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Systemic Financial Risk in Payment Systems

Prepared by David Folkerts-Landau 1/

Approved for Distribution by Donald J. Mathieson

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Abstract

Efficient and stable payments systems are of fundamental importance in maintaining an orderly international monetary system. Major disruptions of national and international payments systems would have highly adverse effects on international trade, capital flows, and real activity. A key issue--now being addressed by authorities in a number of major countries--is whether existing institutional arrangements need to be modified in order to reduce the liquidity and credit risks that have arisen as a result of the expansion of international capital flows and the growing integration of major financial markets. This paper examines the nature of these risks and the policies that are being implemented to manage or curb them.

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Table of Contents

Summary

Efficient and stable payment systems are of fundamental importance in maintaining an orderly international monetary system. Major disruptions of national and international payment systems would have highly adverse effects on international trade, capital flows, and real activity. A key issue now being addressed by the authorities in a number of major countries is whether existing institutional arrangements need to be modified in order to reduce the liquidity and credit risks that have arisen as a result of the increased volume of domestic and international financial transactions.

The internationalization of financial markets and of clearing arrangements has contributed to systemic risk. Clearinghouses directly link the financial solvency of members through credit and debit positions in the clearinghouse. Periodic settlements are major points in time when the liquidity and solvency of banks are tested by the market. Many of the major international banks play the role of settlement banks for international transactions undertaken by smaller regional or local national banks. Thus, disturbances in one national payment system would spread rapidly to other national systems.

One source of concern has been with the growth of international or offshore netting arrangements, in particular in foreign exchange markets. Netting arrangements that are located outside the country whose currency is being netted can change the structure of the international interbank clearing and settlement process, and they make payment system risk less transparent.

It is thought unlikely that market forces alone would produce international payment arrangements that would adequately manage the systemic risks, because the power of private clearinghouses to impose restrictions on members, or to provide the liquidity occasionally required by members at closing time, is limited. Furthermore, the ability of private financial institutions to undertake regulatory arbitrage (i.e., relocate activities to a less regulated environment) suggests that cooperation between major central banks will have to be an important element in the management of payment system risks. Central bank cooperation in the strengthening of the international payments would complement the cooperation that is already under way in bank supervision and monetary policy. Nonetheless, the allocation of supervisory responsibility among the various national supervisory authorities remains an unresolved issue.

I. Introduction

At the core of current international monetary arrangements lies an interlocking network of national and international payments systems which facilitate the exchange of funds associated with almost all international trade and financial transactions. These payments systems have been an almost invisible component of the international monetary system because, to a large degree, they have functioned smoothly and with efficiency. However, during the past two decades, the growing size and integration of major financial markets has sharply increased the volume of transactions both within and across national payments systems. As a result, both private and official sector observers have expressed concerns about whether existing institutional arrangements in the major payments systems can both efficiently cope with the new volume of transactions and effectively manage the risks created by such factors as counterparty failure and liquidity crises. An extended disruption in the largest payments systems would clearly have a highly adverse effect on international trade and financial flows.

While the staff has, in its work on international capital markets, brought to the attention of the Executive Board some of the issues related to systemic risks in payment systems on previous occasions, 1/ this paper takes a more detailed look at both the nature of these risks and the steps being taken by the authorities in the major countries to manage or curb them. The next section of this paper briefly reviews the role, evolution, and public policy issues associated with modern payments systems. Section III identifies the main characteristics of systems for clearing and settling payments, and Section IV examines the financial risks in payments systems. Section V discusses policy initiatives aimed at containing payment system risks, and Section VI summarizes the discussion.

II. Payments Systems: Role, Evolution, and Public Policy Issues

1. The role of payments systems

Most economic transactions in market economies involve an exchange of goods, services, or securities for money. In modern economies, money largely consists of bank liabilities; and, hence, the role of a payments system is to effect the transfer of bank liabilities among transactors. 2/ Although the payment systems in the major industrial countries share a

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1/ See International Capital Markets--Developments and Prospects, April 1989.

2/ The evolution of modern banking systems received strong impetus from the demand for an efficient mechanism to facilitate the payments flows needed to sustain a growing economy. The transfer of securities among buyers and sellers in spot and futures markets has also received increased attention recently (see the Group of Thirty (1989) and Kessler (1988)).

common objective, their institutional arrangements differ as a result of differing patterns regarding the use of checks versus electronic funds transfer, the use of post office accounts versus bank accounts, and the relative importance of large wholesale payments. 1/ Retail payments tend to be large in transaction volume but small in size, while wholesale payments are by their very nature large in size and are executed electronically in all major payments systems. 2/ Moreover, retail payments done through checks tend to be free of systemic risk since the liability for payment falls on the payor only and the failure of a single or a group of payors to make payments is unlikely to affect the depository intermediary.

In contrast, most wholesale payments involve exchanges between large institutions that arise as a result of transactions by their customers in securities markets. Banks are typically the main participants in wholesale payments systems. 3/ Banks play an important role both because of their ability to establish efficient payments arrangements and because of their direct access to "good funds" (i.e., reserves at the central bank) for purposes of payments. Such "good funds" constitute the core of any payment system because they are available for the use of the owner to make payments under all market conditions (especially during market crises).

At first glance, the payments side of a transaction appears to be straightforward--the payor instructs his bank to transfer an agreed upon amount of funds to the bank of the payee. Closer inspection, however,

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1/ Tables 4-9 of Appendix I summarize the main characteristics of major payments systems in the industrial countries.

2/ For example, in the United States, paper checks account for about 95 percent of non-currency payments but only for 14 percent of dollar volume; whereas electronic payments account for 0.1 percent of the number of transactions, but for 80 percent of the dollar volume (see Tables 1 through 6 for a description of some of the characteristics of national payments systems).

3/ The importance of the wholesale payments system in the United States to the international economy is a reflection of the growth of the liquid and deep money and securities markets where trading activity gives rise to large funds transfers. Furthermore, the U.S. dollar system is also the major system for international funds transfer because of the dollar's role as vehicle currency and the importance of Euro-dollar markets. For this reason most of the concern about systemic risk and public sector credit risk in payments system has been focused on Fedwire and CHIPS, the domestic and international large-value U.S. dollar payments system. CHIPS (the Clearing House Inter-Bank Payments System) is the international payments system in that it is the main private system for clearing large international dollar payments among international financial institutions. Fedwire is the U.S. Federal Reserve's nationwide electronic payments and settlement system for dollar payments and movements of U.S. Government securities among domestic and foreign depository institutions.

reveals a number of potential difficulties that could prevent successful transfer from taking place. First, there is the problem of how best to achieve a simultaneous exchange of goods or securities for money so as to minimize the risk that one party to the transaction could renege on his payments or his delivery obligation, while the other party is fulfilling his side of the transaction. This risk can be minimized by closely tying the delivery of securities or goods to the receipt of good funds by the seller. The payments system is, therefore, closely linked to the system of transferring securities and legal arrangements for securing title to goods.

Second, there is the problem of how to transfer funds from one bank to another. In most systems, this is ultimately achieved by having the central bank transfer central bank liabilities (i.e., high-powered money), from the reserve account of the sending bank to the reserve account of the receiving bank. However, this transfer of funds is often achieved indirectly through the use of correspondent bank relationships or clearing house arrangements. A clearing or money center bank may clear payments among a number of smaller correspondent banks that have accounts with the clearing bank. Under this arrangement, each correspondent bank would only have to transfer (or receive) the net amount of his payment to and receipt from the other correspondent banks. In addition, groups of banks in some countries have created clearing houses that net payments among the banks before achieving final settlements on the books of the central bank, e.g. CHIPS in the United States and Giro clearing houses in the Federal Republic of Germany.

Third, there is the issue of how to deal with a payments failure. It is common practice in most countries for banks to send and receive payments instruction from a clearing house or central bank throughout the day and to achieve final settlement only at the end of the day or at the beginning of the next day by transferring the net amounts owed/due on the books of the clearing house or the central bank. If an insolvent bank fails to have sufficient "good funds" at settlement time, then the issue of which parties bear the losses are typically resolved by either (1) unwinding all the payment instructions sent out by this bank during the day (thereby imposing the losses on the counterparties to the banks transactions); (2) letting the settlement stand and imposing a cooperative assessment of losses on the members of the clearing house or payments system; or (3) the provision of temporary public sector credits and a resolution of loss sharing through legal channels.

2. The evolution of payments systems

Structural changes in major payments systems have reflected the evolving transaction requirements of modern banking systems. To an important degree, the growth of modern fractional reserve banking systems was initially stimulated by the reductions in transaction and payments cost that could be obtained by substituting promises to pay of banks for commodity money or currency. 1/ To obtain these cost savings, however,

1/ See Goodfriend (1988).

the depositor had to relinquish "good funds" (e.g., currency) and become a general creditor of the bank. Further gains in payment efficiencies were made by banks through the holding of interbank credit and debit balances on each other overnight or for longer periods, which allowed banks more time to adjust to payments shortages.

