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Sources of Systemic Risk in Large Value Interbank Payment Systems

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Sources of Systemic Risk in Large Value Interbank Payment Systems

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Summary

American officials attempt to track terrorist financing through the banking system. Following money inevitably requires delving into the intricacies of interbank transfers. One might think that banks exchanging with other banks would be the simplest of all transactions. Instead, interbank transfers require cooperation among competitors and silence among those boasting about their assets. Interbank transfers involve significant risks for individuals and for the financial system as a whole.

Specialized payment systems process the largest, most time sensitive, interbank financial transactions. Both public and bank-owned systems serve thousands of institutions processing trillions of dollars of transactions. The revelations that U.S. officials monitor the Society for Worldwide Interbank Financial Transactions (SWIFT) reminds analysts that payment systems are considered critical financial systems. SWIFT, Fedwire, CHIPS, and other payment systems provide timely, accurate, and secure financial messages for the largest financial transactions. Processing such large transactions creates and distributes economic risk. The method of processing and regulating each payment influences the liquidity and solvency of individual institutions. The choice of payment procedures balances an array of systemic risks. These risks include counterparty risk, operational risk, and legal risk.

The government monitors and regulates payment systems to facilitate financial markets, prevent liquidity crises, deter fraud, and track criminal finances. Because terrorists target financial institutions and because U.S. investigators track terrorist financing through the payments system, the functions of large value interbank transfers is a federal issue. An interruption of the payment system could cause a financial crisis, disrupt investment spending, and result in a recession.

This report focuses on large value transactions between financial institutions. It describes the emergence of bank-owned and public systems, provides background on sources of economic risk, and details the features of Fedwire, CHIPS, and SWIFT that relate to these issues. This report will be updated when major system processes change.

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Background

Money is a horrid thing to follow, but a charming thing to meet.

The World Trade Center attacks demonstrated that America's enemies target important financial institutions. Payment system processors are critical financial institutions.[1] These payment systems are important both because their workings are crucial to the American economy and because information flowing through these systems may provide clues to terrorist financing. Normally only of interest to financial specialists, payment systems gained international notoriety when it was revealed that U.S. investigators monitored Belgium-based SWIFT's financial messages. European governments are investigating continued financial information sharing.[2] Non specialists are now trying to understand the complex web of public and private large value interbank payment services. The primary U.S. interbank systems are the Federal Reserve's Fedwire and the bank-owned Clearing House Interbank Payment System (CHIPS).[3] SWIFT focuses on international transactions but U.S. institutions can and do participate. Understanding large value payment systems requires understanding the inherent difficulties in interbank transfers.

Trillions of dollars flow between banks in different countries. The depositors of these banks may use different currencies. The governments of these banks may apply different regulations. The employees of the banks may speak different languages. The technical support of the banks may use different computer protocols. The relative value of currencies fluctuates during the trading day. In the absence of a common banking culture or international regulator, bank-owned payment systems like SWIFT emerged to facilitate transactions between member banks. The features of emergent payment systems address economic risk.

Not all payment systems approach their complex problems in the same way. For example, some payment systems process each transaction at the time it occurs whereas others wait until the end of the day and settle on a net basis. The choice between these approaches is not just a matter of communications equipment or computer processing speed although improved technology is beneficial. The problem is that the total value of transactions in a day is many times the value of the medium of exchange. Because each interbank transaction may be large relative to any one bank's cash reserves, processing transactions as they occur could cause gridlock. That is, a bank may be reluctant to part with its own cash until it receives an expected payment from another bank. If all banks follow this strategy then no banks will be the first to honor payments. Processing each transaction as it occurs risks grinding the entire system to a halt. Settling all transactions on a net basis at the end of the day could alleviate the chances of gridlock but then the system would be subject to the risk that institutions commit to more payments than they can honor. Payment system structure balances these and other risks.

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[1] Government Accountability Office, *Potential Terror Attacks: Additional Actions Needed to Better Prepare Critical Financial Market Participants*, GAO-03-414, Feb. 2003, p. 22.

[2] Michael Peel, "Privacy Probe to Examine SWIFT Scheme," *Financial Times*, Aug. 22, 2006, p.3.

