The Federal Reserve's Reduced Role in Retail Payments: Implications for Efficiency and Risk

By Richard J. Sullivan

The payments system in the United States has undergone fundamental changes in the last decade. The use of paper checks has declined rapidly, replaced by the automated clearinghouse (ACH) and card payments. The processing of paper checks has also changed, with the vast majority of checks now converted to electronic form before collection. The industry that processes payments has adjusted as well, as increased use of electronic payments has enabled a variety of private-sector entities to enter the market.

These changes have reduced the Federal Reserve's role in the clearing and settlement of retail payments. Clearing noncash retail payments consists of transmitting payment information among financial institutions in preparation for the transfer of funds; settlement refers to the process of funds transfer. The Federal Reserve has traditionally played a significant role in the clearing and settlement of checks and of payments through the ACH, a network for electronic transfers between bank accounts. In both types of payment, expansion of private-sector clearing organizations has reduced the Federal Reserve's role in clearing and settlement. Further reduction in the Federal Reserve's role has come from the shift from check payments to debit card payments, all of which are cleared through the private sector.

Richard J. Sullivan is a senior economist at the Federal Reserve Bank of Kansas City.
This article is on the bank's website at ***www.KansasCityFed.org.***

Whether the decline in the Federal Reserve's role in clearing and settlement is cause for concern is a matter of debate among policymakers. According to one view, the main role of the Federal Reserve should be to carry out settlement of payments among financial institutions after clearing has been performed by the private sector. Others argue that the Federal Reserve also needs to be actively involved in the clearing of retail payments to ensure adequate competition among payments providers and to protect the integrity of the payment system.

This article examines the change in the Federal Reserve's role in the clearing and settlement of retail payments since 2000 and discusses possible implications. Section I describes how the Federal Reserve participates in the clearing and/or settlement of each major type of noncash payment. Section II explains the factors that have reduced the Federal Reserve's role in clearing and settlement over the last decade and presents estimates of the magnitude of the decline. Section III discusses the implications of the decline. The article concludes that a further decline could reduce the efficiency and increase the risk of retail payments.

I. HOW THE FEDERAL RESERVE PARTICIPATES IN CLEARING AND SETTLEMENT

Noncash retail payments made by consumers, governments, and businesses require a transfer of money from a payer's bank account to a payee's bank account. The transfer is facilitated by a clearing and settlement system.[1] This section discusses the clearing and settlement of established types of payments and reviews emerging payments, which sometimes combine clearing and settlement of established payments. Each discussion highlights the role of the Federal Reserve in the clearing and settlement process.

What is clearing and settlement?

Noncash payments (wire, ACH, card, and check) are initiated in three steps that occur before clearing and settlement can take place. First, the payer authorizes the payment (such as by signing a check) signaling permission to transfer money out of a bank account. Second, the payee and the bank may then authenticate the payer and/or the payment instrument, for example, by looking at the payer's identification or by consulting records of the card issuer. And third, the payment

is screened to help ensure it is not fraudulent, such as when a merchant consults a "bad check" list or a card issuer compares the payment with the cardholder's transaction history. The payment is accepted if it passes the screening tests.

After the payment is accepted, the payment is cleared. Payment clearing requires transmission of payment information from the point of initiation to banks and to third-party payment processors. A clearing system is a network over which payment information—both paper and electronic—is transported or transmitted to members of the clearing organization (Table 1). The clearing system operator sorts payment information to determine the amount of money banks owe one another for their customers' payments. Most clearing organizations use multilateral netting, which offsets money a bank owes with money the bank is owed. After netting, banks will either be in a net debit position (when a bank owes more than it is owed) or in a net credit position (when a bank owes less than it is owed). Interbank settlement then requires transfers of funds from banks in a net debit position to banks in a net credit position.

Interbank settlement is completed with transfers of funds that banks hold in deposits at an intermediary bank. The clearing system operator starts the settlement process by sending interbank settlement instructions to the intermediary bank. Because many banks hold monetary balances in reserve accounts at Federal Reserve Banks, the Federal Reserve can serve as the settlement intermediary by transferring funds among these accounts.[2] A private bank can also serve as the settlement intermediary if it offers deposit accounts called bankers balance accounts to other private banks. If all clearing organization members hold these accounts at a private settlement intermediary bank, interbank settlement payments can be made by transferring funds among bankers balance accounts. Finally, in some situations several banks are linked to clear checks so that settlement involves transfers of funds among banks standing between the payer's bank and the payee's bank.[3]

Clearing and settlement of four key types of retail payments

The Federal Reserve clears and settles wire, ACH, and check payments. It does not clear debit or credit card payments, but it does have partial involvement in their interbank settlement.

Table 1

SELECTED CLEARING ORGANIZATIONS FOR ACH, CHECK AND CARD PAYMENTS

ACH	Checks	Debit cards	Credit cards
Federal Reserve	Federal Reserve	*Signature debit*	Visa
EPN[1]	Correspondent banks	Visa	MasterCard
	Clearinghouses	MasterCard	American Express
	Regional clearinghouses	*PIN debit*	Discover
	SVPCO[1,2]	Interlink (Visa)	
	Viewpointe[2]	NYCE[3]	
	Processor clearing systems	Star[5]	
	Endpoint Exchange[2,3]	Pulse[6]	
	Fiserv Clearing Network[4]	Co-op	
		Maestro (MasterCard)	
		Regional networks	

[1]Subsidiaries of The Clearing House.
[2]Image check clearing (no paper).
[3]Subsidiary of FIS, a technology service provider to financial institutions.
[4]Subsidiary of Fiserv, a technology service provider to financial institutions.
[5]Subsidiary of First Data Corp.
[6]Subsidiary of Discover Financial Services.

Wire payments. Wire payments are usually associated with large-value, wholesale payments, but many are used for retail payments. For example, a private wire payment service called Clearing House Interbank Payment Service (CHIPS, a subsidiary of The Clearing House Payments Co. LLC) processes large-value, wholesale payments. The Federal Reserve's Fedwire system processes both wholesale and retail payments. In 2000, one-third of Fedwire payments had a value of $5,000 or less (Biehl and others).

A Fedwire payment is initiated when a customer authorizes a bank to transfer funds. Clearing is simple, with the bank sending the payment order to the Federal Reserve on behalf of the payer. The Federal Reserve immediately transfers the gross amount of funds (no netting) between banks. Interbank settlement is done on reserve accounts held at the Federal Reserve.

ACH payments. Like wire payments, the ACH can be used to transfer money into a bank account (a credit), such as when a business sends payroll deposits to its employees' bank accounts. But like checks, the ACH can also be used to withdraw money from a bank account (a

debit), such as when a utility initiates an ACH debit transaction to take payment for a customer's monthly bill. After initiation, one or more ACH payments are combined into an electronic file with payment information such as bank routing numbers, customer account numbers, and the dollar amounts of the payments. The ACH file is then sent to the ACH operator for clearing and settlement.