However, the bilateral clearing and settling of checks between large banks meant that messengers went with bundles of checks from bank to bank on which they were drawn. Such bilateral methods resulted in long periods between settlement during which large amounts of "float" (i.e., free credit to the bank on which the check was drawn) would accumulate. The next stage in the evolution of banking and payments systems, therefore, was the displacement of bilateral bank payment relationships by multilateral clearinghouses. In the United States, for example, such clearinghouses first emerged during the middle of the 19th century in the United States in the form of private cooperative arrangements for the purpose of economizing on check collection. 1/ The clearing house member banks brought checks to the clearinghouse at a fixed settlement time, and after the checks were netted each member's net credit or debit positions against the clearinghouse was computed and banks with debit positions were required to deliver government currency or coins, which was then passed on to the net creditor banks. The later practice of keeping reserves at clearinghouses facilitated an overnight interbank market which produced a more efficient distribution of reserves among banks and allowed banks to reduce their reserve holdings. The period of float was also reduced to a period of hours. 2/

The clearinghouse traditionally provided another benefit, namely some payment finality. Clearinghouse members usually agreed to cover the net debit positions of a failed member bank out of an assessment on their transactions. The clearinghouse then became a general creditor of the failed bank. Thus payments finality meant that the depositor of the check was at least partially insured against the failure of the paying bank from the time of deposit to the time when his account was credited. Such clearinghouse corporations thus allowed member banks to delegate the monitoring of each bank's solvency to the clearinghouse. In return, the clearinghouse restricted membership, imposed capital requirements on members and held periodic inspections. Nonmember banks cleared their checks through correspondent banks.

The clearance of payments required that clearing banks offer lines of credit to their correspondent banks. This meant, however, that clearing banks had to acquire expertise in monitoring and managing interbank credit which frequently arose in the clearing process on short notice and without the safety of collateral. Since clearing banks typically were in a position to make the best evaluation of the creditworthiness of

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1/ Timberlake (1984). The New York Clearing House was founded in 1853 by about 50 member banks.

2/ See Cannon (1911) and Timberlake (1984).

correspondent banks, they become the main supplier of short-term liquidity support for the payments system.

3. Public policy issues

The final step in the development of modern banking and payment systems was the growing involvement of central banks. For payments systems in a fractional reserve system to be stable and work efficiently, checkable deposits must remain convertible into currency. If a clearinghouse restricted conversion of deposits into currency, then deposits would sell at a discount in terms of currency. Thus the prospect of restricted convertibility could cause forward-looking depositors to immediately convert deposits into currency thereby precipitating a liquidity crisis.

The ability to create currency through the open market purchase of securities or direct lending against eligible collateral has allowed central banks to offset these liquidity shortages and thereby helped maintain the exchange rate between bank deposits and currency. 1/ In addition, central banks have also served as a clearinghouse where banks can hold their clearing balances. In providing short-term liquidity to banks, however, central banks have taken on a certain amount of credit risk as the cost of providing a more efficient payment system. In effect, the public as a whole has assumed some of the credit risk inherent in bank assets that serve as collateral for central bank lending in return for an efficient payment system.

The role of the central bank in maintaining payments system stability has raised important policy issues. The real economic costs of a breakdown in the wholesale payments system provide a key rationale for central bank intervention. Nevertheless, such central bank intervention implies a policy of supporting money center or clearing banks that are the main participants in the payments system. This has created the perception in some countries that some banks are too "large" to be allowed to fail. As a result, depositors and other creditors of these institutions may tend to underplay the riskiness of the institution's assets. Moreover, central banks have during crisis periods sometimes not only provided general liquidity but also have indicated support for certain large institutions. The problem here is that extension of the official safety net can encourage the very kinds of excessive risk-taking that ultimately translate the safety net into a large contingent liability of the official sector.

This problem has been magnified by the fact that large clearing or money center banks have supplied liquidity to facilitate not only payments

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1/ Schwartz (1989) has argued that in the United States, there were at least 17 banking crises during the period from 1793 to 1933, but none have occurred since 1933, the beginning of active Federal Reserve intervention.

transactions, but also to finance short-term positions. 1/ Liquidity is supplied to the nonbank financial sector through revolving lines of credit that are designated to "back" the issue of securities, such as commercial paper. These revolving lines of credit assures the lender that he has access to good funds in the event the borrower is unable to roll the security over at maturity. Moreover, banks finance the inventory of securities dealers and other market makers through repurchase agreements. As a result central bank liquidity support for large banks implicitly extends official support to other institutions that rely on liquidity provided by banks.

In recent years, there has also been a growing concern that developments in the major financial markets--increased international integration, higher volatility of asset prices, growth of derivative markets and, above all, substantially larger trading volumes in all markets--are severely testing the adequacy of the existing infrastructure for clearing and settling large-value payments among major international financial institutions. The settling of payments, by the delivery of "good funds" at periodic, usually daily, intervals is a key test of the solvency of financial institutions in the international financial system. An international financial crisis, if one were to occur, would most likely first manifest itself through an inability of a financial institution, or a group of institutions, to settle their obligations in one of the major payments systems. The fear is that such an event would cause inadequately prepared payments system to "freeze"--become unable to effect payments among institutions. Such an inability to settle payments could then be expected to lead to a severe liquidity shortage as healthy institutions, not having received payments expected at settlement time, might be unable to settle on their own payments obligations.

In the absence of central bank intervention, such a liquidity crisis could easily lead to a loss of confidence in depository institutions, which, in turn could precipitate multiple failures of otherwise healthy

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1/ For example, Corrigan (1986), argued that "the efficient work of a large modern economy clearly requires the presence of a stock of financial assets which are highly liquid and readily transferable, thereby facilitating the broad range of transactions needed to sustain the real and financial sectors of the economy. To be highly liquid, such assets must be available to the carrier at very short notice (a day or less) at par. To be readily transferable, ownership rights in such assets must be capable of being readily shifted to other economic agents, also at par and in a form in which they are acceptable by that other party."

financial institutions. 1/ As a result, major central banks have reassured financial markets of their liquidity support during times of stress. However, the sheer size of average daily payments flows--$1.4 trillion in 1988--through the domestic and international U.S. dollar wholesale payments system and the difficulties experienced in settling trades and payments following a computer breakdown at a single clearing bank in New York in 1985 2/ and during the October 1987 equity price downturn have contributed to a sense of unease. In fact, some observers believe "that the greatest threat to the stability of the financial system as a whole during the October stock market crash was the danger of a major default in one of the clearing and settlement systems." 3/

In addition, the growth of private, frequently offshore, payments netting arrangements has raised questions not only about systemic risk, but also about monetary control. If a central bank accommodates an abrupt increase in the demand for central bank money during a financial crisis, this could make it more difficult to control the expansion of the monetary base over the medium-term. But failure to increase the supply of central bank money during times of liquidity shortages may result in a systemic liquidity crisis. Central banks have sought to improve the trade-off between control of the monetary base and the stability of the payments system by regulation and supervision of private payments clearing arrangements. However, when private settlement systems operate outside the jurisdiction of the central bank, then such supervision is more difficult to implement. Nonetheless, problems in an offshore clearing house might affect adversely the stability of a national payments system. For example, if private financial institutions set up a clearing house for U.S. dollar denominated payments outside the United States, final settlement of payments would still ultimately involve clearing payments through the U.S. wholesale payments system. In this situation, problems in this offshore clearing house might affect adversely the stability of the U.S. payments system.

Such growing interdependence between national and offshore payments systems has led financial authorities in the major countries to undertake an extensive program to strengthen wholesale payments systems. First, steps have been taken to enhance the ability of payments systems to

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1/ Some of these concerns have been discussed in recent conferences and symposia. For example, the Group of Thirty symposium on Clearance and Settlement Issues in the Global Securities Markets, in London in March 1988; and the International Symposium on Banking and Payment Services, sponsored by the Board of Governors of the Federal Reserve System, June 7-9, 1989; and the Williamsburg Payments System Symposium of the Federal Reserve Bank of Richmond, May 20, 1988.

2/ The Bank of New York, a major clearing bank in the U.S. payments system, experienced a computer breakdown on November 21, 1985, which led the U.S. Federal Reserve to make an overnight loan of $22.6 billion from the discount window, collateralized by $36 billion in securities.

3/ Greenspan (1989).

withstand operational and liquidity shocks and to allow for an orderly completion of the settlement process in the event of insolvency of a single institution or a group of institutions. Second, a strengthening of the capital positions of international money center banks, as agreed upon in the recently implemented Basle Agreement, was aimed at improving confidence in the ability of these key players to withstand adverse credit or liquidity shocks and thereby making them better placed to fulfill their settlement obligations. Before considering these policy measures in detail, it is useful to first examine some examples of major payments systems in order to more specifically identify what characteristics of these systems generate liquidity and credit risks.

