
Special Studies on Technology and Banking

Technological Innovation in Banking and Payments: Industry Trends and Implications for Banks

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Introduction

The revolution in information and communication technologies has become central to developments in the banking and financial services industry. Most banking industry analysts include technological change on the short list of important factors underlying the dynamics in banking industry structure and performance. For example, improvements in information management are playing a key role in enabling banks to take advantage of expanded powers and reductions in geographic restrictions. More complete and speedier access to customer information is allowing banks to more effectively manage complex customer relationships and to “cross-sell” additional financial services. In addition, technology has been a motivating factor for many of the recent large bank mergers, as institutions with less efficient technology management seek out merger partners with better technology management.

In recent years, technology has become increasingly important to the evolution of bank retail delivery systems and the development of new electronic retail products. The ability to deliver new advanced technology products reliably has become a central theme in the marketing strategies of a growing number of banks. Most institutions see introducing new products and services such as PC (personal computer) banking as a necessary step for retaining highly valued customers, and for positioning themselves strategically for the future. As this trend continues, the nature and magnitude of risks posed by technology will continue to change, and these changes will pose significant challenges for banks and banking supervisors.

A key to responding to these challenges is having a clear picture of the changing banking and payments landscape. This article describes that landscape, focusing in particular on changes in “retail” payments (i.e., business-to-business and consumer-to-business payments). We begin with a brief description of the significant shift in the United States toward electronic means of payment in retail transactions. The article then addresses important developments taking place in the nature and pattern of electronic payments processes. Some of these develop-

ments involve the adoption of new processes, while others reflect a recent surge in the use of technologies that have existed for a number of years. In both cases, these processes combine the electronic transfer of payment related information with the actual payment instructions. While much attention has centered on the shifts away from paper-based payment media, the development and adoption of processes that broaden the scope of information transferred electronically in the course of a payment transaction will likely have a greater long-term impact on electronic commerce and banking.

We discuss the response of banks to these technological developments, and the challenges arising for bank management in the fourth section of the article. Banks are substantially increasing their investments in technology, and we present information on the composition and magnitude of those investments. Our analysis indicates that banks are feeling strong competitive pressures to avoid being left behind in the technology area. This sense of urgency could lead to heightened technology-related risk exposures for banks if they fail to implement appropriate technology risk management practices. We then briefly discuss the steps taken by bank regulators to help institutions develop sound risk management measures. The article concludes with a summary of our key observations.

Developments in Electronic Payment Media

Analysts divide payments into “wholesale” and “retail” payments. Wholesale payments consist of very large value payments, especially interbank payments related to banks’ clearing and settlement role.² Retail payments

² The terms “wholesale payments” and “retail payments,” while not precise, are commonly used, even in official descriptions of payment systems. See, e.g., the section describing the U.S. payment system in detail in Committee on Payment and Settlement Systems (1993). For a recent description of advances in wholesale payment systems see Emmons (1997).

The average value of a wholesale payment in 1996 was \$4.3 million. Thus, while wholesale payments account for less than 1 percent of the number of payments in the United States, they account for almost 90 percent of the value of all payments. The average value of a retail transaction varies by payment medium. In 1996, the average check transaction was \$1,158; the average credit card purchase was \$61; the average debit card transaction was \$37; and the average automated clearing house (ACH) payment was \$3,283.

¹ The authors are grateful to Kori Egland for excellent research assistance, James Kamihachi and David Nebhut for helpful comments, and Rebecca Miller for editorial assistance.

include consumer-to-business and business-to-business payments. Wholesale payments have long been electronic, though technological advances are continually being made. Technological advances in retail payments have also been continual, but recent rapid increases in the pace and scope of such changes has drawn much attention in the financial community, the business press, and among the public at large.

In the United States, retail payments are heavily paper-based. Recent Bank for International Settlements (BIS) and National Automated Clearing House Association (NACHA) data show that approximately 97 percent of retail payments in the United States are made with either cash (about 87 percent) or checks (about 10 percent), with less than 4 percent of retail payments being made electronically. While it is difficult to estimate precisely the use of cash in an economy, it is clear that cash is the overwhelming choice for conducting small-value transactions.³ However, in terms of dollar-value, NACHA estimates that cash accounts for less than 3 percent of retail payments. The data also show significant growth in the use of electronic payment media—credit cards, debit cards, and automated clearing house (ACH) payments, including ACH credit transfers such as direct deposit of payrolls, and ACH direct debits such as automatic mortgage payments.⁴

