The Single-Family Mortgage Industry in the Internet Era: Technology Developments and Market Structure

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PREFACE

This OFHEO Research Paper examines how changes in technology have affected the structure and business practices of firms in the single-family mortgage industry in the last two decades and how lenders, Fannie Mae and Freddie Mac, and other firms are seeking to exploit business opportunities created by the most significant recent technological innovations: automated underwriting and the Internet. The paper was prepared to enhance public understanding of the United States housing finance system.

Forrest Pafenberg, Senior Policy Analyst in the OFHEO Office of Policy Analysis and Research, prepared the study under the supervision of Robert S. Seiler, Jr. Edward Connor, Emily Drake, David Felt, Tom Lutton, and Anthony Pennington-Cross of OFHEO provided helpful comments on an earlier draft. Kate Andersen, Doug Duncan, George Griffin, Rebecca Kees, Michael LaCour-Little, Jeff Lebowitz, Barbara Miles, Gabe Minton, and David Torregrossa also provided useful comments and suggestions.

Armando Falcon
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LIST OF FIGURES

LIST OF BOXES

I. INTRODUCTION AND SUMMARY

The single-family mortgage industry consists of financial institutions that originate, service, and provide funding for mortgages that finance 1- to 4-family residential properties. Many other industries support those functions. The economics of that industry have changed dramatically since the late 1970s. Securitization—the pooling and packaging of loans into securities, which are then sold to investors—has become the preferred means of financing most single-family loans. The growth of securitization has integrated pricing in the primary mortgage market more directly with capital markets, thereby producing both greater volatility in the pricing of and more reliable funding for single-family loans.

Since the mid-1980s lenders have financed most conventional mortgages—those that carry no federal insurance or guarantee—by selling them to or swapping them for mortgage-backed securities (MBSs) guaranteed by Fannie Mae and Freddie Mac. Those two government-sponsored enterprises (GSEs) were created to provide a secondary market for residential mortgages and are critical to the flow of consistent, affordable funding through the mortgage delivery system. Fannie Mae and Freddie Mac also determine, through their underwriting practices, the terms of many conventional single-family loans.

Technological innovation has been an important influence on the evolution of the single-family mortgage industry in recent decades. Changes in technology have made possible improvements throughout the lending process that allow prospective borrowers to apply for loans, and enable lenders and investors to service, price, sell, and trade mortgages, more quickly and efficiently. The development of automated underwriting systems (AUSs) that use scoring models to measure the credit risk of mortgages has completely changed how lenders underwrite loan applications and handle delinquent loans, while other innovations have begun to change the way the ownership of mortgages is recorded.

Freddie Mac and Fannie Mae have both responded to and facilitated the adoption of technological innovations in single-family mortgage lending. For example, the development of AUSs by mortgage insurers and a few large single-family mortgage lenders in the early 1990s created an opportunity for the industry to make sweeping changes in how credit risk is measured and how loans are originated, priced, and serviced. That transformation did not begin in earnest, however, until the Enterprises began marketing their own AUSs to their lender customers in the middle of the decade. Today, each Enterprise offers a suite of lender-directed technology products centered on two basic components: access to automated underwriting and greater electronic connectivity—the ability to communicate electronically—for mortgage brokers and lenders. Fannie Mae and Freddie Mac also are providing connectivity options to their other business partners and to firms that provide services used in the real estate settlement process. Those actions are facilitating, spurring, and shaping the development of electronic commerce among mortgage firms and online mortgage originations.

Since the mid-1990s, computer networks and the Internet have changed how firms in many industries operate, both internally and in the markets in which they do business. The costs of storing, transmitting, and processing information have been dropping continuously by 25 to 35 percent per year for the last 30 years. That trend is expected to continue for at least the next 5 to 10 years.[1] Improvements in computing power, data storage, and data transmission bandwidth have increased business profitability in several ways. They have lowered the cost of information and, thereby, transaction costs. They have also increased the demand for inter- and intra-firm connectivity and contributed to changes in workflow processing within firms. Such changes have led firms to re-evaluate and change how they are organized, which in turn has led to further reductions in transaction costs. Lower information and transaction costs and greater organizational flexibility are allowing firms to re-invent the ways in which they do business, focus their activity on what they do best, and deconstruct hierarchical structures to take advantage of an increasingly connected workforce.

Today the goal of many mortgage lenders is to structure their business operations to be process-driven versus business department-driven, consumer-oriented versus firm-oriented, automated and collaborative versus paper-based and competitive, and adaptable versus doing business the same old way. For many in the industry, full achievement of those goals will require moving from paper-based to electronic mortgages. An electronic mortgage is a mortgage where the critical loan documentation is created, executed, transferred, and ultimately stored electronically. To gain momentum, electronic mortgages will require an extensive, long-term effort to reengineer business processes as well as changes in consumer preferences.

The single-family mortgage industry faces many challenges to the development of electronic mortgages. Online identification and authentication and the security of systems and transactions continue to pose concerns to some in the industry, although a number of competing technology solutions and data standards may adequately address them. Many existing lender systems do not have the ability to create and change mortgage products on both their origination and servicing systems. There continues to be a lack of firm-wide integration of computer and communication technologies. Electronic courthouse recordation is not generally available and, when available, is not used uniformly. There is also a lack of standardization in the online world. A single software platform providing "best practice" technology tools for brokers, servicers, lenders, and settlement service providers has not yet emerged.