III. The Main Features and Examples of Payments Systems

1. Main features

As noted above, most wholesale payments systems consist of (1) a central bank which settles payments among a group of clearing banks via their reserve accounts (e.g., the Fedwire system in the United States); and (2) various private clearinghouse arrangements among subgroups of banks (e.g., the CHIPS for international U.S. dollar payments or regional or Giro clearing systems in the Federal Republic of Germany). The main characteristics of these payments systems that are relevant for a discussion of systemic risk and public sector credit risk are: 1/

Gross or continuous settlement systems. In gross or continuous settlement systems, each payments instruction to the clearinghouse (central bank or private clearing corporation) results in an immediate debit for the sender and credit for the receiver in the settlement accounts that the sending and receiving banks hold with the clearinghouse. If gross or continuous settlement systems do not allow overdrafts against the clearinghouse, as is the case in Switzerland, then payments instructions can be executed only if the payor has a sufficiently large credit in his account. If the clearing house allows overdrafts, as in the Fedwire system in the United States, then it is necessary to determine the length of the period at the end of which the overdraft has to be eliminated. In this case, the clearing house is exposed to intra-settlement period credit risk arising from these overdrafts.

Net periodic settlement systems. In net periodic systems, payments instructions are accumulated by the clearing house over a period of time and only net debits and credits are entered into the settlement accounts of the members at the end of the settlement period. An important determinant of systemic risk in net settlement payments systems is the presence or absence of settlement finality. Under a regime of settlement finality, any payment instruction received by the clearing house is

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1/ Tables 4-9 of Appendix I summarize the key characteristics of major national payments systems.

irrevocably executed even in the event of default of the bank sending the message. 1/ Settlement finality precludes the clearing house from unwinding payments instructions in the event one or several members are unable to supply good funds at the end of the clearing day to settle their debit balances. Moreover, the nondefaulting participants of the settlement system are obliged to cover the shortfall at settlement. Liquidity crises are, therefore, avoided, while the claim against the defaulting institutions are resolved through legal recourse.

The risk-sharing rules adopted by the clearing house have to be explicitly formulated and must define the position of the defaulting institution vis-à-vis the remaining participants. The longer the settlement period, the greater the credit risk to which the clearing house is exposed. Most payments settlement periods are therefore one day or shorter. On the other hand, the shorter the settlement period the greater the need for institutions to hold costly reserves to be able to settle payments balances.

Gross settlement systems automatically achieve settlement finality since each individual payment instruction is executed without netting, thus unsettled balances do not accumulate. Furthermore, most gross settlement systems also have payments finality, i.e., the payment instruction is irrevocably executed and cannot be revoked.

2. Examples of major payments systems

The most prominent example of a gross payments system with payment finality and intra-settlement period overdraft facilities is Fedwire, the world's largest wholesale payment settlement mechanism. Fedwire is the U.S. Federal Reserve's nationwide wire transfer system for the movement of funds and U.S. government securities among foreign and domestic depository institutions operating in the United States. The depository institutions participating in Fedwire operate through the Federal Reserve Banks in their districts. As of January 1989, Fedwire had 11,398 active participants; of that number, 6,163 participated on-line. During the first quarter of 1989, the average daily transaction volume was 231,000, while the average daily value 2/ was almost $700 billion. Direct access to Fedwire is restricted to depository institutions, while other financial and nonfinancial firms, securities firms, insurance companies, etc., can gain access to the system only on terms and conditions set by their depository institutions.

Fedwire payments are made by debiting and crediting reserve accounts maintained by the respective depository institutions at their Federal

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1/ It is possible to refine the concept of finality further into, payments, settlement, and receiver finality depending on the stage of the funds transfer transaction (see Kawazoe (1988), and Federal Reserve System (1989)).

2/ Excluding CHIPS net settlement.

Reserve banks. The Fedwire payment is finally and irrevocably paid when a reserve bank sends the payment message to the receiving bank. Funds are immediately made available to the receiving customer (Federal Reserve Regulation J). Thus payment and settlement are final. It is noteworthy that the Fed will execute payment instructions even if this leads to a debit balance and that the execution of the payment does not depend upon the account of the sender. If the sending bank were to fail while in overdraft, the risk would be borne by the Federal Reserve Bank, which then becomes a general creditor of the failing bank. Such overdraft must, however, be settled by the end of the day, hence the term "daylight overdraft," by recourse to the Fed Funds market if necessary.

Fedwire intra-day overdrafts occur when a depository institution's outgoing Fedwire payments exceed the sum of its opening balance and its incoming Fedwire credits. The precise measurement of daylight overdrafts requires rules to determine when, during the day, debits and credits to a depository institution's account at a reserve bank occurred. For Fedwire transactions the timing is clear, since these are considered to be final payments when the receiver of funds is advised of the credit. Since intra-day reserve balances do not count towards meeting reserve requirements, banks are then primarily concerned about their reserve balances as of the end of the day. This is particularly true since daylight overdrafts do not carry a charge. Banks generally bring their reserve positions up to that required by the end of the day through borrowing in the federal funds market or reduce their reserves to required levels by lending in this market. These funds are then returned the following morning.

U.S. Government securities are also transferred among banks over Fedwire. Each Federal Reserve bank maintains ownership records of the securities in its computer system. Depository institutions can transfer securities held in their name to other institutions through a system of book entries. The transfer of securities in book entry form can be arranged either in conjunction with a transfer of reserves of equal value or as a separate transaction. Such security transactions also contribute to daylight overdrafts. Since reserve accounts are typically debited when book entry securities accounts are credited, a few clearing banks that specialize in transactions with government securities dealers, generate a large share of total daylight overdrafts of bank reserve accounts. For example, in the second quarter of 1988, four clearing banks accounted for about 70 percent of the daylight overdrafts attributable to transactions in book entry securities. Government securities dealers maintain book entry securities accounts and demand deposit accounts with clearing banks but have no direct access to the Fedwire book entry system. Dealers generally hold large inventories of securities during the day to meet the anticipated demands of their customers, but would sell most of their securities by the end of the day through repurchase agreements ("repos") to minimize the cost of holding the inventories. Investors who

enter into these repurchase agreements own the securities overnight and resell them to dealers early the next day. 1/

Fedwire daylight overdrafts averaged between $60-65 billion per day in 1989, with book-entry related overdrafts accounting for about 60 percent of all Fedwire peak intra-day overdrafts. The six largest clearing banks account for about two-thirds of all book entry related daylight overdrafts, while the ten largest clearing banks account for approximately 80 percent of all such overdrafts. Transfers of book entry securities over Fedwire averaged $312 billion per day in 1987.

The largest net settlements system without receiver finality is CHIPS (Clearing House Interbank Payments System), the international U.S. dollar payments system. CHIPS is a private payments network owned by the New York Clearing House Association with about 140 participating domestic and foreign banks, of which 22 are settling banks (i.e., banks that settle daily transactions on a net basis for their own account and as correspondents for nonsettling participants). Settlements among the 22 settling banks are made at the end of the day through the Fedwire system. CHIPS was the first private clearinghouse arrangement that permitted a real time exchange of electronic payment information with net balances being at first settled the next morning. In October 1981, CHIPS began same-day settlement through a special account at the New York Reserve Bank. Hence, overnight and weekend float disappeared from the CHIPS system leaving only daylight float. Most payments on CHIPS are associated with foreign exchange and Euro-dollar transfers. The payments volume is about $700 billion per day, about the same as on Fedwire during the fourth quarter of 1988. Peak volume was reached on November 14, 1988 at $1.2 trillion. The peak intra-day net debit position on CHIPS of about $45 billion per day has been smaller than the Fedwire funds daylight overdrafts of about $60-65 billion per day.

In 1986, the Federal Reserve Bank of New York undertook a special study which focused on CHIPS and Fedwire to ascertain the nature, timing, and the composition of payments on a single day (June 4, 1986) by sampling

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1/ Dealers generally make commitments to deliver specific securities by the end of the day. While the customer receives interest on the promised securities for the day, he pays the dealer only when the securities are delivered. Failure to deliver would expose the dealer to losses, and in order to minimize the probability of such fails, the dealer waits until early afternoon before directing his clearing bank to send the securities sold to the book entry accounts of the banks of the purchasers. When the repo-investor returns the securities to the dealer, the dealer securities' account at the clearing bank increases and his demand deposit account decreases, while at the Fed the book entry account of the clearing bank increases and its reserve account decreases. The dealer will also finance his inventory of securities by overdrawing its account with the clearing bank. The overdraft on the reserve and deposit accounts is reversed later in the day as dealers enter into repurchase agreements.

individual transactions (see Table 1). 1/ On that day, there were 120,000 CHIPS transactions with an aggregate value of $432 billion, and there were 56,000 Fedwire payments with a dollar value of $265 billion (these were payments originating in the New York Federal Reserve district only). 2/ The sample showed that Fedwire accounted for virtually all payments related to transactions for securities purchases/redemption/financing and federal funds purchases and sales, while CHIPS handled payments for almost all foreign exchange transactions. Overlap between the two systems occurred in the categories of payments related bank loans, commercial and miscellaneous transactions, settlement, and Euro-dollar placements. Foreign exchange and Euro-dollar placements made up more than 80 percent of CHIPS dollar volume, while these transactions only accounted for ten percent of Fedwire.