[3] For information on electronic payment systems accessed by smaller retail customers, see CRS Report RL31476, *Electronic Payments and the U.S. Payments System*, by Walter W. Eubanks and Pauline Smale.

Systemic and Idiosyncratic Risk in Interbank Payment Systems

If you owe a bank a hundred dollars, that is your problem. If you owe a bank a million dollars, that is the bank's problem. Similarly, a single bank that cannot meet its obligations is its owners' problem. However, if failure of one bank to meet its obligations causes subsequent banks to miss their obligations, then there is a system-wide problem. Problems of one isolated entity are called idiosyncratic risk while broader problems are systemic risk. The procedures and technologies of payment systems affect the level of systemic risk because banks must process the payments of each other's depositors and clients.

Counterparty Risk: Credit and Liquidity

In simple exchange, a buyer and a seller are each other's counterparty. Counterparty risk is the chance that the counterparty's promised payment, or note, will not be redeemed for full value and on time. The two most important forms of counterparty risk are credit risk and liquidity risk. Credit risk is the risk that promised payment will never be honored. Liquidity risk is the risk that the payment will not be made on time which imposes costs on the holder of the promised payment. A bank's promised payment is a debt. The bank holding the promise to pay is the lender. The risk that the debtor bank will not honor its promise to pay affects the financial condition of its counterparty, the lending bank holding the promise.

Credit Risk

A counterparty's credit risk is the chance that the payment will never be honored. Credit risk is a solvency problem. For an individual bank, the counterparty credit risk is simply the risk that the other bank will become insolvent before being able to honor the payment obligation. Systemic credit risk can be minimized through prudent business practices, transparent accounting, reserve funds, and loss sharing rules.

Credit risk can rise to the level of systemic risk for large or central institutions. For example, financial institutions often publicize their assets and liabilities to bolster confidence in their condition. The bonds of reputable institutions are then held as assets by other institutions. When a major institution suffers financial distress, not only does its credit fall, but the value of its bonds held by other institutions also falls. The capacity of these secondary institutions to meet their own obligations falls because the value of their assets falls. An institution's commitment to make payment is just like a bond and threatens the payment system in a similar fashion.

Modern payment systems seek to minimize credit risk. For one thing, financial transparency is required in most countries for most institutions. The assets and liabilities of most large financial institutions are made public on a periodic basis. In the United States, the banking system's financial condition is subject to government regulation and oversight. American banks are required to observe prudent business practices. Similarly, many banks are subject to international agreements for banking solvency through the Basel[4] accords.

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[4] The Basel Committee on Bank Supervision (BCBS) gathers representatives of financial regulatory authorities of G-10 (continued...)

A payment system can also reduce counterparty credit risk through supplemental reserves. For example, the coordinator of the system could maintain a joint reserve fund to compensate member institutions if there is a default. If the system is run by the monetary authority then payments could be guaranteed by the power to create additional funds. These forms of credit enhancement generate confidence in the system but could also create the incentive for some banks to overextend themselves, knowing that a rescuer stood by in case of trouble.

Loss sharing rules are a third way to reduce counterparty credit risk. Under loss sharing rules, the failure of a participant to make promised payment does not impose all the costs on one counterparty. Instead, a survivor's rule allocates the losses among the remaining institutions according to previously agreed upon arrangements. The loss sharing rule does not eliminate counterparty credit risk but it does reduce the need for each participant to monitor the solvency of each counterparty.

Liquidity Risk

Unlike credit risk, liquidity risk does not depend on the solvency of each counterparty. Although the bank promising to pay cannot honor its promise at the agreed moment, the payment could be made in full if there was additional time. This could happen if the institution's cash assets were drained but it still had strong non-cash reserves. If the non-cash reserve assets are in a form that is difficult to liquidate and the bank is subject to regulatory review prior to borrowing against assets, then the bank might not be able to make payment at the time due. Systemic liquidity risk can be affected by timing rules, reserve funds, and transaction limitations.

Systemic liquidity risk is primarily about timing. The daily value of traded transactions is many times the amount of cash available to the system. As a result, the order of the payments could theoretically constrain participants. For example, a solvent bank may be expecting to receive a payment in the afternoon. However, the bank's cash reserves are at the lowest level it considers prudent. The bank might wish to refrain from committing its own cash until it receives a payment from someone else. However, if all participants are reluctant to be the first to lower their cash on hand then none of the participants receive payments and none will start the round of exchange. A sequential system, called gross settlement, that becomes illiquid is said to be in gridlock.

