

**Structural Change in the U.S.
Banking Industry:**
The Role of Information Technology

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ABSTRACT

Commercial bank investment in information technology (IT) equipment has grown rapidly, from \$104 million in 1960 to more than \$10 billion in 1994. These investments in "hard" technologies (computer hardware, software, telecommunications equipment, etc.) have been accompanied by increases in "soft" technologies, for example, complex financial innovations that were infeasible on a large scale without IT hardware. These developments, together with deregulation, are creating new competitors, new financial markets and instruments, and a new role for commercial banks as providers of financial services.

This study documents how changes in information technology have affected the role of banks in financial markets and have influenced changes in the structure and performance of the U.S. banking industry. The analysis also covers new, fast-growing financial innovations linked to IT investment e.g., asset securitization and derivatives.

IT's effect on the banking industry has been positive. Increased competition has caused banks to lose traditional customers, but IT enabled the banks to offer new products, expand into nontraditional areas, operate more efficiently, and minimize risk. The aggregate economy is better off because of a more efficient financial industry and because of the increased quality and value of banking services.

IT has been central to the evolution of the market for securitized instruments. Mortgage-backed securities have experienced phenomenal growth over the past 25 years. Forty percent of mortgages outstanding are securitized today compared with less than 1 percent in 1960. Banks have benefitted from this market because securitization reduces the risk associated with holding long-term, fixed-rate mortgages. The market for derivatives (i.e., futures, options, swaps) has also been growing rapidly, at an average annual rate of over 30 percent since 1983. Banks earned \$6.5 billion (13 percent of net income) from derivatives trading in 1995 and the derivatives market promises to be an even larger source of income for banks in the future.

The banking industry will continue to consolidate over the next five to ten years. There were 9,941 banks in 1995, compared with the peak of 14,483 in 1984. Consolidation will be driven by interstate banking deregulation and by the inability of less IT-intensive banks to keep pace with innovative banks. Competition from nonbanks and even technology vendors will continue to force banks to venture into nontraditional markets.

Regulators were slow to recognize how rapidly financial markets were changing because of IT and competition, but are now actively developing ways to monitor financial innovations (especially derivatives) and reduce the likelihood of an adverse impact on the overall health and stability of the U.S. banking industry and global financial markets.

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STRUCTURAL CHANGE IN THE U.S. COMMERCIAL BANKING INDUSTRY

The Role of Information Technology

By Sandra D. Cooke*

INTRODUCTION

In recent decades, investment in information technology (IT) by the commercial banking industry has served to streamline operations, improve competitiveness, and increase the variety and quality of services provided. Hardware advances have given rise to new, "soft" technologies, for example, financial innovations that before were too complex to manage on a large scale. These developments, together with ongoing deregulation are creating new competitors, new financial markets and instruments, and a new role for commercial banks as providers of financial services. This study examines how these developments have affected the structure and performance of the banking industry and increased competition between banks and nonbanks.

Many of the changes in banking industry structure and performance are directly or indirectly because of advances in information technology; however, deregulation has also played a crucial role as it has in other once highly regulated industries such as telecommunications, airlines, and trucking. In the banking industry, IT has facilitated competition by giving nonbanks and nonfinancial firms access to information that was once only available to banks, but these firms would not have been allowed to enter the market without deregulation. Hence it is difficult to completely isolate the impact of information technology from the impact of

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deregulation.

In addition, while advances in information technology have helped transform the banking industry in a number of ways, the ultimate impact of IT depends on the types of services the bank provides. If banks provide transactions services, IT is likely to improve productivity, increase efficiency, provide scale economies, and reduce the cost structure. If banks provide risk management services (transferring and distributing risk), IT will tend to reduce the risk of imperfect information. Improved and more accessible information may lead to increased competition, the creation of new markets, new product lines, new sources of revenue, and ultimately to increased consolidation.

Economic theory supported by empirical evidence suggests that, in general, increases in technology investment will raise productivity, lower costs, and allow firms to operate more efficiently. For banks, however, there is limited empirical evidence to support this theory because of the lack of reliable data and measurement problems, and because of the time lag between technology adoption and returns on investment.¹ However, if banking conforms to the pattern of other mature industries, the impact of IT investment should be increased competition and overcapacity, leading eventually to consolidation. The number of banks in the United States has declined by more than 30 percent since 1984. Theory suggests that profits usually suffer during the transition period when automation is occurring. Banks are prone to this since an estimated 90 percent of IT investment by banks goes into automating routine processing tasks that translate only marginally into higher profits. Banks may realize economies of scale, but these are likely to vary in proportion with the level of IT investment.² This study of recent developments in the banking industry suggests that ongoing structural changes are consistent with theory.

There is general agreement that the benefits of technological and financial innovations in the banking industry have spread to the general economy, as evidenced by the improved value and quality of services being provided. However, it is difficult to estimate the worth of these improvements. The economy as a whole is better off because innovations that improve the availability of information, lower transactions costs, and facilitate risk-sharing allow the industry to operate more efficiently. Measurement problems, however, limit our ability to estimate the contribution of the banking industry to overall economic activity.

General speculation that the rapid pace of financial innovation, the ease with which transactions can be made, and the growing interdependence of domestic and international financial markets may expose banks and the economy to new risks, has attracted the attention

¹ Hunter and Timme (1991) found that investment in technology lowers real average costs and raises productivity, with most of the benefits accruing to larger banks.

² Thomas D. Steiner and Diogo B. Teixeira, *Technology in Banking, Creating Value and Destroying Profits*, 1989: 67.

of regulators. However, risk has always been an inherent part of transacting business in financial markets, and there is no clear evidence that current risks are any greater or any different from risks incurred in the past. Regulators are aware of the growing complexity of financial innovations and they are encouraging banks to conduct internal monitoring of risk exposure. They are also developing new guidelines to restrict bank involvement in high-risk activities.

The present study is divided into three parts. Part I compares IT investment trends of banks with nonbanks, and large banks with small banks; looks at how financial activity has grown relative to overall economic activity; examines growth in competition from nonbanks and nonfinancial firms and how this competition, along with IT has changed the asset and liability composition of banks; and considers changes in industry concentration. Part II discusses IT-related financial innovations such as asset securitization and derivatives and their impact on the structure of the banking industry, and assesses the potential impact of interstate banking deregulation. Part III examines whether information technology has influenced industry performance, as measured by changes in profitability, employment, and productivity.

PART I

IT INVESTMENT AND INDUSTRY STRUCTURE

Advances in information technology have contributed to structural changes in the banking industry, including competition from nonbanks, the movement into nontraditional lines of business, and recent industry consolidation. Part I of this study compares bank and nonbank IT investment patterns as well as IT intensity of large and small banks. How and when IT began to influence the structure of the industry is demonstrated through a detailed analysis of the growth in competition from nonbanks, which is, in turn, reflected in changes in the composition of assets and liabilities held by banks. Part I concludes with a discussion of the role of IT in industry concentration.

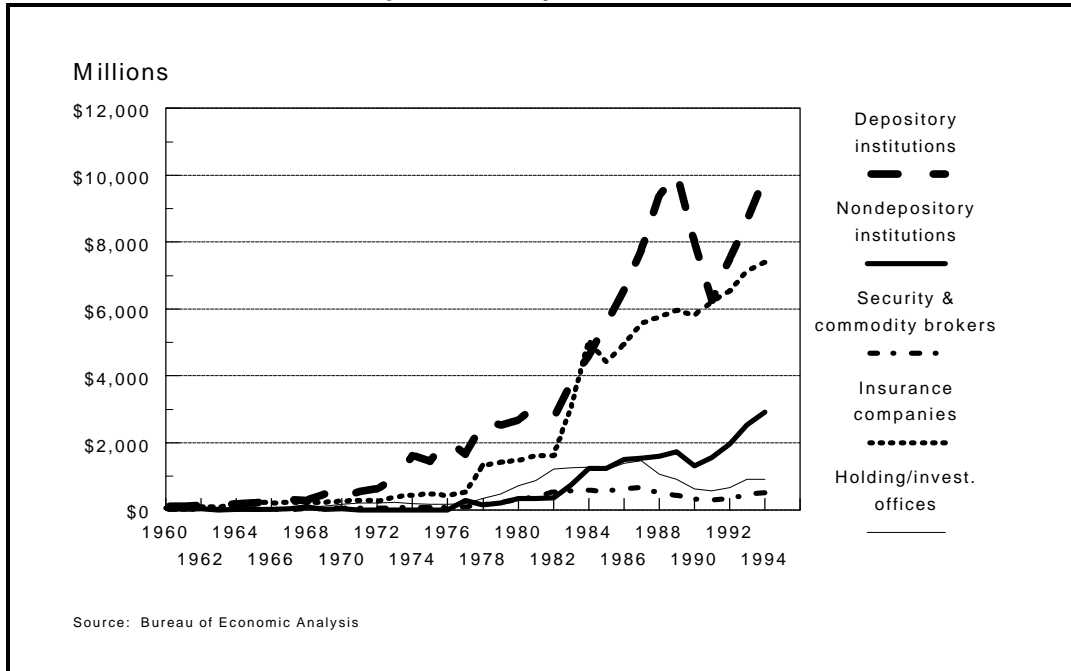
IT INVESTMENT TRENDS — BANKS AND NONBANKS

In 1994, commercial banks spent over \$10 billion on IT-related equipment, more than all other providers of financial services.³ (Figure 1 and Appendix Table 1) Insurance companies ranked next (\$7.3 billion), followed by nondepository institutions such as finance and mortgage companies (\$2.9 billion). Security and commodity brokers and holding and investment companies each invested less than \$1 billion.⁴ In 1994, banks led in IT per worker (\$4,816), followed closely by nondepository institutions which provide the most direct competition for banks (\$3,914), insurance companies (\$3,078), and security and commodity brokers (\$867).

³ Estimates of bank expenditures on IT equipment vary widely, in part because definitions of IT equipment vary. The Bureau of Economic Analysis produces an IT investment data series and defines IT equipment as office, accounting, and computing machinery, photographic-related equipment, communications equipment, and scientific instruments. However, the data are available only for depository institutions (banks, thrifts, and credit unions). According to Census estimates, historically, banks have accounted for 80 to 90 percent of equipment investment made by all depository institutions, so we can assume that the overall trend in IT investment by depository institutions is an accurate reflection of IT investment by banks. In this analysis, data are for depository institutions, and the word "banks" is a shorthand term that connotes such institutions.

⁴ Private estimates of bank investment in information processing equipment, which may be more comprehensive than government estimates, range from \$16 to \$20 billion for 1994 and from \$17 to \$49 billion for 1995. Private estimates of IT spending likely include expenditures for leased equipment. Data published by the Bureau of Economic Analysis may understate IT investment because some leased equipment is counted under the industry of the lessor, so if banks lease their IT equipment from someone other than a bank, the investment value is included in that industry rather than in the banking industry.

Figure 1
IT Investment Expenditures by Financial Service Industries



From 1960 to 1994, all financial service providers have seen double-digit average annual growth rates in IT investment, with banks increasing their investment at the highest rate (14.4 percent) followed by security and commodity brokers (14.0 percent). The rate of growth in IT investment by banks has slowed since 1980 to less than 10 percent annually. In contrast, the rates for nondepository institutions and insurance companies have increased by 17 and 12 percent, respectively. Not surprisingly, this period coincides with the sharp growth in nonbank-bank competition. The banking crisis and low rates of profitability during much of the 1980s may have prohibited banks from keeping pace with nonbank IT investment. The recession and requirements by regulators to hold higher loan loss reserves may explain the decline in IT investment by banks from 1989 to 1991.