Of the 265 foreign-based depository institutions that have a banking presence in the United States, 91 are CHIPS participants (two-thirds of all CHIPS participants). Virtually all major depository institutions based in the United States are Fedwire participants, but fewer than 50 of these are represented on CHIPS. On the sampling day, $270 billion of payments of Fedwire were related to securities transactions, while only $1 billion of CHIPS transactions was related securities business. Bank loan transactions were generally low in frequency and value, indicating that much of this business is done on the bank's own books. Virtually all federal funds transactions occur over Fedwire. CHIPS usage is largely confined to foreign bank customers lacking direct access to Fedwire. The adjustment of correspondent balances constituted the dominant purpose for settlement transactions on both CHIPS (67 percent of transactions, 84 percent of dollar volume) and Fedwire (81 percent of transactions, 61 percent of dollar volume). CHIPS settlement transactions over Fedwire represent 5 percent of the settlement transactions on Fedwire, but more than 30 percent of the dollar volume. CHIPS transacted $23 billion dollars related to foreign transactions, while Fedwire transacted $250 billion of foreign exchange transactions (see Table 1).

A net settlement system which nets payments on a continuous basis avoids, or at least reduces, the systemic risk associated with the possibility that a participant fails to settle at settlement time. An example of such a system is the FXNET, a U.K. limited partnership owned by subsidiaries of 12 banks, which was developed largely to deal with foreign exchange transactions. For any given value date and currency, the

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1/ Transactions were divided into seven categories:
1. Transfers related to securities purchases/redemption financing
2. Bank loan transactions
3. Federal funds transactions
4. Commercial and miscellaneous transactions
5. Settlement transactions for other payments systems
6. Euro-dollar placements and returns
7. Dollar transfers related to foreign exchange.

2/ See Federal Reserve Bank of New York (1987).

Table 1. Estimated Aggregate Transactions by Survey Category by Wire System 1/

(In millions of dollars)

Schedule/Transactions Category	CHIPS				Fedwire			
	Number of Transactions	In Percent	Dollar Amount	In Percent	Number of Transactions	In Percent	Dollar Amount	In Percent
I. Securities purchase/ redemption/ financing	274	1.0	2,842	1.4	4,458	37.7	54,856	27.8
II. Bank loan	399	1.4	3,476	1.7	272	2.3	3,956	2.0
III. Federal funds	107	0.4	788	0.4	2,361	19.9	66,269	33.5
IV. Commercial and miscellaneous	1,295	4.5	12,793	6.2	2,690	22.7	33,593	17.0
V. Settlement	945	3.3	16,198	7.9	915	7.7	18,664	9.5
VI. Eurodollar placements	4,800	16.8	56,255	27.5	966	8.2	18,848	9.6
VII. Foreign exchange	20,674	72.6	112,505	54.9	173	1.5	858	0.4
Total	28,494	100.0	204,857	100.0	11,836	100.0	197,043	100.0

Note: Totals may not add due to rounding.

Source: Federal Reserve Bank of New York Quarterly Review, Winter 1987-88.

1/ The sample consisted of 13 banks accounting for 48 percent of all CHIPS payments on June 4, 1986 and of 9 banks accounting for 76 percent of all Fedwire payments on that day.

successive trades between two FXNET participants are continuously netted throughout the day. Such netting is bilateral, i.e., it occurs between any two participants in FXNET. Thus, the decisions regarding creditworthiness exposure and risk management are under the control of each counterparty. Such netting is done by novation, i.e., each trade is folded into the previous obligations and creates a new net position. This new obligation represents the only remaining binding bilateral currency payment obligation for all of the previous trades. Each counterparty either makes or receives one payment for each currency dealt on each settlement date. It no longer requires the exchange of two payments for each pair of currencies dealt.

Netting by novation transforms an FXNET obligation into a stream of net payments over all forward dates dealt. Such netting reduces settlement risk since the average amounts to settle are reduced and the volatility around the average are reduced. In the absence of an effective netting agreement, a liquidator could chose not to honor the solvent party's profitable contracts but could honor all the contracts that were profitable for the liquidating firm. Under the netting scheme, the liquidator has a claim only to net credits due to a liquidating firm and can default only on net debits. This feature greatly reduces systemic risk since it reduces the exposure of the overall system to the defaulting participant.

An example of a gross settlement system with payment finality that does not extend intra-day overdraft to the senders of payments is the Swiss Interbank Clearing System (SIC). 1/ The SIC is a gross settlement system with payments being settled individually on reserve accounts. It uses queuing to prevent daylight overdrafts on these accounts, operates twenty-four hours on bank working days and has a capacity of approximately 600,000 payments per day. Payments are irrevocable and final. Payment orders which would lead to an overdraft are automatically queued until sufficient funds have accumulated from incoming payments and are then automatically released for settlement on a first in/first out basis. This centralized facility relieves participants from having to synchronize incoming and outgoing payments to prevent overdrafts on reserve accounts. The queued orders may be cancelled by the sending bank at any time. This rule was designed to minimize incentives for participants to make use of payments held in the queue.

A value day starts at around 6:00 p.m. and ends at around 4:15 p.m. of the following bank working day. The 24 hour operations feature allows the coordination of settlement of foreign exchange transactions, in which currencies of countries located in different time zones are involved. Further globalization of financial markets might lead to increased use of this feature in other settlements and payments systems. The SIC participant has real time access to all data entered into this system relating to his account, i.e., he can monitor settled incoming and

1/ See Mengle, et al. (1987); Vital and Mengle (1988).

outgoing payments as well as payment orders stored in the waiting queue and pre-value data file, as well as the actual balance of the reserve account. The value of payments reached Sw f 140 billion on an average day in April 1989--about 50 percent of annual GNP. The value of payments drops to approximately 10 percent of the average on U.S. bank holidays, indicating that foreign exchange transactions are the major source for large payments. Payments of the order of Sw f 1 million or more comprise 97.9 percent of total value.

A change of liquidity regulations in January 1988 in Switzerland made reserve account balances voluntary, thus all reserves became excess reserves. As a result, the balances held by SIC participants decreased from Sw f 7.5 to 2.6 billion in April 1988, or to about one-third their original level. The daily turnover ratio, the relation between daily payment value and reserves, has increased from 12 to 54 on an average day. Almost one-third of payments are made and settled within ten minutes of being validated, while nearly two-thirds are made within two hours, and only 2.5 percent of payments are in the queue for more than five hours. While the Swiss SIC system has eliminated daylight overdrafts, it is nevertheless subject to the risk of having a payments grid lock, a situation in which no payments move over the system because the accumulated credit balances are too small.

There are indications that, if the composition of the payment stream is not changed by subdividing very large payments i.e., those in excess of Sw f 0.5 billion, then further reductions in the reserve account balances may increase the frequency of payments gridlocks. Currently gridlocks are resolved at the end of the day with funds raised in the market or through collateralized lines of credit with the Swiss National Bank at a penalty rate. Alternatively payments pending in the waiting queue may remain unexecuted. Moreover, it is unclear whether sufficient incentives exist to prevent participants from reducing their holdings of reserve account balances to a level where major gridlocks would become likely.

IV. Risk in Payment Systems

There are four basic parties to each transaction in a payments system. *The payor who originates the transfer, the sending bank who* transmits the payments message of the payor, the receiving bank that acts on behalf of the payee, and the payee. Credit risk may arise due to the possibility that any of the parties in the chain of transactions may default on its obligations. For example, the sender could initiate a transfer with his sending bank without having sufficient funds in his account to cover the transfer. The sending bank incurs credit risk if it transmits the payments message before the sender supplies the covering funds. Secondly, the sending bank may fail to provide funds to the receiving bank at settlement. Finally, the payee runs the risk that the receiving bank will not make the funds available. These three risks--sender risk, receiver risk, settlement risk--are to be found in most payments systems. If the clearing house operates under settlement

finality, then the credit risk of the sending bank is distributed over the receiving banks according the loss-sharing formula adopted by the clearing-house. 1/

In addition there is systemic risk, which occurs as an outgrowth of settlement risk (see Appendix II). The failure of one participant to settle deprives other institutions of expected funds and prevents these institutions from settling in their turn. Thus, although a participant does no business directly with a failed institution, chains of obligation may make it suffer because of the impact that the failed institution has on an intermediate participant's ability to settle i.e., the cost of settlement failure reach beyond the exposure of credited bank to the failing bank. While it is generally not difficult to identify credit risk in a payments system, there are difficulties in properly identifying systemic risk.