Two operators clear ACH payments (Table 1, first column). The Federal Reserve's FedACH service accumulates the ACH files it accepts from originating banks (or their processors). ACH debits and ACH credits are processed separately. After the deadline for submitting ACH files, the Federal Reserve combines the files, sorts payments to determine the amount each bank owes or is owed, and offsets payments each bank owes with payments it is owed to determine a net payment required to settle. Interbank settlement payments are made on a predetermined schedule, typically the next day, by transferring funds from one reserve account to another. The Federal Reserve has exclusive responsibility for settlement because it both prepares and executes the interbank settlement instructions (Table 2, Column A).

The Electronic Payments Network (EPN), a subsidiary of The Clearing House Payments Co. LLC, sets its own schedule for clearing the ACH files it receives (EPN 2009). It does not provide its own settlement service but instead uses the Federal Reserve's National Settlement Service (Federal Reserve System 1998a). EPN starts the settlement process by sending a list of interbank payments to the Federal Reserve, which executes the settlement payments with transfers on reserve accounts (Table 2, Column B). In this article, interbank settlement is considered to involve a mix of private and Federal Reserve participation when a private clearing organization prepares settlement instructions and the Federal Reserve executes the instructions.

Some ACH payments require transfer of funds from a bank that uses the services of one ACH operator to a bank that uses the other operator. In these cases, FedACH and EPN transmit these files to one another as needed. The operator that completes the clearing of the transaction then settles interbank payments according to its own procedure (Table 2, Columns A and B).

Table 2

EXAMPLES OF CLEARING AND SETTLEMENT COMBINATIONS

	Interbank Settlement		
	A	**B**	**C**
Clearing	Federal Reserve	Mix of Private and Federal Reserve	Private
Federal Reserve	ACH transactions and checks cleared and settled by the Federal Reserve		
Mix of Private and Federal Reserve	ACH transactions originated on EPN, transferred to FedACH, and settled by the Federal Reserve	ACH transactions originated on FedACH, transferred to EPN, and settled on the Federal Reserve's National Settlement Service Split P2P payment through PayPal	
Private		ACH transactions cleared by EPN and settled on the Federal Reserve's National Settlement Service Checks cleared by SVPCO or other private clearing systems and settled on the Federal Reserve's National Settlement Service or by Fedwire or ACH transfers on reserve accounts Credit and debit card payments cleared in private networks and settled by Fedwire/ACH transfers on reserve accounts	On-me and on-we checks deposited with correspondent bank, cleared by the correspondent, and settled on bankers balance accounts Private clearinghouses that settle on bankers balance accounts of a private settlement intermediary bank P2P payment cleared through book transfer at PayPal

Checks. Check payments are initiated when a payer writes a check. The clearing process typically begins with deposit of the check at the payee's bank. The bank accumulates deposited checks and processes them at the end of the day. The bank can chose from one or more of many check clearing organizations (Table 1, second column). One option is for the bank to send the checks to the Federal Reserve (Federal Reserve System 1997c). The Federal Reserve sorts the checks according to the paying bank and then settles the interbank payment by debiting the payer banks' reserve accounts and crediting the payee bank's reserve account (Table 2, Column A).

Private-sector alternatives for clearing and settling checks include direct presentment, correspondent banks, and clearinghouses. Direct presentment is simplest, where two banks agree on the method of check presentment and settlement. The payee bank sorts checks to separate those that it can present directly to paying banks. Settlement can be made by a credit to a bankers balance account owned by the payee bank and held at the paying bank. Settlement could also be completed by a Fedwire payment or an ACH transfer (Table 2, Column B).

Many banks use check clearing and settlement services at private correspondent banks.[4] A client bank deposits accumulated checks at its correspondent and receives a credit into a bankers balance account. The correspondent then collects on the checks through various clearing and settlement arrangements. If checks are drawn on the correspondent ("on-me" checks) or on other clients of the correspondent ("on-we" checks), the correspondent can serve as the settlement intermediary (Table 2, Column C). The correspondent sorts all checks and separates the on-me and on-we checks, presents them to paying banks, and settles on bankers balance accounts held by clients at the correspondent (Danola). The remaining checks ("on-others") would then be processed through other clearing and settlement channels.

Clearinghouses, another private-sector alternative for clearing checks, are arrangements for members to exchange each others' checks. The clearinghouse sets rules for check presentment, uses multilateral netting, and chooses the interbank settlement channel. One option is for one clearinghouse member to serve as a settlement intermediary (Federal Reserve System 1997c). Net settlement payments are then made on bankers balance accounts (Table 2, Column C). Alternatively, check clearinghouses may use the National Settlement Service (NSS), in which case settlement is a mix of private and Federal Reserve involvement (Table 2, Column B).

Debit card, credit card, and prepaid card payments. Nearly all card payments in the United States are initiated on a real-time electronic connection to card networks and issuers. Consequently, both the payment approval process and the clearing of card payments begin when the payment card information is swiped in a payment card terminal or is entered manually when purchases are made on the Internet. Interbank payments are cleared on private networks (Table 1, third and fourth

columns). Card payment networks accumulate transaction data during the day and set their own rules and schedules for clearing and settlement.

Card networks sort transactions according to card-issuing bank to determine the value of the interbank payments required for cardholder purchases. In some cases, card issuers are also "acquirer banks," the banks of merchants and others that accept card payments (Litell). For these banks, the interbank payment required to settle their cardholder activity is netted against the interbank payment required to settle payments that go to their card-accepting clients.

The card network has a settlement intermediary bank, and interbank settlement payments are made with both wire and ACH payments (Federal Reserve System 1997a). For banks in a net debit position, wire payments are used to transfer funds from reserve accounts of card issuers to the reserve account of the settlement intermediary bank (Table 2, Column B). For banks in a net credit position, funds are then transferred from the settlement intermediary bank's reserve account to the reserve accounts of acquirer banks.

Emerging payment methods. Recently, several new forms of payment have emerged to facilitate person-to-person (P2P) and consumer-to-business (C2B) payments. In part, they have been developed to take advantage of the Internet for e-commerce and new connectivity available via the Internet and mobile networks (Hayes and Frisbie). Some are adapting ACH and card payments to transactions that currently depend on cash and checks, such as P2P payments and consumer-to-service provider payments for home repair or personal services. The best known of these emerging payments is PayPal, which provides P2P and C2B payments over the Internet.

PayPal contracts with a private bank for payment services. The intermediary bank thus serves as the host for the deposit accounts of PayPal customers and also executes payment orders. For example, the account holder could direct PayPal to use an ACH debit payment, a debit card payment, or a credit card payment to transfer funds to the PayPal account and the intermediary bank would execute the payment.

The private sector clears and settles the payment entirely if both the payer and payee are PayPal customers and the funds reside in PayPal accounts (Table 2, Column C). The payer directs PayPal to make a payment, identifying the payee with the payee's email address. PayPal

clears the payment by notifying its intermediary bank, which immediately transfers the funds from the payer's PayPal account to the payee's PayPal account.

