24] Credit limits placed on users of the system, including limits of zero, are one way to limit risk. In addition, real-time monitoring and control mechanisms have been devised for credit extensions made through payment operations. In the strongest of such arrangements, credit transfers over a payment system may be rejected, or placed in queues, until sufficient balances are available, possibly from central bank credit extensions, to complete payments without exceeding relevant credit limits. Credit limit programs also exist that rely on payment system users to stay with limits as payments are made, and rely on after-the-fact detection and penalties for breaching these limits.

Central banks may take collateral to protect themselves against credit risk in the operation of the payment system. Indeed, some collateralized overnight central bank lending facilities were first developed to provide the credit needed to settle debts arising from the clearing of paper instruments. Thus, the basic idea of a central bank taking collateral to protect against credit risk, while providing needed liquidity to the banking system, is a very old concept.

Charging a fee for daylight overdraft credit is a technique that has been adopted by the Federal Reserve Board to influence the demand for daylight overdraft credit in accounts at Federal Reserve Banks. Charging a fee for daylight credit is analogous to the widely used practice of charging

[24]See, for example, "Overview of the Federal Reserve's Payments System Risk Policy," Federal Reserve System (October 1993).

fees for overnight or longer-term central bank credit. As of this time, however, the Federal Reserve is the only central bank that has implemented a program of charging fees for daylight overdrafts, which it began in April 1994.

Other tools for managing risk to the central bank, and to the payment system generally, may depend on the role of a central bank in banking supervision. If a central bank has the power to supervise and examine banks or other payment system users, examinations that touch on the creditworthiness, liquidity, operational controls, contingency procedures, and related areas of a banking organization may provide information on risks to both the central bank and the payment system generally.

Monetary and Banking Policy

Chapter 4 addresses issues involving the interaction of monetary arrangements in an economy and the design and use of payment systems. An important point of that chapter is that monetary regulations, including central bank intraday and overnight credit policy, can affect incentives to design and use payment systems that rely on central bank money and credit for settlement. For example, the more costly it is to obtain central bank money or credit for use in settlement operations in real-time gross settlement systems, the lower are the private sector incentives to use such systems to make payments. Thus, central bank monetary regulations that increase the cost of using real-time gross settlement systems may prompt increased use of somewhat more risky private sector netting arrangements that tend to economize on the use of central bank money.

An important aspect of payment system design and policy that affects monetary policy implementation is the approach to float in systems for clearing and settling paper instruments. The clearing and settlement process for paper payments usually takes more than one day and can take weeks in some developing economies. As explained in Chapter 10, when the central bank is involved in clearing these instruments, the account of one commercial bank at the central bank may be debited (credited) days before the account of another bank is credited (debited) with corresponding funds. The result is a change in the aggregate stock of central bank money held by the banking system, with changes in that stock being heavily dependent on the physical parameters of payment processing and settlement arrangements. Large and often unpredictable variations in the supply of central bank money, which are unrelated to monetary policy changes, tend to complicate monetary management and confuse the banking system about the stance of monetary policy. Similarly, there can be large and erratic changes in short-term interest rates that simply reflect the timing of payment flows. Techniques such as the adoption of announced schedules ("availability schedules") for crediting and debiting

the accounts of banks that use the central bank to process and settle payments are often used to make the timing of central bank money flows more predictable.

A further issue is the predictability of money flows when the central bank performs banking and payment functions for the government.[25] There can be large payment flows in both directions between accounts of the government and accounts held by commercial banks with the central bank. The effect of these flows is to increase or decrease the stock of central bank money held by the commercial banking sector and indirectly by the private sector. Once again, for monetary management purposes it may be necessary to adopt techniques that will help make the timing of these flows more predictable and even to adopt special operating procedures to smooth the flows.

In the area of banking policy, payment system operations within commercial banks may be one of the building blocks for successful general banking operations. If a certain class of banks is denied access to major payment facilities, or receives access to such facilities on substantially more restrictive terms than other organizations, then these banks may be placed at a competitive disadvantage in many areas of banking services. Even if access to central bank or private sector payment services is granted on nondiscriminatory terms, access to credit within payment systems may be granted on discriminatory terms. Since the use of credit within payment systems is often crucial to interbank clearing and settlement operations, discriminatory access to credit may also place affected banks at a competitive disadvantage in offering payment and general banking services. Smaller banks and foreign banks often are affected most by discriminatory policies. The ultimate effects of such policies fall on consumers, businesses, and other end users of payment and banking services.

Conclusion

The goal of payment system policy is thus to encourage the transfer of money reliably, efficiently, and at low risk. Payment system policy and policy analysis must address issues ranging from the application of technology in payment processing to the control and management of financial risk in the payment and banking systems. Financial markets and payment systems are mutually dependent upon one another in a monetary economy, and settlement practices in markets, and in some cases trading practices, depend directly on the design and operation of payment systems.

[25]These comments also apply when central banks provide accounts to foreign governments.

Thus, payment system designs and operations must take into account the needs of financial markets and end users of the payment system in order to create the conditions for an efficient financial system and economy generally.

Reliability and efficiency mean that payment instruments should be provided that meet the needs of end users of payment systems at prices that these users are willing to pay. The supply of payment services may entail providing more than one payment instrument and clearing and settlement mechanism to meet different preferences with respect to the cost of payment, speed of settlement, and distribution of operational and credit risks in the payment process. For example, highly secure large-value payment systems that operate in real time may be necessary to provide for efficient money markets and the core interbank payment system. Somewhat slower and less secure systems may be constructed at lower cost to meet the needs of consumers and businesses for ordinary payment processing. A variety of interbank clearing arrangements may thus complement one another and provide needed choices to intermediary banks. When central banks provide interbank clearing services, efficiency is promoted if these services are priced to recover the full cost of production.

The proper construction of payment system risk policies is also vital to the long-term stability of the payment system and to confidence in financial markets. Such policies are necessary both to help avoid financial crises and to ensure that if such crises arise, payment institutions and systems will provide stability. In constructing payment system risk policies, central banks will be concerned that private sector arrangements, such as clearinghouses, do not simply shift risks to the central bank through faulty risk control designs.

Furthermore, central banks will want to promote designs and operations for both public and private sector arrangements that help prevent or reduce fraud, errors, and other major types of risk in the payment system. These policies should be as clearly defined as possible, so that private institutions know the "rules of the game" and can focus their energies on payment system enhancements. A well-developed statutory and regulatory framework for the payment system can reduce uncertainty and risk and provide needed clarity.

10

Payment System Float and Float Management

John M. Veale and Robert W. Price

The payment process consists of clearing—the transfer of payment instructions—and settlement—the transfer of value associated with a payment. When the value being transferred takes the form of deposit money in banks, the performance of back-office accounting becomes an important part of the payment process and is a crucial factor determining who has the benefit of the value being transferred at any instant in time. In an ideal payment system, processing and related accounting should result in the payor's account being debited and the payee's account being credited at the same time.

When accounting for payments is not synchronized with the clearing of payment instructions, arbitrary costs are imposed on some payment system users and windfall gains are conferred on others. In particular, these windfall costs and gains can result when accounting entries for the two sides of a payment, that for the payor and payee, are not posted simultaneously. The accounting effects of the asynchronous posting of payment entries to the accounts of the payor and payee are known as float. The ideal connection between clearing and settlement times can be broken, particularly when intermediaries are involved in a transaction and when systems used to transport and process payments are relatively slow or unreliable. In such circumstances, special attention needs to be given to the accounting treatment of payments.

This chapter explains the significance of payment system float for individual participants in the payment system and as a public policy issue. It describes the mechanics by which payment system float is generated and explains both why float is important from the business and public policy perspectives and some of the causes of float. It then describes the "availability schedule" approach to float management (an appendix presents a detailed example of how to construct such a schedule), and also describes bank cash management services designed to help bank clients manage float.

The Mechanics of Float

Consider the following transactions made by cash, check, and credit transfer. If an obligation is settled using cash, the payor gives up the cash

at the same instant that the payee receives it. The payee is able to use the cash just as the payor was able to use it an instant before the exchange. Alternatively, if a payor settles an obligation using a paper debit instrument such as a check, say, late on a Friday afternoon, it may be several days before the payor's bank account is debited for the check. Thus, by using a check, the payor has initiated payment but retains use of the funds for several days. The result of delayed processing will be somewhat different in a credit transfer, with the payor possibly losing the use of funds before value is transferred to the payee. The key benefit of retaining use of funds while a payment is being cleared is the interest income that can be earned by investing the funds.

Thus, payment system float is the balance sheet effect of crediting (in a debit transaction like a check) or debiting (in a credit transaction like a payment order) the bank account of the entity originating a payment before the offsetting entry is made to the account of the entity receiving the payment. The presence of float can affect any of the parties to a payment—the payor, the payee, either party's bank, a third commercial bank that is an intermediary to the transaction, or the central bank.

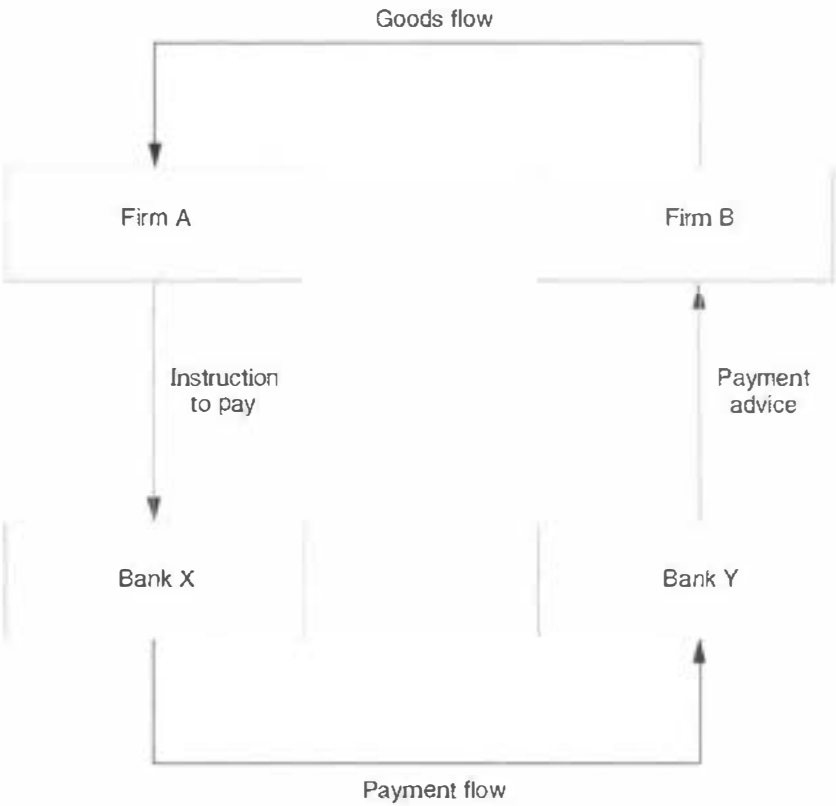
Because of float, some parties may have the use of funds that enter the payment process at the expense of others who are legally due the funds. If banks pay interest on transaction accounts from which payments are initiated and to which receipts are credited, or if there is a market in short-term funds, short-term funds have investment value. Which of the parties to a payment has the opportunity to invest these funds during the payment process depends on (1) whether the payment is made using a debit or credit instrument—for example, a check or a payment order; (2) whether the instrument is electronic or paper—in paper-based transactions it is more difficult to enter all the information into accounting systems simultaneously; (3) the presence of incentives that encourage parties deliberately to delay or to speed up processing of payments; and (4) whether there are rules in force to ensure timely and uniform processing and posting of entries to customers' accounts.

Credit Payments

Assume that firm B supplies goods to firm A. Firm A elects to pay for the goods using a credit instrument, such as a payment order through a giro system. Firm A instructs its bank, bank X, to credit firm B's account at bank Y. The flow of goods and payment is shown in Chart 1.

The first step in the payment process will be for bank X to debit firm A's account. Some time can then elapse before funds are credited to firm B's account at bank Y because of processing time at bank X, time to transport the payment instruction to bank Y, and processing time at bank Y. As a result, firm A's account will be debited and bank X may have use of the

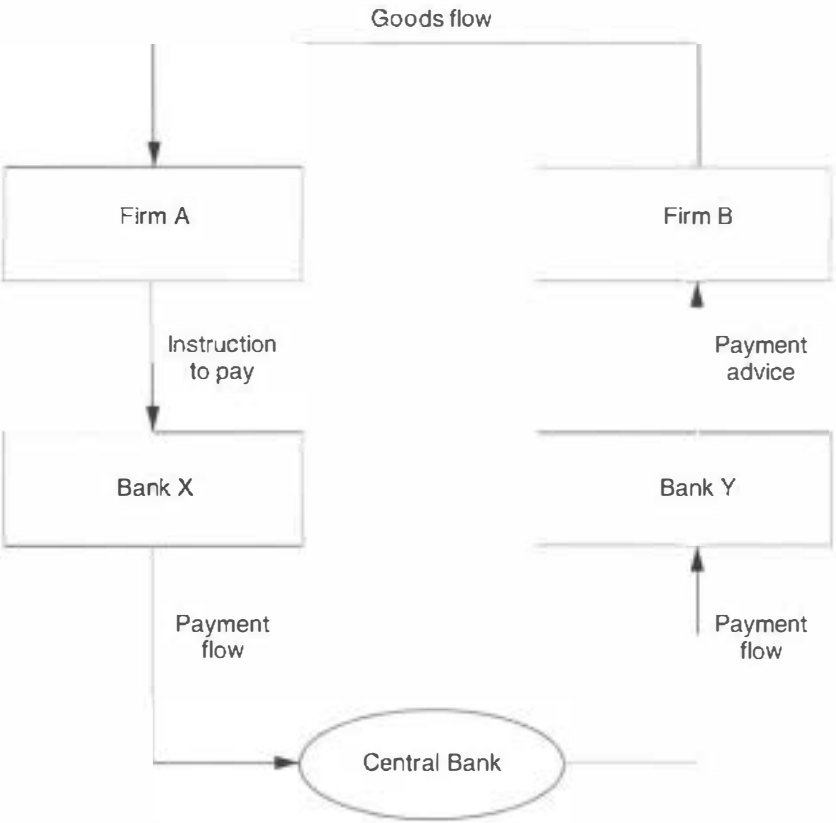
Chart 1. Credit Payment Flow



funds if there is a delay before they are actually transferred to bank Y. Similarly, once bank Y receives the funds and until it credits firm B's account, bank Y has use of the balances. Under these circumstances, banks X and Y have gained the use of funds at the expense of their customers. It is not hard to see that it could benefit the banks deliberately to delay the processing and crediting of payments to customer accounts.

Float can occur at another potential level, with different implications from those just outlined, which involves the central bank as a payment intermediary between commercial banks. Payments can be cleared and settled in several ways, and the exact mechanism will be crucial to how float is generated. Typically, however, the central bank plays a crucial role in interbank settlement, as value is transferred between banks X and Y through their nostro accounts at the central bank. The process can be generalized as illustrated in Chart 2.

Chart 2. Credit Payment Flow and the Central Bank



If the central bank debits the nostro account of bank X at the same time it credits that of bank Y, no central bank float is generated. If, however, the central bank debits bank X's account and there is a delay before it credits bank Y's account, the central bank would have the use of float at the expense of the banking system as a whole. This is central bank credit float that decreases the nostro balances of the commercial banking system at the central bank, thus decreasing commercial bank reserves.

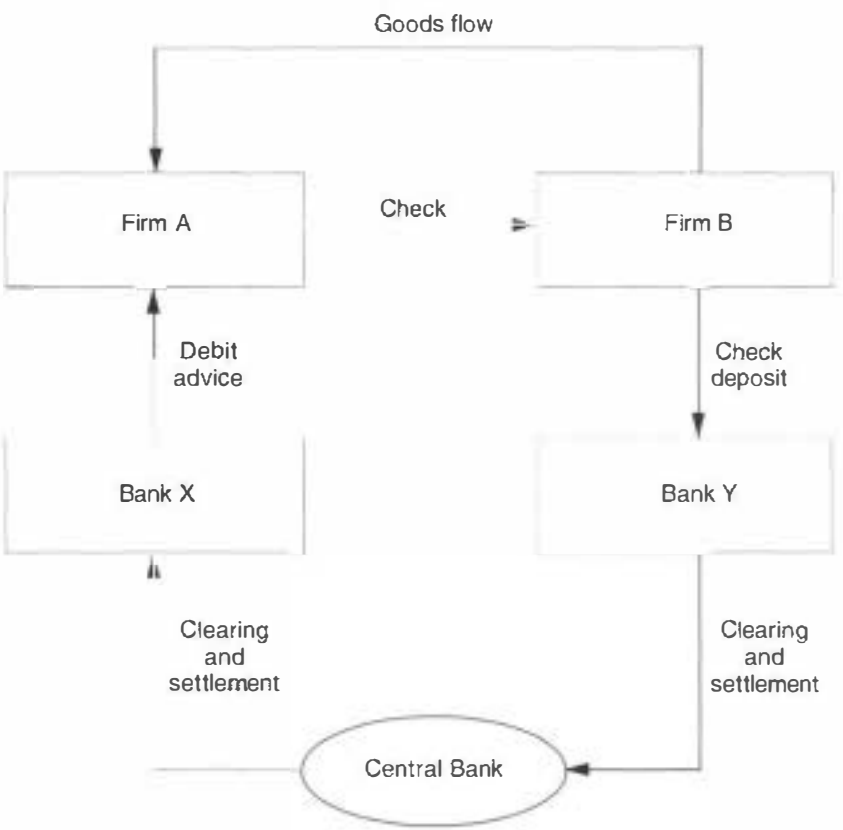
Central bank credit float could arise because the central bank is inefficient at processing or, in paper payments, because of distances between central bank payment processing centers and commercial banks. Alternatively, central bank credit float might occur only periodically, as a result of delays caused by peak processing loads or occasional operational problems.

