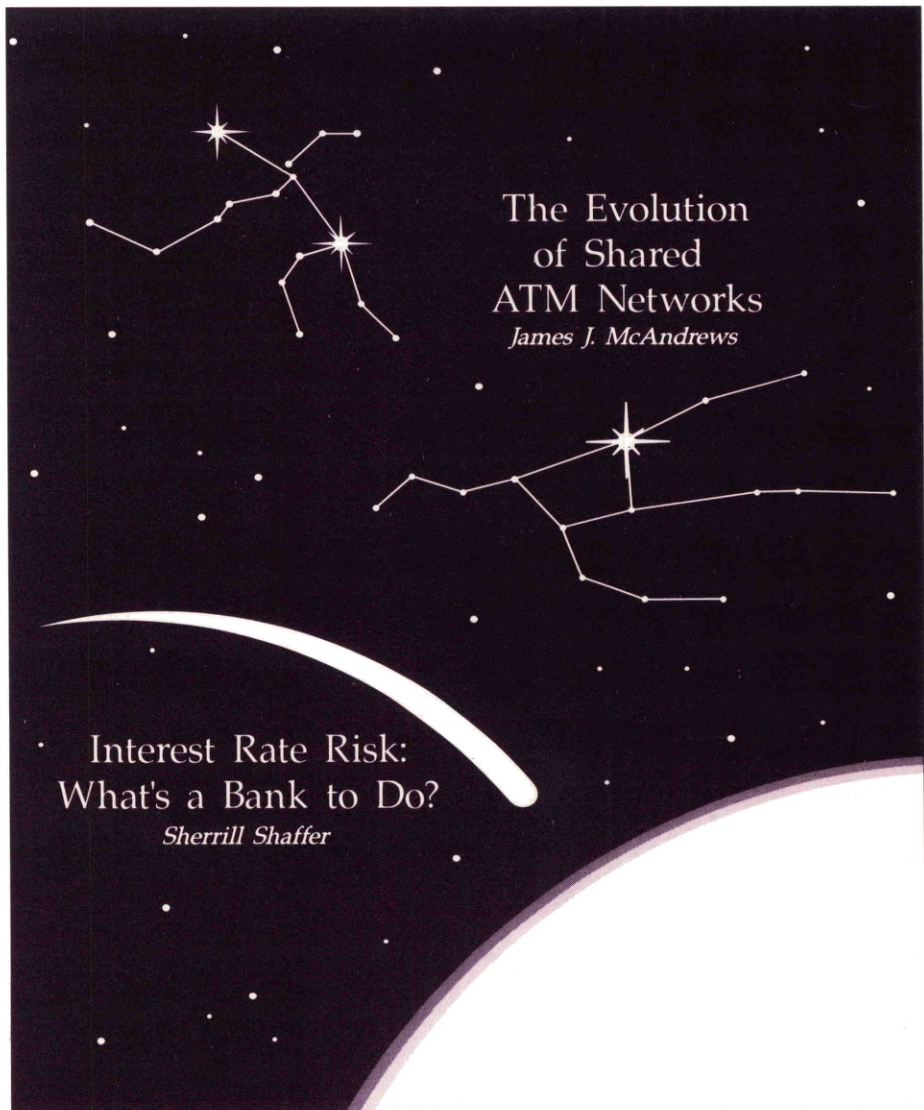


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THE EVOLUTION OF SHARED ATM NETWORKS

James J. McAndrews

Ever since Philadelphia National Bank installed the nation's first automated teller machine in 1969, the number of people accessing their bank accounts through ATMs has increased dramatically. The reason is that most ATMs are now part of shared networks that, through consolidation, have expanded both geographically and in terms of machines. This greater concentration may provide bank customers with more convenience, but is it posing a risk of anticompetitive practices by shared networks?

INTEREST RATE RISK: WHAT'S A BANK TO DO?

Sherrill Shaffer

Stressed by increased competition and a volatile economy, many banks are exposed to more interest rate risk than is healthy. To correct the problem, however, a bank must first measure how much risk it faces. The most reliable technique is some form of "duration" analysis, which calculates an account's average time to repricing using discounted components of cash flow. But applying duration analysis is only half the battle. Once a bank has determined the amount of interest rate risk it faces, what should it do then?

The Evolution of Shared ATM Networks

*James J. McAndrews**

Ever since Philadelphia National Bank installed the nation's first automated teller machine in 1969, the number of consumers accessing their bank accounts through ATMs has increased dramatically. One reason for ATMs' frequent use is that most are part of a shared network—that is, a network that links together a number of banks and their customers.

Only a few shared networks existed in the

1970s, but the number grew quickly right up until the late 1980s, when consolidation eliminated nearly half of them. This consolidation has allowed the remaining networks to expand both geographically and in terms of number of machines, significantly improving the quality of services provided.

The increasing concentration of ATM transactions in the largest networks has raised the issue of anticompetitive behavior. So far, however, competition among ATM networks continues. Nevertheless, both state and federal antitrust authorities continually monitor the practices of ATM networks for evidence of anticompetitive actions.

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GLOSSARY

Automated Teller Machine (ATM) - A machine used for banking services, including withdrawals or deposits, balance inquiries, transfers, and other services. Customers access an ATM by using their debit cards, and the transactions are processed electronically with the aid of computer information systems.

Consumer Fees - The fees customers pay to use ATMs. Consumer fees for ATM use are not uniform; they are determined by the customer's bank, not by the ATM network. Many banks offer certain checking accounts, often with high minimum balances, that include ATM use at no charge. Many accounts, however, do charge the customer a fee for each ATM transaction.

Debit Cards - Also known as access cards, debit cards are plastic cards encoded with electromagnetic identification. The banks issue them to customers upon approval of their applications. Customers can insert the card in an affiliated network ATM to obtain account information and cash.

Duality - The name given to the interchange agreement between the two national networks, Plus and Cirrus. Under this agreement, a member of one can accept cardholders from the other at no additional fee.

Foreign Fees - A transaction fee charged the customer for using another institution's ATM. Typically, foreign fees are higher than the transaction fee customers pay to use their own bank's ATMs.

Gateway - An electronic channel between two networks.

Interchange Fee - Also known as terminal income, an interchange fee is a fee paid to the owner of an ATM by a network member whenever that member's cardholders use an ATM. The fee is typically set by the network and currently ranges from 40 cents to \$1.

ATM NETWORKS ENHANCE CONSUMERS' CONVENIENCE

A *network* is a common way of delivering a product or service that increases the product's value by linking many customers together. For example, the value of a telephone network to customers increases with the number of customers that can be reached via the network. Similarly, ATM networks link together banks in various locations, giving the customers of each institution greater access to their bank accounts.

ATM networks started as proprietary networks of single banks, accessible only by a single bank's customers. Often located within branches of banks, ATMs served as substitutes for human tellers. They were intended to

improve service quality in branches, and in this they were successful. Lines for tellers shrank, and, in some cases, customers were provided access to their accounts 24 hours a day.

Soon, banks realized that, by sharing ATMs, they could spread the costs of the machines and network facilities over many more customers and transactions while giving customers enhanced access to their accounts. As a result, banks created shared ATM networks (see *Glossary*), usually as joint ventures of banks within various regions of the country.¹ The national

¹See Paul Calem, "Joint Ventures: Meeting the Competition in Banking," this *Business Review* (May 1988). Of the 20 largest regional shared ATM networks today, 13 are jointly owned by a group of banks and seven are owned by a single

Interchange Transaction - A transaction in a shared ATM network in which a cardholder of one member bank uses another bank's ATM.

Point-of-Sale (POS) Network - A network of banks, point-of-sale cardholders, and merchants that permits an immediate electronic funds transfer from the bank account of the cardholder to the account of the merchant.

Network Switch - The electronic equipment that receives and transmits transactions between the bank that operates the ATM and the bank that holds the customer's account and issues the card used in the transaction.

Proprietary ATM Network - An ATM network owned and operated by one depository institution and accessible only to that institution's customers.

Reciprocal Sharing Agreement - An interconnection agreement between regional ATM networks that allows the networks to conduct interregional transactions directly rather than route them through a national network.

Shared ATM Network - An ATM network accessible to multiple depository institutions' customers.

Surcharge - A direct charge to ATM users assessed by the owner of the ATM. Surcharges, which are charged only rarely, range from 15 cents to \$1.

Switch Fee - A fee charged by the network for the use of its switch. Typically, it is paid by the bank that holds the customer's account. The fee ranges between 2 cents and 25 cents per transaction, depending on the network and the volume of transactions originated by the member bank.

networks came later, in the early 1980s, and were designed for "long-distance" ATM transactions.