This paper examines how changes in technology have affected the structure and business practices of firms in the single-family mortgage industry in the last two decades. The paper also discusses how mortgage lenders, Fannie Mae and Freddie Mac, and other firms are seeking to exploit business opportunities created by technological innovations, especially automated underwriting and the Internet. Chapter II summarizes the major changes in industry structure in the past two decades, which were facilitated by improvements in technology. Subsequent chapters provide an overview of the

[1] Guldimann, Till M., "How Technology is Reshaping Finance and Risks," *Business Economics,* January 2000, 44-51.

implications of computer networks, and especially the Internet, for how firms organize themselves and do business; analyze the use of scoring technology and automated underwriting in single-family mortgage lending since the mid-1990s; examine how single-family mortgage lenders and Fannie Mae and Freddie Mac are responding to the emergence and growth of the Internet; and identify the potential benefits and challenges to the development of electronic mortgage lending.

II. TECHNOLOGY AND MORTGAGE LENDING, 1980 - 2002

In the last two decades improvements in computer and communications technologies have reduced the money and time spent carrying out financial transactions and have made it easier to obtain and analyze information about market participants and financial instruments (see Box 1). Lower transaction costs and greater transparency have transformed financial markets in many ways:[2]

- Debt markets have become larger, in part because of the development of securitization, with an increased share of debt instruments becoming actively traded;

- Derivatives markets have expanded, allowing firms to trade market risks more efficiently;

- Electronic payments technologies have grown rapidly, increasing the speed and efficiency of payments;

- Economies of scale in financial services have increased, spurring rapid consolidation in the 1990s, particularly among commercial banks because of the loosening of restrictions on geographic and product markets;

- Scoring—the process of using statistical techniques to evaluate the credit risk of specific borrowers of loans—first used to evaluate auto, credit card, and installment loans, has become widely used to underwrite single-family mortgages and small business loans; and

- The Internet has emerged as a powerful communications medium, where a growing share of the customers of financial services are accessing information and executing transactions online.

Improvements in computer and telecommunications technologies profoundly altered the housing finance system during that period. All of the segments of the single-family mortgage lending process became less expensive to perform. Lower costs and faster execution led to significant changes in the structure of mortgage markets and in the business practices of firms throughout the single-family mortgage lending industry.

[2] For a discussion of the effects of changes in technology on financial markets, see Mishkin, Frederick S., and Philip E. Strahan, "What Will Technology Do to Financial Structure?" in Litan, Robert E., and Anthony M. Santomero, eds., *Brookings-Wharton Papers on Financial Services 1999* (Washington, DC: The Brookings Institution, 1999), 249-277.

Box 1:
Declining Information Costs and Technological Innovation

The revolution in computer and telecommunications technologies that is transforming the economy stems from very large, continual declines in the cost of storing, transmitting and processing information. That cost has been dropping at a continuous rate of 25 to 35 percent per year for the last three decades, a trend expected to continue for at least the next five to 10 years.[1] The increase in bandwidth capacity in the U.S. over the last five years has been phenomenal.[2] In 1996, AT&T, MCI, WorldCom and Sprint had an installed capacity in long distance phone lines of one terabit/second (one terabit = 1,000 Gigabits, roughly 15 million simultaneous phone calls). By 1999, with the entrance of Qwest, Level 3, Frontier and others, that figure was 21.7 terabits, and by year's end 2001, it is estimated that, in combination, those companies installed 99.8 terabits of long distance capacity.[3] That massive increase in capacity has dramatically lowered costs to consumers. Combined with technological increases in Internet bandwidth connection speed (from early acoustic 300 bps modems in 1984 to an Integrated Services Digital Network (ISDN) line today that is approximately 128,000 bps), the cost of transmitting information is being dramatically reduced.

Those improvements in computing power, data storage and data transmission bandwidth have dramatically increased business profitability. Specifically, they have:

- lowered the cost of information and, thereby, transaction costs;
- increased the demand for connectivity—the ability to communicate electronically;
- improved communications within and among firms; and
- contributed to changes in workflow processing within firms, which has led them to restructure their organizations, which in turn has led to further reductions in transaction costs.

Financial innovations often occur when technological innovations are used to create new products and services. For example, ever faster computer processing reduced the costs of measuring financial risks and spawned a host of instruments and products used to manage and hedge those risks. Sometimes, however, organizational innovations are involved. A case in point is the increasing use by financial services firms of automated workflow processing[4] to improve "back-office" procedures in order to reduce the costs of existing activities and support the development of new activities or services. Many financial services firms, including most major single-family mortgage lenders, are using improvements in computer and telecommunications technology to redesign how financial services are created, marketed, and delivered to consumers.

[1] Guldimann, Till M., "How Technology is Reshaping Finance and Risks," *Business Economics*, January 2000, 44-51.

[2] Bandwidth, in computer science, is the amount of information that can be sent through a connection between two computers in a given amount of time. Bandwidth is measured by the number of bits per second (bps) that can be sent over a connection. Bandwidth directly affects the quality of transmitted information.

[3] See King, Rachel, "Too Much Long Distance," *Fortune*, 15 March 1999, 106-110.