Debit Payments

Most of the literature on float deals with the debit float generated in connection with check processing. The literature on float comes mainly from the United States, where, in contrast to most European countries, checks are overwhelmingly the most important payment instrument, at least in terms of the number of transactions.

Chart 3 illustrates the flows involved in check payments. Continuing the earlier example, firm A knows that if it gives firm B a check when it takes delivery of goods, it will take some time before its account at bank X is debited. In the meantime, firm A will continue to have the use of the balances that will eventually be used to settle the payment obligation. In fact, firm A's finance director may even take the risk of not funding the account at bank X until he expects the check to be presented, instead

Chart 3. Check Payment Flow



using the funds for other purposes, such as short-term money market investments. Management of cash balances is an important aspect of a firm's overall financial management. The effect of payment patterns, including both disbursements and receipts, is an important part of cash management. Accordingly, as discussed below in the section on cash management, banks have begun to offer rather sophisticated payment services to their corporate customers that are designed to minimize the idle balances held to fund payments.

As in the previous example, a number of levels of float are generated when debit instruments are used. At the bank customer level, if bank Y credits firm B's account when a check is deposited but before bank X debits firm A's account, firm B gains the use of funds before firm A's account is debited for those funds. Essentially, bank Y is making an interest-free short-term loan to firm B during the time it takes to clear the check.

As described in Chapter 2, and as with credit instruments, interbank settlement can involve transfers across banks' nostro accounts at the central bank, thus creating the potential for float between the central bank and the commercial banks. In this case bank Y, the bank at which the check has been deposited, will be quick to advise the central bank to credit its nostro account. If the central bank provides credit before it debits the account of the bank on which the check is drawn, in this example bank X, the central bank will be creating debit float. The central bank debit float created by this practice increases the reserves of the banking system. The central bank is effectively granting the commercial banking system as a whole a subsidy in the form of an interbank loan. This subsidy is ultimately paid by the taxpayer because it reduces the earnings of the central bank.

In relatively small countries where distances between processing centers are not great, transportation delays should not lead to major problems with debit float. Assuming major backlogs do not occur in the central bank's own processing, it will not be too difficult to make the credit and debit entries to the banks' nostro accounts on the same day. But in larger countries with many processing centers and where checks are transported over long distances, several days can elapse between the posting of credit and debit entries. For instance, a central bank branch in one part of a country could credit the account of a bank in its region and then send details of the transaction to another of its branches or processing centers or directly to a commercial bank thousands of miles away. In the United States, in particular, a great deal of careful design and execution has been devoted to the transportation aspects of check processing to meet the challenges posed by vast distances. Moreover, as discussed in Chapter 8, new methods whereby paper checks are converted into electronic instructions, called check truncation, are being more widely used.

The debit float generated through processing of debit payments has different effects than those generated by credit payments. In debit instruments such as checks, banks' customers can gain float at the expense of the banking system. Also, commercial banks may gain float at the expense of the central bank. Table 1 summarizes the types of float generated as a result of using different types of instruments and by account relationship.

Importance of Float

Why is float important? Key issues include the distortions that float can cause to the incomes of economic actors and the problems that it can cause for the implementation of monetary policy by making it more difficult to assess the demand for and supply of bank reserves. The existence of float means that one of the parties to a payment transaction—an enterprise or individual bank customer, a commercial bank, or the central bank—is either granting or receiving free or subsidized credit. Who gains and who loses payment float depends on how payment instructions are cleared and whether credit or debit instruments predominate. Clearly, float effects are potentially greater in a paper-based system, in which processing and transportation delays are potentially lengthy, than in an electronic system, in which such delays should be much shorter.

Table 1. Types of Payment System Float

Account Relationship	Credit Float	Debit Float
Commercial banks and their customers	Generated by credit payments such as a giro or payment orders. The commercial bank benefits at the expense of the customer.	Generated by debit payments such as checks. Customers benefit at the expense of commercial banks.
Central bank and commercial banks	Generated by credit payments when the nostro account of the payor bank at the central bank is debited before the account of the payee bank is credited. The central bank benefits at the expense of the commercial banks as commercial bank reserves are decreased.	Generated by debit payments when the nostro account of the payor bank at the central bank is debited after the account of the payee bank is credited. The commercial banks benefit at the expense of the central bank as commercial bank reserves are increased.

The value of float can be substantial. Float value is calculated by determining the return on investment of funds during the period that the float exists. For example, if the annual interest rate is 10 percent, the value of $1 million in float for one day is computed as

Amount of float	$1,000,000
Annualized return	x .10
Annual value	$100,000
Divided by 365	
Value of float for one day	$273.00

The higher the market rate of interest and the longer the float time, the greater is the value of the float.

Because float has value, it influences choices made by payment system participants regarding the type of instruments they use and the processing options they follow. By definition, float is a zero-sum game, that is, total float gains exactly offset total losses. In this sense, the social costs of float might be thought of as being zero. But the income redistribution effects resulting from float are arbitrary and unlikely to be in any sense optimal. More important, the incentives provided by float to take actions to be a net gainer in the "float game" can degrade the effectiveness of the payment system. The damage that float can do to the reputation of the banking system as a whole is well recognized. To minimize these costs and help ensure an efficient payment system and maintain public confidence, participants in most mature payment systems have agreed to rules governing the minimum times within which payments must be delivered and processed and funds made available to payees. Because of their responsibility for the safe and efficient operation of the payment system, central banks usually play an important role in setting these rules. Even if such rules exist, attempts to exploit float can lead to increased credit, liquidity, and fraud risks to participants. It can also increase the difficulty of implementing monetary policy. Accordingly, from a public policy standpoint, float is undesirable and should be minimized.

Credit and Liquidity Risks

Good banking practice requires that lenders have the ability to assess, and that they actually do assess, the creditworthiness of borrowers. As suggested above, however, payment system inefficiencies can result in commercial banks supplying credit to their customers under operational circumstances that make it difficult for the credit assessment to be made. Moreover, banks themselves can use central bank credit that results from the operation of the payment system in a manner that prevents careful assessment by the central bank of its counterparty credit risks (see Chapter 7 for a discussion of these risks). Further, delays in settlement, especially unanticipated delays, can cause liquidity problems for payment

system participants who expect payment as a result of legitimate transactions in the marketplace but whose receipt of value is delayed by payment system inefficiencies. Unfortunately, circumstances may make it possible for payment system participants to manipulate the payment system in order to generate float, reducing its efficiency and thereby causing liquidity problems for other participants.

Fraud Risks

Clearing and settlement procedures that generate large volumes of float, particularly debit float, can increase the risk of two important types of fraud against the banking system. When bank customers use debit instruments, such as checks, to move funds between accounts, they can gain debit float at the expense of the banking system. Check "kiting" is the process whereby bank customers deliberately generate debit float in their favor. Kiting is accomplished by holding a series of bank accounts, usually in different banks in a variety of distant locations and artificially multiplying deposits in these accounts by writing and redepositing checks between the accounts. This is done with the knowledge that the checks will take some time to clear, thus increasing temporarily the balances in the accounts if the banks at which the deposits are made provide funds based on the deposit but before the checks clear.

Check kiting is an overt manipulation of the payment system that can result in two types of fraud. First, by definition, kiting results in banks unintentionally providing credit to the entity operating the kiting scheme, which results in loss of income to the banks, as the customer uses the funds for investment purposes. Improved processing and the application of availability schedules (discussed below) can address this type of fraud. Also, a second form of fraud can involve the theft of principal, if the customer does not intend to pay the checks. To help protect against this form of kiting-related fraud, usual banking practice is to grant provisional credit for check deposits, that is, funds may not be withdrawn until the bank is confident that the check can be collected.

Impact on Monetary Policy Implementation

Variability in the delivery and processing of payments can mean that float fluctuates widely. One consequence is that bank reserves can also fluctuate widely, making it difficult for the central bank to estimate the day-to-day demand for reserves. This, in turn, adds uncertainty to the execution of open market operations. If the central bank can predict accurately the inflows of funds to and outflows of funds from the commercial banking system in connection with the operation of the payment

system, it can do a better job of hitting monetary policy targets, particularly short-term interest rate targets. Given good information flows, and an efficient market, central banks can generally target short-term interest rates quite accurately. An efficient payment system adds a degree of stability to the setting of monetary policy.

Causes of Float

The earlier discussion outlined how payment system float is generated and pointed out some of the effects that float can have on payment system efficiency. Rules and procedures are necessary to establish and enforce performance standards for payment system participants to minimize float. Such rules and procedures should address the particular types of delays that can lead to float.

All of the operational causes of float discussed below are relevant whether debit or credit payments are being processed. Inefficiencies are more likely to occur in connection with paper-based processing than with electronic processing. Nonetheless, even electronic systems can generate considerable float, especially when they are not fully integrated with bank accounting systems used to post customer accounts.

Four major causes of float are discussed below. These are posting procedures, transportation, holdovers and backlogs of payments, and processing errors.

Posting procedures float arises from the practice of posting an interbank transaction to a customer's account before making an entry for the other side of a transaction. For example, this float occurs when a bank gives credit at the time its customer deposits a check but before it receives credit for the check from the paying bank. That is, the bank receiving the check does not take into consideration the time that is normally needed to present the check and receive payment. This type of float can be reduced by adjusting posting procedures using deferred settlement and availability schedules, as discussed in detail below.

Transportation float occurs because paper payments must be transported between the various participants in the payment system. Transportation delays can be considerable in large countries where payment instruments are transported over slow transportation networks. This float can be reduced by using dedicated air and ground-based transportation networks designed to expedite the movement of value.

Transportation float can also be reduced by utilizing electronic delivery, especially for large-value payments. Electronic delivery helps ensure same-day delivery, processing, and posting of the largest-value payments. In most countries with well-developed financial markets, a relatively small number of large-value payments account for a very high proportion of the

total value of payments. If these payments can be completed within one day, float can be significantly reduced. Especially if the volume of payments is not high, the technology required for an electronic large-value transfer system need not be complex or unduly expensive. Float arising in connection with these largest-value payments can be eliminated using properly controlled telephone, telegraphic, or computer-to-computer techniques to transfer funds. As discussed in Chapter 6, developed economies rely on specialized large-value transfer systems, an important feature of which is that they do not generate float.

Holdover float is generated when a payment is only partially processed during a business day. Holdover occurs when a commercial bank debits its customer for a payment order or gives credit for a check deposited but does not complete processing and forward the payment by the end of that business day. Backlog float is similar to holdover float. In backlog float, however, the payments are not even partially processed. Rather, processing is delayed, as is accounting, owing to backup in workloads.

Holdover and backlog float can be avoided if sufficient processing capacity is available to process the volume of payments received on a same-day basis. That is, the proper types and amounts of equipment and staff must be available to handle each day's payment volumes. These resources need to be flexibly managed to efficiently handle low-, average-, and high-volume days.

Processing error float is created when errors occur during the handling of payments, including accounting for payments. For example, errors can result from payments being sent to the wrong bank, lost in transit between banks, or recorded in the wrong amount. During the time it takes to detect and resolve such errors, float is generated. Careful monitoring of work quality can reduce handling errors and processing error float. When errors do occur, an effective and timely error correction process will help contain the float that is generated by shortening the time needed to correct the error. To be effective, procedures for handling errors must be published, accepted, and used. Bank compensation rules commonly provide incentives for the speedy resolution of processing errors that arise in the payment system.

Availability Schedules

Although it would be ideal if the payment system functioned perfectly and all processing occurred in a timely, error-free manner, this is not a practical goal. At some point, the costs of reducing float by incurring added processing and administrative costs will outweigh the benefits. Nonetheless, float can be significantly reduced by synchronizing relevant accounting entries.

Float can be reduced by the use of funds availability schedules. The purpose of availability schedules is to synchronize the accounting performed for both sides of a payment. Availability schedules recognize the physical constraints that cause delays, such as processing and transportation, and attempt to compensate for the delays by adjusting the timing of accounting to achieve near simultaneity for entries to accounts even if physical handling of a payment results in processing and/or transportation delays between the payor and the payee.

For example, the debit to an account for initiating a payment order could be delayed to approximate the time it normally takes to process, deliver, and post the credit to the receiver's account, thereby reducing float in the banking system. Similarly, the credit for a check could be delayed to approximate the time it normally takes to process, deliver, and post the offsetting debit to the payor's account. These methods essentially tie the timing of accounting for the payment to the timing of the physical handling of the payment. The timing of the accounting entries is known as an availability schedule.

Although use of an appropriately designed availability schedule will reduce float, this method does not improve the speed or reliability of the payment system. Indeed, use of availability schedules, at least in debit payments, may diminish incentives for banks to improve the timeliness of the payment process. A detailed description of how an availability schedule is calculated and how it would be applied in daily processing is given in the appendix. The example is based on a payment system that relies on central bank processing centers and paper-based credit payments.

The example in the appendix raises a number of key issues that need to be addressed when availability schedules are being designed, including the proportion of local and interregional payments in the mix of total payments and the average transportation times for payments sent to and received from various destinations. The appendix makes clear that designing an availability schedule involves a trade-off between the goal of eliminating float and additional procedural and operational complications. Availability schedules should not be overcomplicated so that their use requires an undue amount of time and resources.

Cash Management Services

The analysis of float presented here suggests that enterprises, commercial banks, the central bank, and even individuals can increase income by carefully managing their payment flows. Similarly, the opportunity costs of failing to manage temporary cash balances effectively can be high. This has not escaped the notice of the treasurers of large corporations in particular.

As pressures on firms to minimize costs and maximize revenue intensify and as financial markets spawn new, convenient short-term investments with low transaction costs, corporate treasurers have found more sophisticated ways to avoid the cost of, or even to enjoy the benefits from, payment system float. Competitive pressures have forced commercial banks to offer their larger customers—both corporations and correspondent banks—a range of services to help them manage their cash balances more efficiently and profitably. Although not treated here, some retail banking products, such as overdraft protection for transaction accounts, also offer similar services to consumers.

The types of cash management services offered by banks to their customers fall into three main classes: (1) cash concentration; (2) disbursement; and (3) investment.

Cash Concentration

Many firms need to hold accounts that serve a variety of functions. These accounts are often held in different locations and at different banks. Banks offer services to permit their customers to manage funds held in several accounts easily and efficiently. These concentration services help customers avoid overdrafts and minimize transaction costs of transferring funds between accounts. In this way, corporate treasurers can focus on managing the balances in a single account without having to worry about intra-firm funds transfers.

Disbursement

Banks can also help firms to improve the timing of payment flows, which is crucial to the management of cash balances. Float generally lasts only a few days at most, so firms and banks wanting to control it need highly developed information systems to allow them to anticipate and track payment flows and identify short-term idle balances. Commercial banks' computer programs that monitor customer accounts provide a natural basis for providing a range of cash management services to clients. Rather than delaying sending details of account balances days after entries have been posted to accounts, banks often provide daily updates of customer balances. Larger customers with high values of payments and receipts increasingly demand on-line access to bank computers to allow them to monitor payment flows to and from their accounts during a day.

It is not sufficient for firms to be able to monitor their account balances to exploit float. They must also be able to predict payment inflows and schedule payment outflows closely to ensure that balances are optimized. Banks have responded to these demands by helping firms to identify payment patterns and forecast likely flows. They have also provided their

customers with facilities to schedule payment outflows on particular days, or at particular times during a given day, and to make payments that are guaranteed to be credited to beneficiaries' accounts on the day they are made. These disbursement services rely on the cash pooled from the concentration process described above.

Automatic Investment Services

As well as coordinating their payment flows to minimize float and avoid charges for overdrawing their accounts, banks' customers are increasingly seeking to ensure that credit balances do not lie idle, even for quite short periods. Another type of cash management service facilitates the movement of balances from customers' transactions accounts into investments. For customers without expertise in financial markets or sufficiently large balances to justify a dedicated investment staff, banks offer "sweep" services. Using sweep services, customers can automatically transfer balances above a nominated amount to overnight investment outlets such as securities repurchase agreements or Eurocurrency deposits.

Conclusions

Float can cause significant distortions to the payment system and decrease its efficiency. In addition to its effect on individual payment system participants, float is an important public policy concern because it affects the efficiency of the entire payment system. Two broad approaches to dealing with float have been identified in this chapter. First, improvements in delivery and processing efficiency reduce the delays that lie at the heart of the float problem and bring better service to the customer. Such improvements, however, can be costly, especially in a paper-based payment environment. A second means of controlling float is to use availability schedules that synchronize accounting entries for the payor and payee regardless of the time it takes to process the physical payment.

APPENDIX

Reducing Float Through Funds Availability Schedules

This appendix uses an example to explain how float is generated. It also shows how the application of funds availability schedules can help reduce float. The particular example is that of a country in which the central bank plays a large processing role in the payment system and operates a network of branches or processing centers. The example would work equally well, however, for a commercial bank clearing payments

through private clearing organizations. The example is based on credit payment orders, denoted in dollars.

- The example makes several simplifying assumptions: Only two central bank processing centers exist, namely, CB A and CB B. Each central bank center accepts payment instructions from commercial banks within its region for delivery to other local commercial banks or to the other regional central bank processing center that will, in turn, deliver the payments to commercial banks in its region. CB A and CB B have their own computer centers. Three banks exist in CB A's processing territory, namely, bank A, bank B, and bank C.
- The analysis shows the availability calculations for "mixed" deposits only. Mixed deposits contain both "local" payments and payments destined to commercial banks in the other central bank processing center region. These mixed deposits would normally be received from local commercial banks. Accounting for local payments is performed on the day of receipt.
- The example uses three days of fictional data. In calculating actual availability schedules under real-world conditions, a minimum of two weeks' data is needed; a month's data would be preferred. Availability schedules should be updated regularly as physical delivery and processing times change.
- The availability schedules are developed in terms of banking days designated as DAY 1, DAY 2, DAY 3, etc. It is assumed that payments are not transported on nonbanking days.