Sharing Provides an Expanded Service. Before shared ATM networks, banks had to build

firm. ATM networks serve either a particular region of the country—such as the MAC network, which serves the Mid-Atlantic and Northeast regions—or the entire nation. There are only three national networks: the two largest networks, Plus and Cirrus, and one smaller network, the Exchange. Currently, the vast majority of ATM transactions are carried out within regional networks. For earlier discussions of shared ATM networks, see Steven D. Felgran, "Shared ATM Networks: Market Structure and Public Policy," in *New England Economic Review* (January 1984), and Felgran and R.E. Ferguson, "The Evolution of Retail EFT Networks," *New England Economic Review* (July 1986).

branches in order to enhance their customers' geographical access to bank accounts. However, branching had only limited success in expanding customer service. Banks were prohibited from branching across state lines, and many states imposed limits on branching within their boundaries.² The advent of shared ATM networks, however, meant that one bank's customers could use another bank's ATMs, even if they were located across state lines. (See *Typical ATM Network Transactions*, p. 6.)

²In 1987, for example, eight states restricted banks to having a single office, and 18 other states allowed only limited branching.

Typical ATM Network Transactions

Illustrated here are the possible links between two shared regional networks, "Eastnet" and "Frontier"; a shared national network, "Union National"; and member banks. Besides transactions fees, networks charge membership fees on an annual basis, as well as fees based on the number of cards the member bank issues. The fees used in these examples are actual fees of shared ATM networks.*

A typical shared regional ATM network transaction:

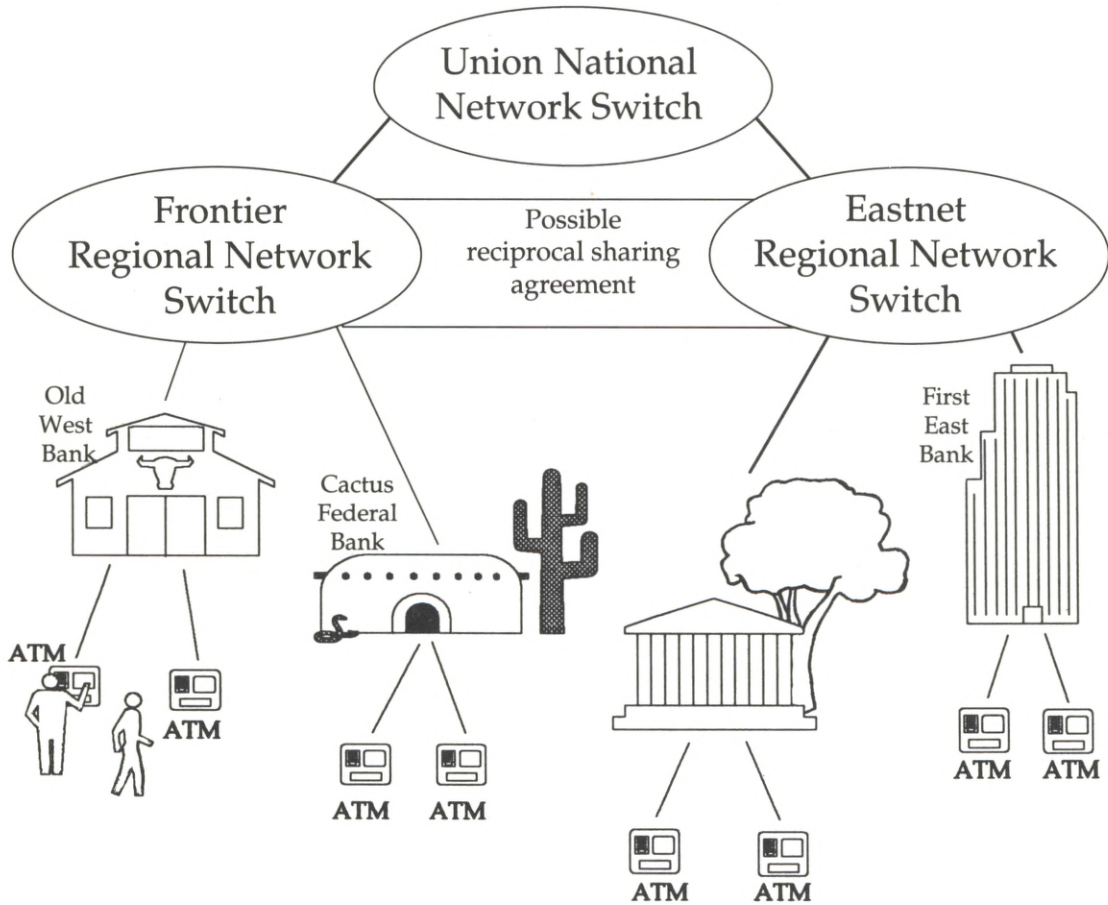
Penelope O'Malley, a customer of First East Bank, wants to withdraw some cash from her account. She uses the nearest ATM, which happens to be owned by Yankee Bank, and her debit card, issued by First East, to initiate the transaction. Both First East and Yankee Bank are members of the Eastnet regional network. The Eastnet regional switch relays the necessary account information and approval to First East and back to Yankee Bank. The transaction is approved, and Penelope gets her cash.

First East must pay the Eastnet network a switch fee of anywhere between 2 and 10 cents for processing the transaction. In addition, First East must pay Yankee Bank a 40-cent fee, called the interchange fee or terminal income, set by the Eastnet network, to compensate Yankee Bank for having deployed the machine and the cash that Penelope received. First East Bank itself may charge Penelope a transaction fee, of 25 cents, just for using an ATM. (Some banks do not charge transactions fees to customers who meet special requirements—for instance, customers who maintain high minimum balances in their accounts.) If First East charges Penelope a higher fee—say 50 cents—it's because she used a network ATM not owned by First East; this higher fee is typically called a foreign fee. And, finally, Penelope may, in rare circumstances, be charged directly by Yankee Bank for using its ATM. Yankee Bank charges from Penelope's account at First East a fee, called a surcharge, which may be as high as \$1. Banks set the consumer fees independently of the network and other network members; the network sets the switch fee and the interchange fee.

A typical national ATM network transaction:

Since her bank is a member of the Union National ATM network, Penelope can obtain cash from any ATM displaying the Union National logo. Suppose she is traveling on the West Coast and wants to withdraw cash from an ATM owned by Cactus Federal, a member of both the Frontier and Union National networks. Once again, the necessary account information and approval are relayed between her bank, First East Bank, and the bank owning the ATM, Cactus Federal. Because these banks have only the national network in common, the national switch relays messages back and forth through gateways provided by the regional switches, Eastnet and Frontier. In this case, First East Bank pays a national switch fee of 5 cents to the national network—plus regional switch fees, which may amount to about 20 cents, both to its regional network, Eastnet, for providing the gateway to the national switch, and to the receiving regional network, Frontier. First East also pays Cactus Federal an interchange fee, set by the Union National network, of 50 cents. In effect, then, First East had to pay three switch fees to carry out Penelope's national network transaction.

*The fees depend on the transactions volume of a bank's customers. The fees presented here are not meant to reflect the average cost of an ATM transaction, but to give the reader an idea of the approximate size of the ATM network fee.



An interregional transaction if there is a reciprocal sharing agreement:

If Eastnet and Frontier have a considerable amount of traffic between their networks, it may pay them to establish a reciprocal sharing agreement that allows them to create a channel between themselves and bypass the national switch in interregional transactions like Penelope's. In this case, First East Bank would pay a total of only 70 cents (as opposed to 75 cents when using the national network), of which 40 cents would go to Cactus Federal as the interchange fee and the remaining 30 cents would be shared by Eastnet and Frontier, to compensate them for the switching and for the channel they had to create in order to carry out the shared transactions.

A key legal decision ratifying this practice was the Marine Midland decision of 1984, in which a Federal Appeals Court held that an ATM is not a branch of a bank. By deciding that network ATMs were not branches of national banks, the court allowed banks to expand access to their customers through network ATMs without being bound by the restrictive prohibitions on branching.

A shared ATM network can expand access to a customer's account in at least two ways. First, geographically diverse member banks, having deployed ATMs for their own depositors, offer use of their machines to other banks' depositors. Second, and perhaps more important, sharing encourages deployment of ATMs at new locations.

For example, consider the deployment of an ATM at a commuter train station. Suppose that the customers of 10 banks pass through the station and that any one bank's customers will generate 1000 transactions per month. Suppose further that it requires 3000 transactions a month for the ATM machine to break even. Without sharing, no machine will be put in place. But with a shared network of all 10 banks, there is a strong incentive to place a machine at such a busy public place because, in addition to serving its own depositors, the ATM owner can earn interchange revenue when other banks' customers use the ATM.