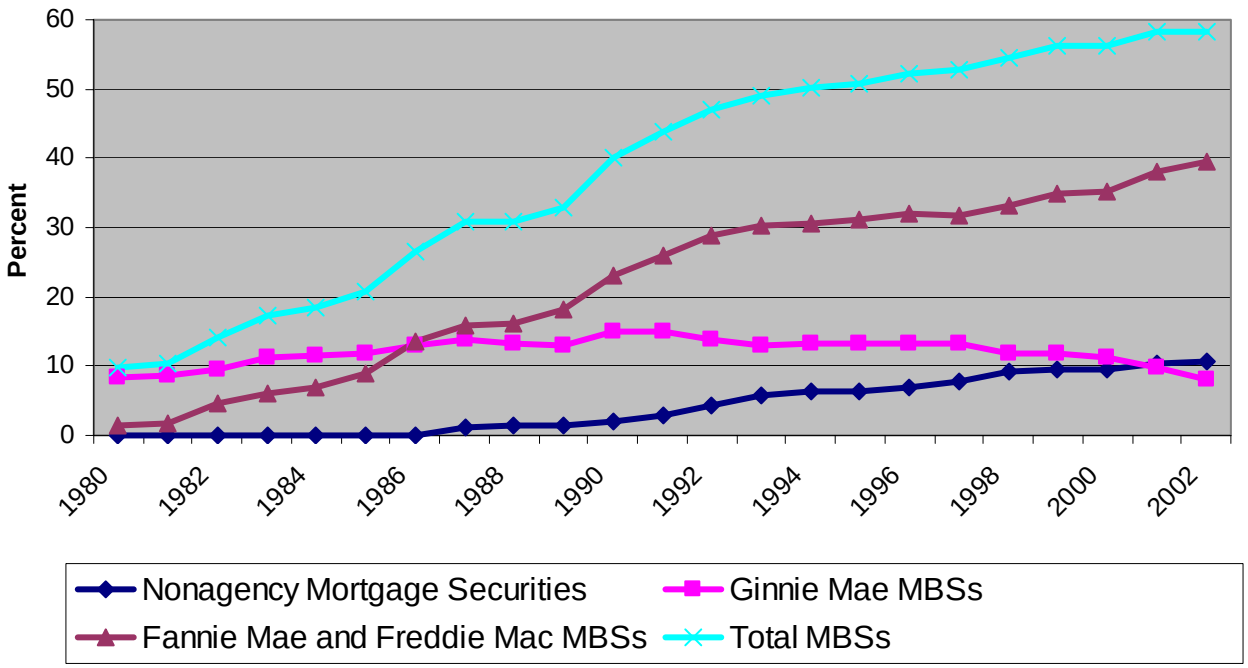
[4] Automated workflow processing is the use of computers to control the flow of information across an organization. Implementation of automated workflow processing often involves redesigning the tasks needed to complete an activity.

This chapter summarizes four major changes made possible by improvements in technology: the growth of mortgage securitization and the "unbundling" of the lending process, automation of lender operations, consolidation in the origination market, and consolidation in servicing.[3] Factors limiting technological innovation by providers of settlement services used in single-family mortgage and real estate transactions are also examined. In discussing those developments, the chapter mentions the two most important recent technological innovations affecting the industry today—automated mortgage underwriting and the Internet. Later chapters of the paper analyze the implications of those innovations in depth.

The Growth of Securitization and the "Unbundling" of the Lending Process

Improvements in information technologies first affected single-family mortgage lending by making securitization the preferred method of funding loans. The growth of securitization (see Figure II-1) was stimulated in the 1970s by the advent of computers and cheap data transmission. Rapid increases in computer processor speeds facilitated the development of multi-class mortgage securities in more active markets for mortgage securities in the 1980s and 1990s.

Figure II-1
Securitized Share of Single-Family Mortgage Debt Outstanding



Source: Fannie Mae, Freddie Mac, Ginnie Mae, Inside Mortgage Finance Publications

[3] For an in-depth discussion of those changes, see LaCour-Little, Michael, "The Evolving Role of Technology in Mortgage Lending," *Journal of Housing Research*, Vol. 11:2, 173-205.

The growth of securitization greatly increased the liquidity of most single-family mortgages and made it easier for lenders to split, or "unbundle", the segments of the lending process. That is, securitization led to a vertically disintegrated model of the mortgage lending process. Instead of most firms functioning as integrated portfolio lenders that make loans, keep them in portfolio and service them until they pay off, separate firms may originate loans (functioning as mortgage brokers), service loans (servicers), securitize pools of loans for sale in the capital market (secondary market entities), and own claims to the cash flows from the assets (mortgage-backed security (MBS) investors). Since the late 1980s, most single-family mortgage lending has occurred through the deconstructed model. In 2002, for example, mortgage brokers originated more than 65 percent of all single-family loans[4] and 62 percent of mortgages originated were securitized.[5] However, there are still a large number of generally smaller thrifts, community banks, and other financial intermediaries who continue to make, hold, and service single-family mortgages, primarily adjustable-rate loans.