In 1996 (the latest available BIS data), payment with electronic media accounted for over 25 percent of noncash retail payments, up from 18 percent at the beginning of the decade, as Figure 1 illustrates. In terms of number of transactions, credit cards are ahead of both ACH transactions and debit cards, accounting for almost three-quarters of all electronic retail payments in the United States. Hence, the nearly 40 percent increase in credit card transactions over the 1992-to-1996 period contributed substantially to the overall shift toward electronic retail payments. However, the most startling growth was in debit card use, as Figure 2

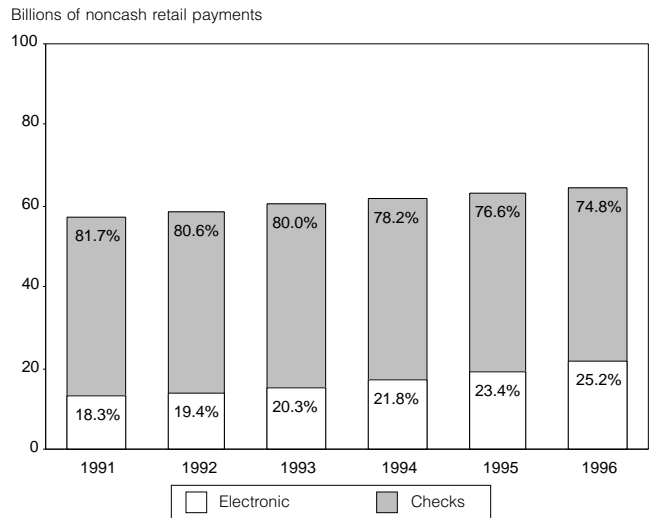
Average ACH payment size is substantially larger than other forms of retail payments because ACH transactions include direct deposit of payrolls by businesses, as well as relatively large consumer-to-business payments such as automatic mortgage payments.

³ Unlike the BIS data on noncash payments, which are widely considered to be accurate, estimates of cash usage are notoriously difficult to make and therefore are considered, at best, ballpark-type figures. On the problems associated with the estimation of cash usage, see Hancock and Humphrey (1997).

⁴ See Committee on Payment and Settlement Systems (1997). The G-10 countries include Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, the United States, and, since 1984, Switzerland as the eleventh member of the group.

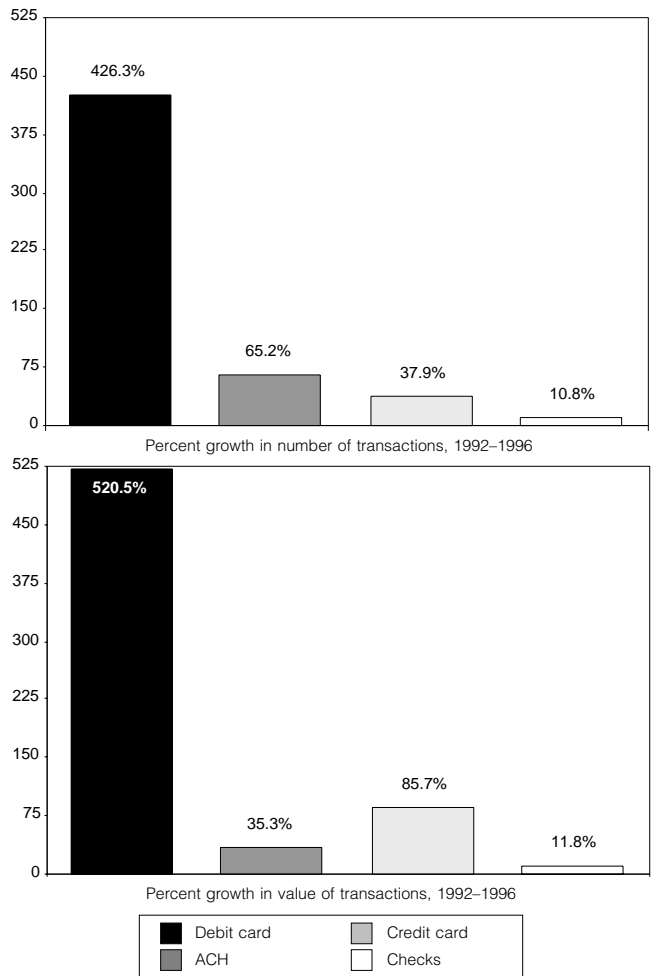
Though there is wide variation in the relative proportion of paper-based versus electronic payments in the Group of Ten (G-10) countries, each of those countries has experienced a significant shift to greater reliance on electronic payments over the past five years.

