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A DESCRIPTION OF ITS OPERATION AND
RISK MANAGEMENT

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Robert T. Clair*
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* The views expressed in this article are solely those of the author and should not be attributed to the Federal Reserve Bank of Dallas, or the Federal Reserve System.

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A Description of Its Operations and Risk Management

I. General Overview of the System

The Clearing House Interbank Payment System (CHIPS) is a high-speed message-switching network owned and operated by the New York Clearing House Association (NYCHA) to clear international dollar payments. Based in New York City, CHIPS was developed in the late 1960s as an electronic replacement for a paper-based payment system, the Paper Exchange Payment System (PEPS).

PEPS provided an effective clearing arrangement but the paper-based structure was unable to handle the rapidly growing volume of payments that needed to be cleared. The growth in payment volume was partially the result of the growth of the Eurodollar market.¹ The change in foreign exchange rate

¹ For a discussion of the causes for the surge in the Eurodollar market, see Sarkis J. Khoury, Dynamics of International Banking, Praeger 1980, p. 24-6.

regime from fixed to floating rates in 1973 also likely increased the volume of international payments that needed to be cleared.

In response to the growing volume of international payments the NYCHA developed the Clearing House Interbank Payments System (CHIPS). The crucial difference between CHIPS and PEPS, its paper-based predecessor, is that CHIPS is an electronic-based payment system capable of handling higher volumes of payments. CHIPS began operations with only 9 NYCHA participants and processed 800,000 transactions with a total value of \$1 trillion in 1971, its first full year of operations. In 1974, it expanded its operation to 56 participants by taking in all the former participants of PEPS. Participation continued to rise during the late 1970s, stabilizing at about 140 in the mid-1980s.² In 1988, CHIPS processed 34 million transactions worth \$165 trillion. (See Appendix A for annual volumes.)

Because CHIPS originated from a paper-based system, it initially retained some of the characteristics of that system, such as next-day settlement. But as demand of participants and the availability of technology have changed over the years, CHIPS has also changed. In 1981, it adopted same-day settlement. In 1984, it began incorporating risk-management measures that are monitored in real time, something only possible on an electronic network.

II. Legal Framework for the System

Twelve New York money-center banks make up the membership of the NYCHA, each of which is represented on the Clearing House Committee that establishes

² In 1980, a moratorium on new participants was imposed. The reason for the moratorium was the need to expand computer capacity and to resolve some legal issues before new participants could be added. That moratorium was lifted in 1983.

the rules for the operation of CHIPS. (See Appendix B for a list of members.) The Clearing House Committee chooses an executive vice president who enforces the rules and oversees all operations of the clearing house. The basic framework for the operations of CHIPS is presented in the Constitution of the New York Clearing House Association and in the Rules Governing the Clearing House Interbank Payment System as adopted by NYCHA. Nonmember of NYCHA must agree to abide by CHIPS rules before being allowed to participate in the system.

Any financial institution can apply to participate in CHIPS if it meets several minimum requirements.

- 1) Participants must be either a commercial banking institution, an Edge Act corporation, or a banking affiliate of a commercial banking institution located in New York City. In addition, the parent company of an Edge Act corporation or an Investment Company as defined by New York State Banking Law may become a substitute participant thereby providing the greater financial strength of the parent in place of its eligible subsidiary.
- 2) Participants must be subject to regulation by the New York State Banking Department or a federal bank regulator.
- 3) Participants must also agree to transmit their messages to CHIPS through a primary connection located in New York City or a backup connection located in the greater New York metropolitan area.
- 4) In addition, there must be located in New York City an officer of the participant institution who is authorized to make binding commitments to CHIPS while CHIPS is operating.
- 5) Finally, potential participants must provide CHIPS with current

financial statements for themselves and any parent companies. The annual financial review process is not specified, but CHIPS seeks to maintain financially strong participants to minimize any risks to the association.

The rules governing the operation of CHIPS are established by the Clearing House Committee and any changes in these rules must be approved by a majority of the members of the association. These rules are administered by the executive vice president of the clearing house. The executive vice president can enforce these rules through his/her power to suspend or terminate a participant from CHIPS. The decisions of the executive vice president can only be appealed to the Clearing House Committee.

All participants are governed by the same rules. There is no distinction made between foreign and domestic banks. Furthermore, there is no explicit distinction made between members of the NYCHA and other participants. However, the 12 NYCHA members write the rules that govern all participants. While the nonmember participants can provide input to important clearing house decisions, ultimately the decision will be made by the twelve members.

III. Structure, Operations and Administration

On a normal business day, CHIPS operates from 7:00 a.m. to 4:30 p.m. with settlement usually completed before 6:00 p.m. CHIPS closes for bank holidays as set by the State of New York and observed by the Federal Reserve Bank of New York (FRB-NY) over whose books CHIPS settles. If CHIPS is closed for a holiday not celebrated in Europe, CHIPS operates for extended hours on the next business day, beginning at 5:00 a.m. and ending at 5:00 p.m. The extended hours accommodate the additional volume generated by foreign banks on

the day that CHIPS was closed. The hours of operation may also be extended or changed by the executive vice president as needed.