As the volume of securitization increased in the 1980s and 1990s, Fannie Mae and Freddie Mac began providing explicit guidance for the industry on electronic delivery of single-family mortgages to them. Each Enterprise determined its own computer and data standard needs and developed the computer formats for delivery of mortgages purchased by that Enterprise. Each requires its business partners to meet specific but different Electronic Data Interchange (EDI) standards for the delivery of large volumes of mortgages purchased by that Enterprise.

Automation of Mortgage Lender Operations

Single-family mortgage lenders began to automate their operations during the 1980s. At that time, the computer systems of most lenders were based on mainframe architecture with application software developed for processing efficiencies. As automation proceeded, applications were designed to meet the needs of individual departments within the firm but were not integrated across the firm—proprietary loan origination systems (LOS) were separate from servicing application software, for example. Data definitions and standards were not consistent across departments of the firm. That the mortgage firm developed software applications in separate departments should be of no surprise, since the segments of the lending process were operationally segregated, and each department defined its technology needs separately. Automation continued to occur largely at the department level until the second half of the 1990s.

Automation has allowed originators of single-family mortgages to transmit information quickly and easily, allocate staff more flexibly, and transform fixed costs into variable costs. One important effect of automation is that refinancing of single-family loans is cheaper and less time-consuming, which has made borrowers more likely to refinance when mortgage rates decline and to shop among originators for the best rates

[4] Since HUD discontinued the Survey of Mortgage Lending Activity in 1998, estimates of mortgage broker originations have been provided by non-government entities. This estimate is from Wholesale Access, *10th Annual Benchmark of Production, Revenue, and Expenses of Mortgage Broker Industry*, 2003.

[5] See Inside Mortgage Finance, *Mortgage Market Statistical Annual 2003, Vol. II*, 4.

and terms. Electronic commerce—the process of evaluating, negotiating, executing, and managing business transactions electronically—has been another source of savings in origination costs. The largest single-family mortgage lenders have used Electronic Data Interchange (EDI) to exchange information and execute transactions with mortgage insurers, credit bureaus, and other business partners since the 1970s. Other lenders and firms in the industry began using EDI in the mid-1990s. Fannie Mae and Freddie Mac accelerated the automation of the mortgage origination process and use of e-commerce by introducing their own proprietary automated underwriting systems (AUSs) and electronic mortgage information networks in 1995.

The largest efficiency gains from automation have occurred in servicing departments. Since 1980 four different technologies—personal computers (PCs), local area networks (LANs) linking PCs, automated voice response technologies, and the Internet—have each reduced the cost of responding to customer inquiries. Another technology—document imaging—has allowed large servicers to retain much less paper for each individual loan and to access records quickly and cheaply. The adoption of those technologies has enabled servicers to achieve increasing economies of scale. Those economies were the principal factor in improving the operational efficiency of the mortgage industry in the last two decades. Although some servicing functions remain labor intensive, the modern servicing department is highly automated in discharging its traditional responsibilities for overseeing tax and insurance payments, monitoring delinquent loans, managing foreclosures and real estate owned (REO), reporting to investors, and communicating changes in loan terms to consumers.

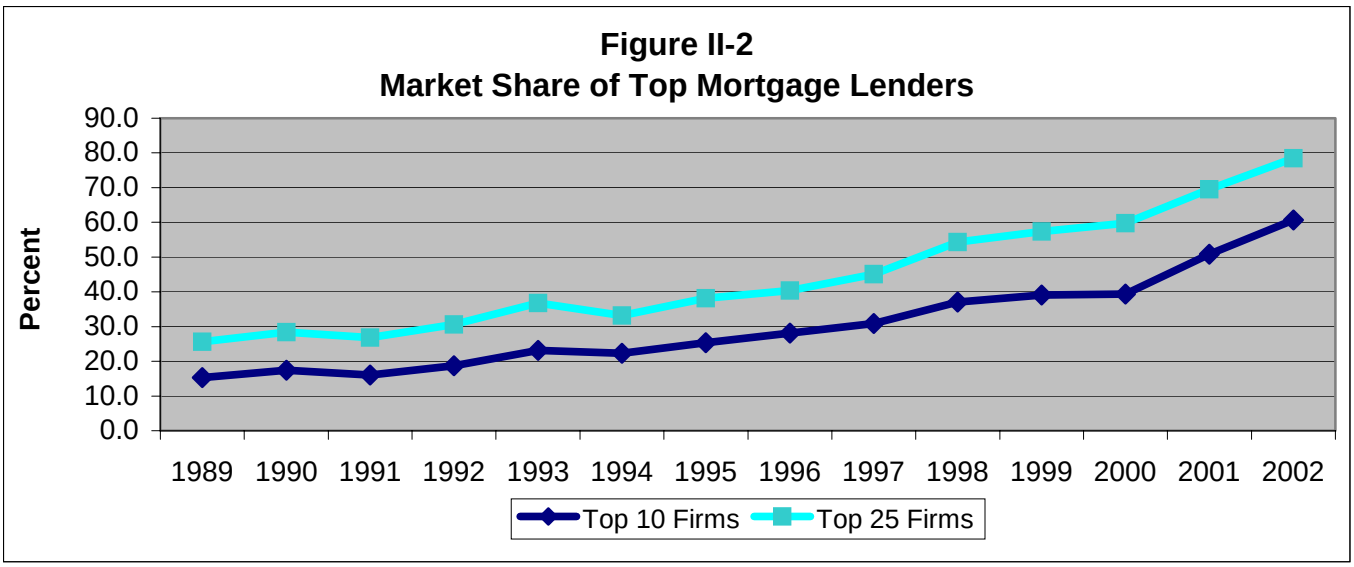
Consolidation in the Origination Market Through Purchased Production

