

INTRADAY CREDIT: RISK, VALUE, AND PRICING

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I. Introduction

Electronic payment networks are of value because they provide certainty of payment, security, timeliness, and low cost relative to the dollar value transferred.¹ Timeliness is particularly important to money market participants who want to be able to act immediately on changes in market conditions, but it does not come without cost. While banks have invested heavily in speeding up wire transfers, the same level of emphasis has not been placed on controlling wire transfer risk. Because the banking system does not exactly synchronize the increasing volume of intraday payments activity, outgoing transfers are not always adequately funded by the originating party. Consequently, wire transfer networks are characterized by exposure of participants to *intraday credit risk*, that is, risk that lenders may not be repaid at the end of the business day.

Traditionally, bank regulation has focused on risks reflected on bank balance sheets. For example, bank supervision attempts to reduce credit risk from loan losses by examining asset quality, while capital requirements seek to build a protective buffer into balance sheets. More recently, regulators have also become concerned with risks connected with growing off balance sheet activities such as letters of credit and loan commitments.² Now, intraday credit risk associated with wire transfer networks is attracting attention. This risk cannot be measured by traditional methods that focus on balance sheets showing banks' financial positions only at the end of the day. Even looking at contingent liabilities off the balance sheet does not help here. Rather, one must look at payment activity *during* the day to see how intraday financial intermediation affects the banking system.

The purpose of this article is to develop a framework to illustrate why intraday credit risk exists and what determines its level. The analysis will show how pricing intraday credit could lead to behavioral changes that would reduce intraday risk exposures. In addition, the empirical section of the paper will explore ways in which pricing might be put into practice.

The views in this article are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Richmond or the Board of Governors of the Federal Reserve System. The authors wish to acknowledge the expert research assistance of William Whelpley. Section IV and the box on pp. 8-9 are based on Humphrey et al. (1987).

¹ The most important wire transfer networks are described in more detail on p. 4.

² Bennett (1986) and Summers (1975).

Most discussions of risk on wire transfer networks assume either explicitly or implicitly that intraday credit risk arises from the inherent nature of electronic funds transfer systems.³ By this assumption, the level of risks faced by payments system participants is attributable to such institutional factors as the large volume of wire transfers, a high degree of interdependence among banks, the speed with which funds change hands, and the extreme difficulty of exactly matching inflows with outflows. In contrast, it will be argued here that risk levels and the institutional factors that determine them are primarily a product of the existing legal and regulatory environment rather than simply intrinsic to the technology of wire transfer systems. If laws, regulations, and expectations regarding Federal Reserve policy were different from what they have been thus far, institutional practices and levels of intraday credit risk would also be different.

II. Risk and Wire Transfer Networks

At present, the two major wire transfer networks are Fedwire and the Clearing House Interbank Payment System (CHIPS). The form intraday credit risks take differs for each network.⁴ On Fedwire, transfers take place by debiting the reserve account of the sending bank and crediting the reserve account of the receiving bank. However, the sending bank is not required to have funds in its reserve account sufficient to cover the transfer at the time it is made. Rather, the transfer must be covered by the end of the day. Allowing reserve balances to become negative during the day leads to "daylight overdrafts," and it is these overdrafts that are the major source of risk to Federal Reserve Banks from Fedwire. Since a Fedwire transfer becomes final when the receiving institution is notified of the transfer, the Federal Reserve could not revoke the transfer if the sending institution failed to cover its overdraft by the end of the day. Thus, the receiving institution would have its funds while the Fed would be left with the task of collecting the payment from the defaulting sending bank. Credit risk in this case is borne by the Reserve Banks and possibly by the public.

³ See, for example, Association of Reserve City Bankers (1983) and Smoot (1985).

⁴ For a more detailed discussion of risks on electronic funds transfer networks, see Mengle (1985).

WIRE TRANSFER NETWORKS

Fedwire is the wire transfer network operated by the Federal Reserve Banks. Currently, approximately 200,000 Fedwire funds transfer transactions totaling over \$500 billion occur on an average day. Mean transfer size is about \$2.5 million. Transfers involving book-entry U.S. government securities total well over 30,000 per day for a total daily value of over \$260 billion. Average securities transfer size is \$8.7 million. Both funds and securities transfers have grown dramatically over the past decade. An important distinction between Fedwire and other networks is that settlement of transactions made over Fedwire is immediate, inasmuch as it occurs by means of credits and debits to depository institution reserve accounts on the books of the Federal Reserve Banks. Because the immediate settlement feature means that Fedwire transactions constitute "good" or final funds as soon as notification of payment is made, banks participating in Fedwire as receivers of payments are relieved of risk. The risk that the sending bank may not be able to fund its position is borne by the Federal Reserve when it accepts and settles a Fedwire transfer.

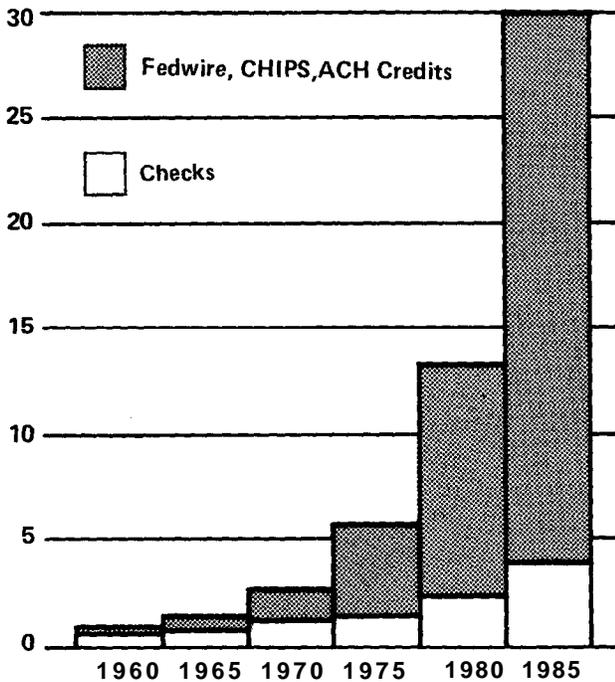
CHIPS The Clearing House Interbank Payments System (CHIPS) is a privately operated funds transfer wire network associated with the New York Clearing House. About one-half of its transfers concern international dollar transactions involving U.S. depository institutions. As of the end of 1986, approximately 114,000 funds transfers amounting to almost \$425 billion were transacted on CHIPS daily. The average transaction was approximately \$3.7 million. CHIPS was started in 1970 to efficiently transfer interbank balances involving international transfer of dollars on the books of the twelve New York Clearing House Association banks. This essentially eliminated the use of the paper draft to effect the transfers. While payment messages are sent over CHIPS throughout the business day, actual settlement of net debit and credit positions takes place at the end of the day through a special account at the Federal Reserve Bank of New York. Membership in CHIPS for other depository institutions is provided through an associate membership arrangement. Associate members must settle their CHIPS transfers on the books of one of the twelve New York banks (also known as settling banks).