Clearing and settlement of P2P or C2B payments require a mix of private sector and Federal Reserve involvement if money is transferred between PayPal and non-PayPal accounts. If both payer and payee transfer funds to and from non-PayPal accounts, for example, then two additional ACH or card payments are required. These transactions, referred to as split payments, add to the complexity of clearing and settlement of PayPal and other emerging payment systems.

II. THE DECLINING SHARE OF THE FEDERAL RESERVE IN CLEARING AND SETTLEMENT

Changes in the processing and use of retail payments have reduced the Federal Reserve's share of clearing retail payments. Summers and Gilbert (1996) document the decline from 1980 to 1994, attributing it to the development of alternative clearing networks, increased on-us transactions caused by regional interstate banking, and increased cost of Federal Reserve services.[5]

This section builds on Summers and Gilbert by reviewing recent developments that have further reduced the Federal Reserve's share of retail payment clearing and settlement. The section first describes these developments and explains their effect on the Federal Reserve's share of clearing and settlement. It then estimates the size of the decline in the share of retail payments cleared and settled by the Federal Reserve.

The effect of recent developments on the Federal Reserve's share of clearing and settlement

Developments since 1996 have influenced the share of retail payments that the Federal Reserve clears and settles.[6] A shift from paper to electronic forms of payments and reduced barriers to forming large clearing systems combined to favor private clearing systems relative to Federal Reserve clearing. Other developments include consolidation that favored private clearing organizations and consumer adoption of debit and credit card payments.

Electronic payments and formation of large private clearing systems. Economies of scale, where added clearing volume allows lower cost per transaction and lower prices for services, are stronger for electronic transactions than for paper transactions (Economides). Two developments in the 2000s shifted clearing from paper to electronic processing. First, NACHA (formerly the National Automated Clearing House Association), which sets rules for ACH transactions, developed a variety of new electronic payments. For example, businesses are now allowed to use information from checks to make ACH payments for telephone or Internet purchases. They can also convert paper checks sent by mail for bill payments or written at a cash register into ACH payments.[7] Second, the Check Clearing for the 21st Century Act of 2003 enabled banks to make a digital image of a check and use the image to clear the check (GAO 2008).[8] Today, the Federal Reserve and all established private systems offer image check clearing.[9]

Barriers to forming large, national clearing systems became less important after 2000. First, the predecessor to the NSS, called the net settlement service, could most easily accommodate interbank settlement for clearing systems within one Federal Reserve district because reserve accounts of banks were housed and administered at their local Reserve Bank. By contrast, payments cleared by the Federal Reserve could accommodate interbank settlement across districts by using its transportation network to transfer checks and ACH payment records among Reserve Banks (GAO 2000; EPN 2003). Relaxed geographic restrictions on banks in the 1990s led to banks serving larger markets and a greater need for interbank settlement across regions. Concerns over the regional limitations of the net settlement service led to modifications that made it easier for private clearing systems to settle interbank payments across Federal Reserve districts. In 1999, the service was introduced as the NSS (Federal Reserve System 1998a).

Second, in the late 1990s, the Federal Reserve reassessed its pricing and processing schedules related to exchange of ACH transactions to determine whether they placed private sector operators of ACH clearing systems at a competitive disadvantage. In October 2001, fees and deadlines for interoperator exchange of ACH transactions were revised (Connolly and Eisenmenger). FedACH also began to negotiate with private operators over fees and deadlines.

Reduction of these barriers allowed clearing networks to recruit new members, opening the door to network externalities that favor larger networks. Positive network externalities occur when current network members benefit as new members join (Katz and Shapiro). In an electronic payment clearing system, current members benefit from a new bank joining the network because they can more easily clear checks drawn on the new bank.

The impacts of electronic payment processing, reduced barriers to the formation of large clearing systems, and network effects are seen in check clearing services. An estimated 150 regional check clearinghouses operated in 1997 (GAO 1997). In the 2000s, many of these closed or were merged into larger organizations. From 2003 to 2005, The Clearing House acquired at least seven large regional clearinghouses (PRNewswire). In 2005, the 22 banks that owned The Clearing House controlled 60 percent of U.S. check volume (Digital Transaction News).

In contrast with private clearing organizations, the Federal Reserve was less able to take advantage of larger volume or added clients. Federal Reserve clearing services were operating at such a large scale in 2000 that added volume may not have allowed significantly lower pricing. The network externality created from added customers was also limited because the Federal Reserve had a nationwide network in 2000.

Consolidation that favored private clearing organizations. Interstate banking began in the 1980s when states began to allow bank acquisitions across state lines. It accelerated when the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 relaxed geographic restrictions on interstate bank branching. The Act allowed banks to more easily operate across state lines and led to mergers that created larger banks serving nationwide markets. This consolidation also led to larger correspondent banks (Osterberg and Thomson).

Consolidation had two effects that favored the clearing operations of correspondent banks. First, larger correspondent banks process more transactions internally, and the associated economies of scale allowed them to price their services competitively. Second, for transactions forwarded to other clearing systems, larger correspondent banks have been able to aggregate larger numbers of transactions and obtain quantity discounts for clearing services (Hayashi).

Consumer adoption of debit and credit cards. The 2000s saw significant changes in the use of retail payments (Table 3).[10] In 2000, checks ranked first among retail payments with a share of 58 percent. By 2009, the number of check payments had dropped by 17 billion and their share had declined to 23.6 percent. Some checks were replaced by ACH payments, which over this period grew from an 8.5 percent share of retail payments to a 17.7 percent share. Debit card payments also grew rapidly, from 8.3 billion in 2000 to 38.5 billion in 2009, and ranked first among retail payments in 2009 with a 37.1 percent share. Credit card transactions also grew, by 6.5 billion, though their share remained in the range of 22 percent to 24 percent.

Because debit and credit card payments are cleared by private networks, the substitution of checks by card payments had a large impact on Federal Reserve clearing. Combined, the annual volume of debit and credit card transactions grew by 60.9 billion from 2000 to 2009 for a combined share of 58.7 percent of retail transactions in 2009. However, debit and credit card payments are typically used for small-value payments and in 2009 combined to account for only 4.7 percent of the value of retail payments, up from 2.6 percent in 2000.

Estimates of the Federal Reserve's share in retail payment clearing and settlement

Data for 2000 to 2009 confirm that, for payments requiring interbank settlement, the share of retail payments the Federal Reserve cleared has declined.[11] The share of retail payments for which the Federal Reserve is the only organization involved in the settlement process has also declined.

Federal Reserve share of clearing retail payments. For payments that require interbank clearing, the share of check and ACH payments that the Federal Reserve cleared fluctuated from 2000 to 2009 but declined overall. The share for check payments declined from 56.9 percent in 2000 to 46.9 percent in 2006, but increased to 49.7 percent in 2009 (Table 4). The share for ACH payments declined from 2000 to 2009, with most of the decline between 2000 and 2006. The share for ACH payments declined from 91.5 percent in 2000 to 68.2 percent in 2006, and declined to 67.3 percent in 2009.