Automation of the origination segment of single-family mortgage lending and the emergence of AUSs and the Internet has facilitated significant consolidation among mortgage originators in recent years. The market share of the top ten firms rose from over 17 percent in 1990 to nearly 61 percent in 2002, while the market share of the top 25 firms rose from 28 percent to nearly 77 percent during the same period (see Figure II-2). Economies of scale achieved through the exploitation of new technologies were one of the primary reasons for that consolidation. Improved data processing, communication efficiencies, the deployment of AUSs, and growing use of the Internet significantly increased productivity, reduced errors, improved risk management decision support, and shortened the time to close a mortgage loan during the decade.

Another explanation for the consolidation trend in the 1990s is the growth in purchased production, which has been facilitated by technology.[6] Retail production of

[6] In the 1980s and early 1990s, mortgage originators adopted three business channels, characterized by their source of funding—retail, wholesale, and correspondent originations. In retail lending, a lender makes a loan directly to a borrower whether through a branch office, a call center, the Internet, or some other direct means. In wholesale lending, a mortgage broker uses "table funding" to close a loan. The broker finds the consumer, facilitates the closing, but uses a wholesale lender's money to fund the closing of the loan. In correspondent lending, a lender buys a loan after it is funded at the closing table. That purchase could occur immediately or after several weeks. See Thomson Financial Publications, *Mortgage Industry Directory, Lenders, Brokers & Servicers, 2002 Edition*, New York, NY, 2-3.

mortgage loans declined steadily during the 1990s, falling from 62 percent in 1990 to 40 percent in 2002, while purchased production rose during that period. Statistics compiled by the Mortgage Bankers Association of America (MBA) document that, as the share of purchased production by the firm increases, the cost per loan-produced decreases. More importantly, firm size, as measured by number of loans produced, is directly related to the share of purchased production.[7]



Source: National Mortgage News, Inside Mortgage Finance

Why is it less expensive to buy externally produced mortgages than to originate those loans in-house? One reason is the large expense of establishing and maintaining a retail operation. Since the mortgage origination business is cyclical (and in recent years has been heavily influenced by the level of refinancing activity), mortgage lenders have found that it is costly to ramp up and down retail operations in response to changes in mortgage demand. Many firms are unable or unwilling to expend the resources needed to expand their retail channel. Second, and related to the above, the emergence of the Internet as a medium for transacting business has significantly reduced the cost of establishing meaningful business relationships between the mortgage brokerage community and mortgage companies and financial institutions. Third, the deployment of automated underwriting technology in multiple venues, including the Internet, has provided the lending community with widespread access to those systems and allowed mortgage bankers and brokers to contemporaneously share loan decisions. That has streamlined the process, reduced paperwork and errors, and allowed for quicker execution of pending transactions.

It is important to emphasize that mortgage lending is a local transaction and that mortgage brokers perform a low-cost loan aggregation function for lenders. Beginning in

[7] See Mortgage Bankers Association of America annual reports, most recent, *2002 Cost Study: Income and Cost for Origination and Servicing of 1- to 4-Unit Residential Loans*, Washington, DC, December 2002.

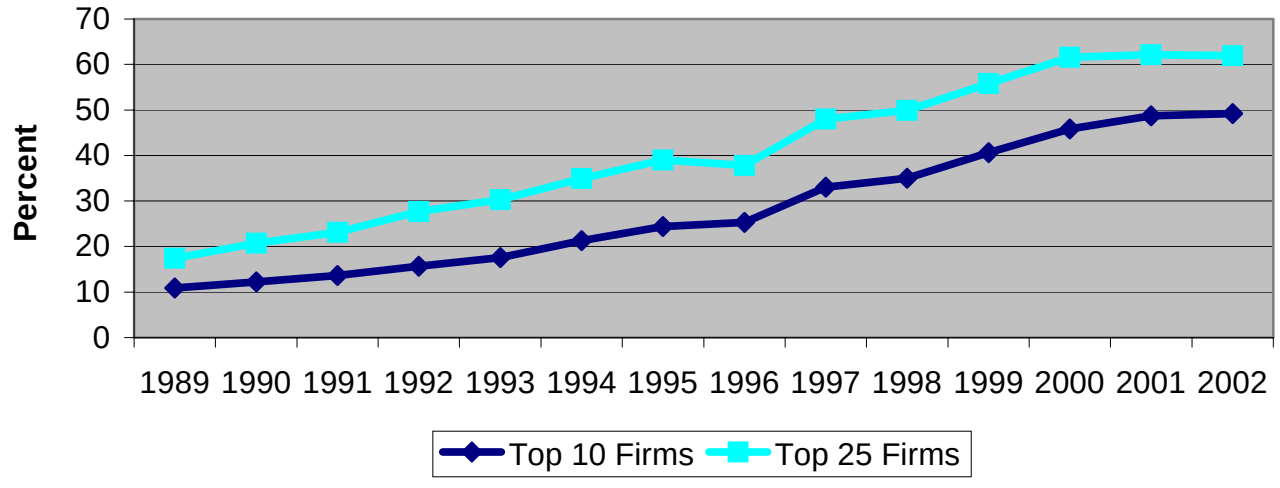
1995, distant lenders began to rely heavily on AUSs to perform the due-diligence functions of credit risk, fraud risk, and collateral risk underwriting. Mortgage lenders now can run mortgage broker names through online fraud prevention services to determine if enforcement or de-licensing actions have been taken, further reducing their counterparty risk. All of those technology innovations have significantly reduced the risks of transacting business with geographically distant parties and increased the willingness of mortgage lenders to use delivery channels other than retail production.