While a private or public payments system with settlement finality, such as the Fedwire system in the United States, is not subject to systemic risk, its participants are subject to credit risk, especially those generated by intraday credit exposures. Moreover, liquidity crises are avoided through a sharing of the debit balance of the failed institutions among the solvent members of the system or through a funding of the debit balance by the central bank. Concerns about intraday credit exposure led the Federal Reserve to introduce caps on debit positions with Fedwire and CHIPS (Table 2), and to propose interest charges on such debit positions. The presence of a cap on the debit position that an individual bank is allowed to run with Fedwire effectively limits the loss that could be incurred by the United States Federal Reserve as a result of payments instructions sent out over the Fedwire by a failing bank. However, in a situation where investors have lost confidence in a large money center bank and fail to renew short-term funds, such as maturing certificates of deposit and repurchase agreements, the bank would quickly reach its net debit limit and may then be unable to repay its short-term creditors. As a result, the central bank could be faced with the need to provide funds to the bank through the discount window and hence be once again subject to the credit risk inherent in the bank assets used as collateral. 2/ Thus, if some banks are regarded as too-large-to-fail, then it may be difficult for the central bank to avoid credit risk completely in a liberalized financial system.

1/ See New York Clearing House (1989), for proposed loss-sharing formula for CHIPS.

2/ A large proportion of the assets of money center or clearing bank are financed by short-term funds--certificates of deposit, repurchase agreements, interbank loans--and it is possible that a loss of such funding could make it necessary for the bank to discount assets other than the eligible government securities. In this case the central bank would be exposed to the private credit risk inherent in such assets.

Table 2. Caps on Daylight Overdrafts Across Payments Systems

(Multiples of adjusted primary capital)

Self-Assessment Category	Cap Applied to	Period Caps in Effect		
		March 27, 1986 to January 13, 1988	January 14, 1988 to May 18, 1988	May 19, 1988 to present
High	Two-week average	2.000	1.700	1.500
	Single day	3.000	2.550	2.250
Above average	Two-week average	1.500	1.275	1.125
	Single day	2.500	2.125	1.875
Average	Two-week average	1.000	0.850	0.750
	Single day	1.500	1.275	1.125
Limited	Two-week average	0.500	0.425	0.375
	Single day	0.500	0.425	0.375

Note: Adjusted primary capital for U.S.--chartered banks is the sum of primary capital less all intangible assets and deferred net losses on loans and other assets sold.

Source: Federal Reserve Bulletin (November 1987), page 843.

In contrast, the main international payments system--CHIPS--has not yet adopted payment finality and hence its members are significantly exposed to the credit risk of lending banks. The 150 member banks of CHIPS are international banks of varying credit ratings. Credit risk arises when banks send out payments for a customer during the day before receiving good funds in the customer's account. For example, a bank might receive a message from the clearing house that an account will be credited with a given amount of dollars at the end of the day. The bank might then be asked by the holder of the account to make payments to other banks from the account through CHIPS even though the bank has not received good funds. Competition has generally forced banks to be prepared to make such payments. All such payments messages are netted at the end of the day by CHIPS and net balances are cleared through Fedwire transfers among the settlement banks. 1/ Thus a central element of the international payments system is the extension of credit among the banks that are members of CHIPS. 2/

In the event of a disturbance in the financial markets, such as the bankruptcy of a major nonfinancial company, it is possible that some CHIPS members might be unable to settle their debit balances by borrowing in the interbank market for federal funds. In this case, payments to and from that participant would be unwound, and new net positions will be calculated for the remaining participants. If one of these remaining participants were unable to settle them, this process of calculating new net positions would continue until settlement is achieved. Participants in CHIPS permit most of their customers to use credits for CHIPS payments during the day prior to settlement while reserving the right to charge back such credits if the transferring bank does not settle its CHIPS position. Simulations of the unwinding of transactions under the assumption that one large CHIPS participant would be unable to meet its payments obligations suggest that such failures could change drastically the net positions of other participants, thus inducing a series of failures to settle by the remaining participants. 3/ This suggests that current CHIPS rules and the practice of unwinding thus could potentially contribute to systemic risks in the banking system and put pressure on the Federal Reserve to provide liquidity assistance while losses and solvency problems are determined.

Since the Federal Reserve does not regulate and supervise the foreign members of CHIPS, it could only guarantee the domestic transactors on CHIPS (as is done on Fedwire). Moreover, attempts by CHIPS itself to impose regulations on its foreign member banks would require the approval of bank regulators in other countries. Under current arrangements, the failure of a major international banking institution could nonetheless

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1/ Foreign banks clear through a CHIPS settlement bank.

2/ CHIPS operates under the legal environment of the U.S Uniform Commercial Code and hence wire transfers represent non-contingent commitments among banks.

3/ Humphrey (1986).

cause a systemic crisis if it were to spread illiquidity across the CHIPS system.

V. Policy Initiatives to Reduce Payment System Risk

This section reviews the major policy initiatives that have been undertaken to reduce credit risk arising from daylight overdrafts in gross payments systems and to reduce systemic risk in net payments systems. The thrust of these initiatives has been to reduce the credit exposure of the clearinghouse, such as Fedwire, and to introduce payments finality in net settlement systems, such as CHIPS, as well as to strengthen to operational, financial, and liquidity characteristics of the private net settlement systems.

The U.S. Federal Reserve introduced in 1986 a payments system risk reduction program which focused on controlling the direct Federal Reserve credit risk exposure arising with the extension of intraday credit on Fedwire (see Tables 2 and 3). The policy was later extended to CHIPS, in that it established a maximum amount of intraday overdraft that depository institutions are permitted to incur over Fedwire and private large dollar payment systems, such as CHIPS. Such caps are defined as a multiple of the depository institutions adjusted primary capital and are based on the institution's self-evaluation of its creditworthiness, credit policies, and operational controls. This policy was further strengthened in July 1987 when the Board adopted a two-step 25 percent reduction in cross-system net debit caps. In addition to the cross-system caps, which apply to the daylight overdraft position on Fedwire and CHIPS, there are also caps which apply to the sum of a bank's overdraft on its reserve account and its net debit position on Chips at each moment during the day. Each bank places itself in one of four self-assessment categories in order to determine its caps for both a one-day and two-week average maximum daylight overdraft as a percentage of primary adjusted capital (Table 2).

In addition to the cross-system caps, the Federal Reserve requires each participant on CHIPS to set a limit on its net credit position vis-à-vis each of the other participants on the system. Finally, CHIPS is required to establish limits on the net debit positions of each participant with all other participants on the system. This limit is set

Table 3. Summary of U.S. Federal Reserve Board Proposals for Payments System Risk Reduction

Issue	Current Policy	Proposed Policy	Proposed Effective Date
Private book-entry delivery-against payment systems	No policy.	If settlement on books of Federal Reserve Bank, must adopt certain liquidity and credit safeguards, prohibit unwinds, and provide open settlement information to participants.	On publication of policy statement.
Offshore dollar clearing networks	No policy.	Interim policy applicable to systems that settle directly or indirectly through Fedwire of CHIPS: (1) must be subject to oversight as a system by some authority; (2) participants responsible for risks and prudent management; (3) system must assure settlement finality; and (4) must be assured that satisfactory settlement can be ascertained.	On publication of policy statement.
Rollovers and continuing contracts	No policy.	Board supports efforts to reduce daylight overdrafts through conversion of overnight borrowing to term and continuing contracts, as well as rollovers of net amount of overnight amounts not repaid; lenders must be aware of additional risk.	On publication of policy statement.
Book-entry overdrafts	Exempt.	Include under cap; require collateral for total Fedwire overdrafts (funds and book-entry) if exceed cap because of book entry overdrafts.	1990.
U.S. agencies and branches of foreign banks.	Collateralized that part of Fedwire overdrafts that exceed cap multiple times U.S. capital equivalency.	Collateralized total Fedwire overdraft exceeds cap multiples times U.S. capital equivalency.	1990.
Defining overdrafts through nonwire posting sequence.	All ACH posted at opening; other nonwire posted net at opening if net is a credit and posted net at close if net is a debit; wire transactions as they occur.	U.S. Treasury book-entry interest, redemption, and net issue entries, and U.S. Treasury ACH credits at opening; U.S. Treasury direct and special direct investment at 2:00 p.m.; all nonwire and commercial ACH at close; wire transactions as they occur.	Late 1990 or early 1991.
Sender net debit cap;	Applies to intraday peak each day and two week average of daily peak values;	Same	
(1) small overdrafters;	(1) included under cap;	(1) exempt from caps if overdrafts are less than $10 million and 20 percent of capital;	(1) when net posting rule is implemented;
(2) CHIPS;	(2) included under cap;	(2) excluded from cap when settlement finality is implemented;	(2) when NYCH implements settlement finality on CHIPS;
(3) Book-entry overdrafts;	(3) excluded; and	(3) included; and	(3) 1990;
(4) De minimis cap.	(4) applicable only to infrequent overdrafters with overdrafts.	(4) No frequency test or dollar limit but retain 20 percent of capital.	(4) When new posting rule is implemented.
Capital (used with cap multiple to define sender net debit cap).	No price.	Applies price of 25 basis points (annual rate): (1) to total Fedwire overdraft (funds and book-entry); (2) to intraday average amount is excess of 10 percent of capital; (3) regardless of cap status.	Phased in over three years beginning mid-1991 (10 basis points first year; 10 basis points second year; and 5 basis points third year).