The Expanded Service Represents a Network Externality. A network externality is a boost in the value customers place on a product or service as its network of users expands. For example, a new bank and its customers, by joining a shared ATM network, create a network externality for all the existing ATM network members by allowing them to access their accounts at more locations. The larger cardholder base in the expanded network makes deployment of new ATMs more profitable, which further enhances the accessibility of existing members' accounts. The larger the network, the more convenient are the ATM loca-

tions, and the more the customer values membership in the network.

Network externalities occur in the provision of many goods and services. Besides the telephone industry, other beneficiaries of network externalities include credit cards and other payment systems, fax machine networks, train systems, and computer software. Each product increases in value as the network of users becomes larger.

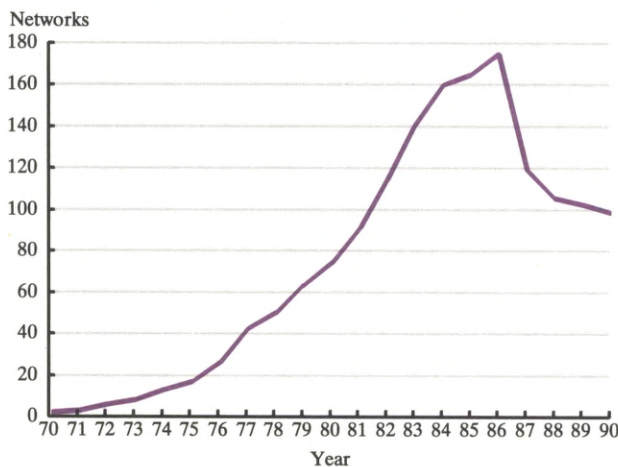
Because an expanded network increases the value of the product, its customers are willing to pay more for it. This greater willingness to pay for the good or service—combined with lower per-unit costs that economies of scale generate for larger networks—creates a surplus that will be shared between the producers and the consumers. Since a growing network can generate a surplus, producers of goods and services that create network externalities have an incentive to expand their network, up to the point when either the network externality or the economies of scale disappear and no additional surplus is generated by expansion.

THE GROWTH AND CONSOLIDATION OF SHARED ATM NETWORKS

As more and more financial institutions recognized the benefits of sharing, the number of shared regional ATM networks increased rapidly, peaking in 1986 at almost 200. Since then, consolidation—mergers and outright purchases of one network by another—has nearly halved the number of regional networks, to about 100 (Figure 1).

Meanwhile, the number of ATMs has continually increased, rising from less than 10,000 machines in 1978 to approximately 80,000 in 1990, one for every 3000 people. The steady increase in the number of transactions and ATM debit cards in recent years reveals that the ATM transaction has become a common way for people to access their bank accounts. It is estimated that half of all U.S. households use ATMs at least once a month.³ Furthermore,

FIGURE 1
Shared ATM Networks



Sources: TransData Corporation; *Bank Network News*; *The Nilson Report* (various years).

although the number of shared ATM networks has declined in the past several years, the activity of existing networks has increased steadily.

Plus and Cirrus, the largest national networks, began as joint ventures in 1982, some 10 years after the regional networks. Banks around the country recognized that travelers would benefit from being able to access their bank accounts even when away from home. Accordingly, the number of transactions in national networks has grown rapidly in recent years.⁴ (See *ATM Transactions and Card Growth*, p. 10.)

Increasing Concentration. The concentra-

tion of network activity has risen even more than we would expect based on the consolidation of networks. Indeed, the largest networks are transacting an increasing share of ATM activity. While in 1982 the top 20 regional shared networks accounted for about 15 percent of all regional shared network transactions, today they account for over 90 percent, and the top six account for 60 percent.

The drop in the number of networks stems from two factors: 1) the formation of new shared networks has slowed; and 2) mergers and acquisitions have reduced the number of existing networks.

Reduced Entry. In the early 1980s, all the ATM networks were small, and the many new entrants to the market did not face the prospect of formidable competition—in other words, the presence of very large, well-known networks. As these large networks evolved, they reduced the incentive for others to form new networks. Consequently, while about 20 new networks entered the market per year in the first half of the 1980s, this rate of entry slowed to about five per year in the last half of the 1980s.

Mergers Concentrate Network Activity. Some of the increase in the largest networks' relative size is due to internal expansion, but much of it owes to mergers and acquisitions. In 1989 and 1990, at least 18 shared networks were either acquired by other networks or merged into a new network. An example is the recent merger of the Honor, Relay, and Avail networks into the Southeast Switch network. Among regional networks, Honor, Relay, and

³"Teaching ATMs New Tricks," *American Banker*, December 3, 1990.

⁴Other national networks that link ATMs, but do not provide access to customers' bank accounts (in other words, they are not used with bank access cards), include the Visa network, which links 17,897 machines, and Express Cash, which links 16,100 machines. And finally there is the Exchange, a third national network, though it is much smaller than either Plus or Cirrus.

ATM Transactions and Card Growth

Year	Monthly Regional ATM Transactions (millions)	Monthly ATM Volume in Cirrus, Plus, and Exchange (millions)	Debit Cards (millions)
1978	41.0	0	NA
1979	63.5	0	NA
1980	100.0	0	NA
1981	135.0	0	NA
1982	167.0	0	60.0
1983	200.0	0.1	74.6
1984	261.0	0.5	100.0
1985	296.0	1.4	130.0
1986	301.0	2.6	140.0
1987	335.3	3.6	152.0
1988	375.3	7.1	170.9
1989	422.2	12.2	183.9
1990	474.9	19.6	191.4

Sources: Bank Administration Institute; *Bank Network News*; Cirrus System, Inc.; Plus System, Inc.; *The Nilson Report*; TransData Corporation (various years).

people will be willing to pay for it—networks have an incentive to expand. In doing so, they can hope to capture at least some of the surplus created through higher revenue, generated in part because more transactions are routed through the network switch. Facing competition for depositors, banks wish to offer their customers membership in the best network available. If one network in the region has many member banks and many ATM locations while another network has few members and locations, then the bank that has decided to offer its customers debit cards would prefer membership in the first network, other things equal.

Avail ranked eighth, ninth, and fourteenth, respectively, in transactions volume in 1990. The merged network would have ranked fourth.

WHY CONSOLIDATION HAS OCCURRED

Consolidation has occurred mainly for three reasons: 1) the presence of network externalities; 2) economies of scale; and 3) relaxed barriers to interstate banking.

Network Externalities Create Incentives for Larger Networks. Because of network externalities—the wider the network, the more

for a network, if it gains some small advantage over a rival network, to benefit from a “bandwagon effect” that increases its size and further enhances its initial advantages.⁵ As these large networks evolve, they create barriers to market entry. By offering their members the benefits of lower switch fees due to economies of scale,

⁵See Joseph Farrell and Garth Saloner, “Standardization, Compatibility, and Innovation,” *Rand Journal of Economics* 16 (1985) for a model and discussion of the bandwagon effect.

There is a tendency

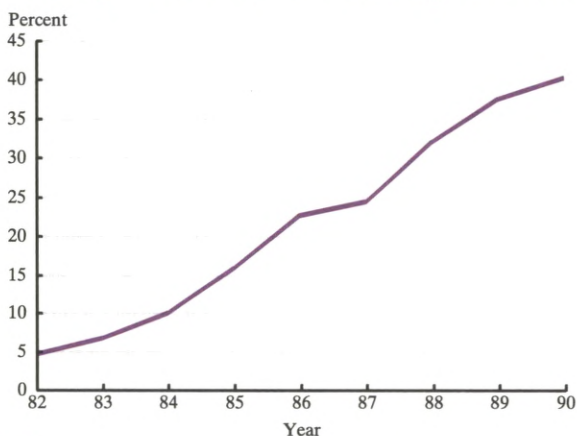
increased interchange due to greater network externalities, and name recognition among consumers, they can stifle other networks' attempts to enter the market.

The importance of this incentive to expand an ATM network can be measured by the number of "interchange" transactions, which occur when the customers of one bank access their accounts through another bank's ATM. As the number of interchange transactions increases, the revenues from the network "switch fee" rise. The percentage of ATM network transactions that are interchange transactions has increased dramatically as ATM activity has become more concentrated in the largest networks (Figure 2). The reason is that the larger networks are able to provide a more convenient service that yields more network activity.