Consolidation in the Servicing Market

The market for servicing single-family mortgages has consolidated far more quickly than the origination market in recent years. The market share of the top ten firms rose from over 11 percent in 1990 to over 49 percent in 2002, while the market share of the top 25 firms rose from 17 percent to nearly 62 percent during the same period (see Figure II-3). The scale economies achieved through automation of servicing operations in the 1980s have allowed the most efficient lenders to increase the size of their servicing portfolios.

Sheer size has in turn required the largest servicers to make continual technology expenditures to be able to process the growing number of loans in their portfolios. That investment has yielded greater economies of scale for the very largest servicers, increasing their demand for even larger levels of servicing in their quest to further lower unit costs. Servicers who made a commitment to growth to achieve additional economies of scale have actively sought loans to purchase or subservice. Firms that were too small to achieve economies on their own left the servicing industry or out-sourced the servicing function to very large servicers.

Figure II-3
Market Share of Top Mortgage Servicers



Source: National Mortgage News, Inside Mortgage Finance

Changes in accounting rules have also spurred the consolidation trend in mortgage servicing. Those rules now require that servicing rights, whether purchased or generated from in-house production, be capitalized and recorded on the balance sheet as assets.[8] Gains in the market value of mortgage servicing rights are booked on the income statement of the firm and amortized over the life of the loan. As a practical matter, firms must periodically revalue their mortgage servicing rights on the basis of market conditions and reflect any change on their balance sheets. Consequently, firms are pursuing hedging strategies to offset potential changes in valuation. New accounting rules also address how firms must account for the changing values of hedging instruments.[9] Servicing requires sophisticated modeling and managerial expertise to ensure that hedging strategies are effective and accounting rules are followed. That expertise is expensive, especially for small and mid-size servicers, and is another factor inducing many of those firms to quit the industry by selling their servicing to the largest servicers.[10]

Limited Technological Innovation in the Mortgage Settlement Services Industries

A variety of firms provide services that lenders need to originate single-family mortgages and sell them to the secondary market. Appraisers, mortgage insurers, title insurers, and pest control and environmental inspectors provide assurance to mortgage lenders, consumers, and investors in mortgage-related securities that the collateral value of a property is sufficient to support the mortgage loan requested, that there are recourse arrangements that reduce the share of the credit risk of the loan born by lenders and secondary market entities, and there are no title defects to ownership. Additionally, services performed by home inspectors, realtors, escrow agents and settlement attorneys, flood certification companies, hazard insurers, homeowner property warranty companies, and title insurers provide assurance to the consumer that the condition of a property is known, that the home is worth what the consumer is paying, and that most of the liabilities involved in buying the property are known and insured against. Many of those services are necessary even in a refinancing or home-equity lending transaction.

The settlement service industries have changed significantly due to technological innovation in single-family mortgage origination and have become both suppliers and

[8] Financial Accounting Standard 125 (now replaced by FAS 140) requires that all originated mortgage servicing rights are assigned a value and recorded on a company's balance sheet as an asset. They are subsequently amortized over their life and expensed on the income statement.

[9] Statement of Financial Accounting Standard Number 133 (FAS 133), *Accounting for Derivative Instruments and Hedging Activities*, requires, among other things, that entities recognize all derivatives as assets or liabilities on their balance sheets as a fair value or cash flow hedge. Different accounting applies to each hedge designation, with different effects on shareholders' equity and current earnings. FAS 133 became effective January 1, 2001.

[10] Michael Jacobides, "Mortgage Banking Unbundling: Structure, Automation and Profit", *Mortgage Banking*, January 2001, 28-40, argues that the consolidation in servicing is not due to economies of scale, but rather the declining transaction costs of buying mortgage servicing rights. He argues that the correlation between size and efficiency in servicing may be spurious—that is, better servicers grow, rather than bigger servicers become more efficient. Rather than changing economies of servicing, Jacobides argues that it is the vertical disintegration of the mortgage company and the differential rate of growth of servicing versus origination that determines the growth of servicing portfolios. Lack of public data on individual servicer costs makes it difficult to evaluate those arguments.

competitors with lenders in the provision of services to support real estate and mortgage lending transactions. However, a number of factors are limiting the extent to which settlement services firms are developing technological solutions to streamline their operations. First, the development of automated underwriting has reduced demand for some settlement services. For example, AUSs use data from borrower credit files obtained electronically from the three national credit repositories, rather that traditional credit reports produced by hand by credit reporting agencies, to evaluate borrower creditworthiness. Similarly, automated valuation models allow lenders and secondary market entities to use statistical valuations of properties, rather than full-blown appraisals, when underwriting some loan applications or valuing mortgage loans.