Payment messages sent over CHIPS are credit transactions, i.e. the message directs CHIPS to debit the sender's account and credit the receiver's account. All messages are initiated by the institution sending funds. The payment message includes at least the identity of the sender, the identity of the sending institution, the amount of funds to be transferred, the identity of the receiving institution and finally the receiver's beneficiary account identity.³ More information can be included if desired, which may be important to the sender to explain in detail the purpose of the payment to the receiver.⁴

A payment message can be either sent or stored on CHIPS. A message can be stored on the CHIPS computers for release later the same day. A stored message can be deleted by the sending participant. Alternatively, a payment message can be sent immediately. In either case, once a payment is sent it is irrevocable and represents an unconditional obligation of the sending institution. The obligation is binding regardless of error, settlement failure, or even bankruptcy of either the sender or the sending institution.⁵

CHIPS utilizes a two-tier settlement procedure. In order to understand

³ Often participants send or receive messages for their own accounts. In these cases the sender and the sending institution are one in the same as are the receiver and the receiving institution.

⁴ Commercial payments for shipments received are often adjusted for damaged goods or other returns. Details explaining what invoices are covered by a particular payment can be useful in completing the transaction.

⁵ When a payment is sent in error, it is left to the two participants to reach a negotiated settlement to resolve the error. The negotiation is outside the CHIPS system. There are accepted conventions as to the appropriate charges paid for errors usually in the form of foregone interest.

the operation of the settlement it is important to know the four basic entities involved in clearing and settling a payment through CHIPS: participants, settling participants, CHIPS as the processing entity and the Federal Reserve Bank of New York (FRB-NY) across whose books settlement is accomplished in a special settlement account. The participants are those financial institutions that are permitted to send and receive payment messages over the communication network established by CHIPS. CHIPS itself is only a high-speed message switching system and a set of accounts. An important subset of the participants are the settling participants. These settling participants are the only participants able to make or receive transfers over Fedwire into or out of the special CHIPS account at the FRB-NY.⁶ They act as correspondent banks for the other participants and make settlement transfers that settle their own accounts and the accounts of other participants that settle through them. Each settling participant either makes a single transfer into or receives a single transfer from the special account maintained for CHIPS at the FRB-NY. The single transfer settles the entire day's transactions for the settling participant and all of its respondents.

The participants can be categorized into three groups. The most numerous are the U.S. agencies and branches of foreign banks. These foreign participants account for 105 of the 140 participants in CHIPS. The large number of foreign participants reflects the fact that CHIPS was developed primarily to handle foreign payments, and these payments continue to make up the vast majority of payments sent over CHIPS. The second category are the fourteen U.S. domestic institutions that are nonsettling participants. Many of

⁶ Fedwire is the wire transfer system operated by the Federal Reserve System.

these participants are the major U.S. regional banks that participate through Edge Corporations located in New York City. Finally there are the 21 domestic settling participants. The settling participants are primarily New York money-center banks. Thirteen of the settling participants settle only their own account and the remaining eight provide settlement services to as few as three or as many as twenty-six nonsettling participants.

The CHIPS communication network is a single-node network. All participants are connected directly to a single message-switching center, CHIPS. Participants provide services in turn to third-party customers including nonparticipating respondent banks. Messages are often received in a preformatted electronic form and resent by the participant through CHIPS.

Each message sent through CHIPS causes the sending participant's account to be debited and the receiving participant's account to be credited. In addition, CHIPS maintains a sophisticated set of accounts needed to enforce its risk-management system, which is described in detail in section VI, and to provide its participants with necessary information to monitor their risk exposures. In particular, accounting information is maintained for each participant relative to every other participant and for every third-party customer of a participant that has been assigned a beneficiary account identification.

The CHIPS inquiry system permits a participant to obtain the status of all the incoming and outgoing payments with respect to an individual account serviced by the participant. In addition, the participant can also obtain the status of its current net credit or debit position vis-a-vis all other CHIPS

participants.⁷ Finally, a participant is permitted to obtain the net net debit or credit position of any other participant whenever CHIPS is open.⁸

The payments transferred on CHIPS are primarily international in nature. A survey of one day's transactions on CHIPS was conducted by the FRB-NY.⁹ The survey indicated that over 82 percent of CHIPS' dollar volume of payments occurred in foreign exchange and Eurodollar placement transactions. The distribution of CHIPS payments by type of transactions is presented in Table 1. The predominance of international transactions is not unexpected since two-thirds of CHIPS participants are branches and agencies of foreign banks.

⁷ The participant net debit or credit position with respect to another participant is the sum of all the funds it has received from that participant less the sum of all the funds it has sent to that participant. If this difference is positive, the participant is in a net credit position, and if the difference is negative, the participant is in a net debit position.

⁸ A participant's net net debit or credit position is the sum of all the funds it has received less the sum of all the funds it has sent. If this difference is positive, the participant is in a net net credit position, and if the difference is negative, the participant is in a net net debit position.

⁹ See "Large-dollar Payment Flows from New York" Quarterly Review Federal Reserve Bank of New York, vol. 12 (Winter 1987-88) p. 9-13 and "A Study of Large-Dollar Payment Flows Through CHIPS and Fedwire" (a bound paper, Federal Reserve Bank of New York, December 1987).