A timing rule can affect liquidity risk. Rather than processing payments immediately, the system could keep a tally and settle up at the end of an agreed period, often the end of a trading day. Settling up on a net basis makes the order of trades within a given trading period irrelevant. Participants become more willing to part with liquid assets as long as they are expecting payments any time during the same trading day. However, all of the daily payment orders of an insolvent bank may be subject to cancellation. The possibility of this unwinding of payments in a net system creates additional credit risk.

Reserve funds reduce liquidity risk in the same way they reduce credit risk. Members can be required to contribute to a joint reserve fund available to resolve liquidity problems. If the system is run by the central bank then cash reserves can be expanded as part of monetary policy. The confidence that a reserve fund is available can itself reduce systemic liquidity risk because participants may be more willing to pay out liquid assets.

(...continued)

countries and recommends minimum banking standards.

Payment systems can reduce liquidity risk by limiting the value of pending transactions for each member. The limit could be based on the institution's known reserves, its trade volume on the exchange, a multiple of a deposit placed with the payment system or other financial calculation. The limit prevents any one institution from locking up the finances of a large portion of the participants.

An Alternative View of Liquidity Risk: Rochet and Tirole

Jean-Charles Rochet and Jean Tirole argued that the core economic problem of modern payment systems was credit risk, not liquidity risk.[5] They argued that liquidity is not a problem because payment system administrators fully understand the risks and robust alternative markets for financial assets exist. If all of the participating banks are solvent then liquidity problems will be resolved by system design or turning to outside suppliers of liquid assets.

Rochet and Tirole did not argue that all problems were solved by system design. Instead, they argued that the banks involved in these payment systems are highly sophisticated and understand the risks. Given opportunities in other financial markets, a solvent bank would not be threatened by the possibility of counterparty unwinding or system gridlock in one settlement system. However, they did concede that a bank's liquidity problem is important because it is a signal of larger financial issues.

Operational Risk

Operational risk includes the physical transmission system and the security of information. Since payment systems consist primarily of simple messages, anything that compromises communications is a threat to the system. Such a disruption occurred in 1985 when the Bank of New York's computer failed to process securities trades correctly, resulting in more than $20 billion worth of overdrafts. Other communications problems are potentially more serious. A computer hacker sending false messages or a power outage could create financial chaos. Payment systems address operational risk through system diversity and information security.

System diversity refers to the existence of multiple transmission systems. The existence of multiple systems allows for payment messages to be sent through alternative channels if one communication network is compromised. Diversity includes multiple channels within one payment system and multiple payment systems serving each market niche. Redundancy assures that the failure of one system does not shut down the entire financial structure.

Information security protects the content of messages. Fraudulent messages could bankrupt institutions, eliminate confidence in the system, and destroy system liquidity. Security measures that authenticate users reduce the risk of fraud. Security measures that prevent improper surveillance reduce the risk that someone will be able to manipulate vulnerable institutions by observing their financial strategies. On the other hand, security measures that cause delays create credit and liquidity risk in gross settlement systems because delays reduce even further the amount of cash available for transactions.

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[5] Jean-Charles Rochet and Jean Tirole, "Controlling Risk in Payment Systems," *Journal of Money, Credit, and Banking*, vol. 28, no. 4 (Nov. 1996, Part 2), pp 832-845.

Legal Risk

Legal risk arises when the laws governing transactions are not administered the way the parties envisioned or when a party's property rights are not enforced. Legal risks are likely to be correlated with other risks because they tend to arise during disputes. For example, a bank might dispute the way loss sharing was processed when another bank's payments were unwound or a bank might dispute the ruling of a regulatory agency concerning the confidentiality of its messages. Banks should have better knowledge of the legal rules in their own country and in the countries that they have common dealings than in countries that they rarely engage.

International transactions have additional legal risk because of the diversity of jurisdictions and regulatory environments. Financial institutions transmit secure payments into a country or jurisdiction where they have little prior knowledge or experience. The relevant financial regulators in different countries may have different scopes of authority and different policy objectives. Payment system structure adapts to the regulatory environment and to the level of risk.