Second, mortgage settlement service providers face intense competition in their individual markets with very small profit margins. As a result, those firms generally lack capital to develop their own technologies and are relying on lenders and secondary market entities to provide connectivity solutions.

Third, the settlement service industries are highly regulated by the Real Estate Settlement Procedures Act (RESPA). RESPA was enacted in the mid-1970s to protect consumers from "excessive" referral fees between settlement service providers. However, technological and financial innovations in financial services in the last 25 years have changed single-family mortgage lending in ways that were not anticipated when RESPA was enacted. Legislation to reform the law in response to those changes has not been enacted. That failure to modernize RESPA, coupled with thin profit margins and a lack of capital, has slowed innovation by individual settlement services firms.

III. COMPUTER NETWORKS AND ELECTRONIC COMMERCE

Since the mid-1990s, computer networks and the Internet have changed how firms in many industries operate, both internally and in the markets in which they do business. Continual improvements in computing power, data storage, and data transmission bandwidth have lowered the cost of information and thereby transaction costs, increased the demand for inter- and intra-firm connectivity, and contributed to changes in workflow processing within firms. Firms are reevaluating and changing how they are organized, which in turn is leading to further reductions in transaction costs. Lower information and transaction costs and greater organizational flexibility are allowing firms to reinvent the ways in which they do business, focus their activity on what they do best, and deconstruct hierarchical structures to take advantage of an increasingly connected workforce. A large and rapidly growing number of firms are engaging in electronic commerce and pursuing online business models.

This chapter examines the far-reaching implications of computer networks, and especially the Internet, for how firms organize themselves and do business. Separate sections discuss the development of computer networks, their potential implications for firms and markets, different models for doing business over the Internet, choices firms must make in deciding to do business with their customers online, issues in managing online and traditional business models simultaneously, and the potential implications of electronic commerce for industry structure.

The Development of Computer Networks

Computer networks were created after the introduction of the personal computer in 1981. Prior to the personal computer, firm computer resources were centralized in one location. Using highly centralized computer operations, businesses sought to increase productivity through automation of internal operations, such as payroll, inventory control and accounting. Connectivity—real-time sharing of information among computers—was virtually non-existent. Remote access to the mainframe computer of the firm was through "dumb" terminals that had no processing capabilities. The introduction of personal computers provided employees with word-processing and spreadsheet applications. However, organization-wide integration of computer capabilities was lacking due to non-connectivity.

The first type of computer network—the local area network (LAN)—was a response to the need to connect personal computers, mainframes, mini-computers, and printers within a firm. Most computers (personal or otherwise) could not communicate with each other directly, and the transfer of information often involved printing out data and manually reentering the information into another computer. Many information technology professionals characterize the creation of computer networks as an attempt by the firm to regain a centralized control of computer resources that had been lost under an environment of stand-alone personal computers. In 1990, only 25 percent of personal

computers used by businesses were connected to a network. By 2000, an estimated 75 percent of all business personal computers were networked.[11]

Firms benefited from the creation of LANs in many ways. Local networks reduced the number of printers and peripheral equipment necessary to support business activity. Networks also allowed standardization of software applications across the corporation, which yielded significant cost savings—site licensing versus individual copies, for example. Further, networking allowed for corporate-wide sharing of documents in a similar application. Corporate communication across a centralized E-mail system significantly improved morale and productivity.

The Internet is the fastest-growing communication technology ever developed. The number of Internet hosts—Internet service providers—rose from less than 100,000 in 1988 to more than 36 million in 1998. The number of Internet users worldwide was estimated at more than 143 million in 1998[12] and nearly 606 million as of September 2002.[13]

Networks can be "real" or "virtual".[14] A real network has physical connections between nodes, like a railroad network or the phone system. Virtual networks do not have physical connections. The users of a computer application or specific computer equipment, like users of Microsoft Word or MAC personal computers, form a virtual network. Computer networks, including the Internet, are real networks. Both types of networks have a fundamental economic characteristic: the value of connecting to the network increases with the number of people connected to it.[15] In addition, networks allow easier entry into and exit from markets and permit firms to compete in new ways.

Implications of Computer Networks

Rapidly growing connectivity has led to rapid innovation. Tremendous productivity gains, falling transaction costs, and the rapid growth of networks have created significant changes and opportunities. As information technologies have made richer and more continuous information flows with parties "outside" the firm much more economical, firms are interacting with suppliers and customers in new ways. Specifically, computer networks are allowing firms to coordinate and integrate communication and computer applications corporate-wide, and the Internet is creating the opportunity to integrate computer applications industry-wide.

Firms are using computer networks to create decentralized, less hierarchical operations and decision-making and to rely on the marketplace to provide goods and

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[11] Moscella, David, "Waves of Power: Dynamics of Global Technological Leadership, 1964-2010," a study by American Management Associates.

[12] See US Department of Education, "Human Development Report 1999," Washington DC, 1999, 58.

[13] See http://www.nua.ie/surveys/how_many_online/index.html, published by Jupitermedia Corporation.

[14] See Shapiro, Carl and Hal R. Varian, *ibid*, 174.