Deposit Data

The fictional data used in this example appear in Table A.1. The table shows all mixed payments deposited at CB A for a three-day period, DAY 1, 2, and 3. On each day, each bank in CB A's local area makes one deposit. No payment instructions are received from CB B. As can be seen from the table, total mixed deposits of $750 consist of $375 of "local" payments and $375 of "nonlocal" payments destined for banks in the CB B region.

Common Method of Processing

If posting procedures simply reflected delivery and processing of paper, the central bank would handle the $250 submitted in mixed payments on DAY 1 by debiting the payor's account on the processing date DAY 1. The local items in those payments ($175) would be credited to the receiving bank's account on that same date DAY 1, since they are sorted

Table A.1. "Mixed" Deposits of Payment Orders at Central Bank Processing Center A

Depositor	Date of Deposit	Amount	Mix of Deposit	
			Local	CB B
Bank A	DAY 1	100	50	50
Bank B	DAY 1	75	55	20
Bank C	DAY 1	75	70	5
Total	DAY 1	250	175	75
Bank A	DAY 2	150	50	100
Bank B	DAY 2	125	30	95
Bank C	DAY 2	25	20	5
Total	DAY 2	300	100	200
Bank A	DAY 3	75	25	50
Bank B	DAY 3	75	35	40
Bank C	DAY 3	50	40	10
Total	DAY 3	200	100	100
Grand Total		750	375	375

and prepared for delivery on the processing date. The nonlocal items, totaling $75, would not be credited to the receiver's account until the items were received and processed at CB B. In the example, assume this occurs five days after processing at CB A—that is, not until DAY 6. These processing and accounting actions are summarized on the first two lines of Table A.2. The result of these postings is also indicated in terms of float. There is no float for the local transactions. There is, however, $375 of float (5 days x $75 = $375) for the items sent to CB B.

The remainder of Table A.2 shows the results of processing the remaining two days' worth of transactions. In total, the table shows that it takes an average of five days for an item to be sent from CB A and CB B, and that $1,875 in float is created by the mismatch in debits to payors and credits to receivers of items sent from CB A to CB B.

Ideal Availability Schedule

To eliminate float in the example, an availability schedule like that shown below would be needed:

Destination of item	Availability
Local	0 (same-day posting)
CB B	5 (five-day posting deferment)

Table A.2. "Mixed" Payment Order Clearing Experience

	CB A Processing			CB B Processing			Float	
Amount	Date of process	Date of debit	Date of credit	Date of process	Date of debit	Date of credit	Days	Amount
175	10/28	10/28	10/28	—	—	—	0	0
75	10/28	10/28	10/28	11/02	11/02	11/02	5	375
100	10/29	10/29	10/29	—	—	—	0	0
200	10/29	10/29	10/29	11/03	11/03	11/03	5	1,000
100	10/30	10/30	10/30	—	—	—	0	0
100	10/30	10/30	10/30	11/04	11/04	11/04	5	500

Average local processing center float days 0
Average interprocessing center float days 5

Total float amount
1,875

Use of such a table is reflected in Table A.3, which is identical in format to Table A.2. Here, the five-day deferment of debits to the paying bank for items destined to CB B is shown in column 3. Table A.3 now reflects an exact match between debits to the payor and credits to the receiver for local *and* nonlocal items. Although delivery and processing routines are unchanged, changed posting procedures have eliminated central bank float.

This is an "ideal" availability schedule in that there is no central bank float and each payor is given a deferment that exactly corresponds to the mix of work it sends.

Table A.3. "Ideal" Use of Deferred Availability

	CB A Processing			CB B Processing			Float	
Amount	Date of process	Date of debit	Date of credit	Date of process	Date of debit	Date of credit	Days	Amount
175	10/28	10/28	10/28	—	—	—	0	0
75	10/28	11/02	11/02	11/02	11/02	11/02	0	0
100	10/29	10/29	10/29	—	—	—	0	0
200	10/29	11/03	11/03	11/03	11/03	11/03	0	0
100	10/30	10/30	10/30	—	—	—	0	0
100	10/30	11/04	11/04	11/04	11/04	11/04	0	0

Average local processing center float days 0
Average interprocessing center float days 0

Total float amount
0

Practical Application of Availability Schedules

To achieve the ideal outcome described above, each payment item in the group would need to be examined for destination and then classified as either a zero-day local item or a five-day nonlocal item. Once all items were classified, totals would be calculated for each category and these totals would need to be balanced to a grand total for the deposit. In a manual environment, this process would be slow and error prone. The process becomes even more difficult where there may be 10 to 20 deferment classifications. Thus, this ideal outcome may need to wait until processing of payments (that is, sorting and accounting) is automated.

There are other, less complex, ways to implement availability schedules, two of which are "split availability" and "average availability." Both of these methods apply the average payment experience of the central bank to each deposit of mixed payments, no matter what its exact make-up. The use of this average expedites processing by eliminating the need to classify every item.

Split availability splits the availability for each set of payments across the dates in the availability schedule according to the average payment experience of the central bank processing center. In the example, CB A has a schedule of "zero days" for local items and "five days" for nonlocal items. Table A.1 shows that the average make-up of a set of payments is 50 percent local and 50 percent nonlocal. Thus, the application of "split availability" would mean each set of mixed payments at CB A would be given 50 percent availability on DAY 1 and 50 percent availability on DAY 6. Bank A's payments on DAY 3 of $75 would be given an availability of $37.5 on DAY 3 and $37.5 on DAY 8 (this would not match the exact make-up of its payments on that date). This method aims at zero central bank float over time but recognizes that on any given day there may be debit or credit float. A drawback is that some commercial banks may benefit or lose over time relative to other commercial banks depending on how close their mix of items corresponds to the average. All paying banks gain from implementation of this method in that a portion of their debit will be deferred.

Average availability also utilizes the central bank processing center's average processing experience. In this case, however, availability for a payment is not split over multiple dates. Rather, all availability is given on the average deferment date. In the example, while "split availability" means that 50 percent of availability is given on DAY 1 and 50 percent on DAY 6, average availability means that all availability should be given 2.5 days after the date of deposit. Since this is not possible, availability would need to be given on DAY 3 or DAY 4. If DAY 3 is chosen, a small amount of central bank credit float will remain ($375). If DAY 4 is chosen, a small amount of central bank debit float will be created ($375) (see Table A.4

for the calculation of these residual float amounts). If DAY 3 is chosen, the availability schedule would be

Destination of item	Availability
Local	2 (two-day posting deferment)
CB B	2 (two-day posting deferment)

For bank A's mixed deposit on DAY 3 of $75, all $75 would be debited on DAY 5.

This alternative has the advantage of simplicity in terms of operations and accounting. It will generate some central bank float but this will be much smaller than if no availability schedules were in force. Like split availability, some commercial banks may benefit or lose over time relative to other banks depending on how close their mix of items corresponds to the processing center average. However, all depositing banks gain the use of funds that are not available to them without availability schedules because the debit for their deposit is deferred two days. A further refinement of these techniques would apply separate availability schedules to each bank. Each bank's schedule would reflect its particular make-up of payments. This method addresses the inequity noted above that can arise under split and averaging systems. The trade-off is in the cost and complexity of operating such a system.

Table A.4. Calculation of Central Bank Float—Average Availability

Processing Date	Debit Float (Local Items)	Credit Float (Noniocal Items)	Net Float
Two-day availability			
10/28	2 × 175 = 350	3 × 75 = 225	(125)
10/29	2 × 100 = 200	3 × 200 = 600	400
10/30	2 × 100 = 200	3 × 100 = 300	100
Total	750	1,125	375
Three-day availability			
10/28	3 × 175 = 525	2 × 75 = 150	(375)
10/29	3 × 100 = 300	2 × 200 = 400	100
10/30	3 × 100 = 300	2 × 100 = 200	(100)
Total	1,125	750	(375)

11

The Central Bank and the Payment System

J. Andrew Spindler and Bruce J. Summers[1]

This chapter describes the central bank's core responsibilities in the payment system. Together with the conduct of monetary policy and oversight of banking and financial markets to ensure their safety and stability, involvement in the payment system is an integral component of the central bank's three-part overall mandate. In meeting this mandate, the central bank helps to maintain public confidence in a country's financial system, even during times of stress. An efficient financial system that engenders public confidence owing to its safety and stability is critical to the performance of the real economy. Without efficiency and public confidence in the payment system, even the simplest and most routine financial transactions may become agonizingly difficult.

The central bank is directly concerned with the smooth functioning of the payment system. Even beyond this direct concern, however, the central bank is interested in the operation of the payment system because it can interact crucially with the central bank's other core responsibilities. More specifically, a safe and efficient payment system is critical to the maintenance of sound banking and financial markets and to the execution of monetary policy.

The chapter discusses the central bank's supervisory responsibilities in the payment system and its responsibilities as a payment system operator, especially regarding large-value transfers. It also discusses the policy role and describes the interrelationships between the central bank's role in the payment system and its other primary functions.

Supervisory Responsibilities

Central banks in developed economies perform a number of different, major functions in their national clearance, settlement, and payment

[1]The authors wish to thank Lawrence M. Sweet for his helpful comments on earlier drafts of this chapter. Roberta J. Puschel also offered helpful comments, and William J. Yohana verified a number of technical facts.

arrangements. These functions, which include supervision, oversight, operations, and the provision of credit and liquidity, are not always performed in the same combination.

Because it is a vital component of the financial system, the payment system requires at least a minimum amount of official supervisory attention. Perhaps the central bank's most important role in overseeing the payment system is its active involvement in developing the principles under which private payment arrangements operate.

Especially critical is the central bank's involvement in establishing principles for, and, when necessary, in supervising and regulating private clearing and settlement arrangements that handle large-value transactions. There are numerous financial, structural, and operational features to help ensure that clearing and settlement take place in a safe and sound manner. Most important, however, are the commitments of private participants, in the form of guarantees or other arrangements, to ensure that final and timely settlement is achieved by these systems, especially multilateral netting schemes. Guarantees or arrangements to ensure timely settlement should be based on carefully constructed membership criteria. Moreover, members in private clearing and settlement arrangements should have the incentives and capabilities to make their own credit judgments about the parties with whom they choose to do business. In addition, concrete commitments are needed to ensure that the financial resources and liquidity are available to guarantee settlement in the event of default by one or more participants. Such commitments should include loss-sharing arrangements backed by collateral and/or lines of credit.

A good deal of analysis is taking place in the Group of Ten countries, in both central banks and the private sector, to refine the principles that should be used to assess private large-value transfer systems, including delivery-versus-payment systems. Delivery-versus-payment systems provide a mechanism to ensure that the final transfer of one asset (for example, a security) occurs if and only if final payment also occurs.

Finally, as described in Chapter 6, for example, the New York Clearing House Association has adopted settlement guarantees for the Clearing House Interbank Payments System (CHIPS), a private credit transfer mechanism for large-value payments. Also in the United States, the Federal Reserve in recent years has given regulatory approval for the operation of a private clearing arrangement for U.S. Government securities transactions through the Government Securities Clearing Corporation. A private arrangement for settling mortgage-backed securities transactions through the Participants Trust Company has also been approved. An arrangement for clearing and settling dematerialized commercial paper transactions operated by the Depository Trust Company has also been started.

The principles underlying the proper operation of private clearing and settlement arrangements are universal. Indeed, in 1990 the central banks

of the Group of Ten countries adopted minimum standards to guide the design and operation of cross-border and multicurrency interbank netting arrangements.[2] These standards state that netting arrangements should have, inter alia, a well-founded legal basis, clearly-defined procedures for the management of credit and liquidity risks, and the capability to ensure the timely completion of daily settlement, even if the largest participant in the system becomes insolvent.

The central banks of the Group of Ten countries have also recognized the need to oversee the operation of significant interbank netting arrangements and have established principles for cooperation when such arrangements operate across borders.[3] A key principle is that every cross-border netting arrangement should be supervised by a central bank that will serve as its "primary regulator." At the same time, the primary regulator of a netting arrangement should consult with other central banks that have an interest in the arrangement's soundness. In addition, if a central bank lacks confidence in a netting arrangement, it should influence institutions under its supervision so that they do not use the arrangement.

One means of ensuring the proper application of sound payment system principles is through the supervision of privately operated clearing organizations. In fulfilling its mandate to ensure the integrity of the financial system, the central bank can influence the structure and operation of a private clearing organization in a variety of ways. The central bank can thereby play an important role in ensuring that new and existing payment systems identify and manage the risks facing them. Specific aspects of supervision might include approving an organization's charter and rules. Further, the central bank can influence a clearing organization by overseeing its individual participants, as discussed below. Overall, central banks have a variety of ways to execute supervision, ranging from dialogue to, in extreme cases, denying settlement services to "unsafe" systems and prohibiting banks from participating in such systems.

An important tool to ensure compliance with sound payment system principles is the regular commercial bank examination process. Central banks and other government authorities with bank supervisory responsibilities conduct safety and soundness inspections of individual banks through this process. A bank's participation in a private clearing arrangement can be scrutinized as part of the examination, and the behavior of the clearing organization can be influenced through the examination of the institutions that use it.

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[2]See Bank for International Settlements, *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries*, prepared by the Committee on Interbank Netting Schemes chaired by M.A. Lamfalussy (Basle, November 1990).

[3]Ibid.

The central bank can require commercial banks to identify and control the risks that they face in the payment system. Moreover, by issuing broad guidelines for risk management, bank supervisors can establish a mechanism for compliance with proper risk management by banks. Commercial banks should evaluate and control their credit exposures to other participants, assess and manage their liquidity risks, and establish critical operational support systems for payment activities. Banks should also manage these risks through appropriate credit, liquidity, and contingency plans. For example, banks should have bilateral credit limits for different participants. They should develop reliable means of obtaining liquidity when needed. Also, they should ensure that their operational backup facilities are adequate to support critical payment operations in the event of operational difficulties.

Operational Responsibilities

An operating role in the payment system, including the operation of large-value payment mechanisms, is another key function that central banks may assume in their national clearance, settlement, and payment systems. Although central bank accounts are universally relied upon to settle interbank payments, the extent to which central banks operate the payment mechanism itself varies widely across different countries.

At one end of the spectrum of central bank payment system operations is the example of the United States. The Federal Reserve System, through the 12 Federal Reserve Banks, has operated both large- and small-value, paper and electronic payment mechanisms since the passage of the Federal Reserve Act in 1913. The Federal Reserve handles approximately one-third of all checks cleared in the United States and the majority of automated clearinghouse (ACH) transactions. Moreover, it handles about half of the country's large-value funds transfers over the Fedwire system. In addition, Fedwire is used to effect the book-entry transfer of U.S. Government securities, securities issued by certain federal government agencies and government-sponsored enterprises, and securities issued by certain international organizations, such as the International Bank for Reconstruction and Development, the Asian Development Bank, and the African Development Bank.

Since the passage of the Monetary Control Act of 1980, the Federal Reserve has charged fees for the payment services it provides to banks and other depository institutions. Federal Reserve payment services compete with services offered by private sector providers. The policy of the Federal Reserve is to recover the full costs of providing these services, including the imputed costs of capital, debt, and taxes that a private firm would incur. In this manner, efficiency is promoted by allowing the market to determine the sources of payment services used. Federal Reserve

revenues resulting from the provision of payment services now total about $800 million annually. Although many other central banks also charge for payment services, not all central banks attempt to recover fully the costs of providing these services.

Although geography and banking structure have heavily influenced the extent of the Federal Reserve's involvement in the payment system of the United States, other considerations may also lead a central bank to play a significant operating role in a country's payment system. For example, in some countries, such as France, the central bank has assumed an active operational role in the payment system on behalf of the banking system. In this model, which has probably been influenced by economies of scale and national preferences regarding the degree of direct government involvement in the management of national "utilities," the central bank is the logical entity to operate the payment infrastructure.

At the other end of the spectrum, a central bank may play a relatively minor role in the operation of its country's payment mechanism. In Canada and the United Kingdom, for example, payment processing is largely carried out by private enterprises and is governed at least in part by a ruling body comprised of representatives of the financial services sector. Although the central banks of these two countries do not provide payment services on a broad scale, they influence the operations of the payment system through participation in the governing bodies. These central banks also influence their nations' payment systems by providing interbank settlement for large-value transfer mechanisms.

As suggested above, a nation's payment system may exhibit certain natural monopoly characteristics, such as increasing returns to scale in the processing aspects of clearing and settlement. Under natural monopoly conditions, an entity like the central bank should perhaps play a major role in operating the payment system. Nonetheless, competitive market conditions for most payment services, including interbank payment services, offer the most promise for efficient outcomes. (An important caveat to this view discussed below is the operation of a real-time gross settlement system for large-value payments.) Indeed, in virtually every other market for goods and services, the benefits of competition in ensuring a continuous high standard of performance are best attained through a free market approach. Assuming that principles governing the safe operation of the payment process are clearly laid out and that compliance with these principles is adequately supervised by the central bank, other things being equal, the process should generally work best when governed by competitive forces in a market environment.

Large-Value Transfer System

The large-value transfer mechanism, which is the vehicle for making large payments, is critical to the efficient operation of a modern economy,

especially the financial markets. Such a mechanism depends on the transfer of balances held in accounts with the central bank for final (that is, irrevocable and unconditional) settlement. When such a system operates as a gross payment system in real time, special credit risks may be faced by the settlement authority, namely, the central bank. Consequently, it is logical for the central bank to control and operate a nation's large-value transfer mechanism, or at least the mechanism that provides gross settlement in real time.