Payment System Structure: Fedwire, CHIPS, and SWIFT Examples

Because risks vary with conditions, there is no single payment system structure. Consider three categories of transactions: (1) U.S. financial institutions initiating communication with other U.S. financial institutions, (2) U.S. financial institutions initiating communication with foreign institutions, and (3) U.S. financial institutions receiving communication initiated from foreign institutions. In the case of U.S. banks communicating with other U.S. banks, both institutions are likely to use the same language, the same currency, similar operational protocols, and are subject to the same regulatory environment. The second and third cases successively increase uncertainty from the point of view of U.S. financial institutions. Payment systems have emerged that primarily serve each category of transaction although many systems serve more than one category. A description of three large payment systems serving U.S. financial institutions follows.

Fedwire

Fedwire primarily serves U.S. financial institutions and some foreign institutions with U.S. branches or subsidiaries. The Federal Reserve banks own and operate Fedwire. The term Fedwire refers to both the system's procedures and the FEDNET computer technology. Most Fedwire transactions are between financial institutions with Federal Reserve accounts, involve large dollar value, and are time critical. A Fedwire message instructs the system to reduce the balance of one institution's Federal Reserve account and increase another institution's Federal Reserve account. These cashless adjustments of accounting balances are immediate and irrevocable. In the second quarter of 2006, Fedwire processed an average of 1.5 million messages per day. The average value per transfer during that period was $17 million.[6]

Because Fedwire is operated by an institution with regulatory authority over its direct participants and with monetary authority, Fedwire has some control over credit risk and liquidity risk. The

[6] http://www.federalreserve.gov/paymentsystems/fedwire/fedwirebookentryqtr.pdf.

Federal Reserve can monitor credit risk because its regulatory authority puts it in a position to have superior knowledge of each bank's financial condition. The Federal Reserve can alleviate liquidity risk because its monetary authority allows it to credit the reserve accounts which form the basis of each transaction. Confident that the Federal Reserve's control of each party's Federal Reserve account could guarantee each payment if necessary, Fedwire transactions are processed immediately and are irrevocable. Fedwire effectively includes the Federal Reserve as a third counterparty for each transaction.

Although the Federal Reserve's regulatory authority addresses some counterparty risks, Fedwire must still synchronize the timing of payments. It is a real-time gross settlement system (RTGS). Real-time refers to the policy of updating accounts as payments occur. The participant's running account balance must cover the payment or the transaction could be rejected, although some institutions have limited overdraft ability. The Federal Reserve charges a fee to discourage abuse of the limited overdraft ability. Although gross settlement systems could theoretically suffer gridlock, the Federal Reserve's monetary powers alleviate this risk.

Although owned by the Federal Reserve, Fedwire must operate as a business. The Federal Reserve charges a fee for each Fedwire message and when institutions with limited overdraft ability exceed their balance. The Gramm-Leach-Bliley Act[7] requires the Fedwire fee structure to cover its expenses plus a normal business profit. The Federal Reserve's 2005 budget estimates 101.4% cost recovery for Fedwire's core service. The figure is budgeted at 105.6% in 2006.[8] The per-transaction fees have been declining in recent years because of improved communications technology.

CHIPS

Fedwire is owned by the Federal Reserve, whereas the Clearing House Interbank Payment System (CHIPS) is owned and operated by commercial banks. CHIPS has a higher percentage of messages involving foreign institutions than Fedwire. CHIPS competes with Fedwire in the sense that it offers interbank payment services and collects fees to cover its expenses. However, CHIPS relies on Fedwire because any CHIPS member with a negative position at the end of a trading day is required to settle with a Fedwire payment. Also, CHIPS cooperates with Fedwire to harmonize U.S. financial transactions and provide diverse systems in case of damage to one. In June 2006, CHIPS transmitted an average of 310,437 messages per day. The average daily total value of trades was 1.6 trillion dollars for the first half of 2006.[9] **Table 1** compares CHIPS payments to Fedwire payments.

[7] P.L. 106-102, 113 Stat. 1338-148; Nov. 12, 1999.

[8] http://www.federalreserve.gov/paymentsystems/pricing/2006repricing.pdf.