IT Investment Patterns of Large and Small Banks

Whether large banks are investing in IT at higher rates than small banks has implications for future consolidation. Unfortunately, there are no IT investment data by bank size comparable to those at the aggregate level.⁵ However, by using the portions of noninterest expenses that

⁵ Steiner and Teixeira (1989) found that annual "systems expenditures" were dominated by a few large banks, and from 1980 to 1988 such expenditures by large banks were three times those of small banks. Systems expenses of large banks grew at over 20 percent per year over this period while small banks' systems spending grew at less than 7 percent per year.

include IT spending on equipment and services as a proxy for IT spending, we can see the disparity between spending patterns of large and small banks.⁶ IT-related noninterest spending (expenditures on fixed assets and other noninterest expenses) as a share of total assets for the 45 largest banks surpassed that of small banks in 1983 and the gap continued to widen until recently. (Figure 2) The decline in noninterest spending by large banks since 1993 reflects a slight decline in fixed asset spending, but to a greater extent reflects a decline in "other noninterest expenses" which includes taxes, costs associated with foreclosures, and outsourcing of data processing services. Noninterest spending by small banks remained relatively flat over the period. IT concentration levels, as measured by noninterest spending, are basically consistent with the levels of banking activity conducted by each group. The largest banks (the money center banks) account for a larger share of the banking market and also invest more heavily in IT. Small banks control less of the market and invest less heavily in IT. The IT investment proxy suggests that large banks accounted for one-fourth of all IT spending by banks in 1994, while private estimates (which define IT more narrowly than noninterest spending) are as high as 80 percent for the 35 largest banks.⁷

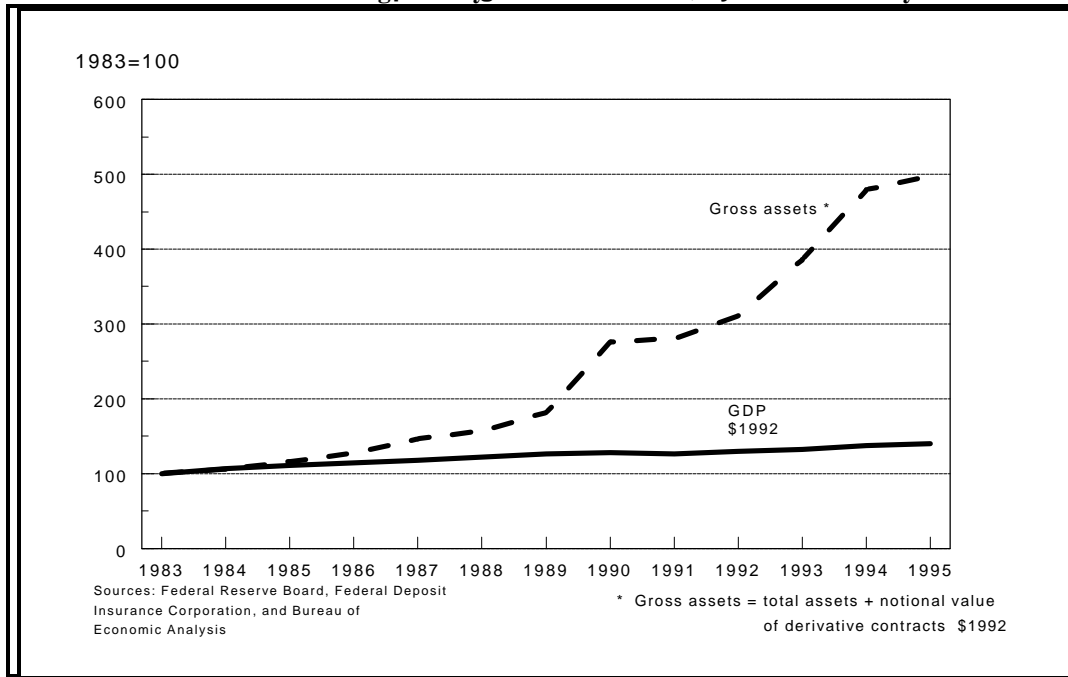
Concentration of IT investment among the largest banks may have important effects on industry structure and competitiveness. If IT-intensity makes large firms more competitive, they may ultimately acquire or merge with the smaller firms and create higher industry concentration. Also, large banks and small banks serve different markets. Large banks are involved more in international lending, derivatives, and lending to large corporations. Smaller banks extend proportionately more loans to small businesses, farmers, and individual consumers.⁸ It is conceivable that some of these markets could be left underserved if there

⁶ Bank size data are only available by three asset classes: banks with assets greater than \$100 billion, banks with assets greater than \$100 million and less than \$100 billion, and banks with assets under \$100 million. For this analysis, "large" banks have assets greater than \$100 billion and "small" banks have assets less than \$100 million. Although the data are available historically from 1979 to 1994, the sample size of each asset group changed over time and as a result, changes in noninterest expenses, profitability, productivity, etc., may not be solely the result of bank size, but may reflect changes caused by growth or decline in the number of banks in each asset size category.

⁷ Steiner and Teixeira, 22.

⁸ Allen N. Berger, Anil K. Kashyap, and Joseph Scalise, "The Transformation of the U.S. Banking Industry: What a Long, Strange Trip It's Been," *Brookings Papers on Economic Activity*: 2, 1995: 91. The authors estimate that over 80 percent of commercial and industrial loans granted by small banks go to firms with credit limits under \$1 million (and most less than \$250,000).

Figure 2
 Growth in Total Assets, by Bank Size



are fewer small banks. IT, however, could make it feasible and profitable for large banks to serve some of these markets.

The apparent result of the competition faced by banks has been a trend toward consolidation. Deregulation permitted much of the increased competition but IT made it practical to pursue and has made the consolidation process easier. Many banks are not financially equipped to make the types of IT investment (in equipment and training) necessary to remain competitive and see consolidation as the key to survival. Banks generally benefit from consolidation because they can reduce operating costs by not having to duplicate services, and the loss of bank business is usually small.

GROWTH IN FINANCIAL ACTIVITY

IT-led declines in the cost of processing and disseminating information are responsible for significant growth in financial activity relative to overall economic activity from 1983 to 1995. Total assets of commercial banks have grown slightly slower than GDP, but gross assets (a broader measure of financial activity that includes off-balance sheet derivatives) have grown at 14 percent per year since 1983 while GDP growth has been less than 3 percent per year. (Figure 3)

The volume of electronic fund transfers (EFT) is another indicator of how IT has contributed to the growth in financial activity. The Automated Clearinghouse (ACH) is an EFT system developed jointly by the Federal Reserve and the private sector as an alternative to check processing. Transactions are typically small and include routine payments such as direct payroll deposits and direct payments of mortgages. The number of ACH transactions funneled through the Federal Reserve has grown at 18 percent annually from 227 million in 1980 to over 2.7 billion in 1995. Growth in the value of ACH transactions is even more impressive. The value of such transactions was \$287 billion in 1980 and over \$9 trillion in 1995.

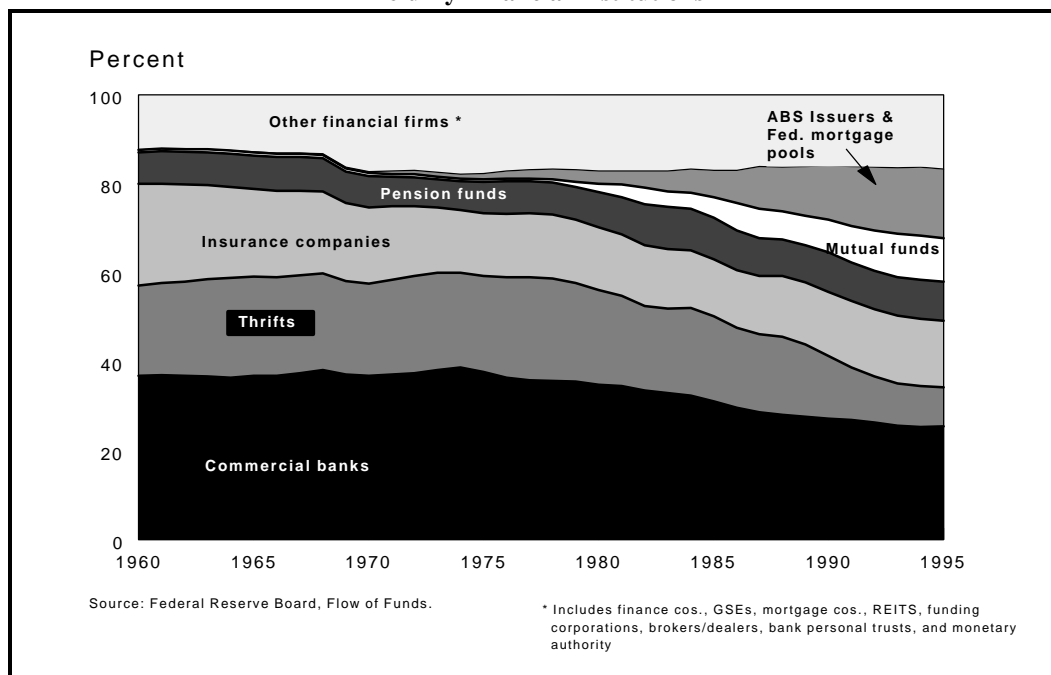
INCREASED COMPETITIVE PRESSURE

The banking industry historically had several advantages over other financial service industries that insulated it from outside competition. Most importantly, banks had a clear advantage in assessing credit risk since only they could support the high cost of collecting and managing information. But today, in large part because of the availability of IT, the cost of assessing credit risk has declined and now much of the same information that was available to banks only is also available to nonbanks. Banks have begun to lose their uniqueness as other financial intermediaries now offer similar services at competitive prices.

U.S. banks compete with a variety of domestic financial and nonfinancial institutions as well as foreign banks. Some bank competitors provide a variety of bank-like services while others specialize in only one product line. For example, credit unions offer checking accounts; thrifts and mortgage companies offer residential financing; pension funds and insurance companies offer long-term investment opportunities; large corporations issue commercial paper as an alternative to commercial and industrial loans; large retailers offer credit cards and in-house financing for consumer purchases; and quasi-financial institutions securitize debt or issue commercial paper. At the same time, IT is allowing nonbank subsidiaries of bank holding companies to compete with insurance companies and security brokers, but regulations prohibit open competition.

The proliferation of nonbank competition is evident in the decline in the banking industry's share of the \$18+ trillion U.S. financial credit market.⁹ (Figure 4) Banks are losing ground to a number of institutions including mutual funds, pension funds, ABS (asset-backed

Figure 4
Relative Shares of Financial Credit Market Debt
Held By Financial Institutions



⁹ Boyd and Gertler (1994) suggest that the decline in credit market share is not as great as it appears since off-balance sheet items and off-shore banking activities do not show up in flow of funds data.

security) issuers, and Federal mortgage pools.¹⁰ The share of financial credit market debt held by these bank competitors grew from 8 percent in 1960 to 34 percent in 1995. The fastest growth has occurred since 1980. The banking industry's share of financial credit market debt declined from 37 percent in 1960 to 26 percent in 1995. Thrifts, insurance companies, and finance companies account for much of the remaining 40 percent of financial credit market debt. The loss of credit market share is even more pronounced for thrifts as their share declined from 20 percent to 9 percent over the same period.

IT has also allowed greater competition from foreign banks, as sophisticated networks facilitate global transactions. Foreign banks have been successful in capturing a substantial portion of the U.S. commercial and industrial loan market. Between 1983 and 1993, foreign banks increased their share of this market from 19 to 47 percent.¹¹

Banks are also finding themselves competing directly with their customers as IT-led declines in information and transactions costs have reduced the need for financial intermediation. Many functions that nonfinancial corporations once relied on banks to perform are now handled directly in the markets. IT now enables large companies (some of which have higher credit ratings than banks) to borrow directly from the public by issuing commercial paper. In addition, as financial services move toward "direct access," banks will face competition from technology vendors themselves. For example, Microsoft expects to offer on-line financial services to the more than 20 million households that own personal computers with modems.

CHANGES IN ASSET AND LIABILITY COMPOSITION

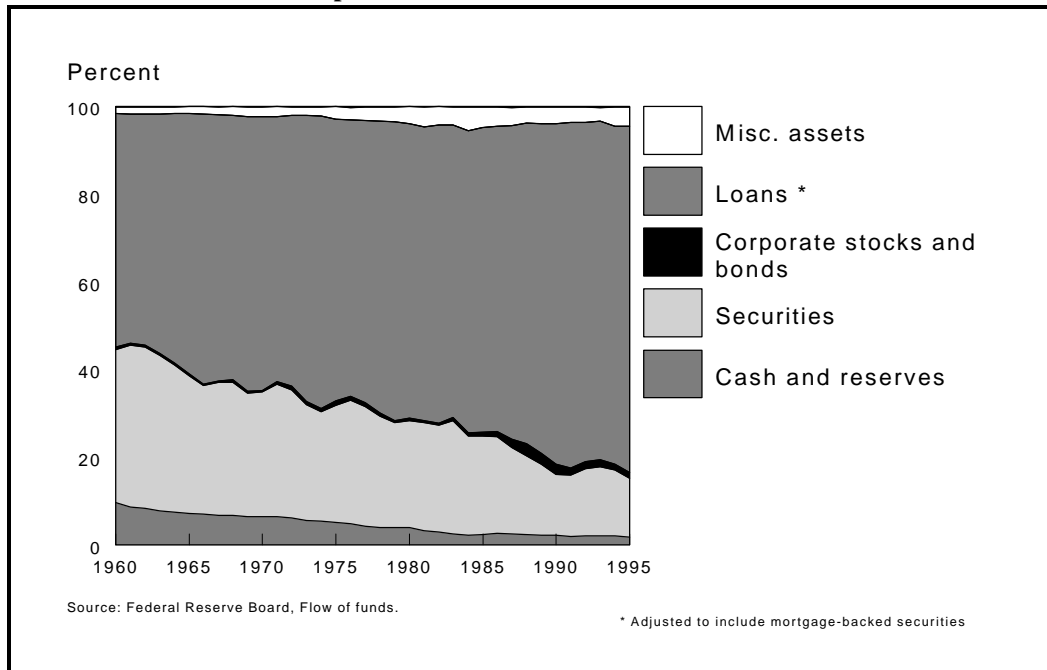
By examining how the composition of financial assets and liabilities of commercial banks has changed over time, we can see how and when industry structure and the role of banks changed.¹² Historically, loans have constituted the majority of bank assets, increasing from about one-half of these assets (\$116 billion of \$217 billion) in 1960 to four-fifths (\$2,564 billion of \$3,244 billion) in 1995. (Figure 5) Bank holdings of government securities, which are primarily short-term assets with low returns, have declined steadily over the past 30 years (from 35 percent in 1960 to 13 percent in 1995). This decline could reflect investment in

¹⁰ ABS issuers and Federally-related mortgage pools are not a group of institutions, but rather a set of legal arrangements. ABS issuers represent claims against loan assets that have been pooled as collateral for issues of securities. Federally-related mortgage pools consist of pools of assets, which are mortgages held by Ginnie Mae, Fannie Mae, Freddie Mac, and Farmer Mac, and liabilities which are securities issued against the packages of mortgages as collateral.

¹¹ Charles Colomiris and Mark Carey, "Loan Market Competition Between Foreign and U.S. Banks: Some Facts About Loans and Borrowers," in *The Declining Role of Banking*, Federal Reserve Bank of Chicago, May 1994: 332.

¹² Throughout this section, the term "assets" refers to financial assets and does not include premises and equipment.