Because only the central bank can provide finality of settlement in central bank money, backed by unlimited liquidity, private banks cannot provide the same degree of safety and liquidity for the transfer of money balances. Put another way, the final transfer of value on the books of the central bank offers the surest means of providing final and certain settlement. Chapter 6 describes and compares the operation of central bank large-value transfer systems in Japan, Switzerland, and the United States.

Modern financial markets have typically developed in ways that have resulted in large volumes of high-value payments. Experience has shown that the payment system needs to be insulated from shocks that may have systemic risk consequences, such as the inability of one or more participants to meet their high-value payment obligations.[4] Systemic risk can be reduced by minimizing temporal risk, even within the business day, and by establishing effective settlement guarantees and risk control mechanisms for privately operated payment systems that process high values.

A large-value credit transfer mechanism run by the central bank can be flexible enough to support many types of payments, including net settlement transfers generated by private clearing organizations. For example, in the United States, CHIPS net settlement obligations are met each evening on Fedwire. In Japan, net settlement obligations from the Foreign Exchange Yen Settlement System (FEYSS) are met on BOJ-NET at the end of the day, during the final net settlement period.

A central bank can also operate a delivery-versus-payment system for a subset of financial instruments, such as government securities, in which gross transfers are settled as they occur across the central bank's books. In addition, the central bank can make its gross real-time funds transfer capabilities available to private book-entry depositories that transfer securities to achieve final settlement. In the United States, for example, net payment obligations are settled over Fedwire for a variety of private depositories, including Participants Trust Company for mortgage-backed securities and Depository Trust Company for commercial paper and other instruments.

[4]Consider, for example, the case of the 1974 failure of Bankhaus Herstatt, discussed in more detail later in this chapter, and the more recent failure of Drexel, Burnham, Lambert, Inc.

Large-value transfer mechanisms are important channels through which the operators, including central banks, may provide intraday liquidity to the payment system. For example, in systems in which payments are final as soon as they are processed, such as Fedwire, the central bank may choose to allow banks to effect funds transfers even when the funds in the account of the paying bank are insufficient to cover the payment. The resulting overdraft is a form of intraday liquidity provided by the central bank. But caution must be exercised lest the central bank become the primary source of intraday liquidity in the payment system.

The practice of providing liquidity through the extension of intraday credit as part of the payment process is now recognized as a basic banking activity, just as is more traditional lending. In the United States, the Federal Reserve provides a large amount of intraday credit and liquidity to support the U.S. payment system. There is also a private sector source of intraday credit through CHIPS, where the bilateral credit limits between participants and the system net debit caps define the limits on the intraday credit that can be extended.

The demand for intraday credit is roughly analogous to the demand for short-term working capital by firms whose patterns of receipts may not exactly match their patterns of expenditures. A large, complex, market-oriented economy could not function effectively without a certain amount of intraday liquidity to fund the gaps that result from the difficulty of synchronizing the timing of high volumes of payment transactions. In the United States, the Federal Reserve provides intraday credit to depository institutions through Fedwire and began pricing this intraday credit in April 1994. In Switzerland, in contrast, the central bank does not permit intraday overdrafts, and banks have managed to conduct their business without an intraday market by relying on the queuing feature of SIC. In Japan, the central bank provides no intraday credit, but a private market for daylight (morning and afternoon) credit has emerged.

Consideration of the role of the central bank as the operator of a large-value funds transfer system leads naturally to the question of the "safety net" attributes of this role. Access to the payment system through clearing and settlement services provided by the central bank, including perhaps central bank credit, is one component of the safety net that central banks and governments place under their financial systems.

Like any other part of the safety net, access to the payment system must be judiciously managed to ensure that it is not abused. Used properly, however, and in coordination with the central bank's supervisory and regulatory oversight of the banking system, access to the payment system can be a useful regulatory tool in ensuring that depository institutions do not fail prematurely.

In essence, the central bank gives financial system participants confidence that the payments they may receive from a troubled institution are

good value. With this confidence, counterparties should be willing to continue to deal with the troubled institution, thus giving bank regulatory authorities the time they may need to work out an orderly solution to the problem. Without such confidence, a troubled institution, by being frozen out of the payment system, would be isolated and doomed to immediate failure.

Policy Responsibilities

As has already been suggested, a third key role that the central bank may play in the payment system concerns the development of policies to govern the overall structure and operation of a country's payment system. Of particular importance are policies to ensure the safety and soundness of the payment system.

To contain systemic risk, payment system design must ensure that problems in one financial institution are not readily transmitted to other institutions. For example, a failure by one participant to transfer funds or to deliver securities could lead to similar failures by other participants counting on such payments or deliveries to meet their own obligations. Since problems in the payment system can potentially affect all participants, each participant depends on the smooth functioning of the entire system. Even participants with no dealings with an insolvent institution might still be adversely affected by the insolvency through the payment system.

Payment systems can adopt measures to reduce systemic risk, such as enforcement of caps or limits on the extension of intraday credit between participants and loss-sharing arrangements in multilateral netting systems. These types of measures typically impose costs on the participants, however.

Individual participants in clearing and settlement arrangements, as well as the private sector providers of such arrangements, may be reluctant to bear these costs because of their natural tendency to focus on their own profitability. The central bank brings its concerns about systemic risk to this process and its broad perspective regarding which payment arrangements will most effectively promote the public interest. By assuming a leadership role in formulating policies to govern the overall structure and operation of a country's payment system, the central bank can help ensure that its desires to limit systemic risk and to promote the public interest are adequately taken into account.

Interrelationship Among Central Bank Functions

Until about the 1980s, the payment system was not high on the central banking policy agenda. Instead, the payment system was of interest

primarily to central bank staff with operations and automation responsibilities, reflecting the view that the payment system is essentially mechanical. Increasingly, however, central bankers have recognized both the operational and policy linkages between the payment system and other primary central bank responsibilities. The payment system has now entered the mainstream for central bankers, and experience and analysis combine to underscore its importance across a broad range of policy matters. The linkages between the payment system and other central bank responsibilities are described below.

Conduct of Monetary Policy

One of the central bank's chief roles is that of national monetary authority. A direct link exists between the payment system and the execution of monetary policy because of the influence of payment system operations on the public's use of the money stock. The implications of payment system operations for monetary policy are treated in Chapters 2 and 4. Some concrete illustrations of the linkages are provided here.

Payment for transactions among economic actors in a modern, developed economy is often made using deposit money in banks. The result of the clearing and settlement of payments is that one economic actor obtains a bank deposit, which is one component of "money," from another economic actor. Thus, the payment system links economic activity and money. The efficiency with which deposit money is used is largely determined by the efficiency of the payment system. For example, the length and variability of time lags between the initiation and completion of payment affect the balance sheets of the parties to transactions as well as commercial banks. As discussed in Chapter 10, the balance sheet effects of such time lags are known as payment system float, which is an important variable in the money supply equation.

In addition to the float that normally results from payment processing inefficiencies, malfunctions in clearing and settlement can affect monetary policy. Examples of such malfunctions that have affected the financial markets and monetary policy are easy to find. In August 1990, a power outage on Wall Street led to disruptions in money market operations, including Fedwire.[5] These operating disruptions resulted in interest rate swings owing to the banks' inability to trade interbank funds efficiently. Similarly, in November 1985, a computer software error at a major New York securities clearing bank led that institution to incur a massive daylight overdraft with the Federal Reserve. This daylight overdraft could

[5]See, for example, "Wall Street Limps Through a Blackout Monday," *Wall Street Journal*, August 14, 1990.

not be fully extinguished at the end of the business day, resulting in a need for very large amounts of overnight financing that substantially exceeded the capacity of the money markets. As a consequence, the Federal Reserve was obliged to step in and make a $23 billion discount window loan, the largest on record.[6]

Supervision of Banks and Financial Market Stability

An important two-way interaction exists between the payment process and the stability of the banking and financial systems. Disruptions in the payment system have the potential to weaken confidence in individual financial institutions, particularly in cases where confidence in an institution is already shaken. As a result, an institution's ability to make timely payments or to deliver securities to its creditors and counterparties could be impaired. If an institution's role in the payment system is broad, in terms of either the extent of its dealings with domestic and foreign counterparties or its involvement in high-value transactions, its inability to meet settlement obligations could quickly translate into a systemic problem. Even a technical malfunctioning in the payment system affecting such a participant could cause the markets to question its worthiness as a counterparty, thus transmitting shocks through the banking and financial systems generally. The disruption of a particular institution's payment patterns, therefore, could raise complex concerns for banking supervisors and other central bank policymakers who are not directly involved with payment matters.

Conversely, problems of a bank supervisory nature also have the potential to trigger disruptions in the payment system. If, for example, the counterparties to a bank were fearful that the bank might not be able to meet its payment obligations, they might delay their own transfers of funds or securities to it in an attempt to reduce their exposure to the bank. If the bank were engaged in transactions with a large number of counterparties, financial gridlock could result, with counterparties throughout the payment system refusing to make transfers until they received the corresponding payments or deliveries of securities.

In light of interactions such as those described above, both banking supervisors and central bank officials responsible for the functioning of the payment system must communicate closely with one another—and before serious problems arise. Neither group can be truly informed, or ultimately effective in their own jobs over the longer run, without an awareness of the interdependent nature of their work and responsibilities.

[6]See, for example, Phillip L. Zweig and Allanna Sullivan, "A Computer Snafu Snarls the Handling of Treasury Issues," *Wall Street Journal*, November 25, 1985; and "Fed Is Queried on Failure of Bank Computer System," *Wall Street Journal*, December 13, 1985.

At the heart of the common concerns of bank supervisors and central bank payment officials is the broader interest of the central bank in the stability of the financial system. This stability depends, in part, on the integrity of the payment process, that is, the ability of the payment system to function safely and efficiently even during times of financial stress. Such financial stress may arise in connection with generalized market factors, such as wide swings in asset prices that make it difficult for the "losers" in the markets to meet their obligations. Or financial stress may be caused by the credit problems of a specific large participant in the payment system that make it difficult for that participant to meet its own or its customers' obligations.

Financial stress will manifest itself quite early on in the payment system through the inability of institutions or individuals with payment obligations to meet those obligations. Serious problems involving one or several payment system participants, if contained, should not pose a threat to the safe and efficient functioning of the entire system. Such problems at a commercial bank, adversely affecting its ability to meet payment obligations, would properly be the concern of the central bank in its bank supervisory role. Depending on the nature of the problem, however, financial stress suffered by one or more participants can translate into systemic problems that threaten the overall viability of the payment system.

The well-known case of the failure of Bankhaus Herstatt in 1974, for example, illustrates how just one institution's inability to discharge its payment obligations (in this case payment of dollars against deutsche mark in foreign exchange transactions) can seriously hamper the ability of other entities to meet their payment obligations.[7] When the financial problems of one or several participants threaten the viability of the entire process, the possibility of systemic risk to the payment system becomes real.

Central banks and other bank supervisory authorities have a number of tools at their disposal to ensure that financial problems at individual financial institutions do not expand into problems of a systemic nature. Bank supervisors, for example, can look for early warning signs of deterioration in the condition of individual banks, particularly worsening asset quality. The earlier such problems are identified, the more promptly bank supervisors can begin to work with a bank's management and board of directors to take steps to strengthen the bank's condition. Such strengthening,

[7]The 1974 Herstatt case has given rise to the term "Herstatt risk," which describes the temporal dimension of the credit risk assumed by a counterparty in a foreign exchange transaction when payment of one currency becomes final some time before the payment of the second currency is completed. Herstatt risk arises in part because the operating schedules of national payment systems are not synchronized. In addition, there is no mechanism in foreign exchange markets today that offers the benefits of concurrency that could be derived from a delivery-versus-payment mechanism.

which might take the form of additions to a bank's capital base and contingency reserves, among other measures, should help to restore market confidence in a troubled institution and hence to contain the problem.

In certain unusual instances, the central bank may choose to extend temporary credit to a troubled bank in order to provide it with sufficient liquidity to meet its obligations during a crisis. Such emergency liquidity assistance, provided by the central bank in its capacity as lender of last resort, can enable a commercial bank to weather a period of adversity either until it regains sufficient strength (and the confidence of counterparties) to operate independently in the marketplace, or until the financial authorities can arrange a more permanent, orderly solution to the bank's problems. The central bank's lender-of-last-resort capability, in this regard, constitutes another tool for limiting the spread of financial problems from a single troubled institution to the payment and financial systems more generally.

Nevertheless, as suggested previously, a country's financial authorities must seek to manage carefully this and all other components of the safety net underlying the financial system in order to prevent their abuse. The authorities need to be conscious of the moral hazard risk created by the various features of the safety net, and they should seek to minimize that risk. One means of doing so is by ensuring that commercial banks and any other financial institutions that benefit from the safety net take all reasonable steps to assure their own financial soundness, as well as the soundness of clearing and settlement arrangements in which they participate. In sum, a central bank must use its lender-of-last-resort capability judiciously and with an awareness of the higher risk-taking profiles that individual financial institutions might adopt if they believed they could rely on that capability—or other aspects of the safety net—to "bail them out" if they got into trouble.

Conclusions

The payment system is now recognized as an essential component of an efficient financial system in a smoothly operating market economy. The central bank has a proper role in (1) supervising clearing organizations and banks that play key roles in the payment system; (2) providing settlement across its books; (3) operating the large-value transfer system; and (4) establishing appropriate public policy to govern the structure of private clearing and settlement arrangements. Much is to be gained by permitting private entities to compete in the provision of payment services to the public. Because of the critical nature and safety net attributes of large-value payment systems, however, operation of such a mechanism, alone or in conjunction with privately operated clearance and settlement mechanisms, is properly a role of the central bank. Central banks

must take care in controlling the intraday credit and liquidity they provide to the financial system and the payment system risk they absorb.

The central bank's core responsibilities in the payment system interact fundamentally with the other components of the central bank's three-part overall mandate. A direct linkage exists between the payment system and the execution of monetary policy because of the influence of payment system operations on the public's use of the money stock. In this regard, the float that normally results from payment processing inefficiencies can affect monetary policy, just as can malfunctions in the clearing and settlement process. An important two-way interaction also exists between the payment process and the stability of the banking and financial systems. Disruptions in the payment system have the potential to weaken confidence in individual financial institutions, and conversely, problems of a bank supervisory nature have the potential to trigger disruptions in the payment system.

The bank supervisory process provides an important vehicle for ensuring that privately operated clearing organizations are in compliance with sound payment system principles. A bank's participation in a private clearing arrangement can be scrutinized as part of the regular commercial bank examination process, and the behavior of the clearing arrangement can be influenced through the examination of the institutions that use it. Another means of ensuring the proper application of sound payment system principles is through the central bank's direct oversight of the private clearing organizations themselves. Central banks might be involved, for example, in approving a clearing organization's charter, rules, and access to central bank payment services and credit facilities.

At the heart of the common concerns of bank supervisors and central bank payment officials is the broader concern of the central bank with the stability of the financial system. This broader concern leads directly to an interest in the integrity of the payment process, that is, the ability of the payment system to function safely and efficiently even during times of financial stress. Because of the interdependent nature of their work, banking supervisors and central bank officials responsible for the functioning of the payment system need to communicate closely with one another, and before serious problems arise.

A complex, delicate balance characterizes the central bank's multiple responsibilities in the payments area. For example, even as the central bank has an appropriate role to play as the operator of a country's large-value payment system, and in providing other payment services as well, a potential conflict can arise between the central bank's active role in the payment process and the benefits from competitive market conditions for most payment services.

Perhaps an even more delicate balance derives from the safety net aspects of the central bank's involvement in the payment system. Relevant

components of the safety net in this regard can include, for example, the central bank's ability to manage access to the payment system and to provide emergency liquidity assistance to participants. Like any other aspects of the safety net, these components must be judiciously managed to ensure that they are not abused. Used properly, however, and in combination with the central bank's supervisory and regulatory oversight of the banking system, these components of the safety net can provide useful tools for ensuring that depository institutions do not fail prematurely and that the integrity of the financial system is maintained.

12

Technology and the Payment System

Israel Sendrovic

Previous chapters in this book have defined the payment system as the combination of laws, institutions maintaining settlement accounts, and operating facilities that are used to make payments. This chapter focuses on the operating facilities component—or the "plumbing"—of the payment system. It describes the main operational components of a modern payment system and then goes on to address capacity planning and management issues. It also deals with procurement of technology.

Many different methods are used to make payments and a great variety of technological platforms exist for processing them. The main focus of this chapter is on electronic technologies used to support large-value transfer systems.

Components of a Modern Operating System

Well-organized and smoothly functioning operational facilities are absolutely essential to the payment system. In advanced market economies, in which the volume and value of transactions and associated payments are large, manual systems obviously cannot effectively support high levels of activity. Therefore, automated systems that use modern technologies are required. Such automated systems depend on data processing facilities, data communications facilities, and highly skilled operations and support personnel.

Data processing facilities consist of computer equipment, the environmental software needed to operate and control that equipment, the application software designed for processing the payments, and skilled staff who manage and operate the entire complex. Data communications facilities, composed of communications equipment and software, allow for the transmission of payment information. Transmission may occur over long distances between the processor, the sender, and the receiver.

Taken together, the technologies used in payment systems can be extremely complex. The time needed from conception to implementation of the system, or to make changes to existing systems, can be extensive.

Moreover, implementing technical changes can pose operational risks and is expensive. Once operational, and business requirements for safety and reliability are firmly established, there is no room for operational disruptions.