Large Networks Can Take Advantage of Economies of Scale. Every network must have computer equipment and standards by which a transaction is "switched," or processed. These resources are subject to economies of scale—as more banks join the network and more transactions are routed through the switch, the cost per transaction drops. In fact, the switch fees of networks have declined as the networks have grown larger, which provides evidence of this effect.⁶ A clear example of reduced switch fees

⁶See "The Switch Fee Elevator: 'Going Down,'" *Bank Network News*, February 10, 1990.

FIGURE 2
Interchange Volume of the Top 60 Networks



Note: The figure shows the interchange volume of the top 60 networks as a percent of the total transaction volume of the top 100 networks.

Source: *Bank Network News* (various years).

due to economies of scale has been the Plus network. Having charged a 10-cent switch fee since its inception, this national network eventually lowered the fee to 5 cents per transaction in 1989 after its transaction volume had grown sufficiently large.

Interstate Banking Has Spurred Network Consolidation. Today, many states offer some form of interstate banking, and bank holding companies have been quick to cross state lines by purchasing or organizing a new subsidiary bank.⁷ But as banking organizations entered a new state, they frequently found that a different network was prominent. The result was that banks often had to join both networks, resulting in duplicate membership fees and different formats for transactions—a strong incentive for consolidation. The merger of the

⁷For a review of interstate banking legislation, see Paul Calem, "Interstate Bank Mergers and Competition in Banking," this *Business Review* (January 1987).

southeastern networks Honor, Relay, and Avail into the Southeast Switch is a prime example of this incentive's effects. The southeastern states have allowed regional bank holding companies to cross state lines for many years. By merging the networks, the multistate banking member can use a standard format and avoid competing with itself.

WILL NETWORK CONSOLIDATION CONTINUE?

It is difficult to judge how extensive network externalities and economies of scale are for shared ATM networks. In some network industries, such as the telephone industry, consolidation led to a single monopoly firm. In others, such as the credit-card industry, multiple firms compete.

National Network Duality. The Plus and Cirrus networks concluded an agreement of interconnection, popularly known as "duality," in 1990. Under this agreement, an ATM owner, by belonging to only one of the two networks, can service the cardholders of either network without having to pay additional membership fees. As a result, "long-distance" ATM service may soon be available through a single network, since not all ATM owners have yet taken advantage of duality. This network now represents a more credible competitive threat to regional networks, since a bank could drop membership in, say, a high-fee regional network and be a member only of the national network. Since most ATMs in the country are owned by banks that are members of either Plus or Cirrus, the bank would still be able to offer its customers convenient service. As a result, depending on the costs of providing quick and efficient service, the national network could ultimately displace regional networks.

Regional Networks Continue to Merge. The merger of regional networks is a continuing trend. Increasingly, single networks are coming to dominate the ATM market in a city or region. A good example is the MAC net-

work, the only regional network in the Philadelphia area.

In addition to consolidation, many regional networks have made bilateral interconnection agreements. These agreements allow one network's customers to use another network's machines without the customer's bank incurring both a national and a regional switch fee. A recent survey estimates that the number of transactions conducted under such agreements grew by 50 percent between 1989 and 1990.⁸

By expanding the size of their effective network, the interconnected regionals can more successfully rebuff competition from another network. In particular, through either consolidation or bilateral interconnection, the regional networks can give the national network increased competition, since the interchange traffic between the regional networks can effectively bypass the national switch. These agreements are limited to networks that have a sufficiently large volume of transactions flowing between them to support developing both a channel between the networks and the methods to process the transactions.

PUBLIC POLICY CONCERNS

Weighed against the obvious benefits of shared ATM networks are concerns about non-competitive behavior by network industries. While joint ventures among competing firms often result in superior service to the public, they always raise questions of collusion in pricing and of attempts to exclude other competition from entering the business. A dominant network can extract a large share of the benefits of network externalities through monopolistic pricing and restrictions on membership.

Discriminatory and Exclusive Membership Practices. One practice considered anticom-

⁸"Network-to-Network Links Build Transactions," *Bank Network News*, October 11, 1989.

petitive is discriminatory access to the network, such as allowing a small bank to join only if it pays an exorbitant membership fee unrelated to the cost of membership; the small bank, in order to offer its customers the convenience that other banks offer theirs, would probably be willing to pay a high fee. Also considered discriminatory is the fact that most ATM networks restrict membership to depository financial institutions, even though money-market mutual funds and brokerage firms could offer many of the same services through ATMs. These other types of firms could conceivably start their own ATM networks; however, if an ATM network of depository institutions becomes the dominant network, then entry would be difficult owing to the bandwagon effect, and the other institutions may be denied access to an important method of delivering services.

Another practice that can be anticompetitive is exclusionary membership: forbidding a network member from simultaneously joining another network. Before duality, for example, the Plus network forbade its members from belonging to Cirrus. Regional ATM networks, however, allow their members to also join a national network, which reduces the concern about this particular anticompetitive practice.

In October 1990, the Plus network proposed a rule that some regional networks believe may be anticompetitive.⁹ It requires that any transaction carried out between two regional networks whose only logo in common is Plus (on both access card and machine) be routed through the Plus switch. The routing requirement reduces the regional network's ability to engage in reciprocal interconnection, discouraging this type of competition. The rule on transactions routing is a type of exclusionary

clause in that Plus is requiring the transaction to be routed through the national switch even if the two regional networks involved can more efficiently route the transactions directly. Because of the regional networks' criticism of the rule, its implementation has been postponed pending further discussions with the regional networks.¹⁰

Anticompetitive Pricing Practices. If one network charges an extremely low fee for its services in the short run, it may—thanks to the bandwagon effect—be able to establish a dominant, or even monopolistic, position by attracting a large base of members from other networks. Once it establishes its monopoly by engaging in predatory pricing, it could then raise prices to a high, noncompetitive level. Compared to a competitive network, a monopoly network can set prices to extract a larger share of its service's benefits. But entry into the industry would be deterred nonetheless, since no entrant could offer a prospective member a large base of other members.

Public Policy in Action. U.S. antitrust laws provide penalties for networks found to be engaging in anticompetitive practices. In 1985, a Justice Department official, in outlining Justice's views on shared ATM networks, stated that the agency would not attempt "to apply limitations to the structural evolution of the industry."¹¹ However, the official pointed out that anticompetitive practices by networks *would* be cause for limitations on their behavior. The Justice Department and the Conference of State Attorneys General monitor shared ATM networks to determine if a particular practice warrants an antitrust action. To date, there

⁹See "Plus Establishes a Routing Rule," *Bank Network News*, October 26, 1990, and "Plus's Routing Rule Faces An EFT Baptism By Fire," *Bank Network News*, November 10, 1990.

¹⁰See "Plus Takes a Routing Rule Time-Out," *Bank Network News*, January 26, 1991.

¹¹See "Remarks of Charles F. Rule, Acting Assistant Attorney General, Antitrust Division, Before the Federal Bar Association and the American Bar Association," May 23, 1985.

have been few instances of regulatory action against ATM networks. (See *The Bandwagon Effect: Plus, Cirrus, and Entree* for a case in which several states brought suit alleging violations of the antitrust laws in an allied electronic funds transfer network.)

Because of the interconnection of the Plus and Cirrus systems, the Conference of State Attorneys General has stated it will be closely monitoring the behavior of these two national networks for anticompetitive practices.¹² The Attorneys General expressed concern that duality would stifle technological developments, reduce ATM deployment, and result in higher prices. They have decided, however, not to obstruct the duality agreement on antitrust grounds.

Meanwhile, the same group is concerned about national networks engaging in predatory pricing that encourages banks to bypass regional networks. In 1988, an assistant attorney general of New York State expressed concern that Visa was engaging in predatory pricing when it offered to process the transactions of several southeastern ATM networks for 2 cents per transaction—a level far lower than the transactions fees charged at that time.¹³ (The offer was not accepted.) Significantly, however, a great deal of information is required to judge whether a particular pricing practice is anticompetitive.

Additional laws at the state level—called mandatory-sharing laws—assist in preventing anticompetitive practices.¹⁴ By the mid-1980s,

more than 20 states had enacted laws requiring a shared ATM network to allow membership, at a reasonable fee, of any financial institution seeking to join. The mandatory-sharing laws reduce the network's ability to engage in discriminatory membership practices and to charge excessive fees. Although the laws do not define a "reasonable" fee, a financial institution could take the network to court if it had evidence that the network's fees were unreasonable. The network, then, must stand ready to justify its prices in court.

If a monopoly ATM network *were* to develop, we may expect policymakers to create a regulatory agency that oversees the system's prices, much like state public utility boards regulate prices charged by gas and electric utilities. To date, however, no direct regulation of prices has been implemented.