Figure 5
Asset Composition of U.S.-Chartered Commercial Banks



government securities through other means, for example, money market funds.

Analysis of the composition of bank lending over time reveals that bank loans n.e.c., which are primarily loans to businesses, have declined from one-half (\$56 billion of \$116 billion) to one-fourth (\$673 billion of \$2,564 billion) of total loans. (Figure 6) Several factors underlie the decline in commercial bank lending to businesses. IT now allows large companies to raise their own financing by issuing and trading commercial paper. IT also allows nonbanks to offer competitive alternative financing and foreign banks to compete for U.S. commercial and industrial loans. This is also evident in the change in the composition of liabilities of nonfinancial corporate organizations. (Figure 7) Businesses are holding less than half the proportion of the mortgages and bank loans they held in 1960, while commercial paper is on the rise. Businesses have also increased their borrowing from abroad, from about 2 percent to 10 percent of total liabilities from 1960 to 1995.

Figure 6
Loan Composition of U.S.-Chartered Commercial Banks

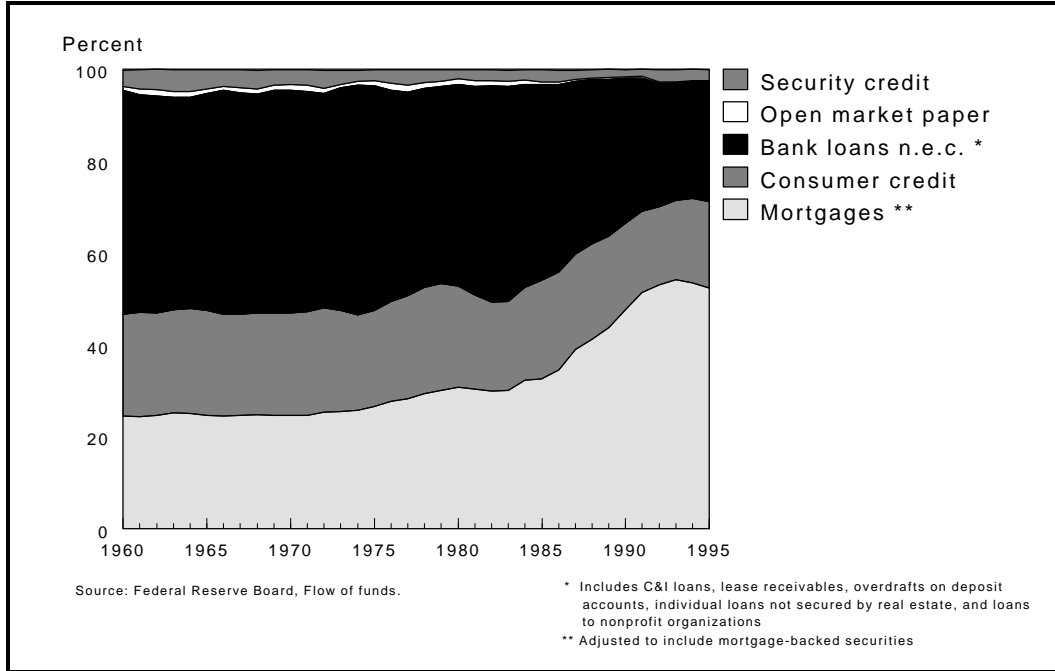
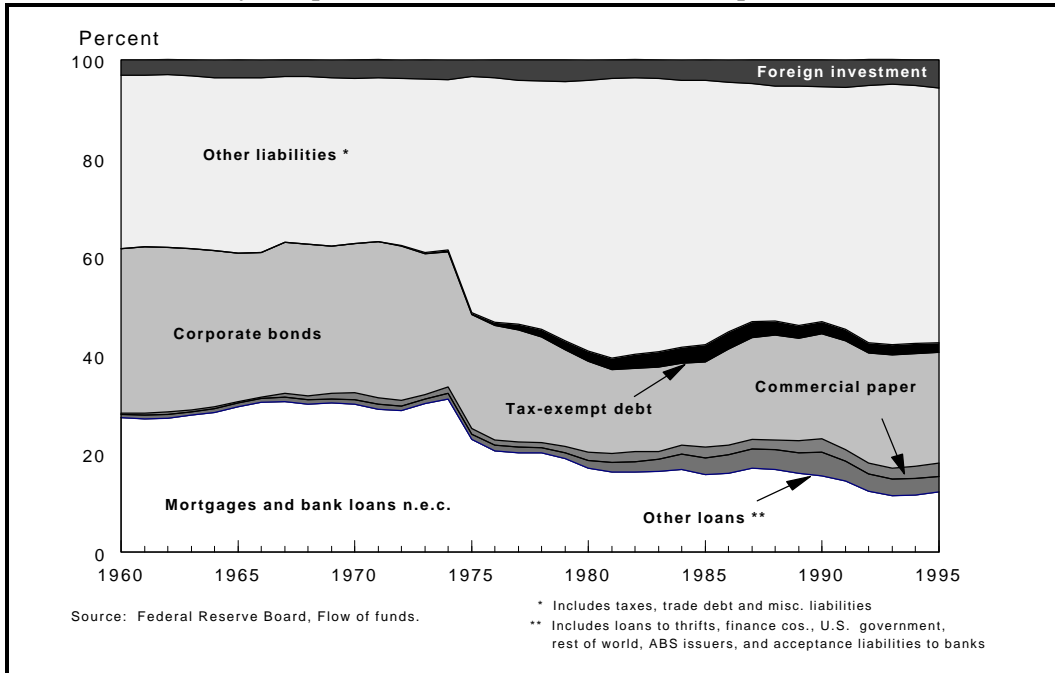
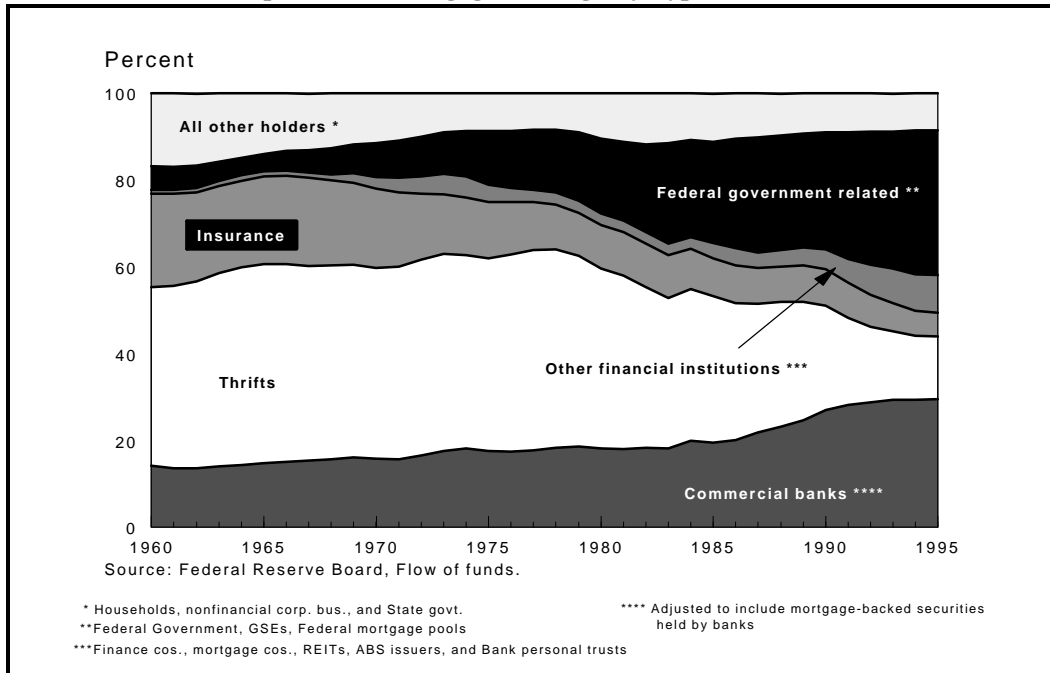


Figure 7
Liability Composition of Nonfarm Nonfinancial Corporate Business



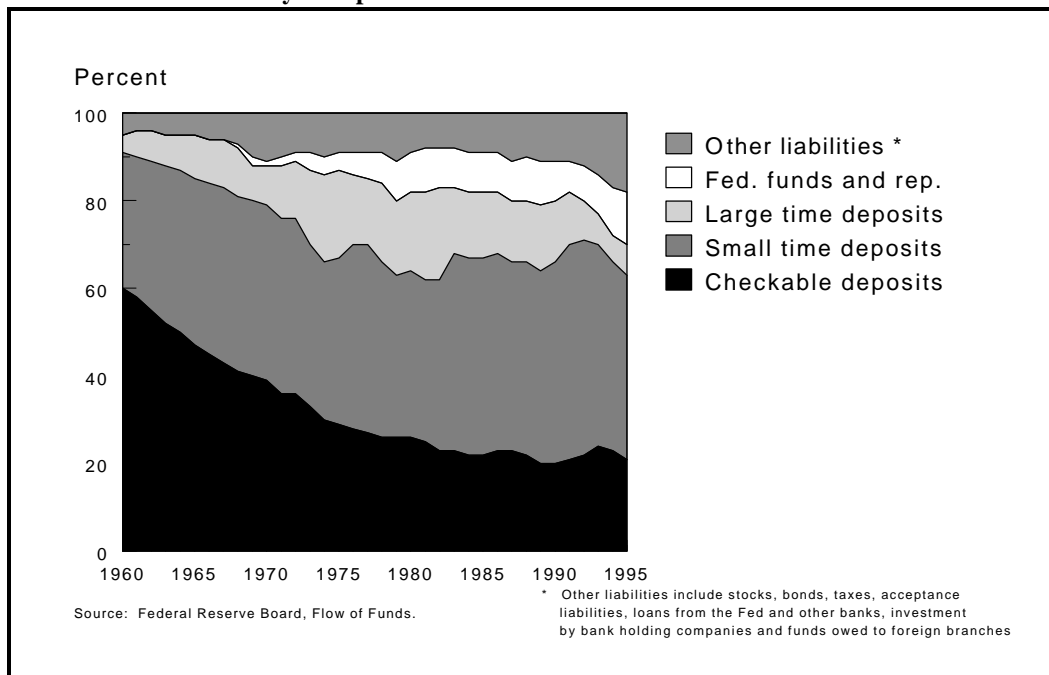
U.S. banks have countered the decline in loans to businesses by increasing their mortgage lending. They held more than \$1.3 trillion in mortgages and mortgage-backed securities in 1995, up from just \$28 billion in 1960. Much of the growth in mortgages has come from the decline of the savings and loan industry and the ability of banks to issue mortgage-backed securities. (Figure 8) Thrifts held over 40 percent of all mortgages in 1960, but now hold only 14 percent, while the share held by banks has grown from 14 to almost 30 percent. Banks have also tried to compensate for declining business loans by remaining competitive in the lucrative market for consumer loans (including credit cards). However, IT-led competition from nonbanks has eaten away at this segment of the market, especially since 1985. Banks' share of revolving credit has declined from 62 percent (\$131 billion of \$210 billion) in 1989 to 48 percent in 1995 (\$210 billion of \$436 billion).

Figure 8
Composition of Mortgage Holdings, by Type of Institution



As the cost of information has declined, many individuals and businesses have become more informed investors and increasingly shop around for the best yields. As a result, bank deposits have declined from almost 95 percent of total liabilities in 1960 to less than 70 percent in 1995. (Figure 9) The biggest decline has been in checkable deposits which fell from 60 percent of total liabilities in 1960 to 20 percent in 1995. Many consumers choose to hold funds in interest earning savings or money market accounts and electronically transfer funds to their checking accounts as needed. Households and businesses now invest more in mutual funds and the stock market and as the population ages, more funds will flow into long-

Figure 9
Liability Composition of U.S.-Chartered Commercial Banks



term investments such as pension funds and retirement funds. When banks are unable to satisfy loan demand with in-house deposits, they resort to higher cost funds, such as borrowing in wholesale markets or liquidating securities portfolios.

CONCENTRATION IN THE BANKING SECTOR

The past 15 years have witnessed major changes in the structure of the banking industry, including increased concentration. Some consolidation has been in response to increased competitive pressure from nonbanks, but to a larger extent consolidation has come from the gradual relaxation of interstate banking restrictions (which is discussed in detail in Part II). The number of banks in existence declined by almost one-third, from 14,404 in 1980 to 9,941 by the end of 1995. The industry has also experienced record bank failures and rapid merger growth. In 1995, 608 banks either merged or were acquired--the largest number since 1988 (a record year with 221 bank failures). The size of the industry, however, as measured by assets and deposits, has more than doubled to \$4.3 trillion and \$3 trillion, respectively.

The U.S. banking industry is dominated by very large banks that compete globally; it also remains highly fragmented with a large number of small banks that compete primarily in local and regional markets. This structure is largely a function of the U.S. regulatory environment. Other countries with less regulated banking industries, like Canada and Germany, have fewer

banks and less disparity in bank size. Concentration has been increasing in the U.S. banking industry. In 1995, the top four banks held almost 20 percent of the banking industry's deposits and 23 percent of total assets, compared with 16 percent of deposits and 17 percent of total assets in 1991. In 1994, there were 45 banks with assets over \$100 billion but in 1979 there were only four such banks. The number of small banks, with assets less than \$100 million, continues to decline -- from 10,050 in 1979 to just 5,893 in 1994. Concentration also varies at the state level and even within specific parts of states. For example, in 1995, the three-firm concentration ratio (assets) for banks in Arkansas was only 15 percent while that of Rhode Island was 95 percent.