The processing of payments almost always depends on large-scale automation and technology. For example, in the United States, over 10,000 depository institutions are connected electronically to the 12 Federal Reserve Banks for electronic processing of payments. Given the large volume of payment transactions and the specialized business requirements to be supported, the computers used to process payment transactions at the Federal Reserve Banks are large and require a special support infrastructure.

Support Infrastructure

The support infrastructure consists of the primary and backup systems that provide electrical power, air conditioning, raised flooring that allows access to areas beneath the computer devices, space for electric and signal carrying cables, and a passageway for the circulation of cooled air. In addition, the infrastructure should provide monitoring devices to sense water leakage, heat, smoke, and failures in the electrical or air conditioning equipment. Physical security of the computer processing area is another important aspect.

Large-scale computers used to operate payment systems require greater amounts of electrical power and generate far more heat than does the equipment normally housed in an office environment. The design of the computer room must provide the appropriate support systems to address both of these conditions. In addition to supplying the proper power and water, all of the infrastructure components must be connected to safe and reliable power and water sources. Additionally, the computer equipment has to be interconnected through complex cabling and switching equipment so that signals can pass from one device to another. The interconnected grid should provide primary and backup paths to alternate devices that can be readily substituted in case of equipment malfunctions.

Raised flooring is needed to meet these requirements. The raised flooring provides space for the complex nerwork of interconnected cables, air and water supply lines, and acts as a chamber for the circulation of cool air.

The temperature and humidity within and around the computer equipment must be maintained within certain tolerances. The computer room is air-conditioned to provide these conditions. Cooling towers and chillers are required to ensure that the water required by the air-conditioning system is sufficiently cold.

Air blowers are typically placed near the computer equipment and pump air beneath the raised floor. Fans installed in the computer equipment circulate this chilled air through the devices to keep the components

that generate heat at their appropriate operating temperature. Some very large computers rely on the circulation of chilled water around the heat-generating components within the processor itself.

All components of the infrastructure must be integrated, monitored, and protected. Sensors should test for changes in voltage, water leaks, excessive temperature, and humidity, smoke, and heat. Monitoring systems should sound an audible alarm when trouble is sensed, and automatic corrective action, wherever possible and prudent, should be built into the system.

The provision of electrical power for this equipment is another area of complexity, since both voltage and amperage must be maintained within certain levels. The electricity that is delivered by most utility companies, which is commonly referred to as "raw street power," can oscillate outside the limits required to keep the equipment functioning free of error. If extreme fluctuations in voltage or amperage occur, the computer equipment could be damaged. Also, because of disruptions within the power supply system, electrical power may be temporarily severed. To compensate for these potential problems, computer installations rely on uninterruptible power supply (UPS) equipment.

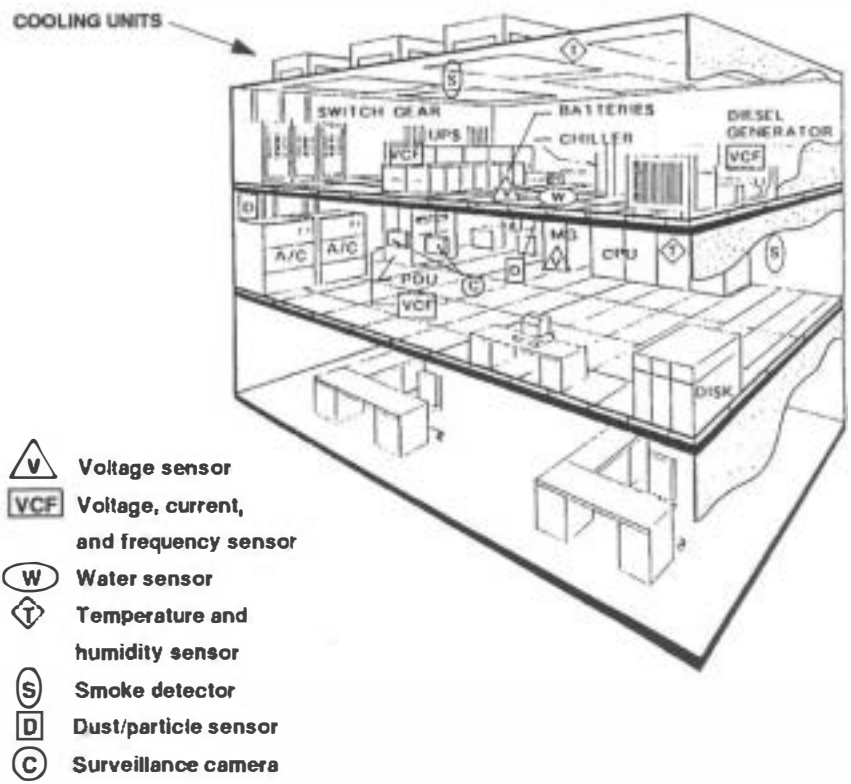
UPS devices compensate for excessive swings in electrical power fluctuations from the street. In addition, if the incoming power is cut completely, UPS devices automatically switch the supply source to batteries. The batteries are installed within the building containing the computer equipment and allow the computers to continue to function unimpaired for a brief period until diesel generators can be started and brought online as a substitute power source. This, in turn, requires that sufficient fuel must be kept available so that the diesel generators can operate for the entire duration of the emergency. Switching gear can automatically change the source of power supply so that the computers continue to operate without interruption.

In summary, the infrastructure should provide a stable, reliable physical environment in which to house the computer equipment. It should also provide systems to sustain this environment during emergencies. Chart 1 illustrates a typical computer room and its physical infrastructure.

Hardware

Many different types of hardware are available, produced by different manufacturers from around the world. Data processing hardware includes the computer processing unit (CPU), which performs the required calculations, and data storage devices to store all the transaction records. These records include, for example, the accounts required by the payment system as well as individual payment instructions. Many different types of storage devices exist, but the most prevalent today are disk and

Chart 1. Physical Infrastructure of a Computing Facility



tape devices. Disk drives can supply information to the processor at high speeds, whereas tapes retrieve information at lower speeds. Disks, however, are much more expensive than tapes per unit of data storage.

Other necessary hardware includes video display terminals to monitor what the computer is doing. The computer operators and users can call up information on their terminals about the state of the operation and can also issue instructions to the computers. Printers produce physical output of computer information. The movement of data between the computers, the storage devices, the video display terminals, and the printers need to be synchronized to ensure that the right data get to the right device at the right time, a task performed by devices known as controllers.

Software

The infrastructure and hardware required for data processing are not specific to payment systems but are required of all large computer

installations. What makes payment system computers unique is the functions they perform. The computers are instructed to accomplish a specific task through the use of software. There are two categories of software: environmental software and application software.

Environmental software provides the logic to allow the computer to manage its processing resources and to structure how such resources are used by computer applications. There are five main types of environmental software: (1) operating system; (2) data base management system; (3) telecommunications monitor; (4) data security software; and (5) performance monitoring system. The operating system is responsible for controlling the operation of the computers and the interaction of the computers with other hardware and software. Computers are designed to do numerous millions—sometimes billions—of computations every second. Even small computers are designed to do many things at the same time. Ensuring that all hardware and software work in harmony, that all users are satisfactorily served, and that all tasks are performed correctly are the functions of the operating system.

Data base management software organizes the information stored on disks and tapes in a manner that is convenient for users to access and update. For example, the records representing accounts used to make and receive payments are organized so that they can be quickly located and updated with new data resulting from transactions. Whereas a data base manager provides for the organized storage of information and the rules used for its retrieval, a telecommunications monitor is used to effectively manage the movement of the data between the computer and the users. It is not unusual for thousands of small computers or terminals to be connected to a large computer. The telecommunications monitor ensures that data destined to any of these computers or terminals are delivered to the appropriate destination.

High levels of security and confidentiality are essential in any computer installation, especially one that is used to process payments. Computer security software is used to ensure that only authorized parties can send and receive payments—the software guarantees against tampering with the data. Further, security software ensures that only those who are authorized to access payments data can do so—the software also maintains the confidentiality of the data. There are different types of security and confidentiality software. The first and most basic security software controls access to the system. This type of software examines whether someone wanting to use the computer for a particular function is authorized to do so. Access control software can be set to restrict access by a specific person or a physical terminal. In addition, once access is authorized for people at particular physical terminals, it can be restricted to specific types of data.

An additional security control is message authentication. Using message authentication, each participant in a payment system is given a special code

that is applied to payment messages to generate a set of characters. This set of unique characters is appended to each message. By checking this set of characters, the receiver knows that the authorized sender sent the message and that the message was not tampered with during transmission.

An additional security technique, which can be used in conjunction with message authentication, is encryption. Using encryption, payment messages are scrambled before they leave the sending point and are unscrambled when they reach the intended receiving point. In this way, even if someone was to intercept the payment data during transmission, the confidentiality of the data would still be protected.

Another type of environmental software—the performance monitoring software—enables those who run data processing facilities to determine whether the computers are functioning properly. Objective criteria are used to gauge computer performance, such as the number of transactions processed per second, the time needed to process a transaction, and the peak volume that can be supported. Performance monitoring software is used to gauge current performance and to help determine future computing needs by providing the basis for making projections of future growth.

The computer installation described thus far for a payment system is quite similar to installations used for other purposes, such as systems to control space flight missions, manage inventory, or collect statistical data. The exact performance characteristics of the computer facilities used to support these different "businesses" may vary, but the underlying infrastructure is by and large the same. What distinguishes the systems is the application software that gives the computer unique business capabilities. Application software provides the business functions that are being performed and implements the rules governing these functions. The acquisition or development of application software is the most difficult part of managing the technology required for an electronic payment system.

Telecommunications

An electronic payment system is not complete without a telecommunications system by which payment information can be exchanged. Modern electronic payment systems connect terminals, or even computers, at the users' locations, to the electronic payments computer system. Various types of data communications networks, which vary in size and complexity, can be used to make these connections.

At the most basic level, the public telephone network can be used to provide the physical connection between a user's terminal and the computer used to process electronic payments. Since the telephone network was designed for voice communications, special devices called modems (modulator/demodulator) are needed to convert the digital information (the ones and zeroes) used by digital computers to analog signals that can be transmitted over a voice telephone network.

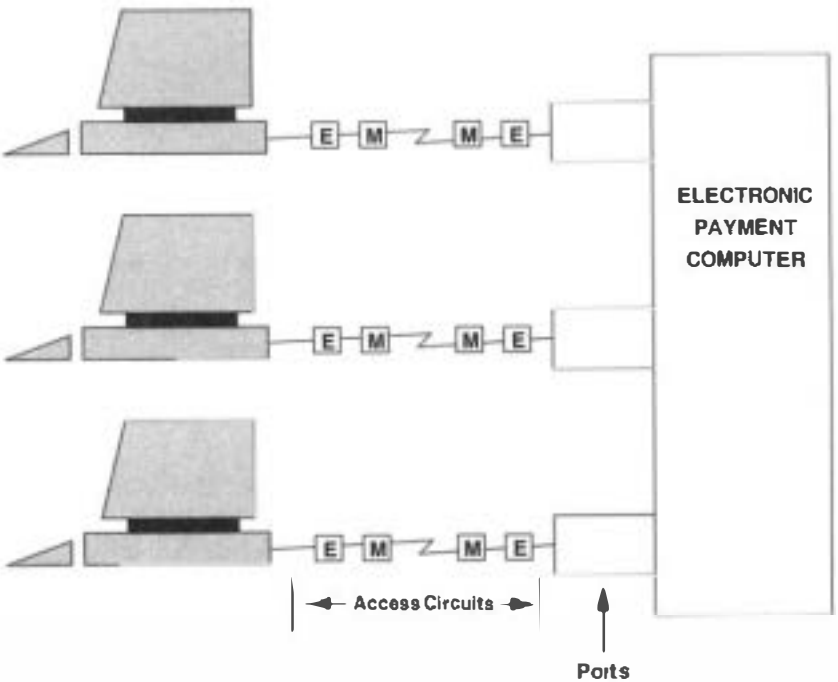
The physical connection to the telephone network may require the user to dial a telephone number to connect with the computer system, so-called switched circuits. Alternatively, the connection may be reserved, or dedicated to provide continuous availability, so-called dedicated circuits. Dedicated circuits, which can be leased from the telephone company, offer better control over the network for trouble-shooting and maintenance but are expensive and require individuals ports, or connecting points, to the communications equipment that is part of the payment processing system. Switched circuits are a cost-effective alternative to dedicated circuits, and several such circuits can share a single port. Because data can be monitored or tampered with by unauthorized individuals while it is being transmitted, encryption devices are frequently used to encode the data to ensure confidentiality. The telephone circuits and equipment (such as modems and encryptors) used to connect payment system users are referred to as access circuits and access equipment. The configuration of data communications components in a simple network using dedicated circuits is illustrated in Chart 2.

If the number of users located within a given geographical area and connecting to the electronic payment system increases, multiplexer equipment can be added to eliminate the need for an individual communications line for each user. A multiplexer combines the transmission signals from two or more users onto a single, high-speed circuit, to which modems may also need to be connected. At the site of the electronic payments processor, a second multiplexer is required to separate the transmission signals for each user before connection to the computer ports. Thus, although use of a multiplexer reduces circuit costs, it does not reduce use of computer ports. High-speed circuits using multiplexer equipment are often referred to as backbone (or trunk) circuits. Chart 3 illustrates the configuration of a network using multiplexers and a backbone circuit.

As the number of users and their geographical distribution increase, the need for an even more sophisticated data communications network arises. The next step in design of a communications network is to install strategically located communications nodes. Multiple users within a geographical area are then connected through local access circuits and equipment (an access network) to one of these communications nodes. Adjacent nodes are linked to one or more high-speed trunk circuits and ultimately to the electronic payments computer. These nodes and trunk circuits also form a backbone network.

A sophisticated backbone network based on nodes allows multiple users to share trunk circuits and provides multiple paths over which data can be routed to provide alternatives should a particular circuit fail. The equipment at each node selects the telecommunications path from that node to the ultimate destination that makes the best use of available capacity and routes the data over that path.

Chart 2. Components of a Simple Communications Network Using Dedicated Circuits

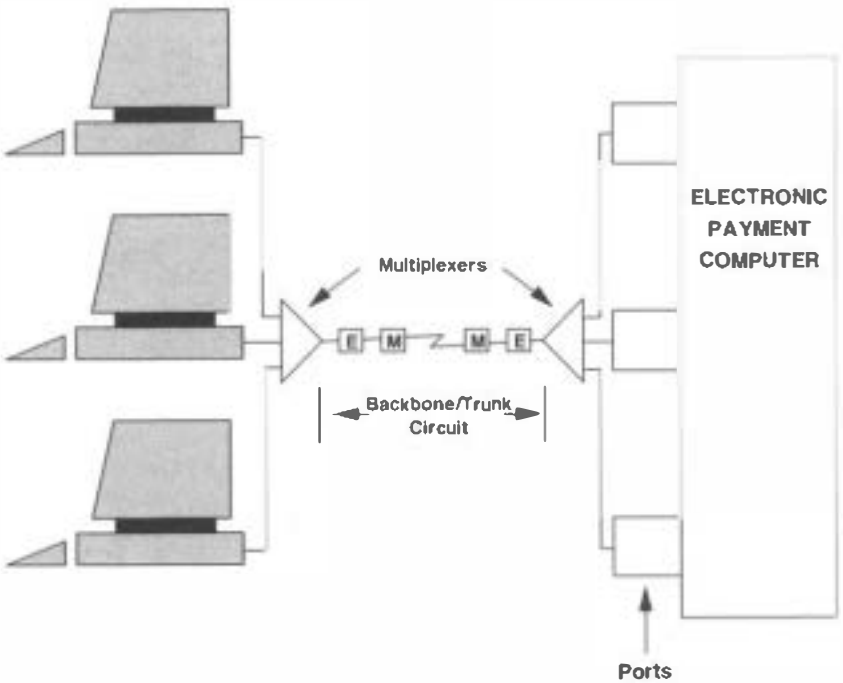


E = Encryptor
M = Modem

Networks that rely on nodes and incorporate multiple paths are referred to as packet networks, because they divide a stream of data into small units, or packets, for transmission across the backbone network. Typically, the computer system requires only one port connection to each communications node, unlike networks based on dedicated circuits or multiplexers, where separate computer ports are required for each user. Packet networks reduce circuit costs as well as computer port costs while providing improved network reliability because of their ability to route data over alternative paths. Chart 4 illustrates the components of a packet network and how these components are connected.

Rules, called network protocols, are required for the operation of a communications network. There is a variety of protocols, some of which are proprietary, such as IBM's System Network Architecture (SNA), and

Chart 3. Components of a Communications Network Based on a Backbone with Multiplexers

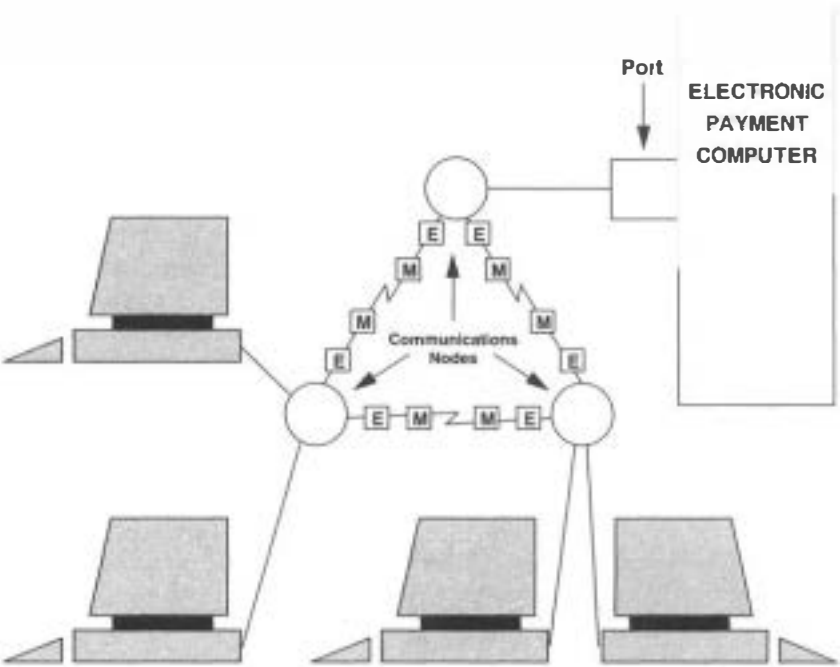


E = Encryptor
M = Modem

are used by individual computer manufacturers. Some protocols, however, such as X.25, are consistent with emerging international standards.