Because CHIPS, a private wire transfer network, is a net settlement system, it presents a more complex set of risks. With net settlement, actual transfer of funds does not occur until settlement of net positions takes place at the end of the day. But bank customers may be given access to these transfers prior to settlement, creating credit risk that a sending bank might fail to settle. This leads to systemic risk, in which the failure of one system participant to settle its debit obligation to other participants in the network might, if the debit were large enough, lead to a domino-like pattern of settlement failures among other participants. Such risks are found on CHIPS not only because net debit positions and dollar values are large, but also because there is uncertainty regarding the precise rights and liabilities of all parties to a payment transaction in the event of a settlement failure. Statutory law is unclear in this area and, since a settlement failure has never actually occurred, case law has not developed to fill the void.

At the end of 1986, the size of the average funds transfer on Fedwire was \$2.5 million. On CHIPS, the average funds transfer was \$3.7 million. Securities transfers over Fedwire averaged \$8.7 million. Given the growing number of such large transfers each day, there is increasing concern with the credit risks assumed by banks as they clear payments many times the size of their reserve positions. An idea of the size of payments relative to reserve balances may be seen in Chart 1, which shows the ratio of average daily payments through the major payment networks to average daily reserve balances maintained with the Federal Reserve Banks. This ratio is a rough measure of the leverage exerted using reserve balances to support payment activity. The ratio has increased steadily from only about .9 in 1960 to over 30 by 1985. The largest increase in payments has taken place on Fedwire and CHIPS, both of which are used primarily for money market activity and third party payments. The growth of wire transfers has far exceeded that of checks.

Chart 1

**RATIO OF
PAYMENTS TO RESERVES
1960 - 1985**



Note: Payments are average daily dollar volume of checks, and Fedwire, CHIPS, and ACH credit payments. "On us" checks are excluded. Reserves are average daily reserve balances.

III.

The Nature of Intraday Credit Risk

Demand for Intraday Credit⁵

Payments system participants value intraday credit on electronic funds transfer networks because wire transfer payments and receipts are not perfectly synchronized. Intraday credit is an alternative to delaying payments until they are funded by receipts. In addition, it eliminates the necessity of holding clearing balances large enough to cover all expected outflows of funds. By using intraday credit, payments system participants escape the costs of scheduling payments to match receipts, along with overnight interest and opportunity costs of maintaining higher reserve balances. In short, there would be little if any demand for intraday credit if it were not costly to schedule all receipts to arrive at a bank in time to fund payments to be sent out.

⁵ In the remainder of this article, intraday credit will refer to both Fedwire daylight overdrafts and CHIPS net debits. Neither necessarily involves overdraft credit extended by banks to corporate customers.

The cost of synchronizing payments and receipts is likely to grow as funds transfer volume expands. Thus, anything that increases volume is likely to increase demand for intraday credit as well, other things staying the same. Contributing to higher payment volumes and demand for intraday credit are two legal requirements that cause banks and their corporate customers to use more funds transfers than would otherwise be the case.

First, prohibitions on paying interest on demand deposits held by medium- and large-sized businesses create incentives to reduce these deposits to the minimum each evening in order to put funds to work earning interest. The resulting investments in overnight money market instruments lead to a higher volume of Fedwire and CHIPS transfers than would otherwise occur. This means a higher probability that the banks through which these transactions are sent will go into overdraft. Second, Federal Reserve Banks cannot pay interest on reserve balances held by depository institutions. Since demand deposits are subject to higher reserve requirements than are other deposits, paying interest on reserves would reduce the cost to banks of paying interest on demand deposits.

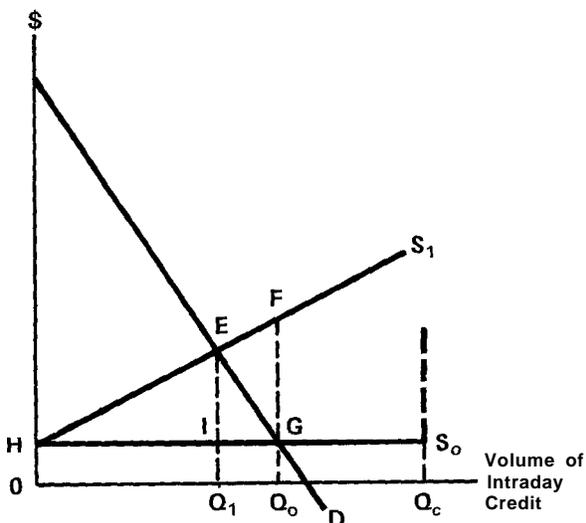
Besides bridging payments and receipts, intraday credit on wire transfer networks also enhances the ability of banks and their customers to make an immediate payment considered final by all parties involved whether or not sufficient clearing balances are held at the time of the transfer. Without intraday credit, final payment could only be made if sufficient clearing balances were on hand. Alternatively, immediate use of funds would be possible using a check or cash, but the opportunity costs of using these other means of payment are relatively high.