The Federal Reserve does not clear debit or credit card payments, so the share of card transactions that require interbank clearing is 100

Table 3
NONCASH RETAIL PAYMENTS BY TYPE OF PAYMENT

A. VOLUME

	2000		2003		2006		2009	
	Number (billions)	Share (%)	Number (billions)	Share (%)	Number (billions)	Share (%)	Number (billions)	Share (%)
Check[1]	41.9	58.0	37.3	46.4	30.5	32.6	24.5	23.6
ACH	6.1	8.5	8.9	11.1	14.6	15.7	18.4	17.7
Debit cards	8.3	11.5	16.2	20.1	26.0	27.8	38.5	37.1
Credit cards	15.9	22.0	18.0	22.4	22.4	23.9	22.4	21.6
Total	72.2	100.0	80.4	100.0	93.6	100.0	103.7	100.0

B. VALUE

	2000		2003		2006		2009	
	Value (trillions)	Share (%)	Value (trillions)	Share (%)	Value (trillions)	Share (%)	Value (trillions)	Share (%)
Check[1]	39.8	66.8	41.1	60.9	41.6	55.1	31.6	44.6
ACH	18.3	30.6	24.4	36.1	31.0	41.0	35.8	50.6
Debit cards	0.3	0.5	0.6	0.9	1.0	1.4	1.4	2.0
Credit cards	1.2	2.1	1.5	2.2	1.9	2.6	1.9	2.7
Total	59.7	100.0	67.6	100.0	75.5	100.0	70.8	100.0

[1]Checks are checks paid rather than checks written. In other words, check payments exclude checks that are cleared through ACH, while ACH payments include such checks.

Notes: Fedwire is excluded due to lack of data. Number, share and value do not sum to toal due to rounding.

Sources: The Federal Reserve's share of the volume clearing of retail payments is calculated with data on the total volume of retail transactions and the total volume of transactions cleared by the Federal Reserve, based on data from the Committee on Payments and Settlement Systems (CPSS 2006; 2009; 2012) of the Bank for International Settlements. The original source of data on the total volume of check and ACH transactions reported by the CPSS are the Federal Reserve studies of retail payments conducted tri-annually since 2000 (Federal Reserve System 2002; 2007; 2011a). The original source for check and ACH transactions reported by the CPSS as cleared by the Federal Reserve comes from Federal Reserve annual reports. The CPSS data are published annually and include updates and revisions of information from the Federal Reserve payments studies.

percent for private clearing systems during the entire period from 2000 to 2009. Card transactions that require interbank settlement more than doubled, from 24.2 billion in 2000 to 60.9 billion in 2009. Because card transactions clear on private networks, their increase has had a significant impact on the share of total retail payments that the Federal Reserve clears. Roughly 80 percent of noncash retail payments are now cleared in private systems.

Federal Reserve share of settlement of retail payments. Quantifying how the change in noncash retail payment clearing has affected the

Table 4

VOLUME OF INTERBANK NONCASH RETAIL PAYMENTS BY FEDERAL RESERVE AND PRIVATE CLEARING CHANNELS[1]

	2000		2003		2006		2009	
	Number (billions)	Share (%)	Number (billions)	Share (%)	Number (billions)	Share (%)	Number (billions)	Share (%)
Check[2]								
Fed	17.5	56.9	16.3	56.0	11.5	46.9	8.9	49.7
Private	13.2	43.1	12.8	44.0	13.0	53.1	9.0	50.3
Total	30.7	100.0	29.1	100.0	24.5	100.0	17.9	100.0
ACH								
Fed	4.8	91.5	6.1	80.3	8.4	68.2	10.3	67.3
Private	0.4	8.5	1.5	19.7	3.9	31.8	5.0	32.7
Total	5.2	100.0	7.5	100.0	12.3	100.0	15.3	100.0
Card Payments								
Fed	-	-	-	-	-	-	-	-
Private	24.2	100.0	34.2	100.0	48.4	100.0	60.9	100.0
Total	24.2	100.0	34.2	100.0	48.4	100.0	60.9	100.0
All Noncash Retail Payments								
Fed	22.2	37.0	22.3	31.5	19.9	23.3	19.2	20.4
Private	37.8	63.0	48.5	68.5	65.3	76.7	74.9	79.6
Total	60.1	100.0	70.8	100.0	85.2	100.0	94.1	100.0

[1]Interbank transactions require settlement payments across banks. On-us transactions are those where the payee bank is the same as the payer bank and may not require interbank settlement.
[2]Checks are checks paid rather than checks written. In other words, check payments exclude checks that are cleared through ACH, while ACH payments include such checks.

Notes: Check and ACH transactions exclude on-us transaction but debit and credit card transactions include on-us transactions. Adjustments for debit and credit on-us transactions, such as assuming the share of on-us transactions for debit and credit is the same as for checks, raises the Federal Reserve share but does not change the pattern over time. The Federal Reserve's ACH transactions are adjusted by subtracting transactions that it passes on to other ACH operators and adding transactions passed to it from other ACH operators. Thus the share for the Federal Reserve is for ACH transaction where it the final processor and for which it settles on reserve accounts. Number, share and value do not sum to toal due to rounding.

Sources: The Federal Reserve's share of the volume clearing of retail payments is calculated with data on the total volume of retail transactions and the total volume of transactions cleared by the Federal Reserve, based on data from the Committee on Payments and Settlement Systems (CPSS 2006; 2009; 2012) of the Bank for International Settlements. The original source of data on the total volume of check and ACH transactions reported by the CPSS are the Federal Reserve studies of retail payments conducted tri-annually since 2000 (Federal Reserve System 2002; 2007; 2011a). The original source for check and ACH transactions reported by the CPSS as cleared by the Federal Reserve comes from Federal Reserve annual reports. The CPSS data are published annually and include updates and revisions of information from the Federal Reserve payments studies.

Federal Reserve's share of interbank settlement is difficult. First, most private clearing organizations do not disclose their settlement activity.[12] Second, depending on clearing arrangements, Federal Reserve involvement in settlement varies, from exclusive, to partial, and to none.

The share of retail payments for which the Federal Reserve is the only organization involved in the settlement process is the same as the share of the payments it also clears (Table 2, Column A). The share of noncash retail payments cleared by the Federal Reserve declined to 20.4 percent in 2009 from 37 percent in 2000 (Table 4), a total decline of 16.6 percentage points. The same 16.6-percentage-point decline also measures the decline in the share of retail payment transactions for which the Federal Reserve is exclusively involved in the settlement process.

Some transactions have shifted to settlement with partial Federal Reserve involvement, where a private clearing organization determines the net settlement positions of its members and the Federal Reserve executes the settlement transactions (Table 2, Column B). Growth at EPN and SVPCO increased interbank transactions sent to the NSS. Growth in card payments sent more interbank settlement transactions to the wire and ACH systems.

Some transactions may have shifted to settlement at private settlement intermediary banks on bankers balance accounts and without involvement of the Federal Reserve (Table 2, Column C). The low cost of image check exchange, in particular, may encourage settlement at private intermediary banks. Two correspondents, for example, may find it cost effective to exchange checks drawn on one another's clients and could settle interbank payments using only bankers balance accounts.[13]

III. IS THE DECLINE IN THE FEDERAL RESERVE'S ROLE A CONCERN?

The shares of retail payments that the Federal Reserve clears and settles have declined. Both shares are expected to decline further as card and ACH payments continue to replace checks.