Theoretically, greater concentration implies greater market power and less competition, which could result in higher prices to customers. However, most individual lines of business remain competitive because of competition from nonbanks. Also, many large and small banks do not compete in the same markets. The largest banks compete globally and provide services to large corporations, while smaller banks are more involved with lending to individuals and small businesses. Small banks that have targeted lending to local markets have survived despite growing industry concentration. So increased concentration among banks should help them compete with highly efficient, aggressive nonbanks and customers should benefit from the competition.

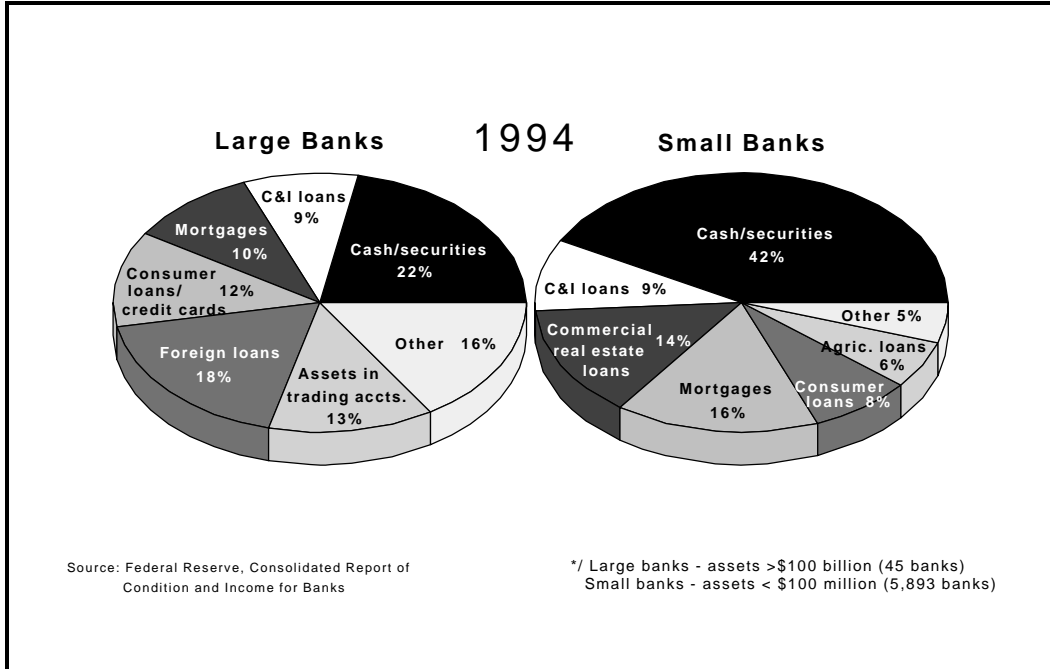
Changes in Asset and Liability Composition of Large and Small Banks

The composition of assets and liabilities of large banks and small banks is generally quite different. In 1994, the 45 largest banks held the majority of their assets in commercial and industrial loans, mortgages, consumer loans and credit cards, foreign loans, and trading accounts.¹³ (Appendix Table 2) The smallest banks (5,893) held more cash and securities, commercial real estate loans, and agricultural loans as well as mortgages, consumer loans, and commercial and industrial loans. (Figure 10) Large banks may appear to be more diversified than small banks, but many of their assets carry higher risk.

On the liability side, nonbank competition has affected large banks more than small banks, as reflected by the decline in deposit share of large banks. Small banks rely more on deposits as funding sources than large banks and continued nonbank competition could eventually erode their deposit base. Foreign deposits are more important to large banks but this importance has declined over time.

¹³ The apparent growth in assets in trading accounts and other liabilities for large banks reflect an accounting change that required banks to report profitable (assets) and unprofitable (liabilities) derivative positions separately.

Figure 10
Asset Composition of Large and Small Banks



PART II

IT-RELATED INNOVATIONS AND INDUSTRY STRUCTURE

In order to remain competitive in a deregulated environment, banks have sought new lines of business and new sources of income. Part II discusses how IT-related innovations such as asset securitization and derivatives trading have changed the business of banking over the past 15 years and how IT and interstate banking deregulation will further influence industry consolidation in the future.

ASSET SECURITIZATION

Asset securitization is one of the most important developments in banking's history. The broad definition of securitization includes the pooling of assets (mortgages, consumer credit, and other loans) for sale in the form of securities; the sale of standardized portions of very large loans (loan participations); and the direct issuance of debt (commercial paper). Although securitization was motivated by deregulation, it was only made possible by a series of IT-related financial operating innovations, e.g., improved payments tracking. Over time, asset securitization has allowed banks to restructure their assets and improve liquidity and profitability.

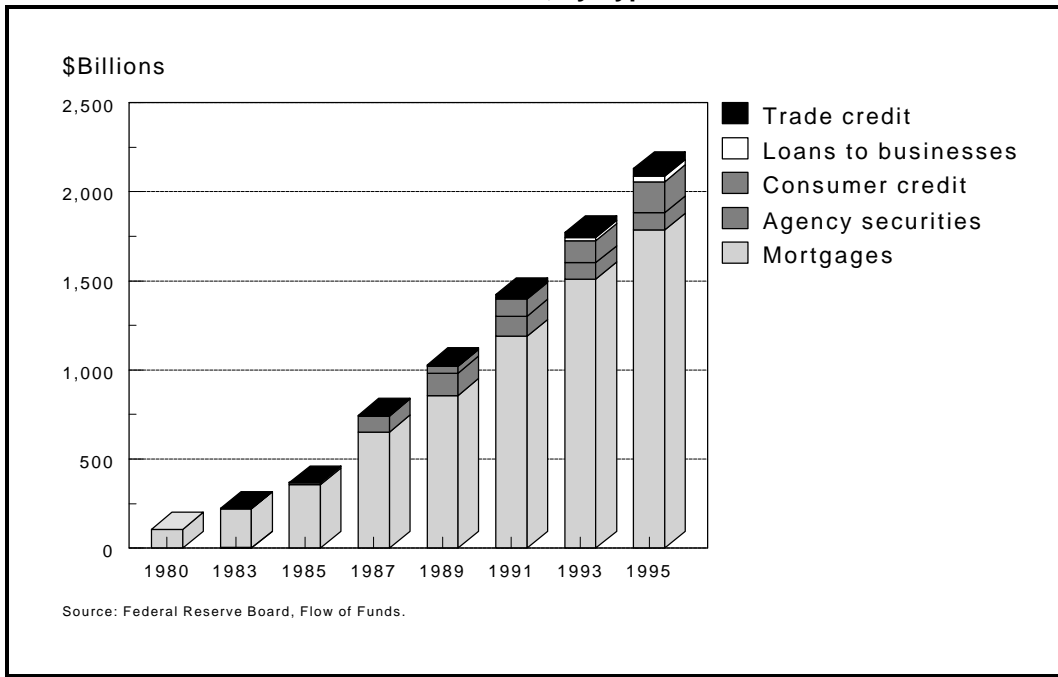
Efforts to create a secondary market for mortgages (to help relieve thrifts of the burden of funding long-term mortgages with short-term deposits) date back to the 1930s. However, it was only in the 1970s and 1980s that the popularity of mortgage-backed securities began to accelerate. Deregulation allowed banks and thrifts to pay competitive rates on deposits, but the thrifts remained saddled with long-term, illiquid, low interest earning assets (mainly mortgages). Advances in finance theory suggested that the separation of the functions associated with mortgage lending, such as origination, servicing, credit enhancement, placement, etc. would be a more efficient and profitable way of conducting mortgage lending. IT allowed the theory to be applied in practice. IT-related equipment and software have facilitated the tracking of millions of payment streams and security holdings and has forced standardization of the process. Mortgage securitization allowed banks to earn fee income by originating mortgages and then packaging and selling them to those more suited for holding long-term assets, such as institutional investors. Some banks have opted to earn fee income

by maintaining the servicing function. This form of securitization enables banks to specialize in loan origination, a task for which they were traditionally well-suited because of their information advantage. Nonbanks, however, now also have access to much of the same credit information as banks and are providing serious competition in the market for securitized assets.

Growth in the Market for Securitized Assets

Securitization began with the issuance of mortgage-backed securities, and then spread to other types of assets including consumer loans, credit card debt, and some commercial and industrial loans. The share of mortgages that has been securitized has grown steadily over the past 25 years, from less than 1 percent of total mortgages to almost 40 percent (\$1.8 trillion) in 1995. Banks held about one-fifth of their mortgages in the form of mortgage-backed securities in 1995 (\$295 billion). Total asset securitization, including mortgages, consumer debt, loans to businesses, agency securities, and trade credit was well over \$2 trillion in 1995. (Figure 11) Most securitized assets are still in the form of mortgages (over 80 percent in 1995), but the amount of securitized consumer debt and loans to businesses has grown substantially since 1989.

Figure 11
Asset Securitization, by Type of Asset

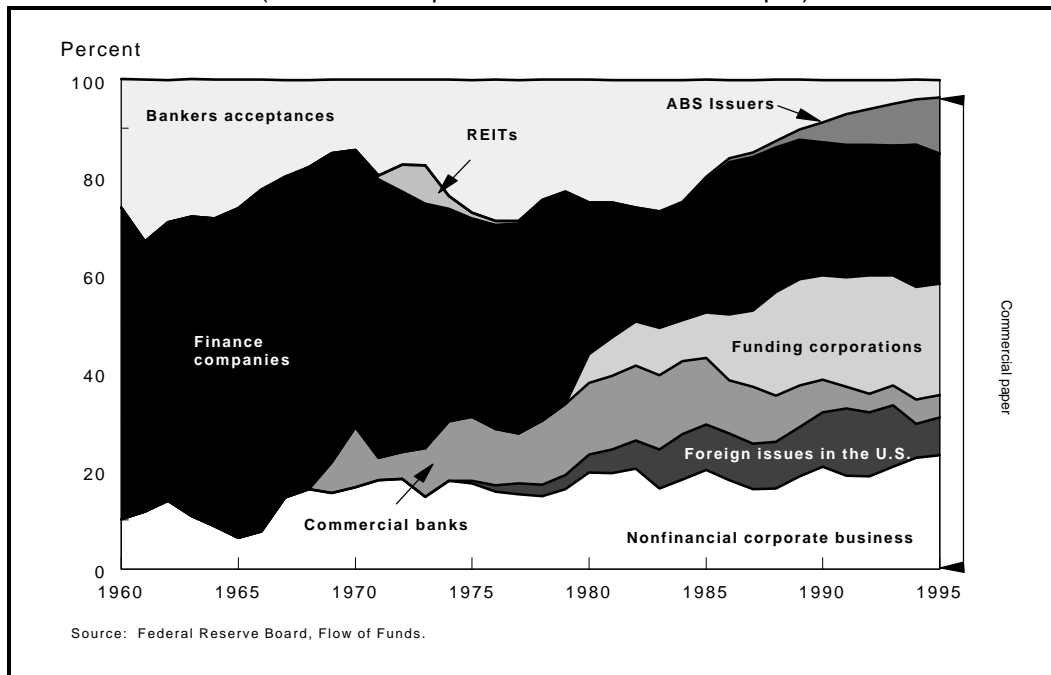


Several factors in addition to IT were behind the growth in securitization in the 1980s. Banks

needed a way to quickly liquidate assets to comply with capital requirements. Interest rate volatility often made assets with fixed rates of return unprofitable. Also, competition between banks and nonbanks spurred innovation.

IT has also facilitated the growth of direct issuance of debt, which is a form of securitization. The commercial paper market reached \$656 billion in 1995, up from just \$121 billion in 1980 and is now an important short-term source of funds for corporations. Large companies are now able to issue commercial paper directly because IT, by increasing access to information and lowering its cost, provides investors with better information about the quality of potential investments. This trend is apparent in the change in the composition of issuers of open market paper. (Figure 12) Bankers acceptances declined drastically (from 26 percent to 4 percent) while the business sector's share grew from 10 percent to 23 percent from 1960 to 1995.¹⁴ The growth in the relative shares of commercial paper issued by funding corporations

Figure 12
Open Market Paper Outstanding
 (Bankers Acceptances and Commercial Paper)



¹⁴ Open market paper consists of bankers acceptances and commercial paper. Both are short-term, high grade, highly liquid sources of funding for businesses. Because of the similarities, the decline in bankers acceptances likely reflects the direct substitution of commercial paper for acceptances as more companies became capable of issuing their own commercial paper.

is another indicator of how IT and securitization have created entirely new financial firms.¹⁵

Rapid growth in commercial paper issuance during the 1980s also reflects factors other than IT, for example, the increase in demand for short-term financing as a result of a growing economy, the merger and leveraged-buyout activity of the latter 1980s, and the growth in derivatives.¹⁶

Although IT has reduced the importance of commercial and industrial (C&I) lending for banks, the commercial paper market could not operate without banks providing 'liquidity' and 'credit' enhancements.¹⁷ Liquidity enhancements or backup lines of credit provide the interim funding that firms need to continuously issue new paper and pay off maturing paper. Credit agencies require backup lines of credit before issuing a rating for a commercial paper issue. Credit enhancements or standby letters of credit guarantee the commercial paper issued. Banks earn fee income from these services that offsets some of the loss in interest income from C&I loans. Thus IT has not only triggered growth in the market for commercial paper to the relative disadvantage to some banks, but it has also provided for a profitable reallocation of bank services.