For example, in order for a check recipient to gain immediate access to funds, he or his bank would have to present the check for collection at the paying institution. If the check were written on a bank in another city or country, immediate (or same day) access to funds could be quite costly, if not downright impossible in certain situations. Thus, even if the explicit costs (in the form of charges and fees) of payment by check are lower than those of wire transfer, the implicit costs of getting the check to the payor bank, along with foregone interest when same day presentment is not feasible, are likely to be higher. As an alternative to payment by check, payment in cash would give the recipient immediate use of funds. Still, there is a relatively high risk of loss or theft. In addition, transporting large amounts of cash can be cumbersome and time-consuming. As with checks, the implicit costs of using cash to gain immediate use of funds are likely to be much higher than those for wire transfers. This more than offsets the relatively high observed explicit wire transfer costs.

The demand for intraday credit is portrayed as the demand curve in Figure 1. The horizontal axis measures the dollar volume of intraday credit within a given time period, and the vertical axis shows the value placed on each additional dollar of credit. As is generally the case for other goods and services, the demand curve is expected to be downward sloping, although very little is known empirically about the curve. It is reasonable to say, however, that as the price of intraday credit is raised, payments system participants can be expected to use less of it. That is, banks will use more intraday credit so long as the extra revenue generated by the credit exceeds what must be given up to use it.

Changes in the overall value placed on intraday credit would shift the entire demand curve. For example, demand could shift due to structural changes in the banking system that make intraday credit less useful to banks. Specifically, if all unit banking states converted to unlimited branching, large banks in unit states that previously gathered funds through the federal funds market would now be able to provide some part of them internally through branches rather than continue to purchase them from other banks. Since fewer electronic funds transfers would be necessary, demand for intraday credit would decrease and the curve would shift to the left. The shift would likely be greater if, along with unrestricted intrastate branching, interstate banking were permitted on a wider scale than today.

Figure 1
**MARKET SUPPLY
 AND DEMAND FOR
 INTRADAY CREDIT**



The elasticity of demand, that is, the sensitivity or responsiveness of volume of intraday credit demanded to changes in its price, is determined by existing technological factors and institutional payment practices. Since technology and institutional practices are costly to change quickly, demand may be expected to be more inelastic (that is, less responsive to price) in the short run than over a longer period. Given more time to adjust, banks would be better able to develop substitutes for intraday credit for processing payments. Examples of institutional changes that could serve as substitutes making the curve more elastic are discussed separately in "Institutional Changes That Reduce Intraday Credit Risk," page 8.

Supply of Intraday Credit

If intraday credit were supplied in a private market in which all parties bear directly the costs they incur, the supply curve for intraday credit would slope upward to reflect the increasing opportunity cost of additional units of credit. This cost would in turn consist of transactions costs plus two elements. The first is the value of intraday credit to suppliers, that is, the value suppliers place on using additional units of credit themselves.⁶ The second is a premium to compensate suppliers for credit risks assumed. At present, however, there is no active private market for intraday credit. In order to both simplify the exposition and concentrate on the risk issues involved, the supply curve presented in this analysis will be assumed to reflect only transactions costs plus costs related to risks, and will abstract from the value of intraday credit to suppliers.

The current supply curve (S_0), showing how the marginal or incremental cost of additional units of intraday credit changes with volume supplied, is horizontal in Figure 1 because the only cost to banks of each additional dollar of intraday credit used is the transactions cost of the transfer. This transactions cost, represented by the vertical distance OH , is assumed to remain constant as volume increases. Higher volumes of credit extended during a period, however, mean higher potential losses, so the true opportunity cost of intraday credit is better portrayed as rising as more intraday credit is extended. The shape of supply curve S_1 , then, illustrates the full social costs of wire transfer intraday credit due to risks to the payments system. But under the current institutional and regulatory framework, S_0 is the supply curve faced by depository institutions on both Fedwire and CHIPS, so private costs associated with intraday credit volume Q_c diverge from actual costs to society by an amount equal to the area of triangle HFG in Figure 1. The reasons banks do not face the full costs they incur differ between the two networks.

⁶ In loanable funds analysis, this is called the risk-free rate, and it reflects the pure time preference component of interest.

On Fedwire, the supply curve perceived by banks is horizontal mainly because the current charge levied by Federal Reserve Banks on each transfer does not vary to reflect the amount of intraday credit extended. Fedwire fees do not take account of the size of daylight overdrafts associated with the payments being processed, even though the Federal Reserve assumes the risk that a daylight overdraft will not be covered by the end of the day. Thus, the availability of unpriced daylight overdrafts guaranteed by the Fed leads to a supply curve (S_0) for banks that does not reflect the full costs they incur, and area HFG represents an implicit subsidy from the Federal Reserve to banks using intraday credit on Fedwire.

On private net settlement networks such as CHIPS, the supply curve faced by payments system participants diverges from the supply curve reflecting risks to society the same as occurs on Fedwire. This reflects the degree to which systemic risk may not be borne by CHIPS participants. The divergence is at least partly due to the belief of some CHIPS participants that the Federal Reserve as lender of last resort would intervene to prevent systemic failure rather than allow a chain of settlement failures to significantly disrupt financial markets. If payment network participants believe that regulatory agencies would likely take actions to enable a failing institution to complete settlement, then the consequences of one institution's failure to settle would not appear as severe to the other participants as would be the case if they had to bear the risk themselves. For example, if a discount window loan were extended to a bank failing to settle on a private sector wire transfer network, systemic failure would be averted. However, the assumed availability of such a loan would also reduce incentives for receiving banks to monitor the riskiness of sending banks. As a result, existing institutional arrangements on such networks are likely to be more risk-prone than would be the case if the Federal Reserve were expected definitely to take a "hands-off" attitude toward settlement failures regardless of the consequences for financial markets.⁷

Another factor contributing to the divergence between costs perceived by CHIPS participants and costs to society is the lack of a uniform body of law dealing with electronic funds transfers. The Uniform Commercial Code and CHIPS rules are silent regarding when payment obligations between customers are discharged and payments are final. Consequently, it is not nearly as clear who would bear the risk if a sending bank on CHIPS were to fail to settle as it is with, say, check payments. Although receiving banks might attempt to revoke funds they had released to receiving customers, there is no assurance that they would be successful. If revocation is successful, receiving customers might then attempt to collect pay-

ment from sending customers. This could be a problem, however, if the sending customer had released funds to the sending bank that failed before settlement. Because the law does not specify whether the sending customer had discharged his payment obligation to the receiving customer, the assignment of risks between the parties to the transaction is unclear. In such an environment, incentives for receiving banks to monitor risks could be weaker for some participants than they would be if the assignment of risks and liabilities were more explicit.