The primary international standards organizations are the Consultative Committee for International Telegraph and Telephone (CCITT) and the International Organization for Standardization (ISO). These organizations have defined a broad set of communications standards that address various types of communications systems, including electronic mail, file transfer, and transaction processing, any of which might be used for different payment applications. In any event, the participants in an electronic payment system must follow the same protocols in sending data between terminals and computers over a network. If different protocols are used, translation devices called protocol converters are required to ensure that the integrity of the data is maintained while traveling over the network.

Chart 4. Components of a Packet Network



E = Encryptor
M = Modem

The most widely used form of packet network today is based on the international CCITT X.25 standard. Proprietary packet networks based on the IBM communications architecture, SNA, are also in wide use. Other, newer, packet technologies that support much higher transmission speeds are now emerging.

A packet network can be either private or public. In a private packet network, the payment system provider owns and operates the network. Installing a private network is expensive and requires a great deal of technical skill to implement. The benefits of a private network include good security and guaranteed throughput capacity, since other organizations are not permitted access to and use of the network. In a public packet network, the payment system provider will lease capacity from a public network vendor over facilities that may be shared with a number of

other users. Initial costs are lower and the vendor has responsibility for operating the network and providing the necessary technical skills. However, security may be weakened and throughput capacity may be adversely affected by other users.

Three different types of trunk circuits are used in communications networks: terrestrial, microwave, and satellite. Terrestrial circuits, or ground lines, are usually leased from specialized providers of telecommunications services and take the form of traditional copper wires or fiber-optic lines. Microwave circuits rely on ground relay stations whose range is limited to a maximum 15-mile line-of-sight distance, so that a series of relay stations are needed to cover longer distances. Weather conditions can also adversely affect the quality of microwave signals. Satellite circuits are typically used for long-distance transmissions. Because of the distances involved, propagation delays of about one-fourth of a second result, which require the use of special protocols that adjust signals for the delay. Most modem protocols, including X.25 and SNA, are designed for use with satellite telecommunications.

Four key factors must be carefully considered in the design and implementation of a communications network to support an electronic payment system. First, the quantity of data traffic must be detemined and the network properly sized to support peak transmission volumes. Insufficient capacity will result in less than satisfactory delivery and response times for the users.

Second, fallback plans and procedures must be in place to provide backup for circuit and equipment failures and these plans should be exercised regularly. It is common to use switched circuits provided by the public telephone network as the backup communications path for networks based on dedicated circuits. If terrestrial circuits are used, redundant and diversely routed ground cables are also recommended. Spare equipment, such as modems and encryptors, should also be readily available. In a packet network, the communications nodes should include redundancy so that the failure of any single component does not disrupt the operation of the entire node.

Third, the communications network must be flexible enough to accommodate changes that will occur as a result of volume growth, an expanded user community, and the introduction of new payment services. Once in place, it is very difficult to modify the design of a network. It is therefore essential that future needs be anticipated in the initial network design. Finally, a communications network must be carefully and continuously managed to ensure proper operations, prevent problems, and diagnose and resolve problems quickly should they occur. Network management is a highly technical discipline that is essential to the effective operation of the electronic payment system.

Capacity Management

Capacity management is the discipline for ensuring that adequate data processing resources are available to meet performance requirements for payment system applications. The primary function of capacity management is to exploit efficiently the capabilities of the computer hardware, software, and telecommunications utility to meet the requirements of the user community. The capacity management process can be divided into two major subsets: performance tuning and capacity planning.

Performance tuning involves maximizing overall performance of current operations through fine-tuning of the individual hardware and software components of the processing complex. Such tuning is usually necessary in response to performance problems arising from unforeseen changes in the nature of the workload.

Capacity planning is a complex, iterative process, which anticipates and accounts for changes in business demand and available automation technologies to configure systems to meet future requirements. The purpose of capacity planning is to ensure that adequate automation resources are available to process a given workload and to provide the user with an adequate level of performance both in the current environment and for the foreseeable future. The capacity planner uses mathematical tools to determine the rate of resource consumption and to predict the anticipated effects of future business requirements on that consumption rate.

The result of proper capacity planning is that an appropriate amount of automation resources will be available to support the daily processing requirements of the business, with just enough excess processing capability to handle seasonal and unanticipated peaks in demand. Too little capacity means that the performance of the system will be inadequate. Too much capacity, on the other hand, is a waste of money.

There is a longer-term dimension to capacity planning, whereby work is done with the users and the applications developers to project the future automation requirements of the organization. By mapping anticipated future demand against currently available resources, potential performance bottlenecks and/or degradation points can be identified. Using modeling techniques, capacity planners try to determine the optimal mix of additional resources and/or new technologies that will most efficiently meet the changing workload demand curve.

An effective capacity planning program provides management with the necessary lead-time to plan adequately for the future and to make rational, economical investment choices from the alternative solutions developed by the planners. As such, capacity planning should be considered an integral part of any organization's strategic business planning efforts.

Managing Automation Resources

The data processing and data communications infrastructure described above must be managed if it is to perform up to expectations over time. Continuity of operations is a major management objective in data processing and data communications operations. The computers, communications, and related systems used to process payments need to work all the time, not only when things go right but also when the systems are subjected to stress, even in cases where certain components of the infrastructure fail. No systems are absolutely fail-safe. Equipment malfunctions and people make mistakes; mechanisms must be in place to compensate for problems when they do occur, and to fix them quickly.

Careful management must start with application development. Along these lines, development of any system must adhere to the principle that one can only program what one understands. Those responsible for the payment system must have a solid, practical understanding of the day-to-day business combined with a long-range vision of how the payment system operates. This understanding and vision needs to be described clearly and in sufficient detail so that those who are proficient in technology can produce a conceptual design describing how the processing system will work and how it will appear in business terms to its users. This conceptual design is then used as a base for the software developers to develop and implement the system.

A strong project management team must be headed by a master architect. This master architect must know both the payments business and technology. He or she must be a capable manager who is able to deal with all levels and types of people, including vendors and suppliers.

In developing a new system, it is important to avoid grand schemes that make the system unduly large and complex. Developing too grandiose a system is a pitfall that can result from sincere attempts to satisfy every constituency at the initial implementation. This "all or nothing" approach most often results in the latter—failure to implement successfully any system at all. Many examples exist of development projects that have been canceled after large sums of money have been spent. Employing a gradual approach to system development, relying on prototypes, and limiting introduction of the system to a small number of users and then gradually enlarging the number served enhances the chances of success.

Developing a new process for payment systems may take time, as there are no shortcuts. All involved should have realistic expectations, and having the right focus and management team is all important.

To ensure that technical operations perform flawlessly, the initial implementation of new systems must undergo vigorous testing and certification. Once the testing is completed and a system is in production, all subsequent changes to the technical platform must be rigorously controlled to ensure that the proposed changes do not adversely affect the proper functioning of

the system. Careful management will help ensure that initial certification and control over subsequent systems changes are properly carried out.

All components of the computer environment are dynamic by nature. Each day modifications in some form are introduced into production environments. Such modifications arise from changes in business functions and/or changes in technology. As a result, it is necessary to establish and delineate a controlled process, including both policies and procedures, by which changes are introduced to transform the sound, steady-state production environment into a "new" production environment that is equally or more reliable.

Changes to production systems should undergo demanding quality assurance testing. Test conditions must replicate the production environment as closely as possible, and tests should be conducted at both the technical and business levels. Functional testing of business requirements within application systems should be the responsibility of the user community while testing of environmental software and hardware changes should be done by automation technicians.

When changes are made to environmental software or hardware, testing of the application software should also be conducted to ensure that the *interaction* between the environmental and application components continues to function properly. Test scripts must be developed that cover all possible potential problems. Adequate testing and strict change control procedures are essential for high-availability systems, such as those used to process electronic payments. Indeed, the cause of most systems failures is poorly controlled change, followed by human error, and finally faults in the software, hardware, and infrastructure.

One method for ensuring high availability is to automate as much of the operation of the computer system as possible. Many of the routine steps in starting and operating the computer system are repetitive. These steps and the logic for decision making within the sequence can be programmed in advance. Once tested to ensure that the instructions perform the operations that they are intended to accomplish, the sequence can be initiated by a computer operator and from that point the software takes over, replacing the manual actions formerly performed by the computer operators. Automated operations greatly reduces the risk of human error and improves the total reliability of the system.

Redundancy in computer systems is another method to ensure high availability. Redundancy or "backup" can be established for any element of the system whose individual failure would cause the entire system to fail. Such backup includes, but is not limited to, power supply, water supply, computers and peripheral devices, and data bases. In some cases, separate, redundant physical facilities housing a backup computer system may be deemed necessary to provide the required degree of assurance for uninterrupted service.

Whatever the extent of redundancy, backup systems must be periodically tested so that they are in an immediate state of readiness if they are needed in an emergency. Such tests should approximate the true production environment as closely as possible. In some installations, actual production is periodically alternated between the primary and backup systems so that the distinction between the two systems depends simply on which system is operating at a point in time.

Invariably, regardless of the redundancy of systems, problems will occur that will threaten or actually interrupt the continuity of computer service. It is essential that a methodology for problem management be established whereby each problem is recorded and analyzed in detail, to ensure that resolution is completed and changes have been made to prevent the problem from recurring.

Hardware problems, when they do occur, require the availability of trained personnel who have the skill to fix equipment malfunctions quickly. However, the most difficult problems to fix are problems occurring within the environmental or application software. The people who are most capable of fixing software problems are the ones who actually developed the software. The developers know best how the software works and they can more easily diagnose and fix problems than can people who did not take part in the development. Therefore, access to software developers must be available at all times.

Critical payment systems must operate well for nearly 100 percent of the scheduled operating hours, especially during times of financial crisis. Operational problems cannot be allowed to compound credit or liquidity problems in the marketplace. Loss of confidence resulting from operational problems, as well as other reasons, can be difficult to regain.

Operational problems can arise from many sources, as two real-life examples will illustrate. In November 1985, a major clearing bank for U.S. Government securities experienced an application software problem that prevented it from sending securities and receiving payment in return. By the end of the business day, the institution had amassed a net liability of about $23 billion as a result of its securities clearing problem. The Federal Reserve, in its role as lender of last resort, was obliged to step in and provide funds so that the institution could cover its position. Although the integrity of the payment system was maintained, a costly lesson was learned--a seemingly small application software problem resulted in a major disruption to an important financial market and resort to the Federal Reserve's discount window, costing approximately $5 million in interest charges.

During August 1990, a major power failure in lower Manhattan left much of the New York financial district without electrical power for up to a week. Fortunately, owing to recognition in the United States in recent

years of the need for improved computer backup, the financial community as a whole coped with this problem extremely well. Although many financial institutions had to relocate their computer operations to backup sites, payment system services were generally maintained throughout the crisis. In many ways, this incident served as a "rite of passage" for many institutions, which had developed detailed contingency plans and practiced them repeatedly over the years. Before the power outage, some financial market participants had even begun to question whether the expenses involved in maintaining elaborate backup systems were cost effective. The August 1990 power failure served as a dramatic reminder to all parties why costly and time-consuming backup systems and contingency plans are a worthwhile investment.

Procurement

Procurement is a crucial aspect of the management and operation of payment system technologies for at least two reasons. First, with so many vendors and different types of solutions available, it is important to pick the one that will best meet the business requirements at hand. Second, investment in these technologies can involve very large amounts of money. A well-organized and competitive bidding process will help ensure that the maximum value is returned for the investment.

There are three basic approaches to acquiring and operating systems used for payment processing. These are

(1) "In-house" development of systems and operation of equipment to support the systems.

(2) Contracting with specialized firms to develop application software, keeping operation of the system "in-house" after development has been completed—commonly referred to as the turnkey approach.

(3) Contracting with others, such as specialized firms or associations of financial institutions, to develop and operate the system. This approach is referred to as outsourcing.

Several risk issues must be addressed as part of the technology procurement process whose management will help determine whether the system should be managed in-house or contracted out to a third party. An early decision that must be made in each particular situation is to determine the proper balance between internal and external development and operation of the system, taking into account business and policy objectives (especially reliability and availability requirements), cost-effectiveness, and the desired level of direct control over risk factors.

There is significant risk in the development process itself. If an outside organization is relied upon for development, does the organization selected have the technical experience, people, and financial resources to

live up to its commitments? Can it deliver the product as contracted for, on time, at the negotiated price, demonstrating all of the specified functionality and performance requirements?

Once a system has been developed, tested, and implemented, operational risk must be controlled. Operational risk is defined here as the risk that the system can--and usually will--break down for reasons ranging from software glitches to hardware or infrastructure failures to acts of God. The resources required for rapid problem resolution must be available quickly, whether development is in-house or contracted out to a third party. The system's performance over time is another risk factor, as new program code is often grafted on to the original system to provide added functionality or, perhaps, the volume of transactions increases beyond the capacity limits of the system as originally designed.

Operational risk is increased if a third party service bureau is relied upon to run the payment system operation. In this case, by definition, the owner of the system thus places itself at arm's length from the operation and must rely upon the service bureau management's assurances that the system will be operated and supported conscientiously by technically qualified personnel on appropriately configured equipment. In this situation, the owner must have a great deal of trust in the service bureau, regardless of how many protective clauses are included in the service agreement. In many, if not most, cases of severe operational failure, the business costs will be too severe to overcome by the time contract remedies can be invoked, and a cash rebate is scant comfort if the payment processing business is severely damaged. Therefore, it is generally recommended that "mission-critical" lines of business—and payment systems usually fall into this category—avoid reliance on service bureaus.

Another critical risk that must be guarded against is fraud. It is absolutely necessary in any payment system to ensure that only properly authorized transactions will be processed. If a fraud is successfully perpetrated using a given payment system, the owner of that system will face not only the immediate monetary loss from the fraudulent transaction(s), but also a loss of business confidence engendered by questions about the integrity of the system.

Fraud can result from not demanding that adequate access controls and quality/integrity checks be designed into the system. Further, the insertion into the system of "trap doors" and "trojan horses" by those responsible for writing the programs must be zealously guarded against. This is even more difficult to control if there is a contract with an outside organization for programming and design services, since the owner is not in a position to supervise closely the work being done or to ensure that adequate checks are included in the design process.

Most consulting and programming organizations will refuse to turn over the source code for the programs they produce. This makes it all the more

important to ensure that a verifiable source code escrow clause is part of the contract entered into with any outside organization for programming services. This clause should provide for access to the source code in the event of an emergency. It has the essential added benefit of making the code available to the payment system owner if the contracting company goes out of business or refuses to provide support services according to the terms of the contract.

Examples of the three approaches to procurement of application software and operating services exist today in developed economies, although in-house development and operations is common for large-value transfer systems. For example, in the United States, the Federal Reserve has developed and operates Fedwire. Similarly, the New York Clearing House has developed and operates CHIPS, while in the United Kingdom CHAPS was developed and is operated by an association of large banks. In Switzerland, SIC was developed and is operated by Telekurs.

Bank participants in electronic payment systems, including large-value transfer systems, often obtain their application software from third party vendors, but operate the system in-house. For example, it is common for banks in the United States, including institutions that have high volumes and values of transfers, to purchase the application software they use to process Fedwire and CHIPS payments from specialized software development houses. Most banks, however, operate the software in-house.

With regard to the acquisition of data processing hardware, a formal request for proposals (RFP) approach is recommended. Many vendors are capable of delivering and supporting the technologies employed by payment systems, so a variety of choice is generally not a problem. Organizing the procurement process so that decisions are made with impartiality and vendors are encouraged to compete with each other on the basis of price and performance makes it easier to arrive at an optimal acquisition decision, especially in an environment where there is large variety.

One of the keys to a successful procurement is to establish clear evaluation and selection criteria---cost is only one criterion, and possibly not even the most important—and to include the criteria in the RFP document. This establishes a level playing field for all bidders and generates vendor confidence in the impartiality of the procurement process. An open, arm's-length, competitive procurement is a primary ingredient in ensuring an acquisition that meets the organization's needs and maximizes the potential return on investment.

One exception to the recommended use of the RFP approach to procurement is in the acquisition of application software. Although an RFP can be developed for application software acquisitions, acquiring application software is much more complicated than acquiring hardware. There are additional pitfalls in procuring application software. The functional and performance specifications for software are complex subjects, easily

prone to misinterpretation. The organization must, for all practical purposes, complete the detailed design specifications for the application software and issue these specifications as part of the RFP. And, if the intended acquisition is for an existing software package rather than completely new programming, the amount of customization that will be necessary to adapt the package to meet the organization's requirements must be analyzed. Such activities are difficult to accomplish under the strictures of the RFP process.