CONCLUSION

The billions of transactions carried out each year by shared ATM networks are indisputable evidence that these networks have greatly enhanced the convenience of basic banking services. The ability of shared networks to offer a new service—geographically convenient access to bank accounts at a substantially lower cost—has spurred the creation and growth of networks at both the regional and national levels.

National network duality has led to the possibility of an interconnected national network, although that has not happened to date; in many regions of the country, a single network transacts most ATM activity. Network consolidation will likely continue at the regional level through mergers and interconnection with other networks.

The consolidation overall has been due to the incentive producers have to expand the networks. The wider the network, the more customers will be willing to pay for it, which in turn creates a surplus to be shared by network and consumer alike.

¹²From a letter by Kenneth O. Eikenberry, Attorney General of Washington, to Plus and Cirrus, August 13, 1990.

¹³See "Trustbusters Spear Entree and More," *Bank Network News*, August 11, 1989.

¹⁴To learn more about the effects of mandatory-sharing laws, see Elizabeth S. Laderman, "The Public Policy Implications of State Laws Pertaining to Automated Teller Machines," Federal Reserve Bank of San Francisco *Economic Review* (Winter 1990).

The Bandwagon Effect: Plus, Cirrus, and Entree

Plus began in the 1970s as the proprietary network of Colorado National Bank. Originally, it positioned itself as a processor of ATM transactions for other banks in the region. Then, in the mid-1970s, Colorado National decided to include shared ATMs, creating the Rocky Mountain BankCard system. By 1979, more than 15 percent of the banks in Colorado, New Mexico, and Wyoming had joined the network. In 1982, the network saw the need for a national network, and 26 banks from around the nation incorporated the Plus System, Inc.

Cirrus, too, was formed in 1982, when a group of 12 large banks around the nation also saw a need for a national ATM network. Both Cirrus and Plus were quickly organized, and both were in operation by 1983.

In February 1987, Visa acquired an ownership interest in Plus, and in January 1988 MasterCard acquired Cirrus. In June 1987, Visa and MasterCard, with the assistance of Plus and Cirrus, agreed to jointly develop a point-of-sale (POS) system called Entree. A POS system is an on-line method for merchants to receive payment from their customers. A shared POS system, like a shared ATM system, allows many banks' customers to use the POS machine at the merchant's site. The system directly debits the customer's bank account and provides payment to the merchant.

By February 1989, more than 170 banks had joined the planned network, representing a potential card base of 17.8 million. However, few merchants had been introduced to the program.

With the creation of Entree, several states in July 1989 filed suit against Visa and MasterCard, alleging intent to monopolize the POS market in violation of the Clayton and Sherman antitrust acts. The State Attorneys General contended that "defendants have obtained dominant control of the manner, pace and circumstances for introduction of a national EFT-POS system.... This dominant control also suppresses competition because potential entrants into the national EFT-POS market confront what is essentially a joint venture of the two bankcard associations, the two largest shared national ATM networks ... and potentially all of the major banks in the United States."^a

The allegation that the Entree plan deterred entry into the POS market is supported by studies of network industry competition. Researchers have shown that a product preannouncement in an industry with strong network externalities, such as Entree, can deter entry by preventing an alternative network from gaining a large enough base of members to make it an attractive alternative.^b Such an announcement can work in this way if it succeeds in convincing enough participants to delay joining any network other than the preannounced one. In other words, if enough participants anticipate the bandwagon effect in the preannounced product, they can reduce the possible bandwagon for competing products.

The suit sought a divestiture of Plus and Cirrus, as well as prohibitions on Visa and MasterCard from jointly operating Entree or any other POS system. In an out-of-court settlement in May 1990, Visa and MasterCard agreed not to develop Entree. However, they admitted no wrongdoing and were not required to divest themselves of Plus and Cirrus.

^a"The States of New York, Arizona, California, Connecticut, Louisiana, Maryland, Massachusetts, Minnesota, Tennessee, Texas, Utah, Washington, West Virginia, and Wisconsin against Visa U.S.A., Inc., and MasterCard International, Inc.," First Amended Complaint, CV-89-5043 (PNL), United States District Court, Southern District of New York.

^bSee Joseph Farrell and Garth Saloner, "Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation," *American Economic Review* 76 (1986).

Large networks, however, pose risks of anticompetitive practices, such as discriminatory membership rules and monopolistic pricing. Federal antitrust laws and the mandatory-sharing laws in many states are designed to prevent these practices. So far, however, spirited competition continues between the national systems and the regionals (due to the regionals' reciprocal sharing agreements) and among regional networks.

Interest Rate Risk: What's a Bank to Do?

*Sherrill Shaffer**

In today's competitive environment, banks and regulators alike must become more familiar with ways to measure and control interest rate risk, despite the complexities involved. Fluctuations in interest rates can either raise or lower the net worth of a financial institution when its assets and liabilities do not respond in the same direction or by equal amounts. True, gains and losses may tend to average out over time if interest rates move in both directions

over the long term; nevertheless, the short-term losses from even temporary adverse conditions can be very costly. For example, the rise in interest rates in the early 1980s was a leading cause of losses in the savings and loan industry.

To do anything about interest rate risk, a bank must first measure how much it has. Unfortunately, traditional measures of such risk, while convenient, provide only rough approximations at best. Analysts have known better measures for years, but banks have been slow to adopt them because of their complexity and data requirements. Similarly, regulators to date have sometimes appeared ambivalent about encouraging banks in this direction.

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Once it has adopted a reliable measure of interest rate risk, a bank must choose how to respond. Techniques now exist for hedging against interest rate movements, but those same techniques can just as easily be used for speculative purposes. Moreover, hedging involves direct costs, as well as the forgone profits that an unhedged bank would have earned had it gambled correctly on a change in rates. Gone are the days, however, when a bank can safely ignore the issue.

Recent losses and the current economic environment strongly suggest that many banks are exposed to more risk than is desirable and that at least some degree of hedging is essential. Interest rates have fluctuated much more over the past decade than in earlier periods, implying larger potential losses for an unhedged portfolio. Moreover, even though interest rates are currently lower than in the early 1980s, banks' operating margins tend to be thinner and more variable—and hence more vulnerable to losses due to interest rate risk—because financial markets are more competitive.

MEASURING INTEREST RATE RISK

The traditional measure of interest rate risk is the maturity gap between assets and liabilities, which is based on the repricing interval of each component of the balance sheet—that is, the period of time over which the interest rate is required by contract to remain fixed. The repricing interval of a fixed-rate account equals its maturity. For adjustable-rate assets or liabilities, the repricing interval is given by the date of the next adjustment.

To compute the maturity gap, an analyst would first group assets and liabilities according to their repricing intervals, such as less than

three months, three months to one year, and so on. Within each category, the gap is then expressed as the dollar amount of assets minus liabilities. This approach, however, offers no single summary statistic that expresses the bank's interest rate risk.

Traditionally, depository institutions have had longer average maturities on the asset side than on the liability side. For example, smaller banks and thrifts, especially, often use deposit liabilities payable on demand to fund long-term assets such as fixed-rate mortgage loans. Such banks would have a large negative maturity gap in the shorter-maturity brackets (short-

term liabilities exceed short-term assets) and a large positive gap in the longer-maturity brackets (long-term assets exceed long-term liabilities). In this situation, a rise in interest rates would lead to a higher cost of

funds before loan rates could adjust, narrowing the bank's interest rate spread and lowering its profits.

Even though the maturity gap can suggest how a bank's condition will respond to a given change in interest rates, it omits certain important factors, including cash flow, unequal interest rates on assets and liabilities, and initial net worth. It is therefore more appropriate to view the maturity gap as an indicator of a bank's liquidity risk, not its interest rate risk: in the event of massive withdrawals of deposits, the rate of withdrawal is limited by the maturity of the deposit accounts; likewise, the rate at which assets can be liquidated to meet the withdrawals is limited by the maturity of loans and other assets. Liquidity risk is important and plays a valid role in maturity-gap management. However, we need a better measure of interest rate risk.

The "right" theory for the problem was advanced at least as far back as 1938.

A Conceptual Alternative. The “right” theory for the problem was advanced at least as far back as 1938, when Frederick Macaulay formulated the concept of *duration*. Duration is usually presented as an account’s weighted average time to repricing, where the weights are discounted components of cash flow. Originally, however, the technique was devised to determine what percentage change in present value would result from a 1 percent change in the interest rate.¹ In its simplest form, duration provides the correct answer to this question only under special conditions. The most restrictive conditions are that interest rate movements be small and that long-term interest rates be equal to short-term rates at all times. (See *A Simple Example of Duration Analysis*, p. 21.)