This section evaluates the possible implications of recent changes in the Federal Reserve's role in clearing and settlement for the efficiency and safety of the payment system. Central banks are concerned with payments system efficiency and safety for two reasons. First, an efficient and safe payment system contributes to a smoothly functioning

economy. Second, efficient and safe payments bolster public confidence in the country's monetary system. The section first explains why some policymakers say a decline in the Federal Reserve's role may be of little concern, and then explains why others say it may be a matter for considerable concern.

Why the declining role of the Federal Reserve in clearing and settlement in retail payments might be of little concern

One reason some policymakers may be little concerned about the decline in the Federal Reserve's role in clearing retail payments is that private clearing services in a competitive market promotes innovation and the efficient use of resources (Lacker and Weinberg). These arguments suggest a significantly reduced role for the Federal Reserve in payment clearing (Green and Todd).

Debit card and credit card payments might illustrate the benefits of private provision of retail payments. Their rapid growth in recent years suggests that they are effective substitutes for check payments at the point of sale. Clearing services for card payments use efficient electronic messages and are reliable. In addition, card payments can fill otherwise unmet needs in retail payments, such as in e-commerce transactions. Card companies have also innovated to expand their markets by, for example, adapting card payments to quick-service restaurants.

According to this view, if the Federal Reserve offers payment clearing services, it should compete with private providers on a level playing field (Stehm; Stern). The reduction of the Federal Reserve's competitive advantage in clearing services after the introduction of the NSS and adjustments to its ACH interoperator pricing and scheduling practices should have led to a shift of retail payment clearing to private systems. The recent increase in the private share of retail payments clearing should, therefore, not be a concern. Entry into check image exchange services by new private organizations (Endpoint Exchange and Viewpointe) and established payment processors (Fiserv) also support competition. Moreover, recent analyses suggest that check clearing has become more efficient. The cost of check clearing has fallen and the time required to clear checks has declined (Bauer and Gerdes; Phoenix-Hecht). Recent research found that image check clearing reduced the Federal Reserve's cost of check processing in 2010 by an estimated

$1.6 billion. In addition, faster check collection reduced the amount of funds that firms and consumers must hold to fund expenditures, resulting in an estimated $1.37 billion in savings to firms and $640 million in consumer benefits (Humphrey and Hunt).

Advocates of a limited role for the Federal Reserve operations in retail payment processing make an exception for services that complement existing Federal Reserve clearing and settlement services. When the ACH was in development, the Federal Reserve already had an extensive network to transport the checks it was clearing. It was efficient for the Federal Reserve to also transport the magnetic tapes containing electronic ACH files (Connolly and Eisenmenger). Another exception is the Federal Reserve's NSS. Banks hold reserve accounts to satisfy reserve requirements, and the Federal Reserve provides services to maintain reserve accounts. These services also allow the Federal Reserve to efficiently and safely complete interbank settlement payments for all banks. Thus, the Federal Reserve's NSS for private clearing systems complements its reserve account services.

Why the declining role of the Federal Reserve in clearing and settlement in retail payments may be a concern

The reduced role of the Federal Reserve in clearing and settlement has raised concern among some policymakers that continued decline may harm retail payment efficiency and increase risk (Hoenig). These concerns include the ability of the Federal Reserve to serve as a check against high concentration, as a backup in case of operational failure, as a promoter of socially beneficial efforts to manage operational risks, and as a provider of safe interbank settlement services.

A check against high concentration. The retail payment clearing industry does not conform to the textbook model of competitive markets with many suppliers and free entry. Only one private operator provides ACH clearing services. Check clearing has more private providers, but SVPCO dominates the private check clearing market. Similarly, many competitors clear card payments, but the industry is nevertheless highly concentrated. In 2009, Visa and MasterCard combined to clear 75 percent and 85 percent, respectively, of general purpose credit card and debit card transactions.[14]

This high concentration is common for network markets such as payment clearing services. Large networks with payment instruments that are accepted by many merchants and are used by many consumers are valued more highly than smaller networks (Katz and Shapiro). Moreover, the market for retail payment clearing services may not be contestable because new entrants cannot easily attain a size large enough to attract consumers and merchants.

Common policy responses to concentrated and noncontestable markets may not work well in network markets. Antitrust solutions, such as preventing mergers or breaking up firms in the name of preserving competition, may destroy value by reducing benefits to members of the networks (Economides). Price regulation is also problematic because economies of scale complicate determination of an appropriate regulated price.

The limitations of competition policy may suggest that the Federal Reserve should operate retail payment clearing systems (Stern). The Federal Reserve provides some competition in ACH and check clearing, even if the competitive balance between it and private providers is not perfectly level. The Federal Reserve has also led efforts to create some far-reaching innovations in retail payments, such as research and development in automated machinery to sort paper checks and in image clearing of checks (Connolly and Eisenmenger; Bauer and Gerdes). Alternatively, if the Federal Reserve determines that innovation in payment clearing is too slow, it may be able to stimulate innovation in private-sector firms by innovating in its own services.

A backup in case of operational failure. The growing complexity and concentration of the clearing and settlement of retail payments in the United States increases the likelihood of more and larger operational disruptions.[15] Separation of clearing from settlement, proliferation of payment processing options, and some emerging payment methods have led to more complicated clearing and settlement arrangements. Studies have shown that the number of operational loss events is positively correlated with organizational complexity (BIS 2009; Chernobai and others).

Sufficiently large operational disruptions have potential to cause serious problems for users and providers of particular payments systems (BIS 2003). The payment processing system of one of Japan's largest banks, for example, malfunctioned after an attempted computer system

upgrade on April 1, 2002 (FSA). System repairs took six weeks, during which many ATMs stopped working and large numbers of payments were mishandled, resulting in duplicated transactions and delayed automated bill payments.[16]

Backup capabilities can mitigate operational disruptions.[17] If a clearing system goes down, consumers could choose an alternative form of payment and shift transactions to another clearing system. But a sufficiently large shift could swamp alternatives that have insufficient capacity. If the Federal Reserve's operating capacity in check processing shrinks with the continued decline in check payments, it may become less able to absorb a large influx of payments in the event that a prominent noncheck payment system is unable to process payments.

A promoter of efforts to control risk. Self-interested users and private processors of retail payments may have insufficient incentives to ensure adequate control of operational and settlement risk (Kahn and Roberds 2009). In network markets, the consequences of operational and settlement disruptions can go beyond the organization that is responsible for the disruption. For example, it was reported that a 2009 data breach affected at least 670 banks, with at least 197 reissuing their payment cards.[18] In addition to the costs of reissuing cards, affected banks must bear the expense of notifying customers, the monetary losses from the use of card information to commit payment fraud, the legal costs of resolution, and the cost of a diminished reputation (Wicks). From society's viewpoint, overall payment security is inadequate if organizations do not take into account spillovers when devoting resources to controlling risk.