Source: Federal Reserve (1989).

at 5 percent of the sum of all bilateral credit limits for a given participant extended by all other CHIPS participants. 1/

In June 1988, the Board of Governors Large Dollar Payment System Advisory Group made recommendations on how to achieve further reductions in payment system risks. It concluded that (1) some level of public and private intraday credit was desirable to absorb the inevitable lack of synchronization of payments flows; (2) the unconstrained access to Federal Reserve overdrafts induces private institutions to use more intraday credit than is optimal; (3) either caps or pricing can in principle be used to discourage the use of daylight overdrafts; and (4) binding caps will produce a more volatile intraday rate than pricing.

With regard to the pricing of daylight overdraft, it has been proposed that the Board charge 25 basis points on daily average overdrafts, less a deductible equal to 10 percent of capital. This fee would be phased in over a three-year period beginning in 1991. The Federal Reserve's Large Dollar Payment System Advisory Group judged that this price should be set so as to "induce the creation of a private sector market to replace much of Federal Reserve funding of intraday credit." 2/ It is expected that the assessment of a fee for daylight overdrafts will create incentives for depository institutions to reduce their demand for intraday extensions of credit for funds transfers by reserve banks, thus reducing the reserve banks direct credit exposure. 3/ Such a reduction in daylight overdrafts could be achieved by delaying less critical payments, shifts of payments to CHIPS, greater use of netting, and the development of an intraday federal funds market.

In view of the anticipated shift of settlement from Fedwire to CHIPS, the Federal Reserve has also been concerned with reducing the systemic risks associated with private sector large dollar payment and clearing systems. It has, therefore, encouraged the New York Clearing House to

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1/ An important category of transactions that is not yet subject to the daylight overdraft caps are book-entry transfers of U.S. Government and federal agencies securities. It is proposed that book-entry-related overdrafts also be included within the existing caps on depository institutions daylight overdrafts. Since the majority of book-entry overdrafts appears to be concentrated in a few clearing banks that act on behalf of major dealers and brokers in Government securities, it has been feared that a restriction on the overdrafts of such institutions could impair the smooth functioning of the Government's securities markets. It is, therefore, proposed to permit such institutions to pledge book-entry securities in transit as collateral for the amount of the total funds and book entry overdrafts.

2/ Federal Reserve System (1989).

3/ Faulhaber, et al. (1988) suggested that efficient pricing of overdrafts would involve a per unit price per transaction, a charge on daylight overdraft and a premium covering possible default on daylight overdraft.

adopt settlement finality for CHIPS. If adopted, settlement finality assures that CHIPS net debit and credits will be settled each day even if some participants are unable to settle. This procedure, therefore, separates liquidity from credit risk since the allocation of losses can be resolved at a later stage. In consultation with the Board of Governors of the Federal Reserve System, the New York Clearing House recommended that all CHIPS participants sign a loss-sharing agreement for the purpose of providing funds necessary to complete CHIPs settlements in the event that one or a limited number of participants are unable to meet their respective debit balances. In addition, if any participant fails, or is otherwise unable to meet his balance, the remaining participants would make up the shortfall. They will contribute amounts computed by a formula under which each bank makes up a portion of the failed participants balance in relation to its own credit judgment regarding the failed banks, i.e., the bilateral limit, which enable the participants to incur the obligation on the system. It is expected that this procedure will also improve the assessment of bilateral credit limits.

An important element involved in instituting payments finality is that the multilateral netting rules on CHIPS be upheld legally. CHIPS and its individual participants cannot take the risk that the general creditors of a failed participant bank will demand immediate payment of the gross amount of payment sent to the failed bank, while at the same time treating payments made by the failed bank as unsecured (and possibly depositor-subordinated) claims against the receivership.

Finality of payment rules, such as those proposed for CHIPS, internalize the costs of a settlement failure and thus provide incentives for market participants to control payments risks. Such finality rules are of particular interest now because the United States National Conference of Commissioners on Uniform State Laws is currently drafting provisions of the uniform commercial code which codify a law of electronic funds transfer (EFT). This effort will largely determine the future statutory environment that guides the rights, obligations, and risk assignments of network participants. Finality rules need to specify with certainty who pays the cost of a settlement failure.

In the absence of established law and precedent, the New York Clearing House is seeking rulings concerning the proposed arrangements from the Federal Reserve and other regulatory agencies, and has proposed an amendment to the Federal Reserve Act. It is envisioned that settlement finality could become operative in 1990. While settlement finality on CHIPS would reduce private credit risk, it does not entirely eliminate it. It is possible, for example, that the debit balance of a group of failed banks is larger than that covered by the contributions of the remaining CHIPS participants.

One further possibility for eliminating the direct credit exposure of the central bank is to establish payment queues with payment transfers being held in the queue until covering funds have arrived, rather than allowing overdrafts. Hence a payment lacking temporary cover is not

rejected but instead is placed in a queue and then processed on a first-in first-out basis once covering funds are received. However, as noted above, the problem with adopting such a centralized payments queuing system is that, in the absence of reserve requirements or some price incentive, there is no guarantee that the voluntarily held level of reserves will remain above that required to avoid system gridlock.

An important public policy issue in the reduction of payments risk relates to the growth of offshore clearance and settlement systems. This has led to the preparation of a report of such systems by a group of experts on payments systems of the Central Banks of the G-10 countries. 1/ The incentives to develop offshore payments networks or netting systems derives from a less stringent regulatory environment and from significant time zone differences among North America, Asia, and Europe. Offshore dollar arrangements must ultimately settle in the United States through either CHIPS or Fedwire since good funds can only be transferred in accounts held with the United States Federal Reserve Banks. As a result, significant disruptions in offshore clearance and settlements system for foreign exchange and securities due to the failure of a participating institution, could well result in systemic problems in the United States and other major countries. Offshore clearing of U.S. dollar payments for subsequent net settlement in the United States has been viewed as obscuring and possibly increase the level of systemic risk in the U.S. large dollar payments system and in the international settlements process. 2/

Finally, offshore multilateral netting arrangements complicate the allocation of supervisory responsibilities. Formalized netting arrangements and offshore payments systems (i.e., groupings of individual banks with interrelated credit and liquidity risks) have shifted risks among participants; and it is, at times, unclear at what level a supervisor should examine the credit, liquidity, and operational risks facing these institutions. Both the host country authorities of an offshore system and the home country of the multinational participants in the offshore system have an interest in supervising the offshore system to the extent that it effects the solvency and liquidity of their institutions. In addition, the central bank for the currency that is being cleared in the offshore system could have a supervisory interest in the system for monetary policy reasons.

Another concern is that a shift away from the use of the central payments system towards the offshore netting system might amount to the decentralization of the major monetary mechanisms and thus undermine the relationship between key monetary aggregates and domestic activity. In

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1/ Report on Netting Schemes, Bank for International Settlements (1989).

2/ See Federal Reserve Press Release of June 16, 1989.

particular, netting arrangements can serve as a close substitute for money in terms of economizing on transaction costs. 1/

In response to these concerns, the U.S. Federal Reserve Board published a draft interim policy statement on offshore dollar clearing and netting systems. 2/ This report indicated that (1) any subsystem which settled directly or indirectly through CHIPS or Fedwire should be subject to oversight as a system by a relevant central bank or supervisory authority; (2) participants should clearly identify the operational, liquidity, and credit risks created within the system; (3) the system should provide for the finality of settlement obligations; and (4) the direct or indirect settlement of the system's obligations through CHIPS or Fedwire should be done by a U.S. settlement bank.