Table 1.
Distribution of CHIPS transactions by type
(Percent)

	Number of transactions	Dollar amounts
Foreign Exchange	72.6	54.9
Eurodollar Placements	16.8	27.5
Settlement	3.3	7.9
Commercial & Misc.	4.5	6.2
Bank Loan	1.4	1.7
Securities Purchase/ Redemption/ Financing	1.0	1.4
Federal Funds	0.4	0.4

Source: "Large-dollar Payment Flows from New York" Quarterly Review Federal Reserve Bank of New York, vol. 12 (Winter 1987-88) p. 9.

Little is known about the specific bank customers that use CHIPS to complete payments beyond anecdotal information from individual banks and the FRB-NY survey. The survey indicated that approximately 90 percent of the transactions involving Eurodollar placements or foreign exchange originated from offices outside the U.S.¹⁰ The customers in these transactions were listed as banks but it is unknown if these banks are carrying out transactions on their own behalf or on behalf of their commercial customers. In the foreign exchange transactions the transfers were concentrated in spot contracts for German marks, Japanese yen and the British pounds.

The need for reliability in an electronic payment network is well recognized by CHIPS, which has made extensive efforts to ensure continuous

¹⁰ The definition of originating outside the U.S. deserves explanation. The survey respondents were instructed to treat foreign offices of all banks (including their own) as being "foreign customers" and treat U.S. offices of foreign banks as being "domestic customers."

operations. In addition to a second computer system at its primary site that can maintain operations at the primary site in the event of a single computer failure, CHIPS has a third identical computer located at a back-up site. CHIPS uses "remote logging" at that site to back up the messages sent on its primary system, and it could activate the back-up system and conduct business in a matter of hours. CHIPS also maintains two overlapping independent communication networks to connect participants to the CHIPS computer.

CHIPS requires that each participant maintain both a primary and a back-up site for their connection to CHIPS. Each site is connected directly to both the primary CHIPS processing site and the back-up CHIPS site. All connections are through high-speed lines and communication multiplexers with "dial back-up" lines offering yet another level of redundancy.

CHIPS also has extensive contingency plans. In the event of a power failure, CHIPS has a battery-based reserve and a dual diesel generator system to generate its own electrical power as needed.¹¹ By CHIPS own assessment, "Operational problems are now near zero; uptime is consistently in the 99% to 100% range." During 1988, uptime averaged 99.92% and operational problems within CHIPS caused only a single instance where the CHIPS closing hour was delayed (for a total of 90 minutes).

In recovering its costs, CHIPS acts like a cooperative. Total costs for the CHIPS operation are determined and then allocated to all participants based on their usage. The expenses are assessed monthly based on the number of messages sent and received during the previous month. There is a minimum assessment of \$2,500 per month. This method has resulted in an average cost of

¹¹ The CHIPS processing facility also has environmental controls to prevent or minimize any problems resulting from excess heat or humidity, water leakage, or fire.

\$.29 per message sent or received. Consequently a complete transaction would cost twice that or \$.58.

Participants also incur costs for participating on CHIPS that are not part of the expenses charged by CHIPS. Each participant must maintain two locations for the transmission of payment messages to CHIPS in the New York City area and the staff to operate these offices. In addition, an officer of the participating institution that is authorized to take appropriate action on behalf of the participant in connection with its CHIPS operation must be available in New York City during all hours that CHIPS is open and until CHIPS settles at approximately 6:00 p.m. each business day. Participants recover these costs either through profits generated from executing their own payments over CHIPS or through fees, both implicit and explicit, charged to their customers.

IV. Settlement and Finality

CHIPS is a net net settlement or a multilateral net settlement payment system.¹² Payment messages are sent all day but there is no transfer of funds

¹² A single net settlement system, also known as a bilateral net settlement system, would require one transfer between every pairwise combination of participants on a payment system that dealt with each other. A net net settlement system, also known as a multilateral net settlement system, reduces the number of transfers to just one transfer either sent or received by each participant to a central account. In a two tiered settlement, some participants in a net debit position send their transfers to the central account indirectly through settling participants. After receiving these transfers, settling participants in a net debit position send a transfer to central account designated by the payment system. For a further exposition of different types of settlement systems see David L. Mengle, "Daylight Overdrafts and Payment System Risks" Economic Review, Federal Reserve Bank of Richmond, Volume 71/3 (May/June 1985) p.15 and Group of Experts on Payment Systems, "Report on Netting Schemes" mimeo # BIS/PG/207E, Bank of international Settlement (January 1989).

until settlement time. During a normal day, CHIPS maintains the set of accounts and at 4:30 p.m. it closes the CHIPS system to messages. By 4:45 p.m. CHIPS informs every participant of its net net position and each settling participant of the net net positions of the participants for which they settle.¹³ A participant's net net position is the sum of credits received less the sum of the payments (debits) sent. If the net net position is negative, the participant is said to be in a net debit position and is required to transfer funds to the CHIPS settlement account at the Federal Reserve Bank of New York in order to settle its accounts. If the participant is a nonsettling participant then it makes this transfer indirectly through a settling participant. Settling participants in net debit positions make their transfers directly into the CHIPS settlement account at the FRB-NY.