[9] CHIPS Newsbriefs, July 2006, p.1

Table 1. Comparison of Fedwire and CHIPS Large Value Payments

		Volume of Transactions (millions, total for the year)			
	2000	**2001**	**2002**	**2003**	**2004**
CHIPS	59.8	60.4	63.3	64.5	68.5
Fedwire	108.3	112.5	115	123.3	125.1
		Value of Transactions (billions, per year)			
	2000	**2001**	**2002**	**2003**	**2004**
CHIPS	$292,147.10	$311,706.60	$315,708.50	$326,560.60	$345,793.30
Fedwire	$379,756.40	$423,606.40	$405,761.80	$436,706.30	$469,989.90

Source: Bank for International Settlements, CPSS - Redbook Statistical Update, March 2006, pp. 147-148.

CHIPS' international transactions have greater potential risk than Fedwire's Federal Reserve account transfers. Unlike Fedwire, CHIPS cannot simply create money in the accounts of its members or subpoena the financial records of troubled institutions. However, CHIPS reduces its financial exposure by limiting membership to institutions with Federal Reserve accounts. Although CHIPS' members have Federal Reserve accounts, individual transactions are processed internally to CHIPS. Only end-of-the-day net negative positions require adjustments of Federal Reserve balances.

CHIPS was a net settlement system but adopted some gross settlement procedures in 2001. The result is a hybrid structure. Real time gross settlement occurs on CHIPS' internal accounts but final external settlement occurs on a net basis at the end of the day. To achieve this, CHIPS members post an initial positive position at the beginning of the day; then payments are settled on CHIPS' accounts in real time. The initial positive position reduces the chances of a negative end-day balance. In the event of an end-of-day negative CHIPS account balance, the deficient institution covers its position with a Fedwire message. Requiring members to be capable of providing an end day Fedwire payment is the reason CHIPS member institutions must have a regulated U.S. presence.

SWIFT

Banks without a regulated U.S. presence must use an alternative payment system to communicate with U.S. banks. The Society for Worldwide Interbank Financial Telecommunication (SWIFT) is an example of a payment system catering to foreign banks with some U.S. transactions. SWIFT, like CHIPS, is a bank-owned payment system. SWIFT originated in Belgium to harmonize payments across international markets. SWIFT works to coordinate a common set of procedures and technologies for banks that conduct international business. SWIFT cannot rely on a common central bank regulator like Fedwire. SWIFT cannot count on a single country's account system like CHIPS. SWIFT's primary customers operate in different countries with different currencies, different rules, different languages, and different technology. Yet in the first half of 2006, SWIFT processed an average daily volume of 11 million messages.[10] In 2005, SWIFT served 204 countries. The United States accounted for 16% of SWIFT messages in 2005.

Foreign banks without a U.S. regulated presence cannot use Fedwire or CHIPS. American banks expecting payment communications from these banks must avail themselves of an alternative. The pattern of U.S. payment messages in SWIFT suggests that it could fill this niche. In 2004, U.S. financial institutions received 44 million more SWIFT messages than they initiated. Note that this does not necessarily mean that the U.S. bank is receiving payment. The message could be a demand for the U.S. institution to honor a commitment. **Table 2** shows the pattern of SWIFT messages for U.S. institutions.

Table 2. U.S. Receives More SWIFT Messages Than It Sends

(thousands per year)

	2000	2001	2002	2003	2004
SWIFT Messages Sent from U.S. Institutions	223,175	253,017	286,457	331,729	383,097
SWIFT Messages Received by U.S. Institutions	245,542	277,983	312,733	366,198	427,163

Source: Bank for International Settlements, CPSS - Redbook Statistical Update, March 2006, p. 151.

SWIFT as an organization also provides additional services. For example, SWIFT serves as a consultant to countries creating their own internal payment systems. This is not a case of SWIFT creating competition for SWIFT's own services. Recall the relationship between CHIPS and Fedwire in which CHIPS members have the contingency to use Fedwire to resolve negative net positions. In like manner, SWIFT's domestic consultant services have the potential to expand the set of institutions eligible to use SWIFT's international services.

Other Payment Systems

Fedwire, CHIPS, and SWIFT illustrate the issues facing U.S. banks conducting large value interbank transfers. There are many more payment systems serving large value transactions. Some of these systems specialize in currency transactions while others specialize in more complex securities. Ownership of these systems also varies. Some are owned by a country's central bank. Others are owned by banks and private enterprises. The timing of cash settlement also varies across systems. **Table 3** provides a range of payment system structure with examples.