The increasing globalization of securities markets and foreign exchange markets and the shift towards 24-hour trading of certain types of securities has also led to proposals for extending settlement hours, preferably towards a 24-hour settlement period. Such an option is currently under review by Federal Reserve system. For example, in foreign exchange transactions, the delivery of each currency is made at a bank in the country which issues the currency. If the banking hours of the respective central banks do not overlap, a time gap between final settlements in the time currencies will appear. Currently settlement of spot transactions in foreign exchange markets occurs on the second day after the contract has been entered into. 3/

The counterparty risks in the settlement process for foreign exchange transactions could be minimized by moving toward a system based upon delivery-against-payment methods. However, if a yen-U.S. dollar

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1/ The development of multilateral clearinghouses could also significantly alter the structure of interbank credit relationships. For example, several large over-the-counter markets such as the interbank foreign exchange markets and the interbank swap market could evolve into an organized exchange, as is already the case with Eurodollar futures markets. If this occurred, net claims on the clearing organization would replace gross interbank credit exposure in the deposit markets. Under the Basle capital adequacy standards, bank claims on organized financial exchanges subject to daily margining have a zero risk weight in determining a bank's required regulatory capital.

2/ Federal Reserve System Staff (1989).

3/ If a yen purchase occurs in New York and if the buyer would like to have the yen delivered during that day, for example, the Bank of Japan would have to make a transfer settlement at night. Under the current system, final dollar settlement in a yen-dollar transactions in the New York foreign exchange market is made through Fedwire during the New York daytime, while the yen settlement is done through the GAITAME-YEN Settlement System during Japanese daytime, i.e., early in the morning of the next day in New York. Hence, a time-lag occurs between the two operations.

foreign exchange transactions took place in New York, such a simultaneous matching of the yen settlement to the dollar settlement would require the Bank of Japan to effect the interbank settlement during New York daytime or during night time in Japan. Some major U.S. correspondent clearing bank then would have to make transfers into a dollar account during the night.

In the absence of 24-hour settlement, offshore settlement systems have grown, with the attendant liquidity and credit risks. The inability to make a Fedwire transfer outside the 9:00 a.m. to a 6:30 p.m. eastern time slot has led banks to use other networks to each dollar payments. 1/

VI. Summary and Conclusions

Efficient and stable payments systems are of fundamental importance in maintaining an orderly international monetary system. Major disruptions of national and international payments systems would have highly adverse effects on international trade, capital flows, and real activity. A key issue now being addressed by the authorities in a number of major countries is whether existing institutional arrangements need to be modified in order to better manage the sharp increases in the volume of payments transactions and the liquidity and credit risks that have arisen as a result of the expansion of international trade and capital flows and the growing integration of major financial markets. For example, the direct credit exposure in the form of daylight overdrafts on the world's

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1/ For example, Chase Tokyo operates a dollar-settlement system in Tokyo. Transfers among the correspondent's dollar-deposit accounts with Chase are made in Tokyo. Balances are then transferred from Chase Tokyo to Chase New York after business hours in Tokyo. The final settlement occurs after the opening of the New York market. A net debit dollar-position with Chase is financed by an overdraft extended by Chase Tokyo until the net debit bank is in a position to raise dollar funds in New York through CHIPS and finally deliver it through Fedwire. If the net debit bank in Tokyo exceeds its credit line with Chase, it will then have to raise dollar funds which may be difficult when Fed's funds market is closed. If Fedwire were to operate on a 24-hour basis, it would become necessary to define when and how reserve positions are measured. Currently reserve balances are measured at the end of the day and counted as reserve balances for that day. In a 24-hour payment system, banks might be tempted to deposit funds for the measurement of reserve balances at a particular point in time and withdraw the funds immediately afterwards. Another difficulty might occur in the monitoring of institutions. If for example, a U.S. bank branch in Tokyo runs a negative balance on its accounts for the Fed, the Fed may find it difficult to ascertain whether there is a problem since the bank is located in Tokyo.

largest payment system, the Fedwire, has grown significantly during the last decade, as daily average overdrafts have risen to about $65 billion.

The internationalization of financial markets and of clearing arrangements has further contributed to systemic risk. Clearinghouses directly link the financial solvency of members through credit and debit positions in the clearinghouse. Periodic settlements are major points in time where the liquidity and solvency of banks are tested by the market. Many major international banks play the role of settlement banks for international transactions undertaken by smaller regional or local national banks. Thus, disturbances in one payment system would tend to spread rapidly to other systems.

One source of concern has been with the growth of international or offshore netting arrangements, in particular in foreign exchange markets. Netting arrangements that are located outside the country whose currency is being netted have "the potential to alter significantly the structure of the international interbank clearing and settlement process." 1/ Multilateral netting schemes without settlement finality in which participants retain some responsibility for the gross transactions are particularly exposed to credit risks. The unwinding that would be necessary, in the event a participant is unable to settle, is a significant source of systemic risk. Hence the emphasis on netting by novation, which reduces the overall credit exposure of participants to their net position vis-á-vis the clearing house. Furthermore, novation with settlement finality is the solution desired by regulatory authorities.

Since many of the credit and liquidity risks cannot be directly controlled by individual participants, it is unlikely that market forces alone would produce international payment arrangements that would adequately manage the systemic risks. Private cooperative arrangements without central bank involvement are unlikely to reduce systemic risk to acceptable levels, because the power of private clearinghouses to impose restrictions on members, as well as to provide liquidity occasionally required by members at closing time, is limited. Furthermore, the ability of private financial institutions to undertake regulatory arbitrage (i.e., relocate activities to a less regulated environment) suggests that cooperation between major central banks will have to be an important element in the management of payments system risks. Central bank cooperation in the strengthening of the international payments would complement the cooperation that has already been achieved in the area of bank supervision and monetary policy. 2/ Nonetheless, the allocation of supervisory responsibility among the various national supervisory authorities remains an unresolved issue. In part, this reflects the fact that while the efficiencies of netting arrangements may be enjoyed by banks located in one country, the credit and liquidity risks associated

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1/ Federal Reserve Press Release (June 16, 1989).
2/ Padoa-Schioppa (1989).

with the settlement of payments resulting from that netting system may be experienced in the banking system of another country. This issue is of particular concern to U.S. authorities as most of the offshore netting arrangements are subsequently settled through CHIPS and Fedwire.

These developments have led monetary authorities, particularly the U.S. Federal Reserve Board, to design policy initiatives reducing risks in payments systems. The Federal Reserve's payment system risk-reduction program began in 1986 and has focused on controlling levels of intra day credit extension on both large dollar U.S. payment systems, Fedwire and CHIPS, through the use of limits on total net debit position of participants in the system. In addition, the Federal Reserve has proposed that intraday credit on Fedwire be subject to a 25-basis points interest charge and that CHIPS introduce settlement finality in late 1990 or early 1991.

Since the proposed constraints on Fedwire and private payments systems in the United States are likely to stimulate the use of other private netting systems and offshore networks, the G-10 Central Bank Committee produced a series of proposals to strengthen such netting schemes with emphasis being placed on the finality of payments. Furthermore, it is thought that the globalization of financial markets and the development of a continuous 24-hour trading in some spot and futures contracts might necessitate operating the major clearing systems such as Fedwire on a 24-hour basis so as to avoid the systemic risk associated with current and proposed offshore large dollar payment networks.

A key element containing and reducing systemic risk in payment systems is the finality of payments, i.e., the reduction in the period during which balances remain unsettled. In addition, improvements in the operational efficiency and financial resources of clearing and settlement systems are important in containing credit and liquidity risks. Efficient operational features allows participants to keep track of exposures, including intraday positions. A clearing entity should have the financial resources and commitments in the form of reserves, collateral, committed bank loans, guarantees, etc., in place to ensure that in the event of a default of a participant settlement will still take place, i.e., no unwinding of transaction will occur. The financial resources of payments systems are reflected in the capital structure of member firms, the level of margins, and access to liquidity and collateral. A strengthening of these features is deemed to increase the ability of the institutions to withstand disturbances and thereby reduce payment system risk.

Table 4. United States: Payment System 1987

Instruments	Volume of Transactions (In millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of U.S. dollars)	Value per Capita (In U.S. Dollars)	Percentage of Total Value
Cheques issued 1/	49,200	201.0	82.9	55,917.0	228,140	16.40
Credit card transactions 2/	9,100	37.0	15.3	375.0	1,530	0.10
Payments by debit card at EFT	55	0.2	0.1	0.8	3	0.01
Large-value paperless credit transfers 3/ 4/	84	0.3	0.1	281,000.0	1,146,471	82.60
Other credit transfers by ACH and ATM 5/	613	2.5	1.0	805.0	3	0.20
Direct debits	269	1.1	0.5	2,235.0	9	0.70
Total	59,321	242.1	100.0	340,332.8	1,388,069	100.00

Note: EFT = electronic funds transfers; ACH = automatic clearing houses; and ATM = automated teller machine.
Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.
1/ Includes travellers' cheques (1.4 billion with a value of US$47 billion) and money orders (0.8 billion valued at US$70 billion).
2/ The Nilson Report, May 1988 (Los Angeles, California). Includes all types of credit card transactions; bank card volume: 2.5 billion valued at US$165.3 billion. Credit card payment volume and value included in cheque data.
3/ Includes Fedwire volume of US$53 million valued at US$142 trillion and CHIPS volume of 31 million valued at US$139 trillion.
4/ Approximately 40 percent of the dollar value of Fedwire transfers are for interbank loans transactions, 10 percent for Eurodollar transactions, and 10 percent for commercial transactions. Whereas 55 percent of the dollar value of CHIPS transactions are for foreign exchange transactions and 28 percent for Eurodollar transactions.
5/ ACH credit payments: 584 million transactions with a value of US$803 billion; ATM payments: 29 million transactions with a value of US$2 billion.