Also of concern are news stories about weak security of Internet systems and loss of consumer privacy. Consumers regularly see stories about hackers using stolen personal data to create fraudulent payments. In an age of Internet banking and electronic payments, bank account holders have reasonable concerns about the safety of their accounts. If strong enough, these fears can undermine the confidence that is necessary for modern monetary systems.

The decline of the Federal Reserve's share of the clearing of retail payments reduces its influence on operational risk in retail payments (Summers and Gilbert). The Federal Reserve brings a broader, public interest to its clearing and settlement services, which motivates it to-

ward a more socially optimal standard in limiting its own operational risk.[19] The influence, however, is not limited to its own services because the Federal Reserve participates in organizations such as NACHA and the American National Standards Institute that determine industry standards aimed at controlling operational risk.

Provider of safe settlement services. Interbank settlement for which the Federal Reserve is exclusively involved has a low risk of failure.[20] First, the Federal Reserve both determines and executes interbank settlement payments, which reduces the potential for errors in the execution of settlement transactions. Second, while banks are ultimately responsible for managing their reserve accounts to meet settlement obligations, they can readily manage these risks if settlement is at the Federal Reserve. Account monitoring tools allow banks to easily access their reserve account balance and ensure it is sufficient to meet settlement obligations. In addition, credit worthy banks with temporary financial difficulties can obtain a short-term loan from the Federal Reserve to cover interbank settlement payments.

Payments that are settled with partial Federal Reserve involvement using the NSS, or with Fedwire and ACH payments, also have the advantages of account monitoring and access to Federal Reserve credit but, nevertheless, are more risky. First, the settlement processing chain can be much more complex. For example, in 2002, Visa's settlement intermediary bank directly settled with 40 large banks and the settlement intermediary banks of 60 processors (Litell).[21] Second, private settlement intermediary banks, which have some risk of failure, are custodians of interbank settlement funds in cases where Fedwire or ACH is used for interbank settlement. Finally, multilateral netting introduces a time lag between initiation and completion of interbank settlement (FFIEC). Settlement could fail if, during the settlement window, one or more members have financial difficulties that prevent them from making their interbank settlement payments.[22] Costs of unwinding a failed net settlement process are significant (Shen).[23]

Settlement on bankers balances at private banks, in their roles as correspondents or as a settlement intermediary, is also riskier than settlement processed exclusively by the Federal Reserve. Problems with interbank payments at correspondents in the 19th and early 20th centuries periodically led to disruptions in the payment system.

Failure of a correspondent caused clients to lose access to their bankers balances, which, in turn, caused depositors to lose access to their bank accounts (White; West; Richardson 2007a, 2007b). In some cases, the loss of confidence in payments exacerbated economic downturns (James and others).

Creation of the Federal Reserve System and the FDIC, as well as supervisory oversight, has reduced the potential consequences of payments system disruptions from failures of private banks. The recent economic downturn, however, is a reminder that these problems have not completely disappeared. In 2009, a correspondent was closed by the state of Illinois because of an inability to obtain liquid funds, which led to insufficient reserve account balances to support interbank settlement on behalf of its clients (Office of Inspector General).[24]

Retail payments have migrated from arrangements in which the Federal Reserve has exclusive involvement in the interbank settlement process to arrangements in which it has partial or no involvement. Continued vigilance is required to ensure the worst of the historical problems in interbank settlement do not reappear as settlement migrates away from the Federal Reserve.

IV. SUMMARY AND CONCLUSION

The Federal Reserve and private organizations compete with one another to clear and settle retail payments. The share of retail payments the Federal Reserve clears and settles has declined since at least 1984 and continued to 2009. The decline since 1996 can be attributed to a shift from paper to electronic forms of payments, reduced barriers to forming large clearing systems, consolidation that favored private clearing organizations, and consumer adoption of debit and credit card payments.

In 2000, when the Federal Reserve's share of retail payment clearing was 37 percent and paper was still used to clear checks, policymakers had little reason to be concerned about a declining share of retail payments cleared by the Federal Reserve. Recent reduction in the cost of check clearing and the increased use of efficient and convenient debit and credit cards suggest that the additional decline in the Federal Reserve's share of retail payment clearing since 2000 may also be of little concern.

With the share of retail payment transactions the Federal Reserve clears and settles now close to 20 percent, some policymakers have significant concerns about the diminished role of the Federal Reserve in retail payments. With this declining role the retail payment clearing and settlement industry faces increased challenges in four areas. First, clearing and settlement may become even more concentrated and less competitive; second, operational failures may become more frequent and harder to mitigate; third, some socially beneficial options to manage operational risks may not be implemented; and fourth, payments may be less likely to be settled safely. The challenge for policymakers is to implement strategies to limit further erosion of the Federal Reserve's role in clearing and settlement and/or find other means to promote efficiency and safety in retail payments.

ENDNOTES

[1]In this article "bank" refers to a depository institution, such as a credit union, savings bank, or commercial bank. "Financial institution" refers to a bank or a nonbank payment provider such as PayPal.

[2]The 12 Reserve Banks provide a number of services to banks, including provision and maintenance of reserve accounts as well as clearing and settlement of check and ACH payments. Banks that provide demand deposit accounts in the United States are required to hold reserve balances at the Federal Reserve. The reserves are held in master accounts (Federal Reserve Banks 2011), which also hold funds used for interbank settlement. Master accounts are commonly called reserve accounts.

[3]Settlement also requires payments to and from the accounts of bank customers. Laws, regulations, and industry practice determine when funds are withdrawn from payer accounts and made available to payee accounts.

[4]Correspondents are typically larger commercial banks, but a few are "bankers banks" that do not provide services to consumers. Client banks of correspondents are known as respondents. Other correspondent services include loan participation, Fed funds, investments, and data processing (Knight).

[5]Subsidies of some Federal Reserve payment services were reduced because the Monetary Control Act (MCA) of 1980 directed the Federal Reserve to determine prices for its payment services to fully recover its actual costs of providing clearing and settlement services plus the cost of capital, taxes, and other costs (such as deposit insurance) not explicitly incurred by the Federal Reserve (Jacob and others).

[6]The focus of this article is the Federal Reserve's influence on retail payments as an operator of clearing and settlement systems and its share is an indicator of the extent of its influence. The Federal Reserve also influences retail payments as an overseer of payments systems and supervisor of banks (Weiner; Bernanke).

[7]Twelve percent of paper checks written in 2009 were converted to ACH payments, up from 0.8 percent in 2003 (Federal Reserve System 2007; 2011a).

[8]The Act authorized a paying bank to accept an electronic image or request a substitute check created by printing on paper the image of the check's front and back. Only 4.3 percent of checks required substitutes in 2009 (Federal Reserve System 2011a).

[9]In 2009, only 3.2 percent of checks were cleared and settled as paper (Federal Reserve System 2011a).

[10]Fedwire is excluded from Table 3 due to lack of data.