[10] SWIFT in Figures, see http://www.swift.com.

Table 3. Structure of Selected Settlement Systems

System	Country	Ownership	Settlement Process
CDSX	Canada	Bank	Net
CHIPS	USA	Bank	Hybrid RTGS / Net
CREST	UK	Bank	RTGS
Fedwire	USA	Central Bank	RTGS
JASDEC	Japan	Independent	Depends on the Security
LDT	Italy	Central Bank	Net
MEPS	Singapore	Central Bank	RTGS
SWIFT	Belgium	Bank	RTGS

Source: Bank of International Settlements, CPSS - Redbook Statistical Update, March 2006, p. 196.

Conclusion

Large value interbank payments create systemic risks. These risks arise because the markets are rapid, multilateral, and time sensitive. In the absence of common regulatory environments, private banks have implemented payment systems such as SWIFT. The role of central banks in credit and liquidity issues has led to publicly owned payment systems like Fedwire. Bank-owned and public administered systems are simultaneously competitors and partners in providing interbank payments. Whether public or private, payment systems deal with counterparty risk, operational risk, and legal risk.

The risks inherent in large value interbank payment systems can rise to the level of systemic risks for large institutions and for the coordination of smaller institutions. The structure and interrelationship of these systems affects the level and distribution of these risks throughout the financial system. For these reasons, the diversity, redundancy, stability and reliability of these payment systems is of concern to regulators and an oversight responsibility of Congress.

Appendix. Emergence of a Bank-Owned Payment System: Suffolk Example

American banking in the 19th century bore similarities to modern international banking. Like their modern international counterparts, American banks confronted diverse financial environments and fluctuating monetary values across regulatory jurisdictions. A mixture of state chartered and nationally chartered banks was subject to the laws of their own jurisdictions. The promissory notes of these banks circulated as money (U.S. dollars still say Federal Reserve Note). The notes of unknown or troubled banks often traded at less than face value, a kind of brand quality discount. Banks accumulated each other's notes through the normal course of business with their own depositors then had to redeem each other's notes. Redeeming a large number of notes at once might put a strain on one bank's reserves. However, delaying redemption could strain the finances of the bank demanding payment. Also, the value of the bank's notes could decline during any delay. Boston's Suffolk Bank became the centerpiece of a New England interbank clearinghouse system during 1825-1858.

Suffolk Bank coordinated the interbank clearinghouse. The rules of membership required banks to hold reserve deposits with Suffolk that could be used to help settle accounts. Members also agreed to remain financially prepared to redeem their notes in the system.

The Suffolk clearinghouse system affected more than just banks. A benefit of this system to the typical New England farmer was that the bank notes issued by his local rural bank was more likely to be accepted for full value when the farmer traveled to another town. Another benefit was that it maintained a liquid medium of exchange throughout the region despite the diversity of banks and jurisdictions. However, a disadvantage, as perceived by some rural New Englanders, was that the city banks could manipulate the finances of country banks by observing their note issues and strategically presenting the country banks' notes for redemption. This could have limit the country banks' ability to extend credit in rural areas.

Suffolk Bank's redemption policies reduced systemic risk. Since bank notes circulated as money, even rumors of the insolvency of one bank would decrease the value of cash on hand of any institutions holding the bank's notes. This might affect the ability of many other banks to meet their own obligations while the matter was sorted out. By requiring member banks to post deposits or hold reserves and by coordinating the order of redemption, Suffolk Bank lessened the risk that member banks would not meet their mutual obligations.

During its operation, the Suffolk System was effective in the sense that members' notes traded closer to face value than banks' notes outside the system and New England's financial markets remained relatively liquid. Evidence also shows that Suffolk Bank's administration of the payment system assisted its own interbank lending, which allowed it to provide extra liquidity to other banks in an era without a Federal Reserve or Central Bank. However, the system did not completely provide monetary stability. The Suffolk System ended in 1858 because of the combination of an economic downturn, political unpopularity, and competition. During its operation, the system dealt with many of the same risks inherent in modern interbank payment systems.

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