By 5:30 p.m. all the settling participants should have agreed to settle. The settling participants in a net debit position transfer funds into the settlement account by 5:45 p.m. Once all the funds have been transferred into the account by settling participants, CHIPS, acting as agent of FRB-NY, transfers funds to all settling participants in a net credit position. Once the transfers are completed, CHIPS informs all participants that settlement is completed which normally occurs before 6:00 p.m.

¹³ Participants are also informed of their net position with respect to each other CHIPS participant. This information can be useful in reconciling the participants accounts with CHIPS accounts.

A settling participants net net position is the sum of the credits it has received less the payments it has sent plus the sum of the net net positions of the participants for which it settles.

Chart 1.
CHIPS Settlement Time Table*

4:30 p.m.	CHIPS closes to current day payment traffic.
4:45 p.m.	CHIPS informs all participants of their net net positions.
5:30 p.m.	By this time all settling participants agree to settle.
5:45 p.m.	The settling participants in net net debit positions transfer funds into the CHIPS account at the Federal Reserve Bank of New York.
6:00 p.m.	By this time CHIPS, acting as agent of the Federal Reserve Bank of New York, has transferred funds to all settling participants in net net credit positions and CHIPS informs all participants that settlement is complete.

* = These times are approximate with each successive step beginning as soon as the previous one is finished.

Even though the settlement is not completed until the end of the day, many CHIPS participants permit their customers receiving funds to resend those funds over CHIPS or Fedwire prior to settlement. Payment messages over CHIPS are irrevocable obligations of the participant. If settlement were not to occur and the funds anticipated at settlement were not received, these participants cannot retrieve these transfers and are still obligated for any funds released over CHIPS or Fedwire.

CHIPS has addressed the possibility of a participant not being able to settle by a special rule that effectively reruns the day's payments messages removing all messages initiated or received by the participant that is failing to settle. In effect, application of this process "unwinds" that participant from the system. (The unwind procedure is described in Appendix D.)

There has never been a settlement failure and unwind on CHIPS. However, settlement failures have been simulated in order to test the ability of the system to implement an unwind and to determine the impact of an unwind on settlement. The results of these simulations show that an actual unwind may be extremely complicated with positions differing substantially from original net

net positions.¹⁴ Indeed, as a result of the unwind, other participants may be unable to settle their revised positions, requiring further unwinds. This risk of additional failures is systemic risk.¹⁵

V. Financial Structure of the System

CHIPS operates using intraday, interbank credit. While CHIPS is not a bank and hold no deposits, CHIPS transfers represent an extension of intraday credit from the receiving participant to the sending participant.¹⁶ The receiving participant accepts the payment message realizing that it will not receive the funds until settlement is completed at the end of the day.¹⁷

Intraday credit is essential to the operation of CHIPS. All participants begin each day with a zero balance and debits and credits are posted simultaneously. In such a system, no transactions could occur unless there

¹⁴ See David B. Humphrey, "Payment Finality and Risk of Settlement Failure" in Anthony Saunders and Lawrence J. White, eds., Technology and the Regulation of Financial Markets: Securities, Futures, and Banking (Lexington Books, 1986), chap. 8, pp.97-120

¹⁵ The procedure for dealing with a settlement failure may change in the near future as CHIPS is working on an alternative collateralized loss sharing formula. CHIPS has not at this time published the details of how such a formula would work. The most important aspect is that the formula would reduce the probability of systemic failures.

¹⁶ CHIPS begins and ends each day with a zero balance in its account at the FRB-NY. Consequently, there are no overnight credit extensions on CHIPS.

¹⁷ As mentioned earlier, a participant could minimize the risk of extending this intraday credit by treating the funds as provisional and not permitting its receiving customer access to the funds until settlement is final. Competitive pressures have resulted in a common practice of permitting receivers access to the funds immediately.

were sufficient credit, i.e. a willingness to accept payments messages.¹⁸

The level of intraday credit within CHIPS is the sum of net credit positions of all participants in a positive net credit position. It can rise and fall during the day depending on the flow of payment messages. The average level of intraday credit was calculated for a two-week period from February 9-22, 1989. During this period, the average level of intraday credit was \$43 billion. The extension of this credit occurs early in the day. By 8:15 a.m., nearly \$30 billion of intraday credit has been extended. The level of intraday credit rises smoothly until late morning when at 11:30 a.m. it peaked at almost \$54 billion. Following the peak it declined smoothly to less than \$34 billion at 4:30 p.m. (See Appendix E for the complete data on intraday credit.)

Since the participants on CHIPS utilize only intraday credit, it is difficult to compare the treatment of this type of credit to other bank credit. The credit extended through CHIPS never appears on a balance sheet because balance sheets are based on end-of-day figures. In general, credit extended to other depository institutions for the purposes of clearing payments is treated differently than other types of bank credit. Indeed, credit for clearing payments is not bound by U.S. legal lending limits that restrict credit extended to a single entity to not exceed 10 percent of capital.