Figure 1—Electronic retail payments growing in importance



Source: Office of the Comptroller of the Currency, using data from Committee on Payment and Settlement Systems (1997), *Statistics on Payment Systems in the Group of Ten Countries: Figures for 1996*, Bank for International Settlements, and from the National Automated Clearing House Association (NACHA).

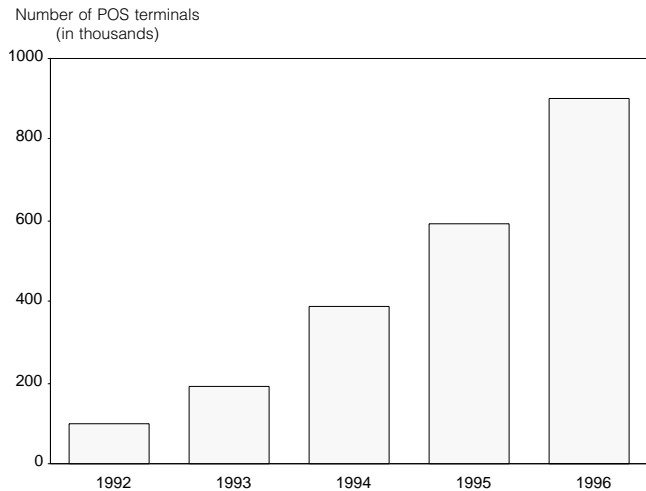
Figure 2—Debit card use explodes



Source: Office of the Comptroller of the Currency, using data from Committee on Payment and Settlement Systems (1997), *Statistics on Payment Systems in the Group of Ten Countries: Figures for 1996*, Bank for International Settlements, and from the National Automated Clearing House Association (NACHA).

shows. Though currently accounting for less than 12 percent of retail electronic payments, debit card use soared four-fold in volume terms and five-fold in value terms from 1992 to 1996. Many debit card transactions occur at point of sale (POS) terminals, and Figure 3 shows the correspondingly steep growth in number of POS terminals over the 1992-to-1996 period.

Figure 3—Steep growth in point-of-sale terminals



Source: Office of the Comptroller of the Currency, using data from Faulkner & Gray, *EFT Network Data Book* (various issues).

Because debit card transactions substitute for paper checks, and, to a far lesser extent, for cash, the potential for growth of debit card use is vast. American consumers currently write an estimated 12 billion checks annually at the point of sale. If only half of those payments were made by debit cards instead of checks, merchants could save an estimated \$1.73 billion.⁵ More generally, greater use of electronic payments not only enhances convenience, but can cut costs for consumers, businesses, and banks. One study estimates that the cost of using electronic payments is about one-third the cost of paper-based transactions.⁶ Given the same study's estimate that the cost of a country's payment system may be equivalent to 3 percent of its GDP, a complete shift away from paper could therefore reduce payments transactions cost for the U.S. economy by \$160 billion annually.

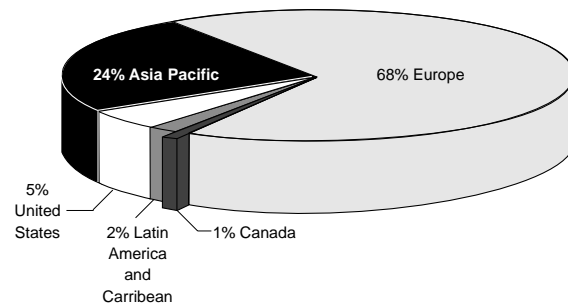
While the use of credit cards, debit cards, and ACH has grown significantly, use of electronic stored value ("e-

⁵ In a recent study, the Food Marketing Institute (1998) includes a detailed comparison of transactions costs for supermarkets to handle customers' payments using various payment instruments. Our estimate of the savings was calculated by taking the difference between the cost to handle a transaction by check (\$0.5827) and a transaction by on-line debit (\$0.2892), multiplied by 5.9 billion (i.e., one half the 11.8 billion checks written by consumers at the point of sale per year in the United States).

⁶ See Hancock and Humphrey (1997).

money") has progressed slowly in the United States.⁷ This stands in contrast to the growing use of e-money in other areas of the world, as indicated in Figure 4. Though there are no widespread open e-money systems operating in the United States, there has been steady growth in e-money use within limited systems on college campuses, military bases, and athletic stadiums.