On both Fedwire and CHIPS, the height of the true supply curve (S_1) and the degree to which it slopes upward is influenced by at least two factors. First, since the marginal cost of intraday credit is largely determined by expected losses if an institution defaults, the supply curve will probably be higher as the riskiness of the banking system in general grows. Second, if banks augment their capabilities to monitor and control risks associated with intraday credit, the supply curve will likely shift down or become flatter. Thus, even if banks continue to perceive their supply curve as the horizontal portion of S_0 , policies that reduce risks connected with banking and that encourage risk control will have the effect of reducing the intraday credit risk associated with the divergence of private from social costs of intraday credit.

Equilibrium

Equilibrium in the market for intraday credit is found where the extra (or marginal) cost to a depository institution of an additional million dollars' worth of intraday credit equals its extra benefit in terms of facilitating payments or other benefits to the using institution. The equilibrium will determine the level of intraday credit risk in the payments system.

When individual payments system participants face the horizontal supply curve S_0 in Figure 1, they do not themselves face all the costs and risks they create. Equilibrium volume of intraday credit is Q_0 and total costs due to intraday credit risks are HFG. In contrast, if depository institutions face the full costs of their decisions as reflected in supply curve S_1 , equilibrium volume of intraday credit is Q_1 and the total cost associated with intraday credit risk is the area HEI.

The difference in costs between using S_0 and S_1 as the supply curve is EFGI. Of this area, EGI represents a transfer from society in general to payments system participants in particular, while EFG represents a cost to all of society. Since actual costs to society exceed the value of the intraday credit to institutions participating directly in the payments system, risk levels are higher than optimal.

⁷ Stevens (1984).

INSTITUTIONAL CHANGES THAT REDUCE INTRADAY CREDIT RISK

Many banks negotiate overnight federal funds purchases in the morning, leading to an inflow of funds to the borrowing banks later the same day. The following morning, the borrowings are repaid. The cycle repeats itself day after day for many net buyers of fed funds. Although the banks often end up borrowing similar if not identical amounts from the same lending banks each day, the borrowers repay most of their fed funds loans each morning in order to have the flexibility to react to changed borrowing requirements. In addition, they are able to take advantage of favorable rates that arise during the day. Finally, lending banks are assured control over their funds before they are re-lent.

These funding practices are encouraged by two aspects of the legal and regulatory environment. First, federal and state laws do not yet allow nationwide branching. If banks could branch nationwide, relatively more funds would be gathered internally from branches rather than externally from the fed funds market. Because fed funds flows move between banks over wire transfer networks, eliminating branching restrictions would mean fewer fed funds transactions and therefore lower daylight overdrafts. Second, in terms of regulatory environment, so long as daylight overdrafts are kept within a bank's net debit cap, there is no explicit penalty for overdrafting. Thus, branching restrictions give banks incentives to borrow more from each other than would otherwise have been the case, while the lack of penalties turn daylight overdrafts into a low cost liabilities management tool.

If branching restrictions continue, what institutional practices might be expected to change if intraday credit in the form of daylight overdrafts were priced? Many likely changes are relatively well known and involve both reduction of the daily payments volume over external wire transfer networks and elimination of the current gap in processing time between totally or partially offsetting payments. For example:

(1) *Rollovers.* The same amount of overnight (or longer) funds borrowing is renegotiated with the same seller. No funds move over the wire networks except the initial borrowing and the final repayment. Importantly, there is no time gap between daily repayment of borrowed funds and receipt of borrowings for the next time period. As a result, the value of payments over wire networks is reduced, the time gap is eliminated, and associated daylight overdrafts fall.

(2) *Continuing contracts.* Differing amounts of daily funds borrowings are renegotiated with the same sellers so only the net change in the position (including interest) is sent over the wire. The value of the single net transfer is less than either the (early in the day) full repayment of the gross funds borrowed or the (later in the day) full reborrowing of an altered gross amount for the next period. Because the value of payments made is reduced and the time gap between the two gross flows eliminated, overdrafts fall.

(3) *Term funds.* Longer-term borrowings are substituted for overnight funding. Overdrafts fall due to the lower average daily value of funds sent and returned over the wire network, as well as the now more infrequent daily time gap between return of borrowed funds and subsequent reborrowing.

(4) *Intraday funding.* Excess funds or unused overdraft cap capacity are sold and sent to other payments participants to fund, for a price, what otherwise would be daylight overdrafts at the purchasing institution.

(5) *Netting by novation.* Gross bilateral payment obligations are netted using contracts among the parties prior to the value or settlement date. Both legal exposure to payment obligations and payment flows satisfying the obligations are reduced from gross to net positions. This eliminates the time gap between flows and thereby reduces both measured overdrafts and risk.

The first three institutional changes or alterations in interbank funding procedures existed prior to the Federal Reserve's risk reduction program and there is some anecdotal information that these procedures are being pursued more intensively than before. In addition, the American Bankers Association has formally supported the first two methods.

The fourth method—intraday funding—has apparently not yet been used to reduce overdrafts. This may be due to the extra costs that would be incurred relative to other overdraft reduction alternatives and because of the extra operational efforts associated with using intraday funds. It is possible that adoption of policies to price intraday credit (see p. 10) could lead to an intraday credit market in two ways. First, if the daylight overdraft fee on Fedwire were set at a very high level, banks might begin to

exchange intraday funds among themselves at rates lower than the administered rate. On CHIPS, if new risk bearing arrangements lead banks to perceive significant risks in the system, they may wish to borrow intraday funds to cover their net debit positions and reduce the risks. Second, if pricing were instituted in connection with caps that were so low as to be binding for many banks, institutions with unused cap capacity might lend to those constrained by the caps. In this case, there would be two prices for intraday credit, the administered Fed price and the intraday funds market price.