The amount of intraday interbank credit currently utilized to make payments over CHIPS is large. The Federal Reserve calculates the daylight overdraft level on CHIPS as the sum of the maximum net debit positions of each participant during the day. In September 1988, the average level of intraday

¹⁸ Often referred to as "grease," this credit represents the willingness of participants to accept payment messages based on the assumption that the sender will cover any net debit obligations at settlement. Such credit does not appear on any balance sheets and is not bound by legal lending limits.

interbank lending on CHIPS was \$45 billion. The comparable credit extended over the Federal Reserve System's Fedwire for funds transfer was \$55 billion.

The current financial structure of CHIPS settlement creates a risk, albeit small, of a substantial potential loss. If a participant were to unexpectedly fail during the day, it would be unable to settle its CHIPS account at the end of the day. While there has never been a settlement failure, simulations of settlement failure indicate that systemic failures could result and the impact of systemic failures would be large. These simulations indicated that a settlement failure could result in the failure of over one third of the participants to settle, and the "unwind" would affect 30 to 40 percent of the payment messages sent over CHIPS.¹⁹ These payments are still considered obligations of the sending participants, but these participants may not be in a position to meet these obligations.

VI. Liquidity and Credit Risk Issues

Payments can be made by a variety of means: cash, check or wire transfer. Often, the choice to utilize a wire transfer or other large-dollar payment system is based on the high degree of finality of payment. Finality requires three characteristics. First, the payments must be irrevocable; payment messages sent on CHIPS meet this criteria. Second, the settlement of the payment must be timely. CHIPS utilizes same-day settlement, which reduces the possibility of a participant failing between the time that a payment message is sent and when settlement is completed. The possibility--however remote--of an unwind does raise some questions as to whether settlement will indeed be timely. Third, if any event should disrupt settlement, there must be a clear

¹⁹ See Humphrey (1986).

determination of which parties will bear any loss and whether there are sufficient resources available to absorb the loss. CHIPS has a well-defined system for how settlement is to be completed in the event of a participant failing to settle, but the ability to determine how losses will ultimately be spread in the event of a settlement failure is not certain. It is the uncertainty with respect to these last two characteristics that CHIPS is currently addressing in order to improve finality.

Liquidity risk in a payment system is the possibility that a participant will not have sufficient funds in liquid assets needed to settle its position. It is important to note that liquidity risk does not imply that a participant is insolvent, but only illiquid at that particular moment in time. Each participant is responsible for its own liquidity in order to settle. Settling participants are not required to provide liquidity to the participants for which they settle. As a practical matter, the settling participants may provide liquidity to other participants to expedite the settlement process, but this is a business and credit decision not addressed by CHIPS rules and procedures.

Liquidity problems usually result from sudden and unexpected events that are often completely unrelated to the financial soundness of the illiquid participant. For example, illiquidity can result from operational problems. A computer failure could prevent a participant from transferring or receiving funds. If the participant was in a large net debit position at the time and the computer problem prevented the participant from borrowing liquid assets, then the participant could be illiquid at settlement time. It is also possible that illiquidity could result from unexpected financial demands. If a customer directed the bank late in the day to transfer a large-dollar volume of funds

and if after sending the funds, the bank discovers it could not buy funds in the market to cover its position, then the bank would be illiquid.

Liquidity risk among CHIPS participants can be managed in several ways. The first approach to dealing with liquidity risk is to require participants to maintain a reasonable level of liquidity. The executive vice president of the NYCHA has the power to review the financial statements of a participant and to require that the participant improve its liquidity if it is perceived that there is any problem. A second approach is to avoid unexpected demands on liquidity. The CHIPS system is excellent in providing a on-line, real-time inquiry system that permits a participant to monitor its liquidity needs constantly. It would also permit a settling participant the ability to monitor the net net positions of the participants for which it settles. Third, the maximum amount of liquidity needed by a participant is limited by a CHIPS-imposed limit on the maximum net debit position allowed for that participant. This limit, a net debit cap, is discussed in detail below. Furthermore, CHIPS requirements for back-up terminals and operational reliability help minimize the liquidity risks that might result from operational failure.

The most direct solution to a liquidity problem for CHIPS participants is to borrow liquid assets. The primary source of settlement assets is the federal funds market. The depth of the federal funds market in the U.S. provides a large pool of liquidity.²⁰

Credit risk differs from liquidity risks in that it is the risk that a participant will be unable to settle at the end of the day because it has failed during the day. The zero starting balance nature of CHIPS dictates that

²⁰ For some of the CHIPS participants, an alternative source of liquid assets would be to request a loan from the Federal Reserve's discount window.

credit must be extended among participants in order for payments to be possible. However, each CHIPS participant limits its exposure to every other participant by a series of bilateral limits on the maximum net payments it will accept from any other participant. CHIPS requires all participants to set these limits referred to as bilateral credit limits. A participant's bilateral net credit limits can be changed at any time and can differ for every participant. As a practical matter, these bilateral limits can be set at zero and sometimes are for smaller participants.

Since the bilateral net credit limit is set by each participant, the participants can enter into private agreements to limit risk further or to accommodate another participants' needs. For instance, a riskier participant may provide collateral to another participant in order to have a higher limit. The collateral may take the form of compensating balances. Alternatively, it is possible for a very sound participant to reach its bilateral credit limit with respect to another participant for some reason such as a large infrequent payment. In these cases, the participant extending the credit can at its discretion temporarily increase the bilateral credit limit in order to facilitate transmission of the payments.