Figure 4—Example of worldwide use of e-money



Source: Office of the Comptroller of the Currency using data on Visa's general-purpose, stored value chip cards, from Visa (1997), *Chip Card Programs Around the World*.

Some analysts question whether there is a significant business case for open-system e-money as a substitute for cash in small-value transactions. Other analysts believe that e-money use will become more widespread when consumers gain confidence in the security and reliability of e-money, and when e-money is combined with other electronic payment media such as debit and credit cards.⁸

Developments in Electronic Payment Processes

The development of electronic payment media can be seen as the spearhead for broader developments in

⁷ Electronic money (e-money) refers to prepaid payment mechanisms ("stored value") for making payments at point-of-sale terminals or over open computer networks. Some e-money devices also enable users to make direct transfers between devices. Stored-value products include card-based mechanisms (also called "electronic purses") and network-based mechanisms (also called "digital cash"). Although stored-value cards can be "single-purpose"—e.g., telephone cards—general use of the term "e-money" has come to be more commonly associated with stored-value cards that can be used for multiple purposes. Because of security and increased functionality, most analysts believe that card-based e-money requires the use of cards that have a computer chip embedded in them (so-called "smart cards") rather than cards using magnetic stripe technology. As pointed out in a G-10 study on e-money, a single precise definition of e-money is difficult to provide, in part because of technological changes. See Group of Ten (1997) and Basle Committee on Banking Supervision (1998) for discussions of this issue.

⁸ For recent discussions of security issues surrounding electronic money, see Committee on Payment and Settlement Systems and the Group of Computer Experts (1996), Group of Ten (1997), and Richards (1997).

electronic payment processes and electronic banking. In their most narrow sense, payment transactions are information transfers that credit and debit accounts. However, most payment transactions involve additional information exchanges accompanying the credit and debit instructions. For example, paper payment transactions typically involve the delivery of receipts or invoices. Many analysts and industry participants believe that the next great source of value and innovation in electronic retail payments will come from expanding the scope of the information exchanged in end-to-end electronic business-to-business and consumer-to-business transactions.

Currently, electronic payment instructions are typically accompanied by additional transfers of information, which are completed in the traditional paper-based way. For example, most companies must mail paper bills to customers even if the customer pays the bill electronically. "Electronic" bill payment instructions are often sent to a third party that provides a biller with a paper list of the "electronic check" information that must then be entered manually into the biller's system. In many cases, a part-electronic and part-paper system may be only a marginal improvement in efficiency relative to an all-paper environment. However, incorporating all of the transaction information into a smooth and efficient end-to-end electronic transaction has the potential to generate great efficiencies for both consumers and businesses through the elimination of the relatively costly paper components of transactions.⁹

This perceived potential for efficiency gains is driving investments in these processes, and it also explains the motivation behind the intense competition by banks and other businesses to become leaders in the implementation of new payments processes. While banks currently play the central role in the payment system, the extent of their future role in these expanded electronic retail payment processes is far from certain.¹⁰ Banks may be able to leverage their current dominance in the payment system to become the dominant force in the new retail payment system. Alternatively, banks could play a relatively narrow role of maintaining transactions accounts, while nonbanks engage in higher value activities associated with new electronic retail payments processes.

⁹ See, e.g., Microbanker (1997), Phillips Business Information Inc. (1998), and Clark (1998) for discussions of this issue.

¹⁰ Increasingly, nonbank firms—including nonfinancial firms—are providing payment system services. In some respects such entities may compete directly with banks, but a bank-versus-nonbank dynamic is not the only possible outcome, inasmuch as banks and nonbanks can, do, and will form alliances and joint-ventures to exploit new technology opportunities. An important area for future research is to describe and analyze this activity and the policy issues emerging from it.

Business-to-Business Payment Systems

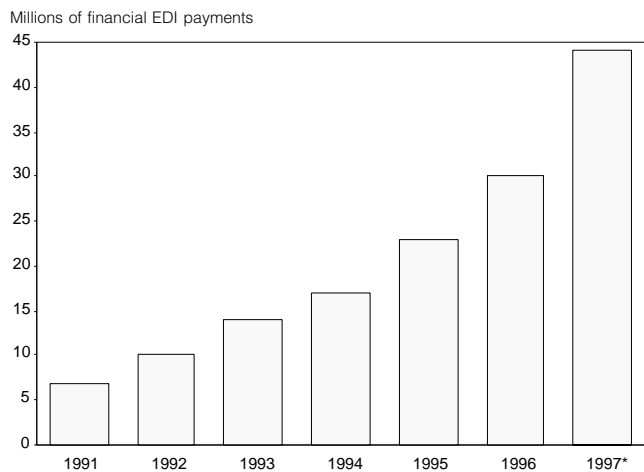
In the last several years there has been considerable growth and investment in electronic data interchange (EDI). Currently EDI is the principal system used by companies to transmit purchase orders and corresponding shipping and invoicing information to one another electronically. This enables information to automatically feed into inventory management and accounting systems within each company. Such information exchange allows businesses to substantially reduce operating costs. Financial EDI (FEDI) is the process of integrating payments with this commercial transmission of sales, inventory, and production information.