Table 5. Japan: Payment System 1987 1/

Instruments	Volume of Transactions (In millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of Yen)	Value per Capita (In Yen)	Percentage of Total Value
Cheques issued	269.4	2.2	7.4	4,129,848.9	33,768,184.0	67.4
Payments by credit card	211.9	1.7	5.8	4,672.2	38,202.8	0.1
Paper-based credit transfers	446.1	3.6	12.2	55,126.5	450,748.2	0.9
Paperless credit transfers	869.1	7.1	23.8	1,917,181.8	15,676,057.2	31.3
Direct debits	1,855.9	15.2	50.8	17,453.0	142,706.5	0.03
Total	3,652.4	29.9	100.0	6,124,282.4	50,758,898.6	100.0

Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.

1/ Estimated figures.

Table 6. Germany: Payment System 1987

Instruments	Volume of Transactions (millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of deutsche marks) 1/	Value per Capita (In deutsche marks)	Percentage of Total Value
Cheques issued	545.0	9	8.6	1,886.0 3,355.0	30,540.0 54,910.0	18.8
Cheques paperless collect 2/	(300.0)	(5)	(4.7)	(85.0)	(1,391.0)	(0.5)
Payments by credit card 3/	38.0	1	0.6	8.0	131.0	0.1
Payments by debit card at EFT	0.4	--	--	0.1	0.9	--
Paper-based credit transfers 4/	1,805.0	30	28.5	10,420.0	170,540.0	58.4
Paperless credit transfers 5/	1,665.0	27	26.3	2,560.0	41,899.0	14.3
Direct debits 6/	2,285.0	38	36.0	1,505.0	24,632.0	8.4
Total	6,338.4	105	100.0	17,848.1	292,112.0	100.0

Note: EFT = electronic funds transfer and ATM = automated teller machines.

Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.

1/ Partly estimated.
2/ Not included in direct debits in order to avoid double counting.
3/ Charge cards and bank cards, excluding retail cards; the card companies' settlements with the retailers (normally credit transfers) and payment of the monthly totals by cardholders to card issuers by credit transfers, direct debit, or cheque are contained in the corresponding items.
4/ Excluding interbank transfers. Interbank transfers via Bundesbank, partly estimated:

	Volume of Transactions (millions)	Value of Transactions deutsche marks (billions)
Local credit transfers	1.0	6,099.0
Local clearing house credit transfers	213.8	64,571.0
Intercity wire transfers	0.8	4,942.0

5/ Including customers' paper-based credit transfers that were routed into the paperless procedure by the bank to which they were first submitted.
6/ Including cash dispenser/ATM withdrawals made with ec-cards at banks other than that issuing the card.

Table 7. United Kingdom: Payment System at Year-End 1987

Instruments	Volume of Transactions (millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of pound sterling)	Value per Capita (In pound sterling)	Percentage of Total Value
Cheques issued 1/						
Town 2/	5	less than 1	less than 1	10,612	186,830	53.0
Other	2,963	52.0	57	1,253	22,059	6.0
Payments by credit card 3/	592	10.0	11	36	634	
Paper-based credit transfers 4/	483	8.5	9	527	9,278	2.5
Paperless credit transfers, Of which:						
Large-value transfers 5/	4	less than 1	less than 1	7,332	129,084	36.5
Others	678	12.0	13	231	4,067	1.0
Direct debits	486	8.5	9	127	2,236	less than 1
Total 6/	5,211	91.0	100	20,101	353,888	100.0

Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.

1/ Excluding an estimated 300 million cashed cheques, valued at US$25 billion (some £ 13 billion).
2/ Including interbranch cheques.
3/ Excluding transactions by holders of an estimated 9 million charge and budget cards issued by retailers, but including transactions by holders of over 1.5 million travel and entertainment cards.
4/ Including standing orders.
5/ Via Clearing House Automated Payments Systems (CHAPS).
6/ Excluding government payments in cash from post offices against state benefit vouchers.

Table 8. France: Payment System 1987 1/

Instruments	Volume of Transactions (millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of French francs)	Value per Capita (In French francs)	Percentage of Total Value
Cheques issued 2/	4,406.4	80.6	65.4	15,225.5	278,345.5	29.9
Payments by debit card at EFT 3/	530.0	9.7	7.9	163.0	2,979.9	0.3
Paper-based credit transfers 4/	128.7	2.4	1.9	30,719.4	561,597.8	60.3
Paperless credit transfers 5/	1,039.5	19.0	15.4	3,893.3	71,175.5	7.7
Direct debits 6/	637.3	11.6	9.4	921.0	16,837.3	1.8
Total	6,741.9	123.3	100.0	50,922.2	930,936.0	100.0

Note: EFT = electronic funds transfers.

Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.

1/ The figures in this table combine the data relating to all payment instruments, irrespective of whether they are routed via "official" circuits or not.
2/ Including postal cheques.
3/ Of which 45 percent (by volume) did not give rise to electronic payment.
4/ These figures include credit transfers of a purely interbank nature that have not been possible to isolate.
5/ A breakdown is not available.
6/ Including the universal payment order.

Table 9. Switzerland: Payment System 1987

Instruments	Volume of Transactions (In millions)	Volume per Capita	Percentage of Total Volume	Value of Transactions (In billions of Swiss francs)	Value per Capita (Swiss franc Value)
Cheques issued 1/	42.1	6.40	13.8	127.7	19,436.0
Payments by credit card 2/	9.2	1.40	3.0	2.7	410.0
Payments by debit card at EFT	1.0	0.15	0.3	0.04	5.0
Paper-based credit transfers	123.7	18.80	40.6	--	--
Paperless credit transfers	119.4	18.20	39.3	--	--
Direct debits 3/	9.1	1.40	3.0	--	--
Total	304.5	46.35	100.0	37.101 4/	5.50

Note: EFT = electronic funds transfer.

Source: Payment systems in 11 developed countries, prepared by Bank for International Settlements, May 1989.

1/ Euro, Bank, Swiss Bankers Traveller, and Postal Cheques.
2/ Rough estimates.
3/ Without payments by debit cards.
4/ Total giro transfers including interbank payments.

Example of Systemic Risk

Consider three participating banks (A, B, and C) on the CHIPS system. These banks receive and send payment during the day as in the figure below.

A		B		C	
Receipts	Payments	Receipts	Payments	Receipts	Payments
10 from C	5 to B	5 from A	10 to C	10 from B	10 to A
15 from C	10 to B	10 from A			15 to A

Assume that A issues an order to pay $5 to B; B makes a $10 payment to C; and C makes a payment of $10 to A. Then C makes an additional payment of $15 to A. Finally, A makes a payment of $10 to B; all these payments are made during the course of one settlement day. After CHIPS clears these payments: A is a net creditor for $10, B is a net creditor for $5, and C has a net debt balance of $15. Thus C would have to send $15 over Fedwire into the CHIPS clearing account at the Federal Reserve either directly or through its clearing bank. CHIPS would then pay out $10 to A's account and $5 to B's account. However, if C was unable to pay its settlement obligation, then CHIPS would unwind the days transactions and delete B's receipts and payments from the relevant net payments. The new transaction structure would become:

A		B		C	
Receipts	Payments	Receipts	Payments	Receipts	Payments
	5 to B	5 from A		--	--
	10 to B	10 from A		--	--

Thus A would be left with a $15 net debit position as opposed to a $10 net credit position. If A does not have $15 in its Federal Reserve account, it has to borrow from the Federal Funds market. However, the bankruptcy of a major bank might make it difficult for a net debit bank to borrow, particularly if its net debit is large relative to its capital. Simulation exercises 1/ have shown that the unwinding of transactions of one large CHIPS participant would make a high percentage of other participants unable to meet their commitments on CHIPS without acquiring additional reserves in the Federal Funds market. In such a situation, the Federal Reserve could lend reserves to bank A against collateral, or, at an earlier stage, to bank C so that the initial settlement could go through.

1/ Humphrey (1988).

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