In addition to the bilateral credit limits, CHIPS imposes a net debit cap on each participant. This cap limits a participant's net net debit position. The cap is a proportion of the sum of bilateral credit limits extended to a participant by the other participants.²¹ The net debit cap will change with a

²¹ In its simplest form, the formula is 5 percent of the sum of all bilateral credit limits extended to this participant by other CHIPS participants. If other participants feel that an institution has become riskier and have lowered their bilateral credit limits, the next day the net debit cap is automatically lowered.

one-day lag any time the bilateral credit limits change. The net debit cap limits the risk exposure of all CHIPS participants collectively to a single participant.

CHIPS monitors all transactions against these caps constantly. If a payment message is sent that would result in the violation of a cap, CHIPS stops the message. The message is queued until the net positions change sufficiently to permit the payment to be sent without violating the cap. This real-time monitoring is extremely effective, because credit risk is primarily a problem of an unexpected failure of a participant. No other measures are currently being considered to further reduce credit risk within the system; however, CHIPS is developing proceeds to improve settlement finality. Any improvement in finality reduces systemic risk.

VII. Audit and Oversight

The Federal Reserve System has stated that it has three responsibilities with regard to the U.S. payment system. It must ensure the reliability and efficiency of the payment system. In addition it must ensure that depository institutions of all sizes have access to the interbank payment system. Finally, and perhaps most importantly, the Federal Reserve must protect the payment system against systemic disruptions.²² It is the opinion within the Federal Reserve System that a systemic disruption of the payment system could hinder the ability of the economy to conduct transactions and reduce real growth and employment as a result.

²² See Board of Governors of the Federal Reserve System, Controlling Risk in the Payment System, Report of the Task Force on Controlling Payment System risk to the Payment System Policy Committee of the Federal Reserve System (August 1988), p. 12.

Supervisory oversight of CHIPS is the joint responsibility of the Federal Reserve System, Federal Deposit Insurance Corporation, Office of the Comptroller of the Currency, and the New York State Department of Banking. CHIPS has been examined annually on such a joint basis as a bank service corporation every year since 1979. The NYCHA has cooperated in these examinations.

Not only is CHIPS examined, but all the CHIPS participants are examined as depository institutions. One of the requirements of a CHIPS participant is that it be subject to regulation by the New York State Banking Department or a federal bank regulator. As a result, the financial condition and operational integrity of each participant is reviewed on a regular basis by one or more bank supervisors to assure the safety and soundness of the institution. These examinations include reviewing wire transfer operations including links with CHIPS.

The NYCHA as the operator of CHIPS also closely monitors the operations of CHIPS. As an association, the members that control CHIPS are also users of CHIPS. As such, they have a vested interest in guaranteeing that CHIPS continues to operate smoothly. To guard against disruptions that might occur on CHIPS, the NYCHA requires that CHIPS participants regularly file financial statements.²³ Furthermore, the executive vice president has the power to suspend any participant on CHIPS at any time.²⁴

In addition to the NYCHA monitoring the financial health of the participants, all the participants have an interest in monitoring the financial condition of all other participants that might send a payment to them. As

²³ See CHIPS Rule 19, section i.

²⁴ See CHIPS Rule 19, section d.

discussed above, accepting a payment requires extending intraday credit. Each participant must evaluate the financial condition of other participants when it determines the bilateral credit limit it will extend to that participant. The bilateral limits offer perhaps the most dynamic form of financial review since they can be changed at any time and are not subject to any appeal process.

VIII. Monetary Policy Issues

The clearing of large-dollar payments over CHIPS has relatively little effect on monetary policy issues, primarily because it has little or no impact on bank reserves, through which monetary policy is implemented. First, CHIPS is only a message-switching system. CHIPS does not hold any assets, particularly bank reserves. Nor does CHIPS hold deposits or other liabilities. CHIPS does maintain an account for settlement purposes at the FRB-NY, but the account begins and ends each day with a zero balance.²⁵

Interbank lending normally takes the form of federal funds lending and does have an impact on monetary policy. However, only intraday, interbank credit is extended over CHIPS and not by CHIPS. As long as there is no private market for intraday credit-- no explicit price is charged for intraday credit--

²⁵ The efficiency of a large-dollar payment system may affect the demand for deposits, which could have an effect on monetary policy. CHIPS, because of its same-day settlement, greatly reduces float in the payment system relative to payment by check. Consequently, to the extent that CHIPS transactions displace checks it reduces float and therefore reduces demand for monetary balances. If on the other hand, CHIPS transactions are not good substitutes for checks and are more likely the substitute for wire transfers on Fedwire, then there is no reduction in float. In either case, the effect would be very stable and predictable and warrant little concern by monetary policymakers.

the interaction between the market for intraday and overnight interbank lending is likely to be minimal.