For example, when a consumer purchases a tool at a retail chain store, inventory management information is generated within the store from the point-of-sale terminal, and (once a set inventory drawdown has been reached) the electronic equivalent of a purchase order is transmitted to the toolmaker. The toolmaker ships the tools and electronically sends an invoice to the store. When the store receives the invoice, that information is routed to its accounts payable. At this point, the EDI transaction becomes a FEDI transaction if payment instructions (the amount to be paid and whom to pay) is electronically transmitted to the store's bank. The bank in turn makes an ACH payment (complete with associated information on the nature of the payment) to the toolmaker. In a variation on this procedure, payment instructions could go to an EDI-capable nonbank entity, which would arrange for payment to be made instead of the bank playing this role. Ultimately, the store's account will be debited by its bank.

Though financial EDI has been available for two decades, it is only in the last few years that its use has taken off, doubling between 1995 and 1997, as Figure 5 shows. Until recently, only the largest businesses and banks were capable of handling EDI transactions because of the high cost of EDI software. This situation has been changing as the costs of EDI-related software has declined significantly in the last several years. This decline in cost will receive an added boost at banking institutions later this year when the Federal Reserve distributes free software that allows banks to translate EDI payment information.

The growth in EDI use is itself increasing the incentives for a firm to become EDI-capable. Many of the costs of becoming EDI-capable are related to one-time set-up costs. These fixed costs are offset by the increased efficiency of information flows. The greater the number of transactions that can be completed using EDI, the greater are the efficiency gains and the more likely these gains will offset the set-up costs. This is an example of what economists refer to as "network externalities," where

Figure 5—Business-to-business electronic payments increasing rapidly



*Projected 1997 figures.

EDI—electronic data interchange.

Source: Office of the Comptroller of the Currency, using data from National Automated Clearing House Association (NACHA).

the value of a firm adopting EDI is positively related to the number of other firms that have adopted this technology.

Growth in the number of EDI-capable banks is likely to continue because EDI capability is now becoming a requirement for effectively servicing many large business customers. In addition, banks may decide to compete with nonbanks as suppliers of a wide range of services related to the receipt or disbursement of commercial payments.¹¹

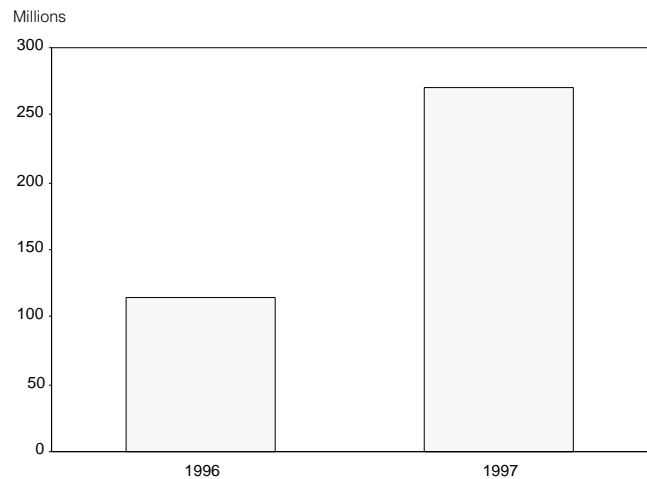
Consumer-to-business payment systems

Consumer-to-business payments technology is another area of rapid change in which banks and nonbanks are making major investments. As with EDI, there is a significant possibility that this market could continue to grow at a rapid pace. Two main aspects of the “electronication” of consumer-to-business transactions are electronic bill payment and electronic bill presentment. With electronic bill payment, a consumer issues payment

¹¹ As a part of their cash management services, banks may offer a comprehensive payables service where a company could send an electronic file to the bank with instructions for all payments (both paper and electronic), and the bank would make the payment in the format specified. Companies may also outsource accounts receivable, such as lockbox services where the remittance data is converted from paper documents (e.g., checks and coupons) to an electronic format during lockbox processing. This electronic data is then transmitted to the company. One of the advantages to a company using these services is that payment information is reported back to the company in a standard format regardless of how the payment or payment information is received by the bank or service provider.

instructions by telephone or by personal computer to his bank or a nonbank firm offering bill payment services. Currently, the bank or bill payment firm completes the bill-paying process by initiating an ACH transaction or by writing a check.¹² Though relatively new for consumers and not yet widely used, the use of electronic bill payment, shown in Figure 6, more than doubled in 1997 compared to 1996.