A bank is perfectly hedged against interest rate risk when the duration of its assets, *weighted by dollars of assets*, equals the duration of its liabilities, *weighted by dollars of liabilities*.² The difference between these two weighted durations is called the duration gap, distinct from the maturity gap discussed above. The larger

the duration gap, the more sensitive the bank’s net worth will be to a given change in interest rates.

The key element distinguishing duration from maturity is the cash flow, in terms of both its timing and its amount. For a zero-coupon bond or a so-called “bullet” loan, the only payment comes at maturity; in such cases, the duration equals the maturity. However, when interim payments are scheduled, each payment received can be reinvested while each payment owed must be funded. Changes in interest rates that occur before the last payment will affect the value of all remaining payments and hence the net worth of the contract or the portfolio to which it belongs.

Likewise, when loan rates differ from deposit rates (as they must in order for the bank to earn a positive spread), the cash-flow amounts will differ between an asset and an otherwise identical liability. Duration incorporates this distinction, whereas the maturity gap does not.

In addition, the initial net worth also affects an organization’s sensitivity to interest rate changes. When assets do not initially equal liabilities, then net worth can change with interest rates even when the duration of assets equals that of liabilities. That is, setting the duration of assets equal to that of liabilities does not by itself necessarily eliminate interest rate risk; these durations need to be weighted by dollars of assets and liabilities to achieve that goal.

Why have these additional factors not been universally incorporated into management and accounting practices more than half a century after their importance was first recognized? There are two reasons, one institutional and the other technical.

Until 1980, not only were interest rates in the U.S. relatively stable, but federal regulations also set the maximum interest rate that banks could pay on deposits. Banks consequently believed they had little reason to worry about interest rate risk. However, the success of

¹Many people are surprised to realize that this response factor corresponds to units of time: percent, divided by percent per year, equals years. Excellent introductions to duration theory are provided by Kaufman (1984), French (1988), and, on a more academic plane, Grove (1974). To see that the duration of an asset need not equal its maturity, consider a two-year loan for \$200 at 8 percent repaid in equal installments of \$112.15 each year. The present values of the cash payments are \$103.85 and \$96.15, so the duration of the loan equals $(1 \times \$103.85 + 2 \times \$96.15) / \$200 = 1.48$ years. More generally, the formula for duration is $[\sum_{t=1}^T tP_t / (1+r_t)^t] / [\sum_{t=1}^T P_t / (1+r_t)^t]$, where P_t is the cash flow in period t , r_t is the interest rate in period t (usually assumed in textbooks to be constant across t), and T is the maturity of the loan. The box on p. 21 explains in more detail how duration is calculated.

²This implication of duration theory was first derived by Samuelson (1945) and Hicks (1946). The property is strictly true either under simplifying assumptions (if the simple concept of duration is used) or when an appropriate generalization of duration is used, as discussed in Kaufman et al. (1983). The requirement of weighting is discussed later.

money market mutual funds during the 1970s demonstrated that regulatory ceilings on interest rates provided false security to banks, as depositors simply shifted their funds from bank accounts to more lucrative investments. After 1980, the institutional environment shifted as regulatory rate ceilings were phased out just as market interest rates were rising to record levels.

Even though banks now have a stronger motive for measuring and managing interest rate risk than before, several technical factors make it difficult to apply duration analysis correctly. First, the detailed information on cash flows required for duration analysis presents a computational and accounting burden. Second, the true cash-flow patterns are not well known for certain types of accounts, such as demand deposits or passbook savings accounts; they are likely to vary with the size or timing of a change in market interest rates, making it all the harder to quantify the associated interest rate risk. For example, during the 1970s and 1980s, demand deposits continued to pay zero interest while nonbank instruments paid increasingly high rates; in response, commercial firms devised new cash-management practices to economize on their demand balances, which led to lower, more volatile demand balances than previously seen. Prepayments similarly complicate the measurement or prediction of cash flows on home mortgages.

And finally, a more complex version of duration is needed to reflect the fact that long-term interest rates do not always equal short-term rates and indeed may move independently of each other. For these reasons, many institutions have thus far chosen either to retain the simpler, but less accurate, maturity gap methods, or to rely on computer scenarios without always acknowledging their linkage to duration. In the latter case, a better understanding of duration can safeguard against misuse of the simulation results.

A Numerical Approach. Some banks simu-

late the impact of various risk scenarios on their portfolios, asking, for example, "If interest rates rise by 2 percentage points, how much will my net worth fall?" When done properly, this technique essentially replicates the same bottom line as duration theory while bypassing the more sophisticated mathematical derivations. Indeed, a computer simulation can be made to yield a single summary statistic representing the bank's interest rate risk, which will then equal its duration gap. A useful way of thinking about both the level of risk and how to hedge it, this technique may be thought of as "brute force" duration analysis. (The box at right gives a simple example.) However, drawbacks remain.

The major complication is, again, the need for detailed cash-flow data for assets and liabilities. When loans are repaid monthly and interest payments accrue daily, for example, correct calculations are more difficult than in the simple example shown in the box. A computer scenario is only as useful as it is realistic, and either oversimplifying the cash flows or omitting them from the model entirely can lead to nasty surprises. As it happens, the inclusion of cash flows is an unavoidable complexity—a cost of doing business in today's market environment. One possible response to this cost is to simplify contractual payment schedules according to the trade-off between the benefits of such simplification (easier calculation of portfolio effects) and the costs (lumpier cash flows and other inconveniences).

Likewise, computers alone cannot solve the problem of forecasting cash-flow patterns for some assets and liabilities. Simulations often rely on historical data to estimate the duration of savings accounts, mortgages, and other types of accounts. This backward-looking approach may give good estimates of cash flow under the historical pattern of interest rates, but possibly not if the pattern changes in the future; for that, a more theoretical approach may provide a better forecast. Techniques to address these

A Simple Example of Duration Analysis

To keep calculations as simple and clear as possible, let's look at a balance sheet in which a single-payment two-year loan of \$100 is funded by two successive one-year \$100 certificates of deposit. (Note that this assumes no initial equity or reserves.) We want to do two things: calculate the duration gap for this portfolio and examine the effect of changing interest rates on the present value of profits (which defines the market value of the portfolio).

Suppose initially that the interest rate is 6 percent for both the loan and the CD. (This means that the bank earns zero spread and, consequently, no profit—not a realistic scenario, but one easy to follow.) At the end of the first year, the bank pays \$106 on the first CD and takes in \$100 for the second CD for a net cash flow of -\$6. In two years it pays out \$106 more. The loan is a “bullet loan,” requiring no repayment until it matures. At that time the entire loan, plus interest for two years at 6 percent, will be repaid: $\$100 \times 1.06 \times 1.06 = \112.36 . So the bank's cash flows, both undiscounted and discounted at a 6 percent annual rate, can be summarized as follows:

Year	Income	(Discounted)	Expense	(Discounted)	Profit	(Discounted)
1	0	(0)	\$6.00	(\$5.66)	-\$6.00	(-\$5.66)
2	\$112.36	(\$100.00)	\$106.00	(\$94.34)	\$6.36	(\$5.66)
Total		(\$100.00)		(\$100.00)		(0)

The net present value of the portfolio is zero.

Duration for each side of the balance sheet is calculated as the weighted average time to repricing, where the weight in each period up to repricing is the discounted cash flow as a proportion of total present value. Since the loan has only a single payment coming at the end, the duration of assets is 1 year \times ($\$0 / \100) + 2 years \times ($\$100 / \100) = 2 years, the same as its maturity. Likewise, each CD has one payment coming at its maturity, so the duration of the liability side is 1 year \times ($\$100 / \100) = 1 year.

The duration gap for the entire portfolio is the *difference* between the asset duration, weighted by the present value of assets, and the liability duration, weighted by the present value of liabilities: $\$100 \times 2$ years - $\$100 \times 1$ year = 100 dollar-years. By comparison, the maturity gap is -\$100 in the zero-to-one-year range and \$100 in the one-to-two-year range, as seen from the outset.

Like that of the typical small bank, this portfolio has a positive duration gap. Consequently, duration theory tells us that an increase in interest rates will *lower* the present value of the portfolio. We can demonstrate this directly. Suppose there is an immediate, unanticipated increase in the market interest rate to 8 percent. Both the loan and the deposit are locked into the original 6 percent rate for the first year. But in the second year, the deposit rate adjusts to 8 percent while the loan rate is still fixed at 6 percent. Discounting at the new market rate of 8 percent, the cash flows become:

Year	Income	(Discounted)	Expense	(Discounted)	Profit	(Discounted)
1	0	(0)	\$6.00	(\$5.56)	-\$6.00	(-\$5.56)
2	\$112.36	(\$96.33)	\$108.00	(\$92.59)	\$4.36	(\$3.74)
Total		(\$96.33)		(\$98.15)		(-\$1.82)

The net present value of the portfolio declines from zero to -\$1.82.