The Impact of Securitization on the Banking Industry

Asset securitization generates important benefits for the banking industry, including reduced liquidity risk, reduced capital requirements, increased efficiency, and lower information costs.¹⁸ These benefits, however, may be short-lived. Nonbanks are now able to securitize assets and whether banks will continue to benefit from this financial innovation depends upon whether they can compete as efficiently as nonbanks.

Regulators are concerned that banks are securitizing lower risk assets, such as mortgages and consumer loans while holding higher risk assets (for example, C&I loans) in their portfolios. Mortgages and consumer loans that are securitized offer less risk than C&I loans because the underlying pools contain a larger and more diverse group of loans. C&I securitization has been slow to evolve because loan buyers still lack access to sufficient information to identify

¹⁵ Funding corporations are usually subsidiaries of parent companies that are set up specifically to raise funds (usually by issuing commercial paper).

¹⁶ Mitchell Post, "The Evolution of the U.S. Commercial Paper Market Since 1980," *Federal Reserve Bulletin*, December 1992: 880.

¹⁷ Mark D. Vaughan, "Thriving in the Information Age--Bullish on Banking," *Federal Reserve Bank of St. Louis Economic Review*, January 1996: 8.

¹⁸ Tamar Frankel, "Securitization: Its Effect on Bank Structure," in *Structural Changes in Banking*, edited by Michael Klausner and Lawrence J. White, 1993: 320.

creditworthy loans. The true benefits of securitization will not be evident until the process for securitizing C&I loans becomes more standardized.¹⁹

As additional types of loans are securitized and traded and as more nonbanks enter the market, banks will have to compete for this business or lose market share. Thus, securitization could contribute to further consolidation of the banking industry.

DERIVATIVES

Derivatives are contracts whose value derives from the value of one or more other underlying assets (stocks, securities, commodities), reference rates (T-bill rates), or stock indexes (S&P 500). (See box on page 24 for definitions of derivatives terminology used in this section.) Prior to the widespread introduction of IT, derivatives contracts were not practical because of the complicated relationships, calculations, and timing required for their valuation and trading. Largely because of their complicated nature and losses incurred by inexperienced participants, they have also been controversial.

Participants usually trade in derivatives because transactions costs are lower than trading directly in a cash market. For example, by purchasing a single futures contract based on the S&P 500 index, a participant can earn the same return for 5 to 10 percent of the cost of purchasing the underlying stocks separately and paying brokerage fees on each purchase. Instead of delivering a portfolio of stocks on a specified delivery date, the participants make a cash settlement. The buyer pays the seller the loss in the value of the index and the seller pays the buyer the gain in the value of the index based on the direction of change in the index between the time the contract was signed and the delivery date.

Banks use derivatives as risk management tools to protect against changes in interest rates, exchange rates, and other price movements. In doing so, banks can act as hedgers, brokers/traders, or investors.²⁰ As a hedger, banks use derivatives to transfer risk that could affect the value of their assets and liabilities (exchange rate risk, interest rate risk, and changes in commodity prices) to other firms. Acting as a broker/trader, banks earn fee income by providing risk-management services to others. As an investor, the bank itself can speculate as to the movement of interest rates or exchange rates for a profit.

¹⁹ Sanford Rose, "The Bittersweet Future of Loan Securitization," *Journal of Retail Banking*, Vol. XV, No. 1, Spring 1993: 30.

²⁰ Joseph F. Sinkey, Jr. and David Carter. "The Derivatives Activities of U.S. Commercial Banks," in *The Declining Role of Banks*, Federal Reserve Bank of Chicago, May 1994: 165.

DERIVATIVES TERMINOLOGY

Derivatives: contracts whose value derives from the value of one or more other underlying assets (stocks, securities, commodities), reference rates (T-bill rates), or stock indexes (S&P 500).

TYPES OF DERIVATIVES:

Options contract: gives the buyer the right, but not the obligation, to buy or sell a specified underlying item at an agreed upon price and time. (There are several types of options.)

Forward contract: commits a buyer and seller to trade a given quantity of an asset on a specific future date for a stated price. Most forward contracts are customized and pre-negotiated.

Types of Forward Contracts:

Futures: standardized forward agreements that are traded on organized exchanges. Futures are available for agricultural and other commodities, bonds, equity interests, and foreign exchange.

Swaps: privately pre-negotiated forward agreements between two parties (or counterparties) to exchange a series of payments without exchanging the underlying debt. Swaps can include the exchange of interest payments, foreign currency transactions, and payments on specific commodities.

MARKETS FOR DERIVATIVES TRADING:

Over-the-counter (OTC): Forwards, options, and swaps are traded in the OTC market, by large international commercial and investment banks. There is no guarantee that contractual obligations will be fulfilled.

Organized exchanges: Futures and some options are traded on major exchanges (Chicago Mercantile Exchange or the New York Stock Exchange) according to established rules. Traders operate through clearing houses that guarantee the performance of exchange-traded derivatives.

MEASURES OF DERIVATIVES ACTIVITY:

Notional value: the face or principal value upon which the performance of a derivatives contract is based.

Credit exposure value: the amount actually lost if a counterparty defaults; usually only a fraction of the notional value.

The ability to constantly monitor, evaluate, and trade risk would not be possible without globally compatible computer and telecommunication networks and access to information made possible by advances in information technology. Risk management software is designed

to automatically adjust for transacting across time zones, currencies, and regulatory environments. Banks now have better information for monitoring counterparties and can quickly access historical data needed to predict volatility in various financial markets. Recent advances in decision-support software give managers and analysts information to help them quickly and independently make decisions, rather than having to request and wait for IT-support personnel to compile and distribute information. This also provides for better internal monitoring of decisions that could affect a bank's risk exposure.

Growth in the Market for Derivatives

Since heavy commercial bank involvement in derivatives started only recently, few historical data are available, especially in terms of earnings and losses. The Federal Reserve only recently revised their surveys to require separate reporting of income from derivatives. There are data, however, on the notional value of U.S. bank involvement in derivatives. Notional values are useful in examining trends, but do not necessarily reflect the amount of loss if a contract is breached. For example, in the earlier example, the notional value of the stock index derivative would be the full market value of the underlying shares at the time the contract was originated, not the value of the funds at risk. The notional value of derivative contracts approached \$17 trillion in the fourth quarter of 1995 and has grown at an average annual rate of over 30 percent since 1983 (when such contracts totalled \$535 billion). (Figure 13) Most derivative contracts are in the form of interest rate swaps (almost \$11 trillion of the \$17 trillion outstanding) while foreign exchange derivatives account for much of the remaining \$6 trillion. (Figure 14) The rapid growth in the derivatives market can be traced to both supply and demand factors. On the supply side, IT advances and financial innovations have made possible a variety of new and complex derivatives contracts, and on the demand side there is growing interest in protection from volatility in interest rates, exchange rates, and prices.

Despite rapid growth in the notional value of derivatives, the level of credit exposure remains small. Credit exposure of the nine largest banks, which held 94 percent of all derivatives contracts in 1995, was 1.4 percent of the notional value. Because the level of credit exposure remains small, proponents of derivatives argue that the financial system is not open to as much risk as appears.

U.S. banks earned over \$6.5 billion in profits from derivatives trading (\$3.3 billion from interest rate contracts, \$2.4 billion from foreign exchange contracts, and \$800 million from all other contracts) in 1995, the first year for which earnings from derivatives were collected.

Figure 13
Notional Value of Derivatives Contracts

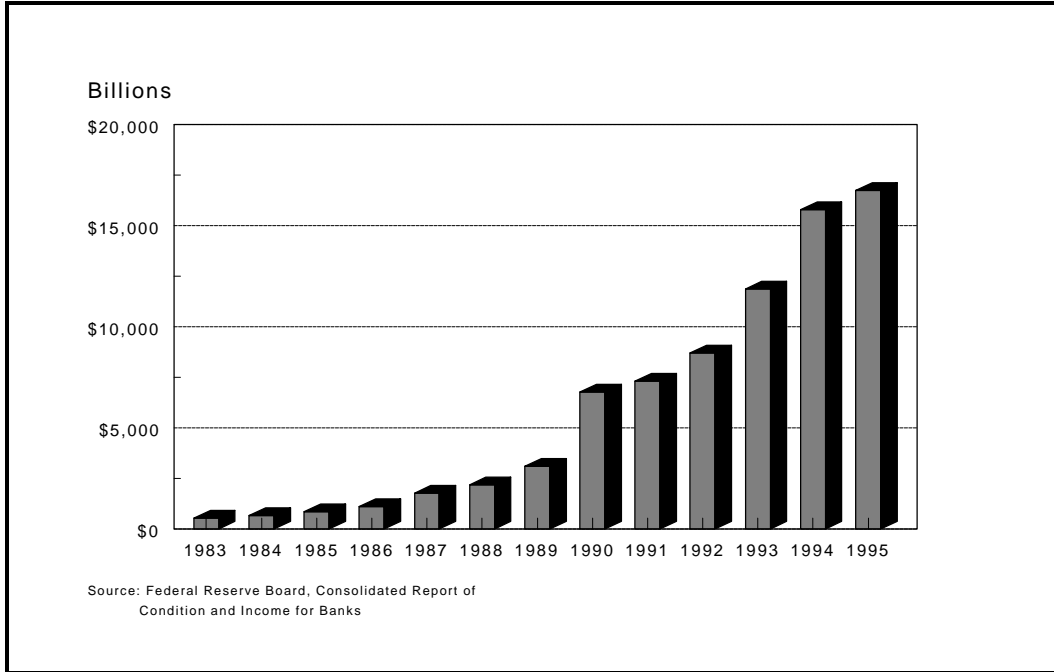
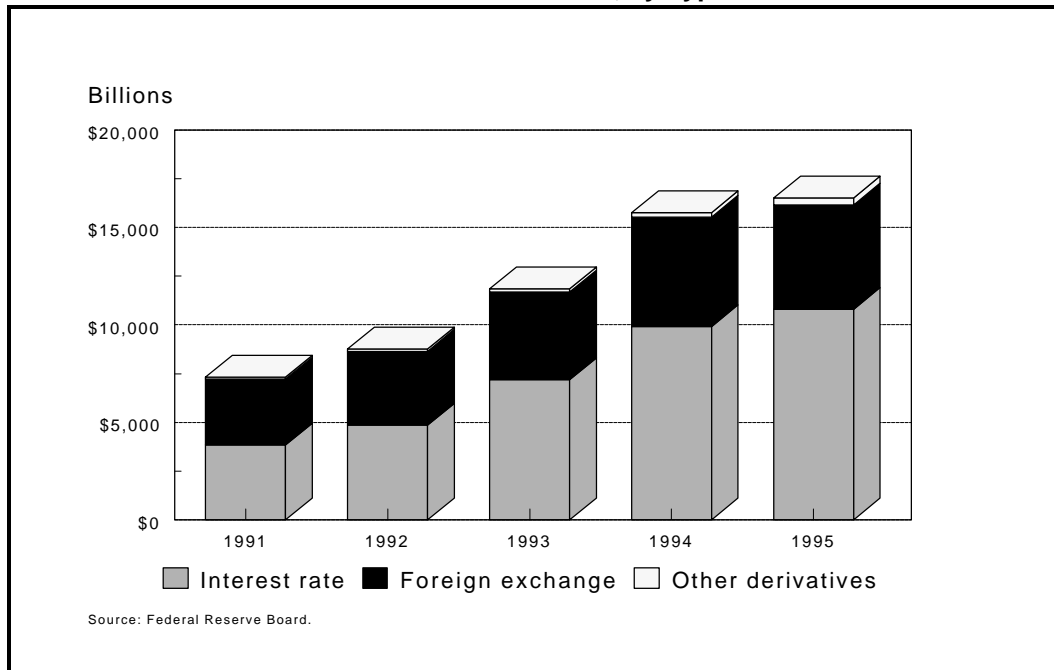


Figure 14
Derivatives Contracts, by Type



Other noninterest income used as a proxy for U.S. banks' derivatives earnings, gives a historical sense of earnings from derivatives. Other noninterest income, which includes derivatives income, increased as a share of total income from about 6 percent in 1979 to 17 percent in 1995. Most of the increase is probably attributable to derivatives.

The Impact of Derivatives on the Banking Industry

A major benefit of bank involvement in derivatives is the much needed infusion of fee income which has come at a time when banks are losing traditional interest income. In addition, banks use derivatives to reduce their costs of funds by capitalizing on differences in interest rates across countries and across maturities.

Critics have pointed out several potential problems that could result from rapid, unmonitored growth in derivatives.²¹ The prospect of large profits could induce excess capacity and reduce profits. A constantly changing industry could increase this risk if investors rely on statistical models based on past performance. Also, operating in the derivatives market allows for greater leverage, leaving marginal borrowers in the market longer than they otherwise would be.

While banks that trade in derivatives encounter several types of risk, some observers argue that these risks are no different from the risks incurred in trading other types of financial contracts, for example, junk bonds.²² The intertemporal nature of financial market transactions involves uncertainty and risk is inherent. (See box on page 28 for a discussion of types of risk.) Credit risk, the risk associated with counterparty default, is a special concern in the over-the-counter (OTC) market because there is no guarantee that the contractual obligations will be honored. However, the level of credit exposure of most derivatives contracts remains relatively small. Regulators are more concerned about systemic risk, especially since financial markets have become global and interconnected.

Several studies have assessed the riskiness of derivatives and the conclusions vary widely. A joint study by the Treasury, Federal Reserve, and FDIC concluded that "trading in derivatives has not contributed to the overall fragility of the financial system and does not pose undue risks to market participants."²³ A comprehensive study conducted by the Group

²¹ Henry Kaufman, "Structural Changes in Financial Markets: Economic and Policy Significance," *Federal Reserve Bank of Kansas City Economic Review*, Second Quarter 1995: 9.