The fifth method-netting by novation-is currently in the experimental stage. New legal contracts providing for this type of netting are now being used by some U.S. banks in the London forward foreign exchange market and there are plans for their possible application to certain types of transactions over CHIPS. There has been no known netting by novation application over Fedwire so far, but some transactions could probably be handled in this manner.

Federal Reserve analyses in 1980 and 1982, summarized in greater detail in Humphrey (1984, pp. 86-89), suggested that upwards of 80 percent of all Fedwire funds transfer plus securities transfer daylight overdrafts at large banks (deposits of \$1 billion or more) could be eliminated if certain amounts of interbank overnight borrowing were shifted to term borrowing or multi-day continuing contracts. At the time of the analyses, large banks accounted for over 90 percent of all funds and securities transfer daylight overdrafts. About one-half of these banks could eliminate all their funds plus securities overdrafts by shifting 2.5 percent of overnight funding to term funding. For some of the remaining large banks, the shift would have to exceed 100 percent. However, many securities transfer overdrafts are to be collateralized in order to lower risk to Reserve Banks. With collateralization, the percentage shifts from overnight to term funding (or rollovers or continuing contracts) required to eliminate funds transfer daylight overdrafts (and the remaining securities transfer overdrafts that cannot be collateralized) would be reduced. As a rough approximation, the above required percentage shifts of 25 and 100 percent could fall to 13 and 50 percent. Thus, widespread adoption of some or all of the five institutional changes listed above would virtually eliminate funds transfer daylight overdrafts from Fedwire.

Note, however, that it is not necessarily in the interest of the payments system to purge the system of all intraday credit risk, but rather to ensure that costs to everyone do not exceed benefits. So long as the value placed on an additional dollar of intraday credit by payments system participants is greater than the cost in the form of risk to the rest of the payments system, it is in the interest of payments system participants and the rest of society to incur that risk. Thus, the purpose of risk control policies is not to eliminate risks, but rather to confine them to levels considered acceptable.

Policies to Control Risks

Caps and Limits In recognition of concerns about intraday credit risks, the Board of Governors of the Federal Reserve System in 1986 implemented a voluntary program to limit intraday credit and improve control over risk by users of all large dollar wire transfer networks.⁸ The current program is voluntary and consists of three main elements.

- (1) Banks using any large-dollar wire transfer system are requested to perform a self-evaluation based on their operational and credit controls, policies, and procedures, as well as their creditworthiness or ability to fund themselves to cover unexpectedly large funds outflows or reduced inflows.
- (2) Based on the results of the self-evaluation, each participant adopts a total ratio of Fedwire daylight overdrafts plus CHIPS net debits to capital as its limit on how much a participant may send out in excess of what it receives across all networks. The ratio is called a cross-system net debit cap multiple.
- (3) Participants also establish network-specific sender net debit caps as well as bilateral net credit limits (limits on how much a receiving bank may be a creditor to a particular sending bank) on CHIPS to obtain net settlement services from the Federal Reserve.

Under the policy, CHIPS participants are required to compute two net debit caps. First, cross-system caps covering Fedwire and CHIPS together are calculated as a multiple of capital. Second, a network-specific cap for CHIPS is based on a formula that attempts to capture the market's assessment of other CHIPS participants' soundness. If a bank only uses Fedwire, then its cross-system cap and its network-specific cap are one and the same.

In Figure 1, the risk control policy is illustrated as the vertical portion of the supply curve, S . While intraday credit within the caps is still not explicitly priced, it is not permitted to rise beyond the level of the caps, Q_0 .

⁸ Board of Governors (1985).

This shows an advantage of net debit caps, namely, they are sure to restrict overdrafts to levels specified by policymakers. In terms of Figure 1, they are designed to limit intraday credit, and they do not necessarily shift the supply curve faced by depository institutions from S_0 to the curve reflecting all costs to society (S_1).

A disadvantage is that caps could either underconstrain or overconstrain intraday credit. Figure 2 shows two possible effects for individual institutions rather than for the entire market. The cap level represented by s_2 brings about some reduction of overdrafts below the unconstrained overdrafts level. While such caps are binding for a very small number of institutions, they underconstrain because they allow a level of intraday credit (q_2) above the equilibrium level that would prevail if banks faced the full costs of their decisions (q_0). The dotted area in Figure 2 shows how underconstraining leaves an excess of intraday credit risk costs over the value of the intraday credit to the participant. On the other hand, the cap level represented by s_3 reduces intraday credit so low that it overconstrains. The crosshatched area in Figure 2 shows that some overdrafts are restricted even though their value to the institution exceeds their cost to society.

Underconstraining overdrafts appears to be a more serious problem than overconstraining because it leaves the payments system with too much intraday credit risk. More important, there are no incentives for participants

to reduce risk toward equilibrium levels. In contrast, attempts to constrain overdrafts by reducing them "too much" are less serious because even highly restrictive caps are not likely to be binding on all institutions. Different demands for overdrafts by different institutions would lead to incentives for development of a private market for intraday credit. In such a market, institutions on whom caps, are binding as shown by s_3 , could borrow intraday funds (that is, excess cap capacity) at a negotiated price from those on whom the caps are not binding. Overall risk levels would be reduced not only by limiting overall intraday credit in the system as a whole, but also by diversifying intraday credit among a larger number of institutions.

Trading excess cap capacity is not the only way an intraday market could work. If some banks maintain excess reserve balances during the day while others incur overdrafts, an intraday market could arise in which funds were lent and repaid during the business day and were still available to lend out overnight. This type of market could arise even if daylight overdrafts were forbidden, since those who would like to incur overdrafts but cannot will have the option of borrowing excess reserves in order to fund payments that would have otherwise created overdrafts.