Figure 6—Very rapid growth in number of electronic bill payment transactions



Source: Office of the Comptroller of the Currency, using data from Coopers & Lybrand as reported in Marjanovic (1998).

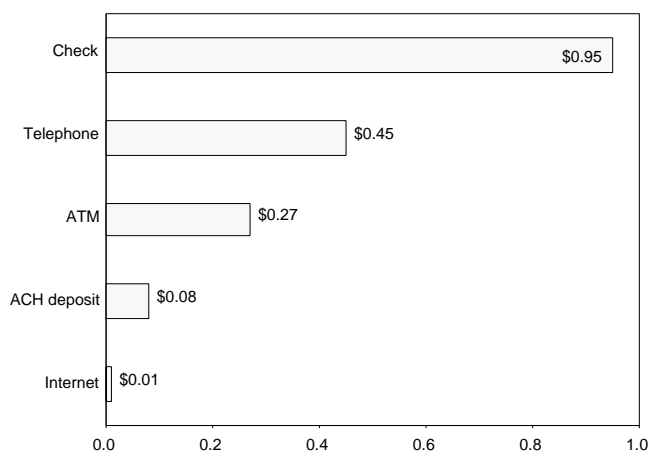
Combining electronic billing with electronic payment can substantially increase the convenience and efficiency of consumer-to-business transactions. Electronic bill presentment is emerging as a practical reality, with several competing alternatives vying for acceptance. “Presenters”—i.e., firms engaged in providing electronic bill presentment services—are creating an electronic version of client businesses’ bills. Consumers could then receive these bills in several ways. Consumers could visit their billers’ Web sites and retrieve electronic bills from each business. Another model calls for consumers to visit presenters’ Web sites for billing information. Alternatively, a bank might collect electronic bills for its customers, who then visit the bank’s Web site for billing information. Consumers could also arrange for billers, presenters, or banks to deliver bills electronically to them as e-mail. Electronic bill presentment has the potential to enable a business to incorporate the receipt of an electronic payment into its accounting system more efficiently and accurately.

¹² Pre-authorized debits such as automatic mortgage payments, which give a consumer’s mortgage holder the ability to originate an ACH transaction for payment by the consumer’s bank, are not included as electronic bill payment because the initiation of each monthly transaction is not controlled by the consumer.

Banks' Response: Substantial Increases in Technology Spending

Technological innovation can increase profitability either through enhancing revenues or lowering costs. Figure 7 illustrates the substantially higher costs for banks of conducting customer transactions via paper checks compared to electronic means. For example, a transaction handled via the Internet may cost a bank about one cent, versus almost a dollar to handle a deposit by check over the counter at a branch office. Benefits may also come from preventing erosions in profitability and market position as banks and nonbanks compete in these emerging markets.

Figure 7—Banks have cost incentives to encourage electronic payments



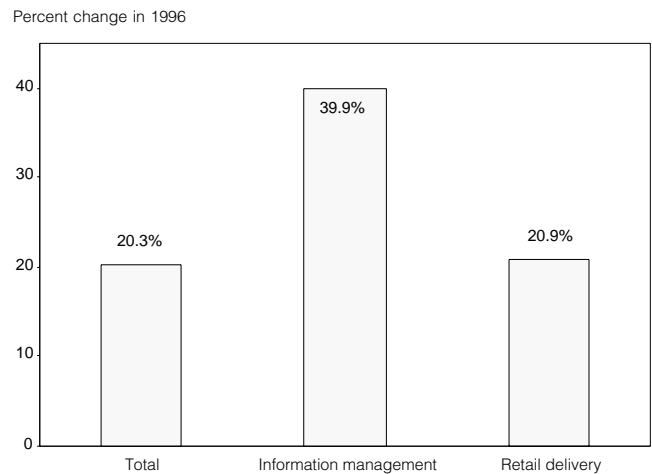
Note: Estimated cost per transaction. For checks, figures are for deposit by check using a bank teller.