²² Gerald Edwards, Jr. and Gregory E. Eller, "Derivatives Disclosures by Major U.S. Banks, 1995," *Federal Reserve Bulletin*, September 1996: 791.

²³ Robert F. Graboyes, "Derivatives Made E-Z," *Cross Sections*, Fall 1994: 12. Graboyes summarizes the findings of the 1993 report *Derivative Product Activities of Commercial Banks, Joint Study Conducted in Response to Questions Posed by Senator Riegle on Derivative Products*.

Risks Associated With Derivatives

Market risk:	risk that a price movement can expose a derivative counterparty to financial losses. (Price behavior of a derivative is the same as the underlying asset.)
Credit risk:	risk of loss associated with counterparty default.
Liquidity risk:	risk that occurs when financial instruments cannot be sold without high costs or a large transaction can cause noticeable changes in prices.
Operating risk:	risk of failed internal controls or human error.
Legal risk:	risk that contracts cannot be enforced because of differing legal systems across countries, legal difficulties of the counterparties, lack of authority, etc.
Systemic risk:	risk that a disruption in one market will create a chain reaction in other markets.

of Thirty (an international policy organization) provided several recommendations for individual banks as well as for Central banks for developing and monitoring an effective risk management system. They even developed a benchmark against which to measure the risk management performance of OTC dealers.²⁴

In 1994, in response to several widely publicized bankruptcies linked to derivatives, Congress requested that the General Accounting Office conduct a comprehensive analysis of soundness of the financial derivatives market. The GAO's report offered guidelines to regulators, banks, and international lending authorities on how to avoid potential problems. GAO was particularly concerned about the OTC market. They noted there were no clear guidelines for trading in the OTC market and without explicit guidelines in place, new, less experienced entrants could take unwarranted risks. Other issues raised include the lack of consistent accounting guidelines for reporting derivatives involvement and the fact that banks, insurance companies, and securities firms are subject to differing regulations on derivatives activity because they are regulated by different agencies. Finally, since a significant number of foreign firms deal in derivatives, the GAO recommended developing a harmonized system of reporting and monitoring guidelines across countries.²⁵

GAO, in its follow up report in 1996, found that some of their recommendations had been addressed, but that many concerns from their original report remain. Specifically, the Federal

²⁴ Thomas F. Siems, "Financial Derivatives: Are New Regulations Warranted?" *Federal Reserve Bank of Dallas, Financial Industry Studies*, August 1994: 11. Siems summarizes the findings published in *Derivatives: Practices and Principles* by the Group of Thirty in 1993.

²⁵ U.S. General Accounting Office, *Financial Derivatives--Actions Needed to Protect the Financial System*, May 1994: 15.

Reserve has revised risk-based capital requirements to account for derivatives and changed derivatives disclosure requirements to separate OTC from exchange-traded activity. Progress has been made in global regulatory coordination and harmonization as well. The GAO still has concerns about uniformity of accounting standards and say that internal monitoring needs to be improved. Compliance to risk management guidelines are voluntary for unregulated participants and derivatives activity conducted by many security brokers and insurance companies still are subject to only limited regulation.²⁶

The job of regulators is becoming increasingly difficult as they try to keep pace with technological changes and complex financial innovations, such as derivatives. With any innovation, there is a time lag during which no information is available for monitoring or determining potential impacts. Federal Reserve Chairman Greenspan recently stated that, because of this time lag, regulators may have exaggerated the potential for increased risk associated with information technologies. He warned, however, that while we see the benefits of new technologies and products such as derivatives, knowledge of statistical modeling techniques is not a substitute for sound knowledge of financial market operations and the customers being served.²⁷

In summary, regulators now have taken a proactive stance in measuring and monitoring derivatives trading by banks and are assessing the risks posed by nonbanks (which are not subject to Fed oversight).

INTERSTATE BANKING

Interstate banking is another area through which IT is changing the structure of the commercial banking industry. The industry has long argued for the liberalization of regulations that prohibit expansion across geographical boundaries. Until the passage of the Interstate Banking and Efficiency Act of 1994, however, the ability of commercial banks to diversify geographically was contingent on state laws which varied widely from state to state. It is not surprising that the relaxation of interstate branching and banking laws occurred only in the last twenty years, when information technology investment began to accelerate. By providing instantaneous access to bank records and account information, IT facilitated statewide branching and helped the movement towards regional banking. In 1997, IT will help nationwide banking become a reality as shared computer and communications networks allow information and transactions to flow throughout the country.

The Potential Impact of Interstate Banking

²⁶ General Accounting Office, *Financial Derivatives, Actions Taken or Proposed Since May 1994*, November 1996, p. 7.

²⁷ Remarks by Alan Greenspan at the Catholic University Leuven, Leuven, Belgium, January 14, 1997.

There are credible arguments on both sides of the interstate banking debate. On the positive side, consumers (household and businesses) would benefit from competition as banks compete for customers by providing a wider variety of services, better quality services, perhaps at lower prices. Technological advances and efficiencies offered by larger banks would bring a larger array of services to customers in rural areas. Also, geographical diversification would reduce banks' exposure to risk of local economic declines. This would mean fewer bank failures and in the long-run the economy as a whole would benefit as the government would not have to pay out as much in deposit insurance claims.

Opponents of interstate banking feel that small banks will be wiped out as larger banks merge across state lines, and that increased concentration of the markets will ultimately lead to higher prices for consumers. There is also concern for existing community reinvestment laws that stipulate that funds obtained from certain areas must be reinvested into those areas. However, these concerns may be misplaced. Growing competition from nonbanks should limit any negative effect on consumers. In addition, the Interstate Banking and Efficiency Act of 1994 contains provisions that will make interstate branches of national banks subject to many existing state laws including community reinvestment laws, consumer protection, fair lending, etc.

A system of nationwide banking and the high cost of delivery systems are likely to add to the consolidation movement. According to one estimate, rapid consolidation over the next 5 to 10 years could result in as few as 5,000 banks (almost half of the current number and a third of the number in the peak year, 1984).²⁸

²⁸ U.S. Department of Commerce, Technology Administration, Office of Technology Policy, "Case Study of the Banking Industry," written by Cynthia Glassman, Washington, DC, April 1995: 21.

PART III

IT AND INDUSTRY PERFORMANCE

Part III seeks to determine whether high levels of IT investment by banks have improved industry performance, as measured by profitability, employment, and productivity. Since large banks are more IT-intensive than small banks, Part III also considers whether large banks outperformed small banks.

PROFITABILITY

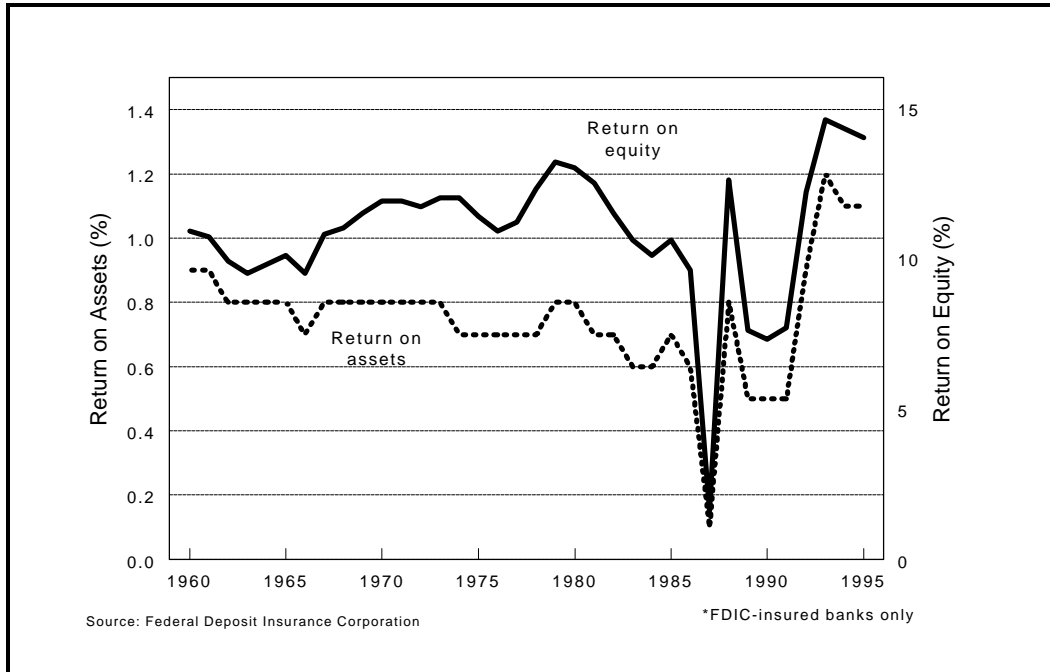
Technology can improve bank profitability by raising revenue and reducing expenses. On the revenue side, technological advances can provide innovative, new services or improvements in quality and convenience that attract new customers and increase demand. On the expense side, IT can reduce labor and processing costs. Other factors that can influence bank profitability include changes in interest rates, the availability of nonbank substitutes for loans, and general economic conditions.

Banking industry profitability as measured by return on assets (ROA) and return on equity (ROE) have both increased in recent years after sharp declines in the mid-1980s under the influence of the collapse of the oil market, investment in risky real estate ventures, losses from the collapse of the junk bond market, and third world loan losses.²⁹ (Figure 15) Through the fourth quarter of 1996, however, the industry enjoyed 16 consecutive quarters with ROA figures exceeding 1 percent.

Profits have doubled over the past 15 years, to \$50 billion in 1995. The changing nature of banking is evident in the growth of income from nontraditional sources. While bank revenues more than doubled to \$385 billion, the share of revenues earned from noninterest sources

²⁹ Return on assets (net income divided by total assets) measures how effectively banks manage their assets to generate profits. Return on equity (net income divided by total equity capital), on the other hand, measures a bank's ability to use the stockholder's investment.

Figure 15
Commercial Bank Profitability *



almost tripled to 21 percent by the end of 1995. Recent record earnings reflect wider margins on loans and other income earning assets, increased asset quality, increased fee income (for example, ATM usage fees, mortgage servicing fees, etc.), some savings from lower deposit insurance premiums, and gains from the sale of merger-related assets.

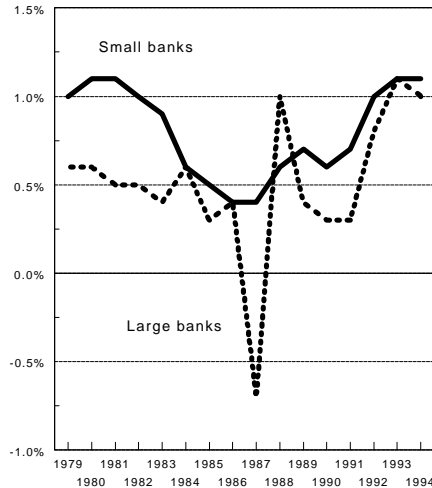
Profitability at small banks, while more stable than at large banks, has been stagnant, possibly reflecting difficulty small banks have competing in today's environment. (Figures 16 and 17) Large banks were able to maintain their profitability (with the exception of the losses from foreign and commercial real estate lending in the mid-1980s) despite shifting revenue sources toward consumer lending and fee-based income.³⁰ IT-intensity undoubtedly contributed to large banks having greater flexibility to adapt to changes caused by competition and deregulation.³¹

With the widespread adoption of electronic banking, banks expect to significantly reduce costs and increase profits further through branch closings. Until now, profitability depended on the frequency of branch visits, which according to the Bank Administration Institute, can

³⁰ These are accounting measures of profitability and do not necessarily reflect when profits and losses actually occurred, e.g., the dramatic decline in 1987 reflects LDC debt write-offs, all of which did not occur in that year.

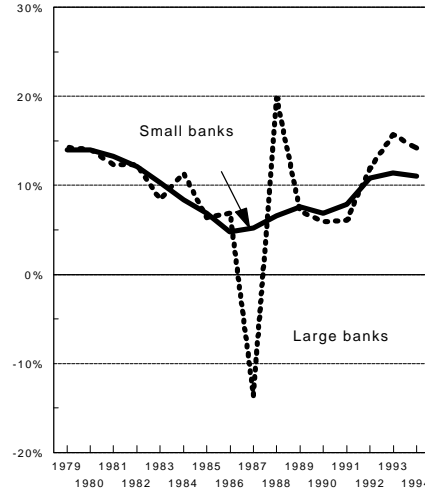
³¹ A survey by the American Bankers Association revealed that the cost of regulatory compliance is disproportionately higher for small banks (24 percent of operating costs in 1991) than for large banks (8 percent of operating costs in 1991).