Deposits held at the FRB-NY, however, are used to settle CHIPS, creating some demand for such reserves. The CHIPS accounting system has a net balance of zero at all times. Consequently, as one participant may be facing a growing net net debit position and therefore need a larger deposit at the Federal Reserve in order to enact settlement, there are other participants that are facing a growing net net credit position and can lend funds from their Federal Reserve accounts.²⁶

IX. Competitive Issues

CHIPS both competes with and is a complement to the Federal Reserve System's Fedwire funds transfer system. On a technical level, Fedwire is capable of handling any transaction that is currently being transmitted over CHIPS. Similarly access to Fedwire is open to all the participants of CHIPS although not all CHIPS participants currently use Fedwire services.²⁷ Key differences between the two systems are in the degree of finality offered (although CHIPS plans to improve finality may make this difference even less significant than it might be now for some participants) and in the cost

²⁶ A participant monitoring its liquidity position may perceive the need to build reserves in order to meet its settlement. Many participants are permitted to request a discount window loan. The effect on monetary policy, however, would be no greater than any other depository institution borrowing from the discount window. Furthermore, the monetary policy effect could be offset easily with an appropriate open market operation.

²⁷ Each application to join Fedwire would be judged on its own merits on a case-by-case basis.

structure for participants.

With respect to the cost structure, CHIPS requirements for connection/back-up facilities generally places a higher up front fixed-cost burden on participants than Fedwire which is offset by a generally lower per transaction cost. Low volume users would thus tend to have a preference for Fedwire.

Perhaps more significantly, however, is the strikingly different uses for the two systems, with CHIPS serving an international and offshore market for dollar payments and Fedwire very much focused on domestic U.S. payments. For major institutions with both international and U.S. business, the complementarity of the two systems seems to be supported by dual participation. Indeed, the foreign bank participants in CHIPS that do not participate in Fedwire are largely those with little domestic U.S. business or limited needs for dollar funding within the U.S. market.

The existence of the two system also has beneficial implications for operational flexibility and reliability. If an institution with links to both CHIPS and Fedwire were experiencing operational difficulties with one system but not the other, the ability to use an alternative path for payments could prove valuable. Indeed, substantial cooperation exists at all levels between the Federal Reserve and CHIPS.

Appendix A.

Annual Volumes and Dollar Values Originated by CHIPS

Year	Total Dollar Volume (trillions)	Total Payment Volume (millions)	Average Payment
1970*	\$.5	.5	\$1,029,782
1971	1	.8	1,410,762
1972	4	2	2,349,033
1973	9	2	3,387,959
1974	10	3	3,081,103
1975	10	6	1,819,960
1976	13	7	1,844,453
1977	16	8	1,963,089
1978	20	9	2,123,267
1979	26	10	2,453,896
1980	37	13	2,802,775
1981	40	15	2,526,910
1982	52	18	2,841,497
1983	60	20	2,987,304
1984	69	22	3,029,283
1985	78	24	3,154,917
1986	107	29	3,689,655
1987	140	32	4,375,000
1988	165	34	4,852,941

* CHIPS began operations on April 6, 1970 and operated for only 180 days that year.

Appendix B.

The Members of the New York Clearing House Association

The Bank of New York

The Chase Manhattan Bank (National Association)

Citibank, N.A.

Chemical Bank

Morgan Guaranty Trust Company of New York

Manufacturers Hanover Trust Company

Irving Trust Company *

Bankers Trust Company

Marine Midland Bank, N.A.

United States Trust Company of New York

National Westminster Bank USA

European American Bank

* The acquisition of Irving Trust Company by The Bank of New York may cause the number of members to decrease by one if the banks are merged.

Appendix C.
List of CHIPS Participants
(to be added as of March 1, 1989)

Settling Participants

(number of participants for which this participants settles is in parentheses)

Bank of New York (1)
Chase Manhattan Bank, N.A. (16)
Citibank, N.A. (11)
Chemical Bank (10)
Morgan Guaranty Trust Company (24)
Manufacturers Hanover Trust Company (27)
National Westminster Bank USA (1)
Irving Trust Company (16)
Bankers Trust Company (19)
Marine Midland Bank, N.A. (4)
European American Bank (1)
Fidelity Bank, N.A. (1)
Mellon Bank N.A. (1)
Philadelphia National Bank (1)
M & T Bank (1)
IBJ Schroder Bank & Trust Company (1)
First National Bank of Boston (1)
Bank of America, N.T. & S.A. (1)
First Interstate Bank of California (1)
First National Bank of Chicago (1)
Continental Bank, N.A. (1)

Nonsettling Participants

American Express Bank Ltd.
Standard Chartered Bank
Westdeutsche Landesbank Girozentrale
Bank of China
The Sumitomo Trust & Bank Co., Ltd.
Arab Banking Corporation
Royal Bank of Canada
Hypo-Bank
Swiss Bank Corporation
Dresdner Bank AG
First Wachovia International Banking Corp.
Extebank
Credit Suisse
Banca Nazionale Del Lavoro
BfG:New York
Bank Leu Ltd.
Banca Nazionale Dell'Agricoltura
The Yasuda Trust & Banking Co., Ltd.
Banque Indosuez
Den Danske Bank