Source: Office of the Comptroller of the Currency, using data from Faulkner & Gray (1997) and from the National Automated Clearing House Association (NACHA).

Banks boosted technology investment spending strongly to address revenue, cost, and competitiveness concerns. One recent study estimated a 20 percent increase in total technology spending by banks in 1996, to \$27.8 billion, approximately one-quarter of which (\$5.2 billion) went for capital investment in technology.¹³ As Figure 8 illustrates, the biggest leap in banks' recent technology investment spending was for information management, which increased almost 40 percent over the previous year. Information management investment spending includes the development of data warehousing (the collection and storage of vast amounts of data on customer relationships from various systems), and data mining (integration and

¹³ These figures are from Faulkner & Gray (1997). "Total technology spending" includes purchases of new equipment, software, and information systems, as well as personnel expenditures. Definitions of what constitutes "technology spending" and "investment in technology" vary widely, and it is therefore difficult to make precise comparisons between sources.

Figure 8—Bank technology investment: substantial increases



Source: Office of the Comptroller of the Currency, using data from Faulkner & Gray (1997).

analysis of data). A key aim of this investment is to enhance the efficiency and revenue-generating potential of both traditional delivery channels such as branches, automated teller machines (ATMs), and call centers, and new delivery channels such as Internet banking.

Many banks are counting on a payoff in the near-term from technological improvements in their traditional delivery channels. In particular, many banks hope to increase marketing and "cross-selling," i.e., the sale of additional products and services to a customer based on an analysis of data about the customer's current purchases of products and services.¹⁴ They look for such an outcome as a direct result of technological improvements in branches and call centers, underpinned by investment in data warehousing and data mining. Consistent with this expectation, banks increased technology investment in retail delivery channels by 21 percent (see Figure 8). Approximately half of this increased investment was allocated to improving the delivery and management of customer information at branches in order to enhance the ability of bank personnel to access information on all of a customer's business with the bank. A majority of the remainder of the technology investment in retail delivery channels was allocated to improvements in ATMs and telephone banking and call centers.

The analysis is somewhat different when it comes to investments in other new technology products and services. Banks are making investments in new electronic

¹⁴ We are not aware of any definitive study demonstrating the profitability of cross-selling, though its virtues are increasingly touted in the business press. See for example Moyer (1998). To establish the efficacy of cross-selling in an analytically sound manner will require grappling with issues such as how a bank can precisely measure both the costs for establishing and operating cross-selling activities, and the returns earned by each "cross-sale."

Table 1—Most important motivation for three types of banking technology

	Installing and upgrading ATMs		Offering PC banking		Data warehousing	
	Banks with large networks	Banks with small networks	All banks (according to GAO survey)	All banks (according to Mentis survey)	Large banks	Small banks
Motivation:						
Response to competitive pressures	X	X	X	X		X
Revenue enhancement					X	
Cost reduction						

Source: Office of the Comptroller of the Currency, using data from Faulkner & Gray (1997); General Accounting Office (1998); and Mentis Corporation (1998).

products and services, such as PC banking, even though the actual volume of transactions using these products is still relatively small, and these products have little direct impact on a bank's bottom line. Why then are so many banks expressing a desire to introduce PC banking and other electronic payment systems? Table 1 shows that the perceived need to respond to competitive pressures is the primary driver for banks' investments in many of the new electronic technologies, as compared with revenue enhancement and cost reduction. Many banks are concerned that they will lose profits and market share over the long run if their competitors are better able to take advantage of these low-cost delivery channels. In addition, banks are concerned that higher-income customers who use multiple bank services will be attracted to institutions offering these new technology products. Banks are facing crucial strategic decisions concerning when to enter the market, and how to maintain sufficient flexibility given rapid changes in technology.

Are Banks Rushing into Technology Decisions?

There is considerable evidence that banks are planning to continue significant expenditures on introducing new technology products.¹⁵ However, in some areas, banks' plans may be overly ambitious. For example, though less than 3 percent of banks currently offer customers the ability to access their accounts via the Internet for transactional purposes, a GAO survey of bankers estimates that almost half of all banks say they intend to offer PC banking by the end of this year. Other surveys report similar results.¹⁶ Such expectations may be unrealistic;

however, they highlight the sense of urgency about technology within the banking community.