We can compare this drop in present value with that predicted by duration theory. As discussed by George Kaufman (1984), the change in the present value of the portfolio equals the negative of the duration gap, times the change in interest rates, divided by the original discount factor. In our example, this equals $-100 \times .02 / 1.06^2 = -\1.78 , very close to the change of -\$1.82 computed directly.

thorny questions have been under development for several years now. For example, several computer programs designed to model mortgage prepayments as interest rates change are now commercially available, and even better answers can be expected in the future.

Choosing appropriate interest rate scenarios within which to explore portfolio effects remains more art than science. It is not enough to project a given rise or fall in rates across the board; the term structure may shift, with long rates changing either more or less than short rates, and each variation can have a different impact on overall net worth. The computer cannot tell an analyst how to do this. But even so, the computer-based scenario method can prove more flexible and require less effort than the strictly theoretical duration approach.

CONTROLLING INTEREST RATE RISK

Once a bank has measured its interest rate risk, what action should it take? Some theories of banking consider it essential that banks accept some degree of interest rate risk, and most bankers prefer not to hedge completely against such risk. However, for a bank to profit consistently from changes in interest rates requires the ability to forecast interest rates better than the rest of the market. Obviously, not everyone can be better than average all the time.

The experience of the 1980s suggests that more hedging would be an improvement for the banking industry, even if a complete hedge is not best. There are several ways of bringing a bank's duration gap near zero to construct a hedge. The various approaches generally involve some combination of adjusting the portfolio of assets and liabilities or using nontraditional financial instruments.

Adjusting the Portfolio. Possibly the simplest, most conventional solution is to adjust the maturity, repricing, and *payment schedules* of assets and liabilities. In its simplest form, this approach does not require exotic instruments or strategies; in fact, many banks already use it

in a general way.

Consider the example of a small bank or thrift with long-term fixed-rate mortgages funded by short-term CDs. The bank may shorten its asset duration to reduce interest rate risk by holding adjustable-rate mortgages (ARMs) instead of fixed-rate ones, thereby changing the repricing interval of assets. A drawback here is that the demand for ARMs may be substantially weaker in some markets than that for fixed-rate mortgages. Accordingly, a bank may not be able to go as far with this strategy as it would like, and it may also have to accept a lower expected return or spread. A second drawback is that an ARM's cash-flow pattern itself may change following large movements in interest rates: if rates fall sharply, ARMs are frequently refinanced using fixed-rate mortgages; and if interest rates rise very much, ARMs may suffer a higher default rate. These changes in the cash-flow pattern would need to be modeled in order to choose the right amount of ARMs to provide the desired degree of hedging against interest rate risk. A third drawback is that most ARMs are sold with a cap on interest rates, leaving the bank exposed to risk if market rates rise above the cap.

Other actions that a bank can take to shorten its average asset duration include holding short-term securities and lending overnight—for example, in the interbank market. Moreover, early amortization by means of accelerated or fixed-amortization payment schedules can reduce the duration of loans.

Another element of portfolio adjustment involves matching the amounts of assets and liabilities within each duration category. For example, suppose a bank found that its savings accounts behave like a long-duration deposit, even though in principle depositors are free to withdraw at any time. Armed with this information, the bank could then try to match the amount of its savings deposits with the amount of its fixed-rate mortgages, relying on short-duration CDs and other deposits to fund any

short-duration assets. In this way the overall weighted duration of liabilities can be brought close to that of the bank's assets, resulting in a hedged balance sheet.

As the example suggests, duration matching is often applied to the balance sheet on an item-by-item basis, where it can provide only an imprecise hedge. More exact hedging is possible if the approach is applied instead to the portfolio as a whole, taking advantage of the fact that a balance between durations of weighted assets and weighted liabilities does not require a perfect match between any subset of the assets and liabilities.

However, a portfolio that is perfectly matched ("immunized") at one set of interest rates will typically require rebalancing as soon as rates move. Such rebalancing can involve transactions costs, as well as more complicated calculations if individual components of the balance sheet are not matched. In addition, at some point greater precision in hedging may require more exotic instruments or techniques.

Using Nontraditional Financial Instruments. Within the past decade, banks have increasingly turned to such hedging instruments as asset-backed securities, futures, options, and swaps.³ Their adoption has been concentrated among the large banks, however, and has tended to meet with suspicion from small bankers (who view them as a costly and unnecessary complication) and even from regulators (who view them as another means by which banks can take on more risk).

There is some truth in all these views. A

³A number of these instruments are described by Grumball (1987).

wider range of instruments requires more resources to manage, but these instruments, if managed well, can save resources in the long run. And indeed, additional instruments can be used either to reduce or to increase overall portfolio risk, according to the intention and

expertise of a bank's management and staff. Examiners would need special training to distinguish good from bad. But as with fire, informed use beats uninformed neglect.

Securitization.

Traditionally, bankers have viewed the activities of originating and

holding a loan as inseparable. More recently, however, they have recognized that the activities are truly distinct, such that the originating institution may differ from the institution that holds the asset to maturity. A bank may originate a loan, shortly thereafter sell the loan for a fee to a third party, and subsequently repeat the process.

When a loan is sold, it may be marketed alone or as part of a package of loans. A common approach is to bundle a number of similar loans, such as auto loans, credit-card loans, or home mortgages, and sell the package at a specified yield—a process called "securitization," since it converts loans into a contractual stream of payments resembling a bond or some other security. The similarity of loans within a bundle makes assessing its risk easier, while the multiplicity of loans allows some diversification of default risk.

Although fee income from the sale has drawn attention as a motivation for this activity, an equally important aspect is that the loan's effective maturity *to the bank* is only the interval between origination and sale. Therefore, securitization may substantially reduce the bank's average asset duration and, in the case

Banks have increasingly turned to asset-backed securities, futures, options, and swaps.

of a typical small bank with long-term mortgages and short-term deposits, reduce its interest rate risk.

The success of this method requires, among other things, a demand for the securitized asset. If interest rates rise, a loan with a fixed rate suddenly below market is no longer an attractive purchase. It could be sold only at a discount, forcing the originating bank to realize an immediate loss.

Recent evidence also suggests that combining traditional banking with securitizing may tend to raise a bank's costs.⁴ This result could be viewed as reflecting a cost of managing interest rate risk: you don't get something for nothing. Subject to these limitations, securitization offers an attractive opportunity for banks to shorten their asset duration.⁵ Of course, misuse is possible. Banks can buy as well as sell securitized assets, and a bank that buys a package of securitized loans may lengthen its asset duration, increasing its interest rate risk. For this reason a bank should make sure that it ends up on the right side of a deal for its own portfolio needs; indeed, some banks have suffered losses by neglecting this principle.

Swaps. A swap is a contract that trades payment streams (but not the underlying principal or associated credit risk) between two parties. For example, a bank having a fixed-rate mortgage with 10 years remaining to maturity may prefer to receive a variable-rate payment stream in order to shorten its asset duration and reduce its interest rate risk. Suppose it finds another institution that has made a variable-rate commercial loan of equivalent principal amount with 10 years left to maturity. If that

institution would prefer to receive fixed-rate payments, the bank can contract to pass through its mortgage payments to the second institution in return for receiving a pass-through of the variable-rate commercial loan payments. The mortgage itself remains on the bank's books, while the commercial loan stays on the books of the second institution. Such a contract is known as a swap.

Interest rate swaps can reduce interest rate risk either by converting a fixed-rate income stream to a variable-rate stream, as in the example, or by converting a variable-rate expense stream to a fixed-rate stream. Used in the first way, a swap shortens the duration of assets; used in the second way, it increases the duration of liabilities. Either or both approaches can help overcome the typical bank's mismatch between long-duration assets and short-duration liabilities.⁶

The arrangement has several shortcomings, however. First, if the commercial borrower defaults, then the variable-rate income stream stops and the bank must turn elsewhere if it desires to continue trading fixed-rate for floating-rate payments. By that time, interest rates may have changed, making it difficult for the bank to find another counterparty at the original terms. This possibility shows that the hedge is not perfect.

Second, the arrangement seemingly requires the bank to find an institution with repricing needs exactly opposite its own. However, approximate matches can be accommodated by more complicated contracts involving more than two assets or parties. A related problem is that if all banks want to be on the same side of the deal, there may not be enough counterparties willing to take the other side.

⁴See Mester (1990).

⁵See Nadler (1987) for an argument that even community banks can benefit from securitization.