Figure 16
Return on Assets



Source: Federal Reserve Board, Consolidated Report of Condition and Income for Banks

Figure 17
Return on Equity



Source: Federal Reserve Board, Consolidated Report of Condition and Income for Banks

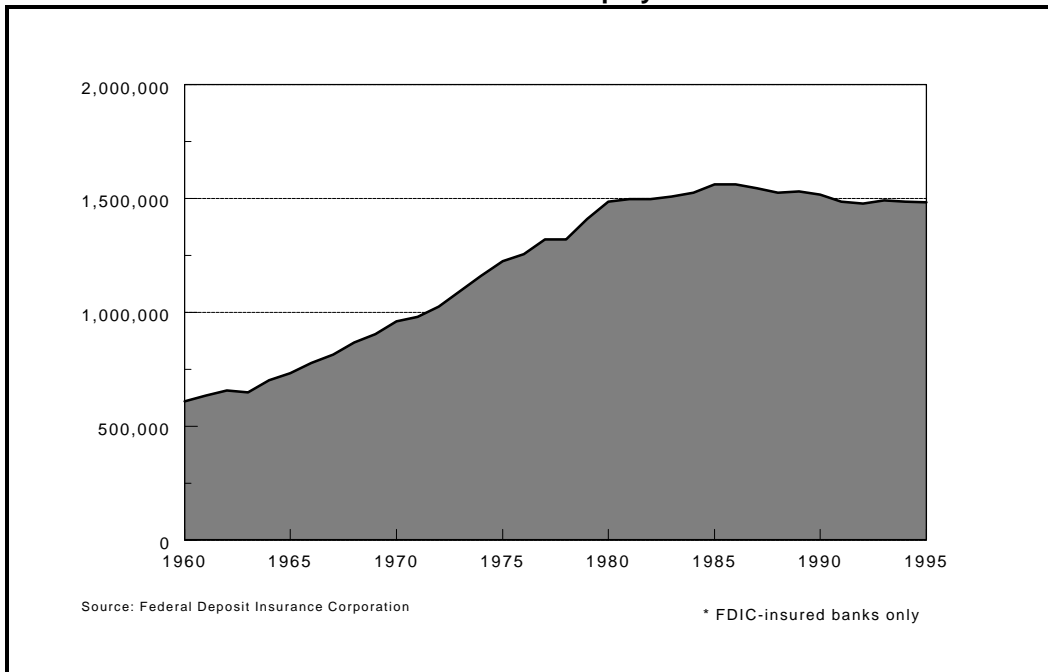
cost 50 percent more to service in person than through on-line services. When ATMs were first introduced, banks expected to reduce the number of branches. The number of branches, however, increased from 51,755 to 65,610 despite an increase in the number of ATM machines from 18,500 in 1980 to 109,080 in 1994. While the increase in the number of branches could simply reflect industry consolidation, it could also reflect consumer reluctance to use new technologies or the preference for human interaction.³² Some banks have found that operating costs have increased in conjunction with IT investment because the added convenience of ATMs or telephone banking has increased usage of these services. For example, if a customer had to wait in line for a bank teller, he or she would likely handle several transactions in one visit, while the convenience of banking by phone or ATM may lead a customer to make several separate transactions. It is difficult to estimate how soon banks will see the returns from electronic banking since many consumers have reservations about the safety and privacy of on-line transactions.

³² The number of banks declined from 14,404 to 10,357 from 1980 to 1994.

EMPLOYMENT

IT investment has changed the employment situation of banks in two ways. IT is facilitating the recent merger wave that reduces the need for separate management staff. In addition, IT eliminates some labor-intensive tasks, specifically those performed by bank tellers and clerks. Despite these points, the impact of IT on bank employment is not evident so far. Bank employment was down only slightly, roughly 5 percent lower than the peak level in 1986, to 1,484,463 workers in 1995.³³ (Figure 18) However, IT has allowed banks to increase the amount and variety of services without increasing employment.

Figure 18
Commercial Bank Employment *



The industry's occupational employment mix has shifted only slightly thus far, with executive, managerial, and administrative workers growing from 23 to 26 percent of all occupations and administrative support and clerical staff (which includes bank tellers) declining from 68 to 65 percent from 1983 to 1993. The number of bank tellers fell from 484,000 in 1985 to 443,000 in 1995, at a much faster rate than the rate of decline in overall bank employment.

³³ Larger banks, that are more IT-intensive, should have seen a relatively larger decline in employment than smaller banks; however, employment data based on our definition of bank size would give misleading results since the sample of banks in each asset category changed over time.

PRODUCTIVITY

Productivity measurement has been a problem for most service industries and is further complicated by the introduction of information technology. For banks the problem is how to define output when many traditional banking services can be considered as both outputs and inputs. (These measurement problems also make it difficult to estimate the contribution of banking to the economy.) Analysts debate how to account for implicit "free" services, such as "free checking," whether to classify only assets as output, or to include transactions derived from both assets and liabilities, such as the number of loans processed or checks cleared. There is also difficulty in aggregating nonhomogeneous products such as loans, which vary according to size and risk. Now there are many nontraditional banking services such as derivatives and lines of credit that need to be incorporated. There is also the issue of valuing improvements in quality and convenience of services provided by ATM machines and on-line banking.³⁴ Consequently, the present study uses more than one measure of productivity growth.

Financial measures of productivity such as the dollar value of assets per employee and loans per employee can give some idea how productivity has changed over time, but underestimate true productivity because off-balance sheet activities and outsourcing of data processing services are not counted under assets or loans. Over the past 34 years, these financial measures of productivity have grown modestly at slightly under 2 percent annually. (Figure 19) Productivity growth at the aggregate level appears to have occurred within the medium-sized banks with assets between \$100 million and \$100 billion, because, when disaggregated according to bank size, little or no average productivity growth is apparent for large or small banks, from 1979 to 1994. (Figures 20 and 21) Declining productivity of large banks during the early to mid-1980s could reflect the period of adjustment following deregulation as well as the learning time needed to realize the full benefits of technology improvements. The sharp increase in productivity since 1992 comes mainly from employment declines, possibly indicating the first measurable gains from years of IT investment.

A more comprehensive measure of productivity is compiled by the Bureau of Labor Statistics and measures output in terms of physical units, i.e., a composite index of the number of transactions, rather than dollar values. According to this measure of productivity, bank output per employee has grown modestly since 1978, about 2.0 percent per year, while IT investment per employee has grown at an average annual rate of 7 percent per year. (Figures 22) This illustrates what has come to be known as the "productivity paradox" whereby investment in technology for banks and many other industries has been increasing rapidly over the years with little corresponding increase in productivity. Faster productivity growth is likely occurring within specific lines of business, for example, basic

³⁴ Jack Triplett, *The New Palgrave Dictionary of Money and Finance*, 1992: 145.

Figure 19
Productivity Growth -- Assets and Loans per Employee *

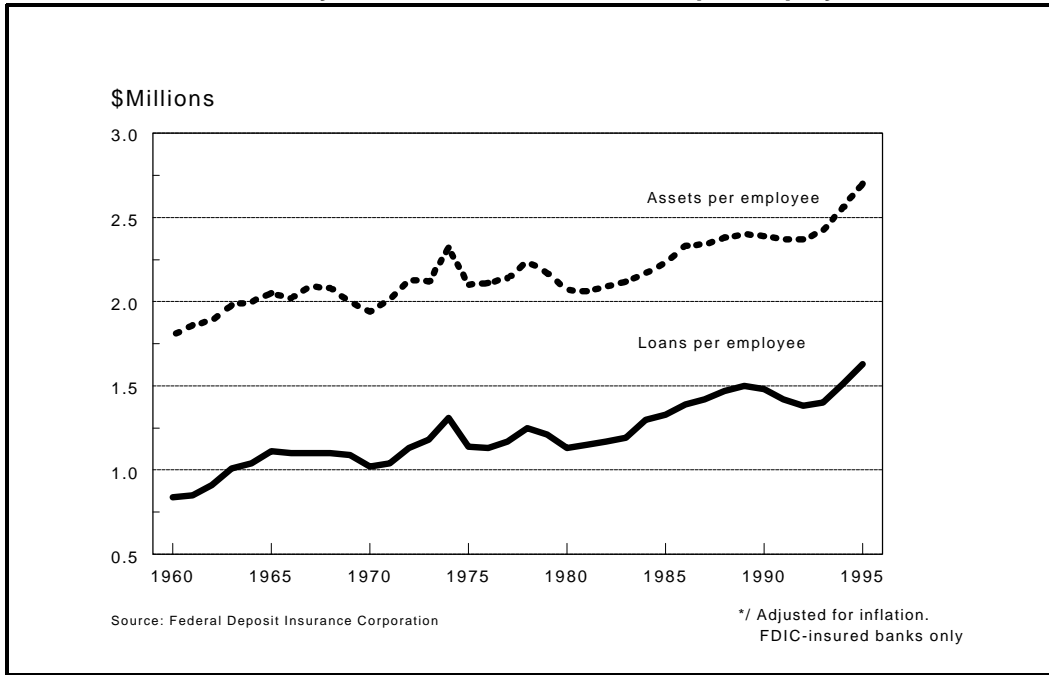


Figure 20
Assets per Employee

Figure 21
Loans per Employee

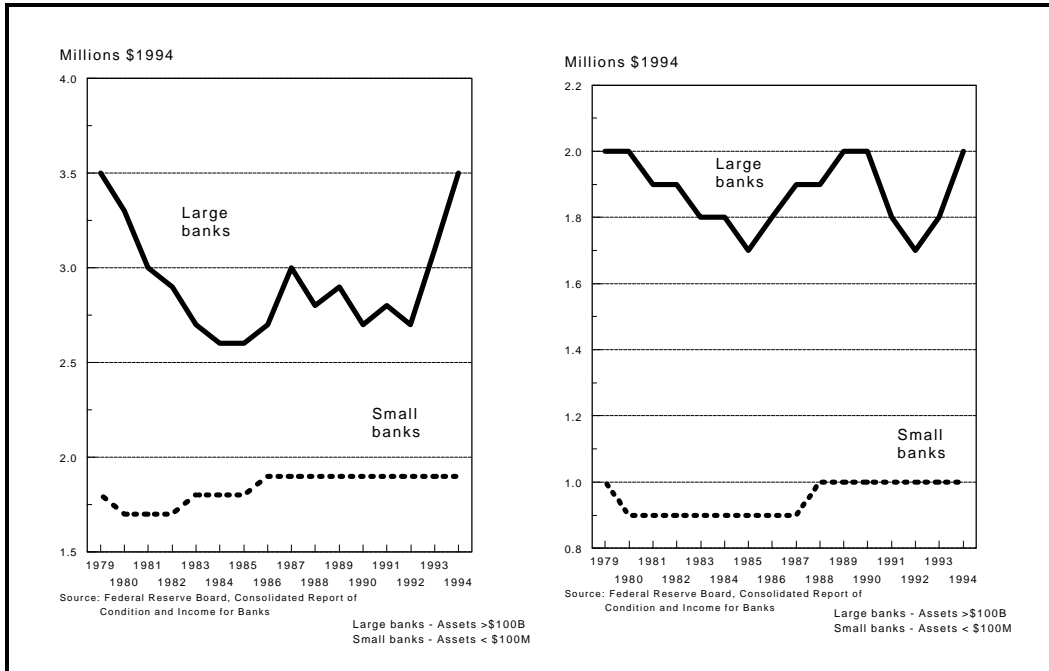


Figure 22
Productivity Paradox

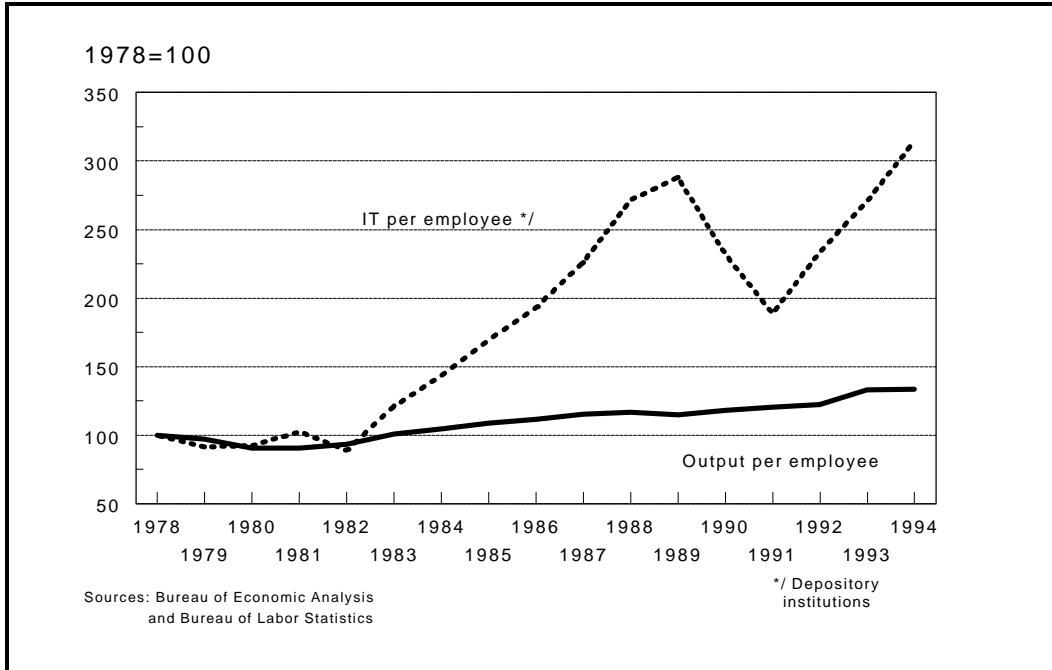
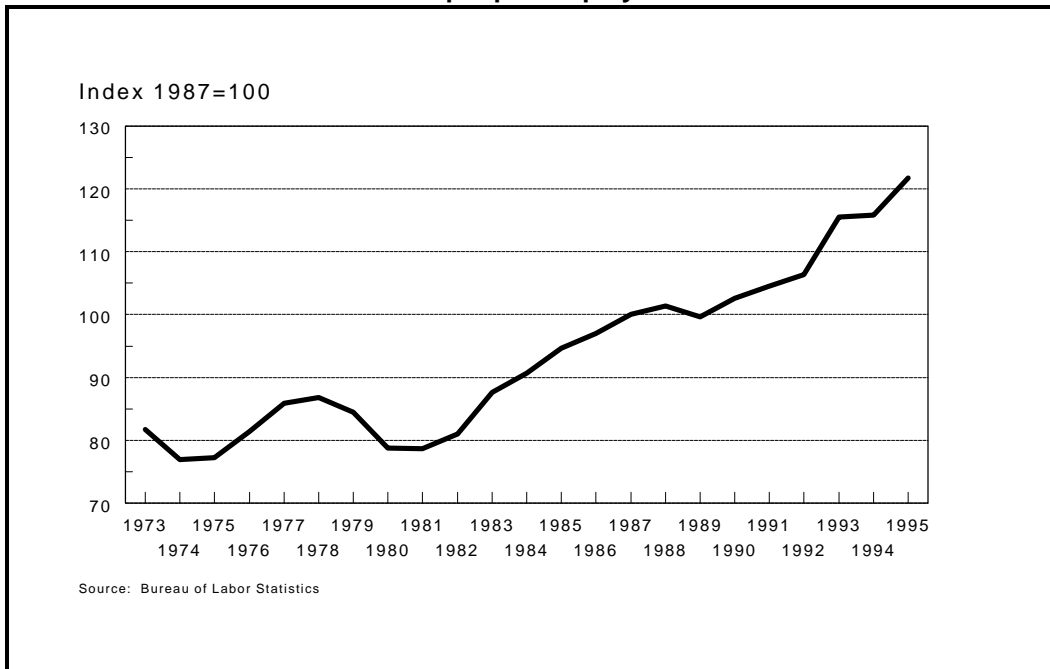


Figure 23
Output per Employee



transactions services (deposit-gathering, electronic payments, etc.). Measured productivity for these services is not available separately and has not thus far affected aggregate productivity measures. Measured productivity might also be higher if the value of quality improvements such as the convenience of 24-hour banking services, faster loan application and approval, etc. were incorporated.