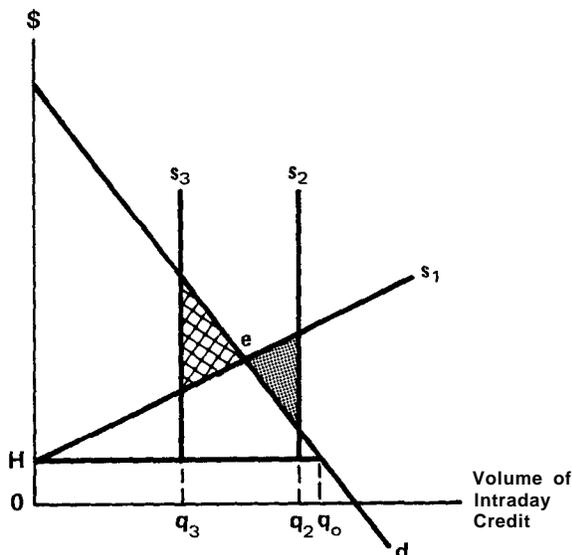
Pricing Intraday Credit Pricing could be brought about indirectly by policies that lead to development of an intraday credit market as just described. Alternatively, pricing could be adopted directly on Fedwire by levying explicit fees on daylight overdrafts. Likely market effects of pricing on Fedwire are shown in Figure 3. Fedwire overdrafts are priced at P_r . Banks will overdraft up to the point at which the price they pay is equal to the value they place on the credit.⁹ Thus, charging a fee for Fedwire overdrafts has an effect similar to that of binding caps, that is, lower overdrafts.

On CHIPS, it is less clear how explicit pricing could operate. A possible solution is to devise policies that attempt to shift the supply curve faced by CHIPS participants from S_0 in Figure 3 to that reflecting the full costs to society (S_1). In other words, risk control policies could attempt to lead banks to internalize the risks in the payments system.

Shifting the supply curve could take the form of policies under which CHIPS and other net settlement networks bear more directly the risks of a settlement failure. For example, a sending bank could effectively post a bond against failure to settle its obligation by collateralizing its net debits. Alternatively, losses due to failure of one bank to settle could be borne by receiving banks that are creditors of the failed sending bank (receiver finality).

Figure 2

EFFECTS OF RESTRICTIONS ON INTRADAY CREDIT (INDIVIDUAL INSTITUTION)



⁹ For the moment, the analysis conveniently assumes that policymakers are able to select the "right" price. The problems involved will be dealt with presently.

Finally, risks could be shared by the receiving bank and its customers (settlement finality).¹⁰ An example of how CHIPS participants could reduce risks under such policies is to not release funds to customers prior to settlement if the sending bank were either of questionable soundness or not known to the receiver.

Figure 3 shows the likely short-run and long-run effects of levying a fee on daylight overdrafts and adopting new risk bearing measures on CHIPS. On Fedwire, a policy of overdraft pricing within caps would effectively shift the supply curve from S_0 up to level P_f . In the short run, relatively inelastic demand (D_{sr}) would lead to a reduction of overdrafts to Q_1 . On CHIPS, since the supply curve faced by participants is now S_1 , volume of intraday credit demanded also falls to Q_1 .¹¹ Over the long run, institutional change (as described on page 8) becomes less costly. This makes demand more elastic over time, as shown by the long-run demand curve D_{lr} . The result is that long-run volume demanded falls to even lower levels on both Fedwire and CHIPS.¹²

¹⁰ In order for the above policies to be effective, all three require that banks know they will not be released from their obligations in the event of a settlement failure.

¹¹ If intraday credit were supplied in a private market, determination of a price would have to take account of the time value of intraday funds to suppliers. This would place the intraday private market supply curve above S_1 .

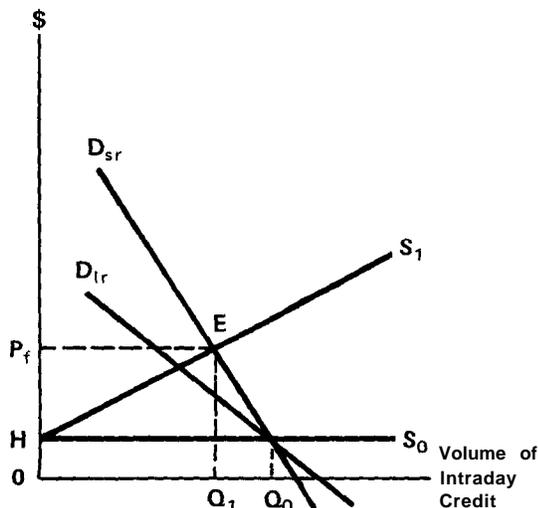
¹² It is also possible that improved risk controls over time would shift the supply curve down or make it less steep.

One objection to pricing is that, while it would provide incentives for most banks to reduce intraday credit, it would do little to discourage highly risky institutions from running excessive daylight overdrafts. This would be especially true of an institution in danger of imminent failure, the managers of which may be tempted to take desperate measures. The answer to this objection is to maintain net debit caps along with pricing. Daylight overdrafts would be permitted to those who pay the price so long as they did not exceed cap levels, but no overdrafts would be allowed beyond the caps. Thus, pricing could be used to regulate overdrafts for most institutions, while caps would still be there to protect the system against the highest risk institutions.

The most obvious problem with a policy of pricing intraday credit is that it is not immediately apparent what the price should be. While the price shown in Figure 3 fortuitously matches the price at which benefits of intraday credit to participants equal costs to society, there is no guarantee that such a price would necessarily be chosen. In practice, the price could be set too low or too high, although the distortions induced by too high a price could be alleviated by a private market for intraday credit. Because Fedwire credit risks are currently absorbed by Reserve Banks without explicit charge, however, no private market for intraday credit has yet arisen. In order to demonstrate some practical problems involved in using pricing to control intraday credit risk, the following section explores possible ways to estimate the value of intraday credit to payments system participants.

Figure 3

MARKET EFFECTS OF PRICING INTRADAY CREDIT



IV.

**From Theory to Practice:
Determining the Value of Intraday Credit**

There are several reasons it would be useful to know the value of intraday credit. For one, if the Federal Reserve were to seriously consider pricing Fedwire daylight overdrafts, it would be important to have some idea of the value placed on intraday credit by market participants. Further, it would give an indication of what the price of borrowed intraday funds might be if net debit cap reductions or pricing were to lead to a private intraday credit market. Finally, if policymakers wanted to quantify and compare the benefits and costs of further risk reduction efforts, estimates of the value of intraday credit would be essential.