Given existing market pressures and the urgency many bankers feel about the necessity of adopting new technology, a "leap-before-you-look" pattern of behavior could emerge if banks do not develop an appropriate approach to managing technology risks. Further, the possibility that some senior bank managers are poorly informed about technology risks faced by their bank is another potential cause for concern.¹⁷ An appropriate risk management system will guard against the urge to invest in new technology without first developing a fundamental understanding of the risks involved.

Increased use of technology in banking and payments is likely to raise consumer protection issues as well. Because technological advancements greatly enhance the ability of banks and other financial institutions to collect and use vast amounts of information, concerns arise about appropriate privacy safeguards. In addition, consumers will wish to have a clear understanding of their rights and responsibilities in using new systems and products, and will want to know how financial institutions intend to resolve disputes in the event of errors or malfunctions. In the midst of their efforts to adopt new payments and banking technologies, banks that fail to effectively address such concerns are likely to erode or destroy customer trust.

The Response of Bank Regulators

Bank supervisory authorities have recognized the important challenges posed by the rapid advance of technology and have devoted increasing attention to technology-related issues. In the United States, the OCC and other federal regulatory authorities have recently published

¹⁵ Several estimates of banks' technology spending in 1997 show spending levels below the Faulkner & Gray (1997) figures for 1996 technology spending. Though these studies are not strictly comparable to each other, a decline in new technology spending accords with recent reports in the business press suggesting that banks may be becoming somewhat cautious about spending on new technology in the face of challenges posed by addressing the year-2000 problem.

¹⁶ See, e.g., General Accounting Office (1998), and Mentis Corporation (1998). A "transactional" Web site allows a customer to engage in activities such as account inquiry, funds transfers between accounts, bill payment services, and loan applications.

¹⁷ The year-2000 problem complicates the issue further. As bankers' awareness of the difficulties facing them in this respect grow, they may be forced to cut back spending on new technology, heightening their fears about "falling behind." Alternatively, if some banks feel the need to go ahead with technology plans regardless of strains on resources caused by dealing with the year-2000 problem, risk exposures could rise.

guidance that helps banks identify and prioritize risks, and which suggests possible risk management measures.¹⁸ Internationally, the Basle Committee on Banking Supervision, whose members include bank regulators from the G-10 countries, has also recently published a report on risk management for electronic banking activities.¹⁹

These various supervisory documents do not address in detail the new technology products being introduced into the market. Rather, they contain common themes that are useful for managing risk in the technology area. First, basic steps in the risk management process include assessing risks, implementing appropriate measures to limit risk exposures, and monitoring risk exposures. Second, while it is conceivable that technology activities may raise a wide variety of risks, banks and supervisors are likely to be particularly concerned with transactional risks, including security risks, as well as reputational and legal/compliance risks. Third, in an environment that will continue to change rapidly, it is crucial that bank management establish and promote two-way communication between the organization's technical experts and senior decision makers. Finally, transparency is central to addressing consumer protection concerns. Banks should strive to explain clearly their intentions regarding collection and use of personal information, as well as product features, costs, and dispute resolution procedures.

Summary and Conclusions

Our analysis yields several key observations:

- There has been a significant shift by consumers and businesses to electronic payments. In some areas of consumer and business electronic payments there are indications that the market may be poised for a rapid and substantial expansion of transactions volume in the near term.

- Significant innovation and investment is under way that could lead to very rapid expansion in fully electronic business-to-business and consumer-to-business payments in the near term. While the pace of change in these markets is difficult to determine, eventually these innovations will generate substantial efficiencies in retail payments systems.
- In response to developments in electronic payments and remote banking, banks have greatly increased their investment in technology, particularly in retail banking. For some activities, banks hope to see a near-term impact on profitability. Other investments are motivated more by a desire to establish a competitive position or avoid falling behind the competition.
- Survey evidence reveals a sense of urgency about the adoption of new technology and reflects substantial competitive pressures to act quickly. Such pressures may heighten the chance that some banks will rush into technology spending without being fully prepared to assess and manage risks.
- Bank regulators are paying significant attention to appropriate risk management of new technology. This will be a growing area of importance that will require greater resources from banks and banking regulators.

The gains from technological advancements in banking and payments are likely to be substantial, both from the point of view of individual financial institutions and economy-wide. In this environment, it is essential that banks review and, if necessary, adjust their risk management practices in tandem with upgrading their technology activities.

¹⁸ See, e.g., Office of the Comptroller of the Currency (1998a) and (1998b); Federal Reserve Bank of New York (1997); Federal Deposit Insurance Corporation (1997); and Office of Thrift Supervision (1997).

¹⁹ Basle Committee on Banking Supervision (1998).

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