Societe Generale
State Bank of New South Wales
The Saitama Bank, Ltd.
The Kyowa Bank, Ltd.
The Mitsubishi Bank, Ltd.
Gulf International Bank, B.S.C.
Skandinaviska Enskilda Banken
Bancomer, S.N.C.
Banco Portugues do Atlantico
Banco Real
Bank of California, N.A.
Banco Nacional de Mexico
Bank of New England, N.A.
Banco do Estado De Sao Paulo, S.A.
Osterreichische Landerbank AK
Banco Bilbao Vizcaya, S.A.
French American Banking Corporation
Amro Bank
Toronto-Dominion Bank
Banesto Banking Corporation
Deutsche Bank AG
State Bank of Victoria
Nederlandsche Middenstandsbank, N.V.
Provinsbanken A/S
The National Bank of Canada
Arab Bank Limited
DBS Bank
National Australia Bank
The Industrial Bank of Japan, Limited
Credito Italiano
Commonwealth Bank of Australia
Bank of New Zealand
Bank of Tokyo, Limited
Sumitomo Bank, Limited
The Mitsui Bank, Limited
The Fuji Bank, Limited
Australia & New Zealand Bkg. Group Ltd.
Northern Trust Int'l Banking Corp.
The National Bank of Kuwait SAK
Pittsburgh National Bank
Norwest Bank Minneapolis, N.A.
Dai-Ichi Kangyp Bank, Ltd.
The Taiyo Kobe Bank, Ltd.
The Tokai Bank, Limited
Republic National Bank of New York
State Street Bank and Trust Company
The Daiwa Bank Limited
Security Pacific National Bank
Banco di Sicilia
Harris Trust and Savings Bank
Commerzbank AG
The Hokkaido Takushoku Bank, Ltd.

UMB Bank and Trust Company
D.G. Bank
NCNB National Bank of North Carolina
Banco de la Nacion, Argentina
Bangkok Bank Limited
The Long-Term Credit Bank of Japan, Ltd.
State Bank of India
Sanwa Bank Limited
Overseas Union Bank, Ltd.
Banque Francaise du Commerce Ext.
Bank of Bermuda Int'l. Ltd.
Canadian Imperial Bank of Commerce
National Westminster Bank PLC
Westpac Banking Corp.
Den norske Creditbank
Privatbanken A/S
The National Commercial Bank
First American Bank of New York
Banco di Napoli
BHF-Bank
Banque Nationale de Paris
Credit Lyonnais
Kredietbank NV
Union Bank of Switzerland
Bayerische Vereinsbank AG
Bank Hapoalim, B.M.
The Bank of Nova Scotia
Barclays Bank PLC
Bank Leumi Trust Co. of N.Y.
Banco do Brasil, S.A.
Brown Brothers Harriman & Company
Banco Commerciale Italiana
Midland Bank plc
United Overseas Bank
The Nippon Credit Bank, Ltd.
Banco di Roma
The Mitsubishi Trust & Bkg Corp.
CIC-Union Europeenne, Intl et Cie
Banco Hispano Americano
Int'l Commercial Bank of China
Algemene Bank Nederland, N.V.
Israel Discount Bank of New York
Banque Paribus
The Toyo Trust & Banking Co., Ltd.
Hong Kong & Shanghai Bkg. Corp.
Bank of Hawaii
Korea Exchange Bank

Appendix D.
Procedures for a Settlement Failure on CHIPS: An "Unwind"

If a settling participant is unwilling to settle the net net balance of one of the participants for which it settles, the settling participant must notify the executive vice president of the NYCHA by 5:30 p.m. The executive vice president notifies the participant that it has one hour to arrange with either its settling participant or a new settling participant to settle its net net balance. If that participant is unable to find a settling participant to settle for it, then a new revised settlement is calculated, i.e. an "unwind."

CHIPS recalculates the day's transactions but eliminates any payment messages either sent by or received by the participant that is unable to settle. Their transactions are unwound from the other transactions of the day. Revised net net positions are calculated and reported to the remaining participants. Settlement then proceeds as it normally would with nonsettling participants transferring funds to their settling participants and the settling participants in a net net debit position transferring funds over Fedwire into the CHIPS settlement account. Finally, CHIPS would transfer funds out of the settlement account to the settling participants in a net net credit position and declare the settlement complete. The recalculation of the settlement in no way relieves the participant that was unable to settle of its obligation to pay the receiving participants.

Appendix E

Aggregate Intraday Interbank Credit Extended over CHIPS

(averages of total net credit positions over the period February 9, 1989 to February 22, 1989)

Time	Amount (Millions of dollars)
8:15 a.m.	29,823
8:30	32,830
8:45	36,147
9:00	38,302
9:15	40,824
9:30	42,226
9:45	43,443
10:00	45,329
10:15	46,324
10:30	48,776
10:45	50,195
11:00	51,497
11:15	53,576
11:30	53,982
11:45	53,790
12:00 noon	53,535
12:15 p.m.	52,711
12:30	51,636
12:45	51,315
1:00	50,242
1:15	48,653
1:30	48,192
1:45	46,137
2:00	45,351
2:15	44,390
2:30	43,529
2:45	42,021
3:00	40,732
3:15	38,703
3:30	38,310
3:45	37,020
4:00	34,678
4:15	33,797
4:30	33,609
4:45	32,705
5:00	32,557
5:15	32,340

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