If an intraday funds market now existed, it would reveal the value of intraday credit. No such market has yet developed to fund daylight overdrafts for at least three reasons. First, intraday credit risk on Fedwire is not borne directly by payments system participants, but rather by the Federal Reserve. Second, the current system of net

debit caps was initially designed to constrain only those institutions with the largest overdrafts and to reduce the aggregate dollar value of daylight overdrafts by only 5 to 7 percent. For the vast majority of institutions, therefore, caps have not yet been binding. Finally, less costly alternatives to purchasing intraday funds, especially rearranging the timing of nonessential customer payments during the day, have been available to reduce interbank overdrafts.

The failure of an intraday market for bank reserves to develop so far does not mean, however, that it is not practical. In fact, there already exist two markets that exhibit some characteristics of an intraday market. These are day loans to securities broker/dealers and intraday funding associated with the market for overnight funds.

Day loans are advanced by banks to securities dealers and brokers in order to permit payment by certified check to sellers at the time of delivery. The market for such loans is relatively small, averaging perhaps \$10 billion per day, compared with total funds transfer daylight overdrafts of \$76 billion per day. This market is almost entirely confined to New York. The loans are granted for periods less than a day (six hours or less), are expected to be repaid by the close of business, and typically cost 100 basis points (annual rate). Although collateralized by the underlying securities so that technically a legally perfected security interest is obtained through the loan agreement, day loans are usually treated as unsecured due to the difficulty of taking actual possession of the securities. Day loans developed because there is a lag between the time broker/dealers pay for securities, subsequently deliver them to customers, and receive payment for them. Brokers and dealers pay by certified check, and funds must actually be in their account in order for the check to be certified. Since the large securities purchases exceed broker/dealer working capital, a loan enables the check to be certified.

The overnight market for federal funds experiences rate fluctuations throughout the working day. Even if a bank starts the day with good information on its funding requirements, it is often necessary to enter the market several times during the day to deal with contingencies that had not been anticipated. Banks may purchase funds in the morning only to find, later in the day, they are not needed overnight and must be sold in the afternoon. It is in this restricted sense that an intraday interbank market already exists, but it apparently is not yet being used specifically to fund interbank daylight overdrafts.¹³

¹³ The average opening federal funds rate over 1984-85 was 9.14 percent while the average (early) closing rate was slightly lower at 9.12 percent. Thus, borrowing in the morning and reselling the funds in the afternoon could cost 2 basis points (neglecting transactions costs) on average. By the end of the day when the market is thin, however, the average difference in rates turns negative to - 15 basis points. This spread between opening and closing rates would likely turn positive if banks attempted to profit by the spread by buying in the morning and reselling late in the afternoon.

Approximating the Long-Run Value of Intraday Credit

This section presents five methods which could be used to determine an approximate value for intraday credit on Fedwire. The methods are:

- (1) Use the existing day loan market rate.
- (2) Determine and use as a rate the costs of shifting from overnight to term funding.
- (3) Determine and use as a rate the observed risk premium between bank certificates of deposit (CDs) and Treasury bills.
- (4) Divide the overnight rate by eight to obtain an implied rate for overdrafts lasting three hours.
- (5) Extrapolate an estimated yield curve backwards to determine an implied rate for three hours of overdrafts.

The first three alternatives develop prices that do not vary according to the length of time an institution is in overdraft. In contrast, the fourth and fifth alternatives attempt to determine a value for three-hour increments of Fedwire overdrafts, which is the average length of time a bank incurs these overdrafts.

Existing Day Loan Market Rate It is possible that the rate on day loans used by broker/dealers to finance securities purchases prior to delivery and payment by customers could be used to approximate a daylight overdraft price. While there is some variation in this intraday rate, reflecting the risk of the securities issued and used as collateral for the loan, the rate is largely administratively determined, has little variation over time, and is typically 100 basis points (on an annual basis).

In this alternative, the broker/dealer intraday funds rate of 100 basis points represents a market rate on a (technically) secured intraday loan for perhaps six hours, while Fedwire overdrafts subject to the cap are unsecured and typically average around three hours a day (for all overdrafting institutions).¹⁴ Although day loans may be secured in the strict legal sense, the arrangements used are loose enough that the loans are usually treated as unsecured credits by the banks that make them. The time difference, however, is more significant, since Fedwire overdrafts are of shorter average duration than broker/dealer loans. Further, since broker/dealers purchase other services from lending banks in addition to intraday loans, the loans, may be priced as part of a package of jointly produced services. Thus the observed 100 basis point intraday loan rate may or may not equal the rate that would exist if fewer related services were purchased, as might be the case in a market for interbank intraday funding for daylight overdrafts.

¹⁴ The average duration of overdrafts for large institutions (those with assets of \$5 billion or more and who today account for 90 percent of all funds transfer overdrafts) is four hours. The average duration of overdrafts within 90 percent of each day's peak overdraft is about 90 minutes for all institutions and 45 minutes for large institutions.

Costs of Shifting from Overnight to Term Funding Overnight funding typically creates daylight overdrafts while term funding is one way they can be reduced (see page 8). The difference between the costs of the two funding methods can represent the cost of reducing daylight overdrafts. Charging an overdraft fee at least equal to this cost would eliminate the cost advantage of overnight funding and reduce daylight overdrafts by making term funding relatively more attractive.

Surprisingly, the cost difference between overnight and 7-day term funding has averaged - 2.2 basis points on an annual basis over 120 weeks during 1984-86. This suggests that 7-day term federal funds are on average cheaper than overnight funding. However, when 30-day term fed funds are compared with overnight funding, the spread becomes positive, averaging 4.5 basis points.

A possible advantage of using the cost of shifting from overnight to term funding as a price for daylight overdrafts is that it can be observed in the market. As such, it would reveal the market value placed on intraday credit by payments system participants. However, the observed -2.2 to 4.5 basis point average spread is a function of demand for term funding under current policies. Demand is likely to change significantly if new risk control measures lead more banks to use term funding to reduce overdrafts. At present these spreads fluctuate from positive to negative at different points in the interest rate cycle. Thus, they appear to be more a function of interest rate expectations than of the lower liquidity and higher default risk of the term instrument. So the observed spread between term and overnight funding would today be a poor indicator of the market value of daylight overdrafts.