[11]Federal Reserve studies have shown a strong relation between a bank's size and on-us transactions (Gerdes and others 2005), suggesting that bank consolidation may have increased the proportion of on-us transactions in retail payments. Summers and Gilbert argued that increases in the number of on-us transactions

would reduce the Federal Reserve's share of retail payment clearing. Data for on-us transactions do not show a clear trend for 2000, 2003, 2006, and 2009: on-us transactions were, respectively, 27, 22, 20, and 26 percent of total ACH transactions and 15, 14, 16 and 19 percent of total check transactions (Federal Reserve System 2002; 2007; 2011a). Because changes in on-us transactions could not have had a major impact on the share of retail payments the Federal Reserve cleared and settled, this article focuses on retail transactions that require interbank clearing and settlement.

[12]Because of its large size, an important exception is The Clearing House, which discloses that its EPN and SVPCO subsidiaries use the Federal Reserve's NSS to settle ACH and check payments for its members.

[13]For example, suppose correspondent A and correspondent B have bankers balance accounts on one another's books. If correspondent A deposits image checks drawn on correspondent B's clients, correspondent B could settle with a credit to correspondent A's bankers balance account. Correspondents A and B could then settle with their clients on their own clients' bankers balance accounts.

[14]Shares are calculated from statistics in the February 2010 issue of The Nilson Report and from the Federal Reserve payments study (Federal Reserve System 2011a).

[15]Examples include a recent, brief outage of the Visa network; a failure of a communications satellite that prevented ATM withdrawals and card payments over a large part of the United States for several days; and an internal failure of a backup system that caused PayPal's online-payment system to stop working (Musil; Marshall; Hayes).

[16]Manmade and natural disasters caused two other large disruptions to retail payments. The terrorist attacks of Sept. 11, 2001, disrupted check payments because airplanes that transported checks across the country were grounded for several days (Lacker). More than 1 million transactions were disrupted at Mizuho Bank in Japan after the earthquake and tsunami of 2011 due to an unusually large volume of ATM withdrawals and mobile phone payments to relief services (Thia). These operational problems are examples of systemwide risk in payments (Bank of England 2000).

[17]An alternative is for the various payment systems to be interoperable and able to stand in if another becomes unavailable. However, private clearing systems in the United States appear to be incompatible with one another.

[18]The breach occurred at Heartland Payments Systems. These statistics are based on a list of affected banks on the Bank Info Security website (*www.bankinfosecurity.com/articles.php?art_id=1200*, accessed Feb. 23, 2012).

[19]To the extent this public interest adds cost to the Federal Reserve clearing operations that it must recover from its priced services, the added security may put the Federal Reserve at a competitive disadvantage relative to private clearing systems.

[20]Advantages of central bank settlement are safety, efficiency, availability, neutrality, and finality (BIS 2003). Safety, as noted in this paragraph, relates to the

ability of banks to plan for settlement payments and access to central bank credit if needed. Central banks have very low risks of failure, which makes their liabilities very safe compared to private banks. As noted above, efficiency reflects complementarities between reserve account services and interbank settlement services, and availability reflects high operating standards. Central banks services are neutral because they do not compete with depository institutions on consumer services. Finality of settlement on reserve accounts helps to reduce credit risk in settlement.

[21]Larger card networks add an additional layer for interbank settlement by allowing third-party payment processors to use a settlement intermediary bank.

[22]The Federal Reserve's Payment System Risk Policy provides guidelines for clearing systems to manage this risk (Federal Reserve System 2011b).

[23]Risk in settlement of retail payments is sometimes discounted because of their small value. Another perspective illustrates the potential for negative consequences of retail payment operational or settlement failure: in 2009, consumers purchased $4.6 trillion worth of goods and services from online and in-store merchants, 60.4 percent of which were made with debit and credit cards (McKinsey). Loss of a prominent card payment network for an extended period of time could have significant consequences for retail commerce in the United States.

[24]A second correspondent failed in 2009 when a number of its real estate investments soured (Ellis).

REFERENCES

Bank of England. 2000. "The Bank of England's Oversight of Systems," *Financial Stability Review,* December.

Bauer, Paul W., and Geoffrey R. Gerdes. 2009. "The Check Is Dead! Long Live the Check! A Check 21 Update," Federal Reserve Bank of Cleveland, *Economic Commentary*, September 29.

Bernanke, Ben S. 2007. "Central Banking and Bank Supervision in the United States," Remarks made at the Allied Social Science Association Annual Meeting, Chicago, Illinois, January 5.

Biehl, Andrew, James McAndrews, and Chris Stefanadis. 2002. "A Review of the Retail and Wholesale Markets for Funds Transfers," Federal Reserve Bank of New York, working paper, June.

BIS. 2003. "The Role of Central Bank Money in Payment Systems," Bank for International Settlements, August.

_____. 2009. "Results from the 2008 Loss Data Collection Exercise for Operational Risk," Bank for International Settlements, July.

CPSS. 2006. "Statistics on Payment and Settlement Systems in the CPSS Countries: Figures for 2004," Committee on Payments and Settlement Systems, Bank for International Settlements, March.

_____. 2009. "Statistics on Payment and Settlement Systems in the CPSS Countries: Figures for 2007," Committee on Payments and Settlement Systems, Bank for International Settlements, March.

_____. 2012. "Statistics on Payment and Settlement Systems in the CPSS Countries: Figures for 2010," Committee on Payments and Settlement Systems, Bank for International Settlements, January.

Chernobai, Anna, Philippe Jorion, and Fan Yu. 2010. "The Determinants of Operational Risk in U.S. Financial Institutions," Syracuse University, working paper.

Connolly, Paul M., and Robert W. Eisenmenger. 2000. "The Role of the Federal Reserve in the Payments System," Chapter 5 in *The Evolution of Monetary Policy and the Federal Reserve System Over the Past Thirty Years: A Conference in Honor of Frank E. Morris*. Federal Reserve Bank of Boston.

Danola, Nick. 2010. "Best Practices: Developing a Check Clearing Strategy," Presentation at the FIS Client Conference.

Digital Transaction News. 2005. "SVPCO Gears for Growth with New Automated Settlement Service," August 18.

Economides, Nicholas. 2006. "Competition Policy in Network Industries: An Introduction," in Dennis W. Jansen, Ed., *The New Economy and Beyond.* Cheltenham, U.K. and Northampton, Mass.: Edward Elgar, 2006, pp. 96-121.

Ellis, David. 2009. "Atlanta Bank Failure to Have Big Impact," CNNMoney.com, May 5.

EPN. 2003. "The Electronic Payments Network and the ACH: A History," Electronic Payments Network.

_____. 2009. "2009 Rules of Membership and Operating Rules," January 2.

Federal Reserve Banks. 2011. *Operating Circular 1*, September 1.

Federal Reserve System. 1997a. "Traditional Payments Primer: Credit Card Payments," Federal Reserve Financial Services.