MEASURABLE IMPROVEMENTS RELATED TO IT INVESTMENT

There are signs that IT investment may be starting to pay off in the banking industry. Productivity has been rising at a faster rate since 1992 (4.6 percent annually from 1992 to 1995), which could mark the beginning of the end of the productivity paradox. (Figure 23) Efficiency ratios (the ratio of noninterest expenses to net revenues) have been declining since 1992, because of declining employment and occupancy costs. (Figure 24) Larger banks have become slightly more efficient over time, but their ratios are still well above those of small banks.³⁵ (Figure 25) The cost of electronic transactions is declining, demonstrating one area where IT is directly responsible for lowering the cost of banking services. From 1979 to 1994, the cost of an electronic transaction declined from 9.0 cents to 1.0 cent, while the cost of processing checks actually increased from 1.9 cents to 2.5 cents because of rising wages and paper costs.³⁶

³⁵ The efficiency ratio of large banks may be higher than small banks because IT investment is a component of noninterest expenses and IT is concentrated among the largest banks.

³⁶ Berger, Kashyap, and Scalise, 69. Values in \$1994.

Figure 24
Efficiency Ratio *

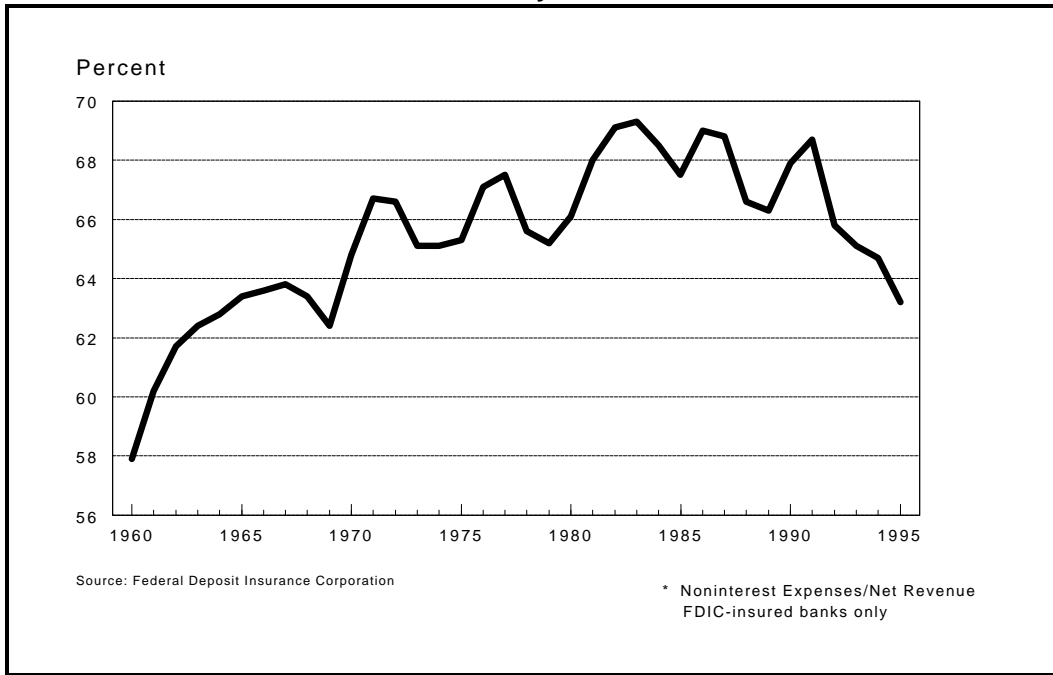
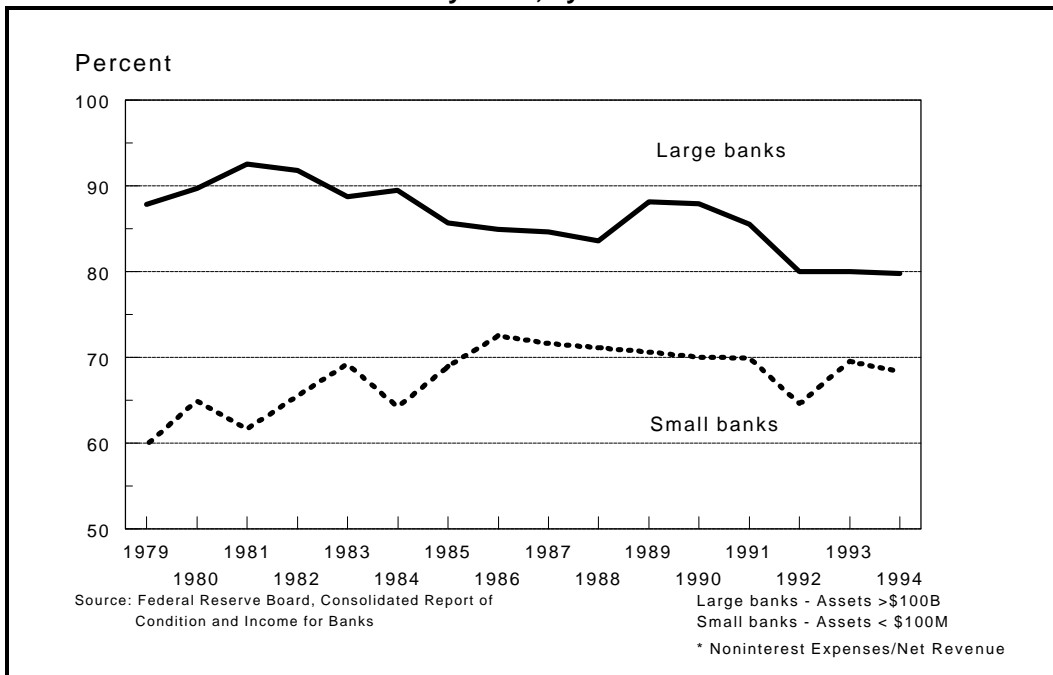


Figure 25
Efficiency Ratio, by Bank Size *



CONCLUSION

Advances in information technology and related financial innovations are directly and indirectly responsible for much of the ongoing change in the structure of the commercial banking industry. IT has spurred competition from nonbanks, encouraged financial innovations that have allowed firms to directly access financial markets, and empowered consumers and businesses with information needed to make better investment decisions. At the same time, IT is allowing banks to offer new products, operate more efficiently, raise productivity, expand geographically, and compete globally. A more efficient, productive banking industry is providing services of greater quality and value. Though these benefits are difficult to quantify, their existence suggests that the benefits of technological and financial innovations are being felt at the aggregate level as well.

Banks have traditionally invested more in information processing equipment than other financial service providers but low profitability during the 1980s hampered their ability to keep pace with nonbanks. Now banks are beginning to realize some measurable productivity and efficiency returns on their IT investments. Banks will continue to benefit from IT advances and financial innovations as the market for securitized products evolves to include more types of loans and as more banks gain entry into the derivatives market. Because some banks will not be able to keep up with the pace of innovation, however, the industry is likely to experience more consolidation.

In addition to increases in productivity and cost savings directly associated with technology improvements, this analysis suggests another benefit of IT investment. IT can indirectly enhance a bank's ability to reduce some types of risk. For example, securitization allows banks to lower liquidity risk; derivatives allow banks to hedge against interest rate and currency risk; and interstate banking minimizes risk associated with holding assets locally. These options would not be feasible without information technologies.

Nonetheless, speculation that the speed and ease of financial transactions, domestically and globally, may pose new risks for banks and their customers has attracted regulatory attention. Regulators are actively monitoring bank (and nonbank) involvement in derivatives and are developing and implementing risk-management guidelines to ensure the overall health of the U.S. banking industry and global financial markets.

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A P P E N D I X

APPENDIX TABLE 1
INVESTMENT IN INFORMATION TECHNOLOGY EQUIPMENT BY FINANCIAL SERVICE INDUSTRIES

	IT Investment (millions\$)										Avg. Ann. Growth	
	1960	1965	1970	1975	1980	1985	1990	1994	1960-94	1980-94	1960-94	1980-94
Depository institutions	\$104	\$210	\$422	\$1,456	\$2,686	\$5,598	\$8,009	\$10,006	14.4%	9.8%		
Nondepository institutions	41	7	26	0	337	1,237	1,317	2,924	13.1	16.7		
Security and commodity brokers	6	16	49	66	327	554	312	510	14.0	3.2		
Insurance companies	144	241	263	478	1,482	4,422	5,820	7,395	12.9	12.2		
Holding and other inv. offices	30	71	173	161	725	1,190	622	918	10.6	1.7		
IT per Worker												
Depository institutions	n.a.	n.a.	n.a.	n.a.	\$1,414	\$2,590	\$3,552	\$4,816	n.a.	9.1%		
Nondepository institutions	n.a.	n.a.	n.a.	n.a.	962	2,648	2,172	3,914	n.a.	10.5		
Security and commodity brokers	n.a.	n.a.	n.a.	n.a.	1,233	1,338	642	867	n.a.	-2.5		
Insurance companies	n.a.	n.a.	n.a.	n.a.	822	2,226	2,525	3,078	n.a.	9.9		

Sources: Bureau of Economic Analysis and Bureau of Labor Statistics.

APPENDIX TABLE 2
COMPARISON OF ASSETS AND LIABILITIES OF LARGE AND SMALL BANKS

	LARGE BANKS			SMALL BANKS		
	(assets > \$100 billion)			(assets < \$100 million)		
	1979	1994	Change	1979	1994	Change
Number of banks	3	45	42	10,050	5,893	-4,157
Gross total assets (bils. \$1994) ...	\$522	\$1,031	\$509	\$375	\$246	-\$129
	Assets			Assets		
	(Share of total assets)			(Share of total assets)		
Cash & securities	0.32	0.22	-0.10	0.42	0.42	0.00
Total loans & leases	0.58	0.57	-0.01	0.55	0.54	-0.01
Domestic loans	0.28	0.39	0.10	0.57	0.55	-0.03
Commercial and industrial	0.12	0.09	-0.03	0.11	0.09	-0.02
Commercial real estate	0.03	0.04	0.02	0.08	0.14	0.06
1-4 residential property	0.04	0.10	0.06	0.12	0.16	0.04
Loans to individuals	0.03	0.06	0.04	0.16	0.08	-0.08
Credit cards and related	0.02	0.06	0.03	0.00	0.00	0.00
Loans to depository inst.	0.01	0.01	-0.01	0.00	0.00	0.00
Loans to foreign governments	0.00	0.00	0.00	0.00	0.00	0.00
Agricultural	0.01	0.00	0.00	0.09	0.06	-0.02
Leases	0.01	0.01	0.00	0.00	0.00	0.00
Other domestic loans	0.02	0.02	0.00	0.01	0.01	0.00
Foreign loans	0.30	0.18	-0.12	0.00	0.00	0.00
Unearned income on loans	0.01	0.00	-0.01	0.02	0.00	-0.02
Other real estate owned	0.00	0.00	0.00	0.00	0.00	0.00
Assets in trading accounts	0.01	0.13	0.12	0.00	0.00	0.00
Fixed assets	0.01	0.02	0.01	0.02	0.02	0.00
Other assets	0.08	0.06	-0.02	0.01	0.02	0.01
	Liabilities & Equity					
Total Deposits	0.77	0.61	-0.16	0.89	0.87	-0.02
Domestic	0.31	0.35	0.04	0.89	0.87	-0.02
CDs > \$100,000	0.09	0.03	-0.06	0.08	0.08	0.00
Time & saving	0.08	0.18	0.09	0.52	0.51	-0.01
Demand	0.14	0.14	0.00	0.29	0.27	-0.01
Foreign	0.46	0.26	-0.20	0.00	0.00	0.00
Federal funds purchased	0.07	0.07	0.01	0.01	0.01	0.01
Other liabilities	0.13	0.25	0.12	0.02	0.02	0.00
Equity	0.04	0.07	0.03	0.09	0.10	0.01