If more banks turn to term funds as a substitute for overnight funds to reduce daylight overdrafts, one can expect two results. First, the observed spread should rise because the demand for term funds would rise while that for overnight funds would fall. Second, because of the shift in demand, the relative effect of interest rate expectations on the relative costs of term or overnight funds should fall. Consequently, the current low spread between term and overnight fed funds understates the spread that would likely be observed if risk control policies like pricing or cap reductions made overdrafts more costly.

Risk Premium between Bank CDs and Treasury Bills This alternative uses the current observed risk premium between 30-day bank CDs and U.S. Treasury bills to approximate an overdraft price that reflects the average risk involved in making an intraday loan to a bank. Over the last ten years, the risk premium has averaged 107 basis points for 30-day instruments, which is the shortest original maturity available for bank CDs. But this risk premium of 107 basis points is also affected by the different tax treatment of income from the two instru-

ments as well as by their differing liquidity in secondary markets. Unless the tax and liquidity effects are believed to be small or can be separated from the risk premium, this measure must be considered only as a first approximation, one that probably overstates the true risk premium by itself.¹⁵

Divide the 24-Hour Overnight Rate by Eight to Obtain an Implied Three-Hour Rate So far, the alternatives presented resemble a charge for an overdraft line of credit in which a price is applied to the maximum amount of credit used during a day. If, in contrast, one wishes to determine the value of shorter increments of intraday credit, it is necessary to use ad hoc or statistical extrapolations to an unobserved maturity (here, three hours). This necessarily generates a certain amount of error even if the assumptions about the extrapolation process are accepted. The ad hoc procedure of dividing the 24-hour overnight rate by eight yields 124 basis points (annual rate) for an implied three-hour overdraft rate based on the 9.91 percent average overnight federal funds rate over the last ten years (1976-85). This implicitly assumes that funds can be lent out in eight three-hour increments or that daylight lending does not inhibit overnight reuse of the same funds by a different borrower. Such an assumption seems reasonable.

Extrapolate the Yield Curve Backwards to an Implied Three-Hour Rate Statistical estimation of a yield curve over 180-day, 90-day, and 30-day bank CDs, and overnight federal funds, gives an implied average three-hour overdraft rate of 9.74 percent. This computed rate is only 17 basis points lower than the average overnight rate over the last ten years. The estimated yield curve is very flat and spreads between instruments often shift from positive to negative over time. The approach gives results equivalent to situations where daylight lending would prevent use of the same funds overnight. Since it is expected that interbank funds borrowed to cover daylight overdrafts could be re-lent overnight to the same or a different borrower, the 974 basis point rate does not appear to be reasonable and should not be used as a guide as to what intraday credit would likely cost if a private market were to develop in the future.

Choosing between the Alternatives

Of the five alternative methods of estimating the intraday price for funds, at least two can be ruled out. Shifting from overnight to term funding can be excluded because the currently measured costs are too low (or negative) to

¹⁵ Further, the spread fluctuates widely, making it even more difficult to distinguish the risk premium from tax and liquidity effects. See Cook and Lawler (1983).

be representative of what the costs would be if more institutions used term funding to reduce overdrafts. Extrapolating the yield curve backwards to a three-hour rate can also be excluded since it implies that funds lent intraday would not be re-lent overnight (and as a result raises the rate charged on an intraday loan to a level very close to the overnight rate). Since a private intraday funds market would probably not involve any restriction on using funds overnight, the rate obtained from the estimated yield curve is unrealistically high.

The remaining three alternatives, the existing day loan market rate for securities broker/dealers, the CD-Treasury bill risk premium, and dividing the overnight fed funds rate by eight, give rates which cluster around one another at 100, 107, and 124 basis points. As a result, a "best guess" of an equilibrium rate which might apply to daylight overdrafts in a private market currently lies in the range of 100 to 125 basis points.

In connection with the above illustrations of what a best guess of an intraday market rate may be, it should be emphasized that markets will change if daylight overdrafts were priced. Today most of the intraday credit risk exposure that creates the costs connected with Fedwire intraday lending is absorbed by the Federal Reserve at a zero explicit charge to users. If the Fed were to charge for the risk it absorbs, or if it were to reduce its risk exposure by tightening the net debit caps well below their current levels, depository institutions could be expected to explore ways of charging for the value of intraday credit they extend to their customers and internal bank profit centers as well. Because of such future efforts, the intraday credit cost estimates presented here should be thought of as only a starting point for daylight overdraft pricing or as points of departure for further research efforts. It is only with the development of an active private sector market for intraday funds and a better understanding of the costs involved in reducing overdrafts that an accurate idea of the value of intraday credit will be obtained.

V. Concluding Comments

The foregoing analysis makes several points. First, intraday credit has value to payments system participants, regardless of whether or not it is explicitly priced. Second, the volume of intraday credit and the associated level of intraday credit risk in the payments system result largely from a failure to require that the full risks and costs of daylight overdrafts be borne by their users. Third, policies seeking to control intraday credit risks may attain their objectives in at least two different ways. One is by limiting intraday credit by such means as sender net debit

caps. The other places costs on the institutions that create overdrafts by pricing the risks involved. Finally, the empirical portion of the article suggests some possibilities for determining the price that may be charged for intraday credit if a private market were to develop. This price ranges from 100 to 124 basis points (annual rate) per dollar of credit extended.

As the payments system grows, two areas for further research become increasingly important. The first, determining the value of intraday credit, was explored in this paper. The second area is no less important, namely, quantification of actual risk exposures connected with intraday credit. While the potential losses are huge, they have not in fact occurred and therefore it has been difficult to determine their expected value. If generally acceptable estimates of expected losses can be developed, they would be helpful in determining the necessity of developing and adopting other, and potentially more stringent, methods the Federal Reserve and private sector payment participants can use to further reduce intraday credit risk.

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