Conclusions

The development, operation, and modification of payment systems technology is a complex technological challenge that requires careful management. Large sums of money are involved in the technical system and the safe and reliable operation of the system helps promote confidence in the payment process. Because of the expense involved, the technology underlying payment systems must be managed efficiently. Establishing and following an arm's-length, businesslike relationship with vendors is an important part of efficient management. Nonetheless, because of the critical role played by the data processing infrastructure, it is also important not to skimp on the system that is put into place. In particular, payment system managers should be willing to invest in the backup systems that can keep the payment system in operation even in the event of the failure of a major component of the primary production system.

Responsibility for the operation of the data processing infrastructure, especially for large-value transfer systems, is generally exercised by the owner of the system. The major systems in the world also tend to develop their own application software. Banks connected to these payment systems also tend to take responsibility for day-to-day operations but often procure their application software from specialized software houses. Careful procedures can help ensure the integrity of the systems that are procured from third parties.

Perhaps the single most important aspect to the successful operation of a payment system is the quality of the dialogue and partnership between the business users of the system and the technology managers. Each has a unique contribution to make, during all phases, including design, operation, and systems modification.

Appendices

The four appendices that follow are reprinted from the fourth edition of Payment Systems in Eleven Developed Countries, *published in December 1993 and prepared under the aegis of the Bank for International Settlements by the Central Banks of the Group of Ten Countries and Switzerland. Minor editorial changes have been made to the original texts.*

APPENDIX 1
Swiss Interbank Clearing System

The role of the Swiss Interbank Clearing System (SIC) is to execute interbank payments in Swiss francs finally and irrevocably 24 hours a day with funds held at the Swiss National Bank (SNB). SIC is the only system available for the execution of payments between Swiss banks by electronic means. It is a gross payment system, that is, all payments are settled individually on the participants' accounts (debiting of the account of the bank issuing the payment instruction and crediting of the account of the receiving bank). SIC is both a large-value payment system and a retail payment system; there are no value limits. In 1992 slightly more than 64 million payments were executed for a total value of approximately Sw F 33 trillion, giving an average value of a little over Sw F 500,000 per payment. SIC's most important objectives are to reduce credit risks, eliminate giro account overdrafts at the SNB, accelerate the payment process, and facilitate banks' cash management.

SIC was developed between 1981 and 1986 by Telekurs AG in collaboration with the Swiss banks and the SNB and came into operation on June 10, 1987. The start-up phase lasted from June 1987 to January 1989. During this period the systems using vouchers or data media were phased out, the banks were progressively linked directly to SIC, and the transaction volume was gradually increased.

Legal and Policy Framework

There are no special legal provisions governing payment systems in Switzerland. SIC is run by the SNB, while Telekurs AG is under contract to provide the computer center service. Private law agreements between these two parties and with the participating banks form the legal framework for the operation and further development of SIC. The contracts are supplemented with technical instructions and handbooks.

Committees including representatives of the SNB and the participating banks promulgate changes and additions to the instructions and handbooks and take decisions on technical modifications to the application. All changes and additions require the approval of the SNB.

Participants

Participants in SIC must be located in Switzerland and must be banks within the meaning of the Swiss Banking Law. In addition, they must keep a giro account at the SNB. At the end of 1992, 162 participants were connected to SIC. This includes the regional banks' computer clearing center, to which 151 banks were linked.

Types of Transactions

Only credit transfers in Swiss francs can be carried out via SIC, that is, payments are always initiated by the paying bank. SIC can be used for payments by bank customers to a bank account, payment orders in favor of third parties, provision of cover, and interbank payments. In addition, payments to a postal account or money orders (the amount concerned is delivered to the beneficiary at home by a postman) can be routed via SIC into the post, telegraph, and telecommunications (PTT) payment system. Conversely, payments initiated at the PTT for the benefit of bank account holders are transferred from the PTT payment system to SIC.

The underlying transaction, whether it originates from a bank's own business or is initiated by a customer, is irrelevant. Large-value payments are accounted for mainly by foreign exchange transactions involving Swiss francs, whereas small-value transactions stem predominantly from customer standing orders, individual customer orders, salary payments, and so forth.

Operation of SIC

The prerequisite for participation in SIC is an on-line connection to the central SIC computer. Payment instructions can be submitted for value the same day (for settlement on the day of presentation) or for settlement up to ten bank business days into the future.

A payment is settled only if there are sufficient funds in the sending bank's SIC account; there is no provision for overdrafts. Settlement is final, and settled payments are delivered immediately to the receiving bank. SIC is thus a gross payment system.

If sufficient funds are not available at the time the payment instruction is submitted, payments are held pending in a queue file. As soon as sufficient funds have accumulated through the settlement of incoming payments, payment instructions are automatically cleared from the queue file. Pending payments are not delivered to the receiving bank and may be canceled at any time by the sending bank (except that the cancellation of a payment order after clearing cutoff time 1, described below, must be agreed with the receiving bank). The receiving bank is notified of any cancellations, since it has knowledge of incoming payments pending and a cancellation signifies a reduction in these pending items.

The payment transactions are processed on a "first-in, first-out" basis. All transactions have the same priority; it is not possible to change the sequence of queued payments. The sending bank can manage its queue of outgoing payments to a limited extent by canceling and resubmitting instructions.

Participants can at any time request an up-to-date statement of their own account balance (total of settled outgoing and incoming items, total of outgoing and

incoming items held pending in queue files, and balances). Data can also be obtained concerning the status of outgoing and incoming payments to determine whether these have been settled or not. The SNB, for its part, has access to data for all the banks participating on SIC.

SIC operates around the clock on bank business days. Settlement is carried out for approximately 22 hours. The day begins at 6 p.m. (Zurich time) on the day before the bank business day in question with the transfer of giro balances from the master accounts at the SNB to the SIC clearing accounts. The day ends in three stages on the bank business day in question. Clearing cutoff time 1 is 3 p.m. From this moment on, payments submitted for same-day settlement are automatically changed to value the next bank business day. The only exception is the provision of cover, which can be submitted up to clearing cutoff time 2, which is 4 p.m., for same-day settlement. After clearing cutoff time 2, only payments submitted by the SNB are accepted for same-day settlement. Day-end processing starts at 4:15 p.m. These cutoff times are fixed, but in exceptional situations (for example, in the event of computer or data communications failures) they can be postponed by the SNB. At the end of the day, totals of debit and credit transactions are transferred from the SIC clearing accounts to the master accounts at the SNB.

The purpose of the hour's difference between clearing cutoff time 1 and clearing cutoff time 2 is to give banks with queued payments, that is, with insufficient funds, the opportunity to acquire the necessary covering funds on the market or from the SNB. Covering funds from the SNB, so-called Lombard loans, are available only against collateral and at a rate of interest that is at present 2 percent above the money market rate. In the quarter-hour between clearing cutoff time 2 and the start of end-of-day processing, only Lombard loans can be accepted. During end-of-day processing, all the payments that are still queued, that is, which it has not been possible to settle, are deleted. These payments must be resubmitted the next day.

Pending payments that are canceled after clearing cutoff time 1 without the consent of the receiving bank or that are deleted during end-of-day processing are subject to a penalty rate of 3 percent per annum of the amount of the payment for the duration of the delay. The receiving bank is entitled to claim this penalty from the bank that issued the payment instruction. The latter is obliged to pay this penalty without delay, irrespective of any further claims by the receiving bank.

Transaction-Processing Environment

Every bank is connected to the SIC system via the network run by Telekurs AG. This network is available not only for SIC but for all services provided by Telekurs AG. The SIC connection is made to each bank's own mainframe or a front-end computer; terminal connections are not permitted.

All payment instructions must be authenticated using special equipment to prevent illicit insertion or alteration of data. Encryption of data transmissions is optional.

If a bank is unable to transmit payment instructions to the SIC computer center by normal methods, it must try to find an alternative solution, for example, delivery of data on magnetic tape or by transmission using another system. Payment messages that cannot be transmitted from the SIC computer center to the beneficiary bank before day-end are issued on magnetic tape or, if necessary, on paper.

An active and a backup computer are available at the SIC computer center for production processing. A third computer, which is normally used for development, is available at a second, remote computer center.

The system's maximum processing capacity is at present approximately 1 million payments a day, with an average hourly throughput of 100,000 transactions. In 1992 over 253,000 payments were processed on the average day. On peak days more than 580,000 payments were processed.

If SIC cannot be used (as a result of software errors, destruction of the infrastructure, etc.), Mini-SIC is available. Mini-SIC is a straightforward data media clearing system by which participants send payment instructions on magnetic tape to a newly designated processing center. All processing for a single day is performed at one time, payments are sorted according to recipient bank, the totals of credits and debits for each bank are calculated, and participants receive payments on magnetic tape. Each bank's total is posted to its giro account at the SNB.

Settlement Procedures

It is established in the contractual agreements between the SNB and the banks participating in SIC that settled payments are final. Payments are made available to the receiving bank immediately after settlement. The Bankers' Association recommends that customer accounts be credited for value the same day.

Under the rules governing compensation for payments whose value dates have been altered and for delayed payments, the receiving bank can claim interest at the call-money rate plus 2 percent, or the Lombard rate, whichever is higher, for the duration of the delay. There are also provisions for dealing with misrouted payments.

Since the introduction of SIC in 1987, participants have changed their payment and account management practices in the following ways:

- balances held in giro accounts have been reduced by two-thirds;[1]
- payment instructions are entered into the system earlier;
- smaller payments are entered before larger ones; and
- very large payments (over Sw F 100 million) are, where possible, split up into smaller transactions.

Pricing Policies

Prices for using SIC are set on a per transaction basis and charged to SIC participants. It is left up to each bank to decide whether and to what extent to pass charges on to its customers. Prices for a given operating year are established to generate revenues that will cover expected operating costs, including the costs associated with the Telekurs network and all line charges, given the expected volume of transactions. If there is a substantial underrecovery of costs during the year, prices can be adjusted in the course of the year.

[1]There has also been a change in liquidity requirements, effective January 1, 1988.

The receiving bank pays a flat-rate fee of Sw F 0.20 per transaction. The sending bank pays a fee based on the sum of two components, one of which depends on the time a payment is initiated and the other on the time a payment is settled. In addition, the fee is partly dependent on the value of the payment. The following table shows the 1993 prices, charged to the sending bank.

Time	Value	Initiation	Settlement
Before 8 a.m.	—	0.06	0.11
8 a.m.–11 a.m.	—	0.08	0.16
11 a.m.–2 p.m.	Under Sw F 100,000	0.10	0.20
11 a.m.–2 p.m.	From Sw F 100,000	0.30	0.90
After 2 p.m.	Under Sw F 100,000	0.20	0.40
After 2 p.m.	From Sw F 100,000	1.00	2.00

An example will help illustrate how prices are assessed. Assume that the sending bank initiates a payment amounting to less than Sw F 100,000 before 8 a.m. and that this payment is settled after 2 p.m. The sending bank in this example pays Sw F 0.46 (0.06 + 0.40). This price structure is intended to reward the sending bank for early submission and settlement of payments. In particular, the price structure is designed to ensure that small-value payments (bulk payments) are submitted and settled as early as possible. This also helps prevent bottlenecks in the queue file at day-end.

Management of Credit and Liquidity Risks

Credit risks arise if a receiving bank acts upon information available about pending incoming payments.[2] In this case, the receiving bank would de facto be extending credit to the sending bank, either intraday or even overnight. Because the initiating bank can at any time cancel pending outgoing payments, or payment orders for a later value date, and because pending payment orders are automatically deleted by the system at the end of the day, receiving banks are in fact reluctant to act on payment instructions. The staggered close of the clearing day, with clearing cutoff times 1 and 2 and the time in between, give banks the opportunity to acquire liquidity on the interbank market or in the form of Lombard loans from the SNB needed to fund payments held in the queue.

Control Over Payments Held in Queue

The experience with SIC has shown that the first-in, first-out processing rule greatly restricts participants' ability to execute transactions for which the timing is crucial (examples of time-critical payments would include cash withdrawals and obligations arising from participation in net settlement systems). SIC is therefore

[2]Information that the system gives to the receiving banks concerning pending payments is not legally binding and, as expressly laid down in the SIC technical instructions, is not to be regarded as a binding assurance that funds will be transferred.

being modified so that payment orders can be given priorities. Pending outgoing payments will then be worked through the queue according to priority, and only within a priority category according to the first-in, first-out principle. In this manner, participants will be able to manage their outgoing payments more efficiently. The system modifications necessary to support this enhancement should be completed in the second half of 1994.

APPENDIX 2
Fedwire

Fedwire is the large-value funds and securities transfer system owned and operated by the U.S. Federal Reserve System. The 12 Federal Reserve Banks are linked together and function as an integrated unit for purposes of Fedwire operations. The two basic types of services provided by Fedwire, funds and securities transfers, are described below.

Fedwire Funds Transfer

The Fedwire funds transfer service is a real-time, gross settlement service in which the sender of the funds initiates the transfer (Fedwire funds transfer is a credit transfer system). In general, depository institutions (including U.S. branches and agencies of foreign banks) that maintain a reserve or clearing account on the books of a Federal Reserve Bank may use Fedwire directly to send or receive payments. Approximately 11,000 institutions use the Fedwire funds transfer service.

Fedwire participants may transfer funds to another institution's Federal Reserve account, either for the benefit of the receiving institution or for the benefit of a third party, such as a respondent institution, a corporation, or an individual. Fedwire funds transfers are primarily used for payments related to interbank overnight loans, interbank settlement transactions, payments between corporations, and settlement of securities transactions. In 1992, 68 million Fedwire funds transfers were made with a value of $199 trillion. The average size of a Fedwire funds transfer is approximately $3 million.

Operation of the Funds Transfer System

The Fedwire funds transfer system operates from 8:30 a.m. to 6:30 p.m. eastern time (ET). The Board of Governors of the Federal Reserve System recently made the decision to open the Fedwire funds transfer system at 12:30 a.m. (ET), beginning in early 1997. Each transfer is settled individually when it is processed and is final (that is, irrevocable and unconditional) at the time of receipt.

Funds can be transferred over Fedwire only at the request of a sending institution (the payor). A sending institution irrevocably authorizes the Federal Reserve Bank holding its account to debit its account for the amount of the funds to be transferred. The receiving institution authorizes the Federal Reserve Bank holding its account to credit the amount of the funds transfer to its account. In doing so, the receiving institution agrees that, if the funds are designated as payable to a third party, it will credit the third party's account promptly.

Fedwire payment messages are sent over a communications network that links the 12 Federal Reserve Banks and the depository institutions holding accounts at the Reserve Banks.[3] Depository institutions send payment instructions to their

[3]The Federal Reserve's communications system is an ANSI X.25 packet-switching system. Each Reserve Bank is connected by multiple communications paths to every other Reserve Bank, and these paths can be dynamically changed to maintain system availability in the event of operational failures.

local Federal Reserve Bank for processing. If the payment is destined for an institution holding an account at another Federal Reserve Bank, the payment is sent through the communications network to the other Reserve Bank and is ultimately communicated to the receiving depository institution through on-line or off-line notification.

Over 70 percent of the users (representing 99 percent of the volume) of the Fedwire funds transfer system are connected electronically to the Federal Reserve. Institutions originating a high volume of transfers (those with more than 1,000 transfers per day) generally are connected by dedicated leased lines to the Federal Reserve. Medium-to-low-volume institutions (those with fewer than 1,000 transfers per day) generally use shared leased lines or dial-up connections. Less than 30 percent of Fedwire users, accounting for very low volume, initiate funds transfers off-line through telephone instructions to a Federal Reserve Bank. Depository institutions without electronic or off-line access to Fedwire rely on correspondent banks to initiate funds transfers on their behalf.

Pricing Policies

In 1993, the price of a Fedwire funds transfer made electronically was $1.06, with $0.53 paid by the originator and $0.53 paid by the receiver. The price to originate an off-line transfer by telephone was $10.00. Institutions advised of incoming transfers by telephone are charged $10.00 per telephone call. Depository institutions also pay connection fees to cover the cost of establishing and maintaining a data-transmission connection. These electronic connections, however, are used for other Federal Reserve services in addition to Fedwire. In 1993 monthly fees for dedicated, shared-leased line, and dial-up connections were $700.00, $300.00, and $65.00, respectively.

Risk Management Policies

In 1985, the Board of Governors of the Federal Reserve System adopted a policy to reduce the risks that large-dollar payment systems present to the Federal Reserve Banks, to the banking system, and to other sectors of the economy. The Federal Reserve's payment system risk policy addresses the control of risks in Fedwire funds and securities transfers, ACH, and other payments processed by the Federal Reserve Banks. It also covers private, offshore, dollar clearing and netting arrangements, and private delivery-versus-payment clearance and settlement systems that settle in same-day funds. An integral component of the ongoing policy has been the Federal Reserve's program to control intraday overdrafts in Federal Reserve accounts.

Because Fedwire funds transfers are final at the time of receipt by the receiving institution, the Federal Reserve effectively guarantees their payment. Thus, any intraday overdraft in a Federal Reserve account incurred by the sender of a Fedwire funds transfer results in a credit exposure for the Federal Reserve to that institution.[4] Total peak intraday overdrafts related to Fedwire funds and securities

[4]The Federal Reserve requires that intraday overdrafts be extinguished by the end of the day.

transfers in Federal Reserve accounts amounted to approximately $170 billion per day, on average, during 1992.

Under its payment system risk policy, the Federal Reserve typically provides intraday credit to healthy depository institutions on an uncollateralized basis up to a net debit cap, or limit, which is generally set as a multiple of an institution's risk-based capital. The Federal Reserve has the ability to monitor institutions' intraday Federal Reserve account balances. For institutions deemed to pose special risks, the Federal Reserve may reject Fedwire funds transfers that would cause an overdraft in an account. In addition, in certain instances, the Federal Reserve Banks will require collateral to secure the intraday credit they provide.