_____. 1997c. "Traditional Payments Primer: Checks," Federal Reserve Financial Services.

_____. 1998a. "Enhancement of Federal Reserve Net Settlement Payment Services," Notice on the Federal Register November 16, 1998, available

on the Internet at *www.federalregister.gov/articles/1998/11/06/98-29709/enhancement-of-federal-reserve-net-settlement-payment-services*.
_____. 2002. "Retail Payment Research Project."
_____. 2007. "The 2007 Federal Reserve Payments Study."
_____. 2010b. *Reserve Maintenance Manual,* January.
_____. 2011a. "The 2010 Federal Reserve Payments Study."
_____. 2011b. "Federal Reserve Policy on Payments System Risk," March 24, available on the Internet at *www.federalreserve.gov/paymentsystems/psr_policy.htm*.
FFIEC. 2004. "*IT Examination Handbook: Wholesale Payment Systems,"* Federal Financial Institutions Examination Council, July.
FSA. 2002. "Administrative Order Against Mizuho Financial Group," Japan Financial Services Agency, press release, June 19.
GAO. 1997. "Payments Clearing and Settlement: A Guide to the Systems, Risks, and Issues," United States General Accounting Office, June.
_____. 2000. "Federal Reserve System: Mandated Report on Potential Conflicts of Interest," United States General Accounting Office, November.
_____. 2008. "Check 21 Act: Most Consumers Have Accepted and Banks Are Progressing Toward Full Adoption of Check Truncation," United States General Accounting Office, October.
Gerdes, Geoff R., and Jack K. Walton II. 2002. "The Use of Checks and Other Noncash Payment Instruments in the United States," *Federal Reserve Bulletin*, August.
_____, Walton II, Jack K., and May X. Liu. 2005. "Trends in the Use of Payment Instruments in the United States," *Federal Reserve Bulletin*, Spring.
Green, Edward J., and Richard M. Todd. 2001. "Thoughts on the Fed's Role in the Payments System," Federal Reserve Bank of Minneapolis, *Quarterly Review* 25(1), Winter.
Hayashi, Fumiko. 2003. "Community Bank Access to Payment Card Networks: Has It Become More Expensive?" Federal Reserve Bank of Kansas City, working paper.
Hayes, Frank. 2010. "Recovery Disaster: PayPal Crash Strands Merchants," Storefront Back Talk website, November 4.
Hayes, Tony, and Ross Frisbie. 2011. "The Regulation of Traditional and Alternative Electronic Payments: The Case for a Level Playing Field," Oliver Wyman, December.
Hoenig, Thomas M. 2010. "Electronic Payments and the Central Bank," speech before the Payment Management Customer Conference, Broomfield, Colorado, August 24.
Humphrey, David B., and Robert Hunt. 2012. "Getting Rid of Paper: Savings from Check 21," Federal Reserve Bank of Philadelphia, Working paper No. 12-12.
Jacob, Katy, Daniel Littman, Richard D. Porter, and Wade Rousse. 2010. "Two Cheers for the Monetary Control Act," Federal Reserve Bank of Chicago, *Chicago Fed Letter*, no. 275, June.
James, John A., James McAndrews, and David F. Weiman. Forthcoming. "Wall Street and Main Street: the Macroeconomic Consequences of New York Bank Suspensions," *Cliometrica*.
Kahn, Charles M., and William Roberds. 2002. "The Economics of Payment Finality," Federal Reserve Bank of Atlanta, *Economic Review*, Second Quarter.
Katz, Michael L., and Carl Shapiro. 1994. "Systems Competition and Network Effects," *Journal of Economic Perspectives*, Spring, pp. 93-115.

Knight, Robert E. 1970. "Correspondent Banking Part I: Balances and Services," Federal Reserve Bank of Kansas City, *Monthly Review*, November.

Lacker, Jeffrey M. 2003. "Payment System Disruptions and the Federal Reserve Following September 11, 2001," Federal Reserve Bank of Richmond, working paper 03-16.

_____, and John A. Weinberg. 1998. "Can the Fed be a Payment System Innovator?" Federal Reserve Bank of Richmond, *Economic Quarterly*, Spring.

Litell, Norman G. 2002. "Card Systems: Settlement, Regulation and Risk," presentation at The Payments Institute.

Marshall, Jonathan. 1998. "Big Push to Restore Pagers/Crews switch to backup satellite," *San Francisco Chronicle*, May 21.

McKinsey & Co. 2011. "Payments Matrix," The Clearing House.

Musil, Steven. 2012. "System Update Causes Brief Outage on Visa Network," CNET News, April 1.

Office of Inspector General. 2011. "Review of the Failure of Independent Bankers' Bank," Board of Governors of the Federal Reserve System, March.

Osterberg, William P., and James B. Thomson. 1999. "Banking Consolidation and Correspondent Banking," Federal Reserve Bank of Cleveland, *Economic Review*, First Quarter.

Phoenix-Hecht. 2012. "Check Clearing Study Highlights," available on the Internet at *www.phoenixhecht.com/ TreasuryResources/Products/Clearing_Study_ Highlights.html*, accessed February 17, 2012.

PRNewswire. 2005. "Latest Consolidation Further Streamlines Nation's Check Processing Infrastructure," August 30.

Richardson, Gary. 2007a. "The Check is in the Mail: Correspondent Clearing and the Collapse of the Banking System, 1930 to 1933," *The Journal of Economic History*, vol. 67, June.

_____. 2007b. "Categories of Bank Distress During the Great Depression, 1929-1933: The Illiquidity versus Insolvency Debate Revisited," *Explorations in Economic History*, vol. 44.

Shen, Pu. 1997. "Settlement Risk in Large-Value Payments Systems," Federal Reserve Bank of Kansas City, *Economic Review*, Second Quarter.

Stehm, Jeff. 2006. "Payments Systems and the Safety Net: The Role of Central Bank Money and Oversight," In *Cross-Border Banking: Regulatory Challenges*. New Jersey: World Scientific.

Stern, Gary H. 2005. "Economic Research and the Role of the Federal Reserve in Payments," Federal Reserve Bank of Minneapolis, *Top of the Ninth*, December.

Summers, Bruce J., and R. Alton Gilbert. 1996. "Clearing and Settlement of U.S. Dollar Payments: Back to the Future?" Federal Reserve Bank of St. Louis, *Economic Review*, September/October.

Thia, Tyler. 2011. "Japan's Mizuho Bank May Be Penalized for System Outage," ZDNet Asia, March 21, available on the Internet at *http://www.zdnetasia.com/ japans-mizuho-bank-may-be-penalized-for-system-outage-62207950.htm*.

Weiner, Stuart E. 2008. "The Federal Reserve's Role in Retail Payments: Adapting to a New Environment," Federal Reserve Bank of Kansas City, *Economic Review*, Fourth Quarter.

West, Robert Craig. 1977. *Banking Reform and the Federal Reserve, 1863-1923*. Ithaca: Cornell University Press.

Wicks, Mark. 2009. "National data security breach hits home," Charles City Press, February 6, available on the Internet at *www.charlescitypress.com/news/ x955247367/National-data-security-breach-hits-home*.

White, Eugene N. 1983. *The Regulation and Reform of the American Banking System, 1900-1929*. Princeton: Princeton University Press.