⁶Even community banks can benefit from this seemingly intricate arrangement; see Findlay (1987).

Futures. An interest rate futures contract is an agreement between two parties to buy (or sell) a fixed-income asset, such as a Treasury security, for a fixed price at a specified date. The holder of such a contract earns a positive or negative profit based on the difference between the specified delivery price and the price at which the underlying securities can be sold after taking delivery.⁷

Unlike securitization and swaps, which alter the repricing intervals of a bank's assets and liabilities, futures can be used to create cash flows that offset losses on the original portfolio. For example, a bank that would lose net worth if interest rates rise can reduce this risk by *selling* bond futures, locking in the current interest rate and, in effect, selling bonds short.⁸ If interest rates rise before the futures contracts expire, bond prices will fall and the bank can close out its futures position at a profit by buying either the bonds or additional futures at a lower price. The profits on the futures offset losses due to declining interest rate spreads on the rest of the portfolio. If interest rates fall, losses on the futures are offset by increased interest rate spreads on the rest of the portfolio. However, it should be emphasized that futures, like any hedging device, cannot totally eliminate all risk; some sources of residual risk remain even after careful application of futures.⁹

Although any interest-rate futures contract can provide a hedge against interest rate risk, futures on U.S. Treasury instruments have spe-

⁷Morris (1989) provides an excellent introduction to the potential use of interest rate futures by banks, while Koppenhaver (1986) describes the role of options on such futures.

⁸See Green (1986), p. 86.

⁹Morris (1989) discusses several types of residual risk.

cial advantages: (1) there is negligible risk of default on the underlying instruments; (2) the relevant markets are highly liquid; and (3) the yields move more in line with market interest rates than with factors unique to the instrument, making them ideal for hedging diversified portfolios.¹⁰

WHAT NEXT?

Fundamental changes in the regulatory and market environment have made interest rate risk a vital issue. The importance of this risk underlies the explosive growth of banking's involvement in so-called derivative instruments (such as futures and options, which are "derived" from other financial contracts) and in new strategies over the past decade. In the period from 1980 to 1985, the volume of interest rate futures held by banks grew tenfold, as did the volume of loan sales by banks in the period from 1983 to 1988.¹¹ Interest rate swaps grew from an estimated world market of \$3 billion in 1982 to well over \$100 billion just three years later and to over \$500 billion by 1987; the outstanding amount of pass-through securities backed by residential mortgages reached \$769 billion by 1988.¹²

However, even though the aggregate volume has grown dramatically, these new activities have been concentrated in a relatively few

¹⁰For a small, undiversified bank, a futures contract on the sector most heavily represented in its portfolio may also be an effective hedge, not only against interest rate risk but also against price or credit risk, if the futures market is liquid and default risk on the contract is low. Examples might be oil futures for Texas banks or commodities futures for agricultural banks.

¹¹See Parkinson and Spindt (1985), p. 226, and Boemio and Edwards (1989).

¹²See Bank for International Settlements (1986), pp. 39-43; Smith et al. (1988); and Boemio and Edwards (1989).

large banks. For example, in the second quarter of 1989, nine money-center banks accounted for about 40 percent of total loan sales, and 54 banks accounted for more than 90 percent.¹³ Most of the nation's 13,000 banks have remained hesitant about plunging in, some on the premise that the fundamental business of banking hasn't changed and therefore doesn't require new approaches, and others on the premise that the costs of learning and managing the new techniques would outweigh any benefit. Such arguments appear short-sighted in today's combination of thinner margins, aggressive competition, and volatile interest rates.

As more banks perceive the need to reduce their interest rate risk, regulators need to be trained in evaluating the use of the new techniques, since a debate inevitably arises when managers and regulators disagree on an institution's position. A recent dispute occurred in Kansas, where regulators argued that Franklin Savings Association was insolvent even though management (and eventually a federal court) held that it was solvent once its sophisticated hedging techniques were properly recognized.¹⁴ Traditional accounting rules further cloud the issue: when the balance sheet is not marked to market, a gain on the portfolio will not be fully reflected on the books, whereas

a corresponding loss on the hedge may have to be recorded. However, the Financial Accounting Standards Board allows a loss on futures or other hedging programs to be kept off the books if it "correlates with and offsets" an unbooked capital gain.¹⁵

To avoid such uncertainty and waste, regulatory guidelines must keep pace with the industry. The Basle accord on banks' risk-based capital requirements recognized this need by incorporating a commitment to augment guidelines over the next few years to account for interest rate risk. This resolve was reiterated in a recent Treasury Department proposal to reform the financial system.¹⁶

The only alternative would be to ban modern hedging techniques, a move that would have at least two unfortunate consequences. First, it would leave the burden of interest rate risk on the banks and the already strained federal safety net. Second, it would place U.S. banks at a further competitive disadvantage relative not only to major players from other nations, but also to other U.S. financial institutions.

In summary, we can't turn back the clock now. Regulators and banks alike need to become more familiar with measures of interest rate risk and the ways of hedging it.

¹³See Mester (1990), p. 5.

¹⁴See Labaton (1990) and Milligan (1991).

¹⁵See Milligan (1991), pp. 54-55.

¹⁶See U.S. Department of the Treasury (1991).

REFERENCES

Bank for International Settlements. *Recent Innovations in International Banking*. Basle: BIS, 1986.

Boemio, Thomas R., and Gerald A. Edwards, Jr. "Asset Securitization: A Supervisory Perspective," *Federal Reserve Bulletin* 75 (October 1989) pp. 659-69.

Findlay, David M. "Swap Applications for Community Banks," *Journal of Commercial Bank Lending* (December 1987) pp. 9-14.

- French, George E. "Measuring the Interest-Rate Exposure of Financial Intermediaries," *FDIC Banking Review* 1 (Fall 1988) pp. 14-27.
- Green, Edward J. "Financial Futures and Price-Level Variability," in Myron L. Kwast, ed., *Financial Futures and Options in the U.S. Economy*. Washington: Board of Governors of the Federal Reserve System (1986) pp. 79-89.
- Grove, Myron A. "On 'Duration' and the Optimal Maturity Structure of the Balance Sheet," *Bell Journal of Economics* 5 (Autumn 1974) pp. 696-709.
- Grumball, Clive. *Managing Interest Rate Risk*. New York: Quorum Books, 1987.
- Hicks, John R. *Value and Capital*. Oxford: Clarendon Press, 1946.
- Kaufman, George G. "Measuring and Managing Interest Rate Risk: A Primer," Federal Reserve Bank of Chicago *Economic Perspectives* (January 1984) pp. 16-29.
- Kaufman, George G., Gerald O. Bierwag, and Alden Toevs, eds. *Innovations in Bond Portfolio Management: Duration Analysis and Immunization*. Greenwich, CT: JAI Press, 1983.
- Koppenhaver, Gary D. "Futures Options and Their Use by Financial Intermediaries," Federal Reserve Bank of Chicago *Economic Perspectives* (January 1986) pp. 18-31.
- Labaton, Stephen. "The Return of S&L Is Ordered," *New York Times*, September 6, 1990.
- Macaulay, Frederick R. *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields, and Stock Prices in the U.S. Since 1856*. New York: National Bureau of Economic Research, 1938.
- Mester, Loretta J. "Traditional and Nontraditional Banking: An Information-Theoretic Approach," Federal Reserve Bank of Philadelphia Working Paper 90-3 (1990).
- Milligan, John W. "Abuse of Power: How the Government Railroaded Franklin Savings," *Institutional Investor* (January 1991) pp. 50-60.
- Morris, Charles S. "Managing Interest Rate Risk with Interest Rate Futures," Federal Reserve Bank of Kansas City *Economic Review* (March 1989) pp. 3-20.
- Nadler, Paul S. "Implications of Securitization for the Community Bank," *Journal of Commercial Bank Lending* (November 1987) pp. 19-25.
- Parkinson, Patrick, and Paul Spindt. "The Use of Interest Rate Futures by Commercial Banks," in Myron L. Kwast, ed., *Financial Futures and Options in the U.S. Economy*. Washington: Board of Governors of the Federal Reserve System (1986) pp. 221-48.
- Samuelson, Paul A. "The Effect of Interest Rate Increases on the Banking System," *American Economic Review* 35 (1945) pp. 16-27.
- Smith, Clifford W., Jr., Charles W. Smithson, and Lee Macdonald Wakeman. "The Market for Interest Rate Swaps," *Financial Management* 17 (Winter 1988) pp. 34-44.
- U.S. Department of the Treasury. *Modernizing the Financial System: Recommendations for Safer, More Competitive Banks*. Washington (February 1991).



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