A fee was imposed for intraday overdrafts incurred in accounts at the Federal Reserve Banks beginning in April 1994. The fee is set initially at an annual rate of 24 basis points. Plans call for raising the fee to 48 basis points and then to 60 basis points in the subsequent two years, although the Board of Governors has indicated that it will be very flexible about when and by how much the fees should change. The intraday rate is quoted on the basis of a 24-hour day and is applied to an institution's average overdraft incurred in its account during the period that the Fedwire funds transfer system operates, currently 10 hours.

The objective of the intraday overdraft pricing policy is to provide a financial incentive for institutions to control their use of intraday Federal Reserve credit and to recognize explicitly the risks inherent in the provision of intraday credit. In connection with the introduction of fees on intraday overdrafts, the Federal Reserve also implemented a revised methodology for measuring intraday overdrafts in October 1993. This methodology includes a schedule for posting debits and credits from non-Fedwire transactions processed by the Federal Reserve, such as check and ACH transactions, to institutions' Federal Reserve accounts during the day. Under the new measurement methodology, all Fedwire payments continue to be posted as they occur.

Fedwire Securities Transfer

The Federal Reserve is the depository for all marketable U.S. Treasury securities, many federal agency securities, and certain mortgage-backed securities issued by government-sponsored enterprises.[5] These securities are almost exclusively in book-entry form. Depository institutions may maintain book-entry securities accounts at the Federal Reserve, in which they hold their own securities and those of customers.

Settlement for most government securities occurs over the Fedwire book-entry securities transfer system. The Fedwire securities transfer service is a real-time, delivery-versus-payment gross settlement system that supports the immediate and simultaneous transfer of securities against funds. Transfers are initiated by the sender of the securities and result in a simultaneous debit and credit to the sender's book-entry securities and funds accounts, respectively, and a credit and debit to the receiver's securities and funds accounts, respectively. The Fedwire

[5]The Federal Reserve also acts as agent and depository for the securities of certain international organizations, such as the World Bank.

securities transfer system normally operates between 8:30 a.m. and 2:30 p.m. eastern time. There are more than 8,500 participants in the service. Approximately 12 million securities transfers valued at $142 trillion were processed in 1992.

APPENDIX 3
The Bank of Japan Financial Network System

The Bank of Japan Financial Network System (BOJ-NET) is an on-line system introduced in October 1988 for electronic funds transfers among financial institutions, including the Bank of Japan (BOJ), which manages it. The system has reduced the use of paper-based services provided by the Bank of Japan, such as BOJ checks. In 1992, the daily transaction volume and value settled through BOJ-NET averaged 14,961 and ¥ 144.8 trillion ($1.1 trillion), respectively.

The Bank of Japan establishes rules on the use of BOJ-NET. To be eligible for the BOJ-NET funds transfer services directly, financial institutions must hold accounts with the Bank of Japan. Banks, securities companies, and money brokers (the so-called *Tanshi* brokers), including foreign banks and foreign securities companies in Japan, participate in the system. As of the end of June 1993, 371 financial institutions participated in BOJ-NET funds transfer services.

Most of the payment services provided by the Bank of Japan can be handled by BOJ-NET. The system is used to conduct

(1) funds transfers among financial institutions associated with interbank money market and securities transactions;

(2) funds transfers within the same financial institution (in-house funds transfers);

(3) settlement of the positions resulting from privately managed clearing systems; and

(4) funds transfers between financial institutions and the Bank of Japan (including treasury funds transfers).

Funds transfers handled by BOJ-NET are generally credit transfers, but in the case of in-house funds transfers, debit transfers can also be made. A sending bank can transmit a payment instruction with information on the sending and/or receiving banks' customers. The minimum value for a third-party transfer is set at ¥ 300 million ($2.8 million). Some restrictions are placed on the use of third-party transfers by financial institutions that are not allowed to engage in the funds transfer business.

Operation of BOJ-NET

Participants make funds transfers from one BOJ account to another by sending payment instructions from BOJ-NET terminals located at the individual participants' installations. Funds transfers are settled either on a real-time gross basis (from 9 a.m. to 5 p.m. Tokyo time) or on a designated-time basis, depending on the choices made by the participant. There are four designated settlement times: 9 a.m., 1 p.m., 3 p.m., and 5 p.m. Payment instructions can also be sent on the day before settlement, with a 5:20 p.m. cutoff time for such settlements.

Funds transfers made through BOJ-NET are final. In the case of designated-time settlement, payment instructions can be revoked before they are executed. Real-time gross payments are instantaneously final.

Processing Environment

BOJ-NET is an on-line network system that links the BOJ-NET center of the Bank of Japan to financial institutions, the Bank of Japan head office, and its branches. Although the basic function of the BOJ-NET system is to provide on-line transactions between participants and the BOJ-NET center through terminals installed by the participants, a direct CPU-to-CPU link is available in the Foreign Exchange Yen Clearing System.

The host computer systems at the BOJ-NET center are duplicated for the purpose of contingency backup. Two systems, systems A and B, are virtually identical, and each system comprises an operating machine and a hot stand-by machine. Thus, four host computers are always ready for operation. Most of the peripheral equipment, such as the communication control unit and the data bases, are also duplicated to ensure safety.

The system network is based on leased lines and DDX (digital data exchange) packet-switching lines, both of which are provided by Nippon Telegraph and Telephone Corporation (NTT), a Japanese common carrier. These two types of lines are connected with computers in the BOJ-NET center; leased lines are used for linkages with participants' BOJ-NET terminals located in Tokyo and for all direct CPU-to-CPU linkages, while DDX packet-switching lines are used for linkages with BOJ-NET terminals outside Tokyo. To ensure backup, lines connecting the BOJ-NET center and the telephone exchanges are duplicated. Similarly, to forestall system malfunctions owing to accidents at a telephone exchange, lines connecting the BOJ-NET center and major branches of the Bank of Japan are housed in two different telephone exchanges. Contingency measures are incorporated into hardware and software operations as well. Operation of the system is constantly monitored at the BOJ-NET center to detect problems as early as possible.

Pricing Policies

Participants pay variable charges to the Bank of Japan for use of BOJ-NET. The charge is ¥ 40 ($ 0.4) for ordinary funds transfers and ¥ 60 ($0.6) for third-party funds transfers. Participants also pay fixed charges for their connections to the BOJ-NET center. Participants set the fees they charge their customers for third-party transfers.

Credit and Liquidity Risk

The Bank of Japan does not extend intraday credit. If a BOJ-NET participant does not have sufficient funds in its account for a real-time funds transfer, the payment instruction is automatically rejected. In the case of designated-time funds transfers, the Bank of Japan monitors the positions of participants so that they will not have negative balances in their BOJ accounts and that designated-time settlement will thereby be executed.

APPENDIX 4
Clearing House Interbank Payments System

The Clearing House Interbank Payments System (CHIPS) is a private sector payment system owned and operated by the New York Clearing House Association (NYCHA). CHIPS began operation in 1971 as an electronic replacement for an existing paper-based clearing arrangement. Like Fedwire, CHIPS is a credit transfer system. Unlike Fedwire, however, CHIPS nets payment transactions multilaterally and settles the net obligations at the end of the day.

CHIPS participants may be commercial banks, Edge Act corporations, investment companies as defined by New York state banking law, or banking affiliates of a commercial banking institution with an office in New York City. A nonparticipant wishing to send payments over CHIPS must employ a CHIPS participant to act as its correspondent or agent. At the end of 1992, the CHIPS network had 122 participants. Of these, 19 were settling participants involved in the settlement of CHIPS transactions at the end of each business day. Eleven of these settling participants settled only for their own account and 8 settled for as few as 2 or as many as 32 nonsettling participants. Of the 103 nonsettling participants in 1992, 86 were U.S. branches or agencies of foreign banks and 22 were U.S.-chartered institutions.[6] Settling participants must maintain funds and book-entry securities accounts at the Federal Reserve Bank of New York.

The payments transferred over CHIPS are primarily related to interbank transactions of an international nature, including the dollar payments resulting from foreign currency transactions (including spot and currency swap contracts) and Eurodollar placements and returns. Payment instructions are also sent over CHIPS for the following purposes: settling obligations on other payment or clearing systems, adjusting correspondent balances, and making payments associated with commercial transactions, bank loans, and securities transactions. In 1992, nearly 40 million payments valued at $240 trillion were made through CHIPS.

CHIPS participants are subject to the supervision of state or federal banking supervisors, and CHIPS itself has been subject to annual examinations by state and federal banking authorities. Eleven New York money center banks make up the membership of the New York Clearing House Association, each of which is represented on the Clearing House Committee that establishes the rules for the operation of CHIPS. Nonmembers must agree to abide by the CHIPS rules before being allowed to participate in the system.

Operation of CHIPS

CHIPS normally operates from 7:00 a.m. to 4:30 p.m. eastern time and settlement is usually completed before 6:00 p.m. The CHIPS communications network is a single-node network with all participants connected directly to a single message-switching center. CHIPS maintains a primary and a backup processing

[6]As of October 29, 1993, CHIPS had 120 participants, 18 of which settled for themselves and others and 10 of which settled only for their own account.

site. Participants are connected directly to both the primary CHIPS processing site and to the CHIPS backup site. All connections have additional dial-up lines for contingency purposes. CHIPS participants must maintain data communications circuits and two computer processing facilities in the New York City area, a primary processing facility and a contingency processing center.

During operating hours, CHIPS acts as a payment message switching and accounting center between its participants. Each participant begins the business day with a starting balance of zero. CHIPS calculates the net position of each participant relative to each other participant continuously during the day based on payment messages sent and received. Payment messages can be entered for same-day or future-day value. Same-day messages are processed immediately upon release by the sender, unless they would cause the sender to exceed its credit limit or net debit cap (described below in the section "Risk Management Policies"). Once a payment message is released to the receiver, it cannot be revoked by the sending institution.

Settlement occurs through designated settling participants. Nonsettling participants must rely on the settling participants as correspondents to settle for them. Soon after 4:30 p.m. each day, the clearinghouse informs every participant of its net position and each settling participant of the overall net positions of the participants for which it settles (the net-net position).[7] If the net-net position of a settling participant is a net debit, the settling participant is required to transfer funds to the CHIPS net settlement account at the Federal Reserve Bank of New York via a Fedwire funds transfer by 5:45 p.m. Once all net debit obligations have been paid, the clearing house transfers funds via Fedwire to all settling participants in a net-net credit position and notifies all participants, typically before 6:00 p.m., that settlement is complete.

Pricing Policies

In recovering the costs of operating CHIPS, the NYCHA acts like a cooperative, allocating its total costs for operations among the participants according to CHIPS usage (the number of messages sent and received during the previous month). There is a minimum charge of $1,500 per month. High-volume users (over 80,000 messages a month) are charged $0.13 for each message sent or received. Other users are charged for the type of message sent. If a message is coded (or "qualified") with the receiver's identification using the CHIPS Universal Identification File, the sender is charged $0.40.[8] All receivers, except high-volume receivers, are charged $0.18.

Risk Management Policies

Because each CHIPS participant begins the day with a zero balance, credit must be extended among participants in order for them to make payments to one

[7]Participants are also informed of their net position with respect to every other participant in order to assist participants in reconciling their accounts with CHIPS.

[8]As of October 1, 1993, the sender of a message is charged $0.25 if the message is coded either with a SWIFT receiver identification code or with the receiver's routing and account numbers (that is, "partially qualified").

another. However, each CHIPS participant limits its credit exposure to every other participant, in part by setting a limit, known as a bilateral credit limit, on the net amount of credit that it will extend to another participant in the course of sending and receiving payments. A participant can set a bilateral credit limit at zero and may change its bilateral limits at any time.

In addition to the bilateral credit limits, the clearinghouse imposes a binding CHIPS net debit cap on each participant. This cap limits a participant's overall (multilateral) net debit position vis-à-vis all other CHIPS participants. For each participant, the net debit cap is equal to 5 percent of the sum of the bilateral limits set for it by the other participants; the cap changes with a one-day lag whenever the bilateral credit limits change.

The CHIPS operating system continuously and automatically monitors payment messages that participants attempt to release to receiving institutions, in relation to the sending participants' bilateral credit limits as well as their net debit caps. The system will not permit the release of any attempted transfers that would cause a sending participant to violate any of these limits.

Liquidity risk among CHIPS participants is managed by the following means. First, participants are required to maintain a reasonable level of liquid assets. The president of the NYCHA has the authority to review the financial statements of a participant and to require that the participant improve its liquidity if it is perceived that there might be a liquidity problem. Second, CHIPS provides an on-line, real-time inquiry system that permits a participant to monitor its net position and its potential need for liquidity. Third, the clearinghouse limits the maximum amount of liquidity that a participant could potentially require by imposing caps on participants' net debit positions. Fourth, back-up terminals and operational reliability are required to minimize the liquidity risks that might result from operational failure.

Last, should a participant fail to settle, CHIPS loss-sharing rules will allocate "additional settlement obligations" to the remaining participants, based on their bilateral credit limits with a defaulting participant, in order to cover the settlement shortfall.[9] These contingent settlement liabilities must be collateralized. Should a nondefaulting participant be unable to meet its additional settlement obligation, its collateral could be used to obtain liquidity. CHIPS procedures ensure that sufficient collateral will be available to cover a default by the largest system net debtor at any time.

[9]CHIPS rules provide certain limits, however, on the amount of such losses that may be allocated to remaining participants.

Biographical Sketches

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Hans J. Blommestein is Senior Economist at the Organization for Economic Cooperation and Development (OECD) and the CSCE (Center for Security and Cooperation in Europe) Professor of Economics, Department of Public Administration and Public Policies, University of Twente, Enschede, Netherlands. Before joining the OECD, he served as Deputy Head of the International Monetary Affairs Division of the Netherlands Ministry of Finance and as an advisor to the Chairman of the Interim Committee of the International Monetary Fund. Mr. Blommestein has been the Netherlands member of the OECD Committee on Capital Movements and Invisible Transactions and a temporary alternate member of the Monetary Committee of the EU. He has organized several OECD seminars and training programs addressing financial sector issues in emerging market economies and has participated in technical assistance missions to Central and Eastern Europe.

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Raj Bhala is Assistant Professor of Law, Marshall-Wythe School of Law, College of William and Mary, Williamsburg, Virginia. He specializes in international business and financial law and is the author of the recent book *Foreign Bank Regulation After BCCI* and articles on the law of electronic funds transfers. Mr. Bhala joined the law faculty in 1993 after working as an attorney in the legal department of the Federal Reserve Bank of New York for four years. He has participated in educational programs on the payment system for bankers from the former Soviet Union and served as a consultant to the International Monetary Fund on banking law matters in developing countries.

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Mr. Horii is Chief Manager and Head of the Economic Research Division, Research and Statistics Department, The Bank of Japan. His previous position was Head of the Payment System Division of the Bank's Financial and Payment System Department, where he was responsible for organization and management of the Bank's technical assistance in the payment system area for the former Soviet Union and developing countries. Mr. Horii has participated as a lecturer in seminars for bankers from the former Soviet Union held at the Bank for International Settlements and the Joint Vienna Institute.

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Jeffrey C. Marquardt is Assistant Director in the Division of Reserve Bank Operations and Payment Systems at the Board of Governors of the Federal Reserve

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Jürgen C. Pingitzer is Head of the Division for Banking Statistics and Minimum Reserves at the Austrian National Bank. Trained in law and economics, he has served in various central banking functions, including credit and banking system analysis. Mr. Pingitzer has served as a consultant to the International Monetary Fund, providing technical assistance on payment system matters in Romania, Belarus, and Ukraine.

Robert W. Price

Robert W. Price is Vice President at the Federal Reserve Bank of Cleveland, where he is responsible for day-to-day operation of the Bank's large- and small-value electronic payment systems (Fedwire and Automated Clearing House), as well as the paper check system. He has led various Federal Reserve System working groups to improve nationwide payment system services and operational efficiency. Mr. Price has served on several International Monetary Fund technical assistance missions to the Russian Federation aimed at reform and modernization of the payment system.

Israel Sendrovic

Israel Sendrovic is Executive Vice President at the Federal Reserve Bank of New York in charge of the automation and systems services group. His responsibilities include the development and operation of the technology that supports Fedwire. Mr. Sendrovic has worked extensively on international technology and related payment system issues affecting central banks and has been actively involved in providing technical assistance to the People's Bank of China.

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Bruce J. Summers is Senior Vice President of the Federal Reserve Bank of Richmond where he is currently chief financial officer. For three and a half years he served as Deputy Director of the Division of Reserve Bank Operations and Payment Systems at the Board of Governors of the Federal Reserve System in Washington, D.C., where he was responsible for payment system policy development and for overseeing the banking operations of the 12 Federal Reserve Banks. Mr. Summers has assisted in the reform of the Russian banking system under the aegis of the Russian-American Bankers Forum and has worked extensively with the International Monetary Fund and the World Bank, providing technical assistance to the financial and banking systems of emerging market economies.

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Paul Van den Bergh is the Secretary of the Committee on Payment and Settlement Systems of the Central Banks of the Group of Ten Countries. He joined the Bank for International Settlements as an economist and for a number of years was involved in the analysis of monetary policy issues. Mr. Van den Bergh has organized a number of courses on payment and settlement systems for officials from East European countries and states of the former Soviet Union at the Joint Vienna Institute.

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John M. Veale is Chief Manager, Financial System Department, Reserve Bank of Australia, where his responsibilities include the development and implementation of payment system policy. Before assuming these responsibilities with the Reserve Bank of Australia, he worked in macroeconomic analysis and forecasting and from June 1991 to 1993 served as Deputy Chief Representative in the Reserve Bank's office in London. Mr. Veale has been a consultant to the International Monetary Fund on payment system matters and has participated in technical assistance missions to Moldova and Armenia.