[15] That is an example of network externalities, which exist when the value of a good or service is at least in part a function of the number of people using that product or service. Positive network externalities arise when a good is more valuable to a user the more users adopt the same good or compatible ones. See Tirole, Jean, *The Theory of Industrial Organization*, MIT Press, 1994.

services traditionally produced internally. In addition, businesses are beginning to adopt interactive, customized customer relationships, relying on the vast amount of consumer information present in their databases to identify the least or most profitable customers. Armed with that information, firms are targeting their activities to retain the most profitable customers and limit relationships with the least profitable. Firms are also using the Internet to facilitate outsourcing of business activity for efficiency.

The ability of groups of firms that use complementary technologies to benefit from network economies is influencing the structure of markets, and the impact of those network economies is beginning to rival the impact of traditional, firm-level scale economies.[16] Low-cost information enables the substitution of flexible, decentralized, real-time decision-making networks for inflexible command-and-control structures. As a result, the structures companies have traditionally adopted may no longer be necessary. In fact, current realities may require companies to reinvent the way they do business in order to focus their activity on what they do best, and to "deconstruct" hierarchical organizations to take advantage of an increasingly "connected" workforce.[17]

The implications of the Internet for the boundaries between firms and markets are difficult to grasp. Management often refers to activities as processes rather than businesses because they assume that the activities should coexist within the firm. The conventional wisdom is that the management of customers, product research and development, and infrastructure must be combined within a single company. If those activities were located in separate companies, it is argued, the costs of coordinating them would be too great. That view—often termed Coase's law after a Nobel Prize-winning economist who first analyzed how firms decide whether to perform activities themselves or rely on markets over sixty years ago—implies that a firm should expand its range of activities by vertically integrating until the cost of performing a transaction inside the firm exceeds the cost of performing the transaction outside the firm.[18]

Coase explained that a firm and a market are alternative means of organizing economic activity. He emphasized that the use of the marketplace involves costs, which help to determine market structure. When costs of buying from other firms are low, a firm is more likely to buy supplies from others than produce the supplies internally. Coase identified three kinds of transaction costs—search costs, contracting costs, and coordination costs. Search costs take into account all the effort a company would have to go through whenever it needed to find other companies with which to do business. Contracting costs involve legal expenses, time spent in negotiations, and other costs of contracting business. Coordination costs are the time and effort a company must expend

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[16] See Malone, Thomas, and Robert Laubacher, "The Dawn of the E-Lance Economy," *Harvard Business Review*, September-October 1998, 145-152 for an excellent argument that a network of independently acting individuals is better able to respond to complex situations than a single centralized body.

[17] Hagel, III, John, and Marc Singer, "Unbundling the Corporation," *Harvard Business Review*, March/April 1999.

[18] Coase, Ronald H., "The Nature of the Firm," *Economica*, 4, November 1937, 386-405, sought to explain why vertically integrated firms in the 1930s such as General Motors owned rubber plantations, glass factories, and other facilities used to produce goods used in making cars rather than buying the goods from suppliers.

to bring together the supplies, labor, and management expertise needed to produce a good.

How has the Internet affected Coase's Law? On the one hand, the law is as valid as ever. But the Internet has caused all three of Coase's transaction costs to decline sharply. Search costs? There are any number of Internet exchanges created to inform firms about suppliers and prices of the goods and/or services. Contracting costs? Online clearinghouses for products exist where, with a few clicks of a mouse, a firm can contract for price, quality and delivery date. Coordination costs? The Internet allows for real time review of location and delivery times of orders.

Coase's Law, revised to reflect the implications of the Internet, can be read in reverse.[19] Firms should shed activities until the cost of performing a transaction internally no longer exceeds the cost of performing it externally. Transaction costs are now often more expensive within the corporation than in the marketplace. It is important to note, however, that the Internet has caused transaction costs to fall not only in the marketplace but also inside the firm.

One key issue in achieving network efficiencies is the development and use of both firm and industry-wide data standards. The lack of firm-specific data standards has created a major impediment to integration of firm operations, and the situation is worse between firms. Exchanging non-standardized data within a firm, let alone across business partners, has been the single biggest impediment to achieving network efficiencies for many firms, including those in the single-family mortgage finance industry, as will be discussed in more detail in the next chapter.

Internet Business Models

e-Commerce and e-business are terms commonly used to describe the use of Internet sites to conduct business activities and pursue multiple business strategies. There is a useful distinction between those terms, however. e-Commerce involves exchanges among customers, business partners, and service providers. e-Business is composed of those same elements, but also includes activities that are conducted within the business itself such as production, development, and product management.[20] e-Business and e-commerce have increased the speed of business transactions and thus have intensified competition. In addition, customers expect access to products and services on a 24-7 basis (24 hours-per-day, 7 days-per-week), and the easiest way for firms to provide that is to move operations online. Major organizations as well as smaller firms are working

[19] For discussions of Coase's Law and the Internet, see Brynjolfsson, Erik and Lorrin Hitt, "Information Technology and Internal Firm Organization: An Exploratory Analysis," *Journal of Management Information Systems*, 14, Fall 1997, 81-101; Downes, Larry, and Chunka Mui, *Unleashing the Killer App* Cambridge, MA: Harvard Business School Press, 1998; and Tapscott, Don, David Ticoll, and Alex Lowy, "Internet Nirvana," *eCompany Now*, December 2000, available online at http://www.business2.com/webfile/0,1638,8850,00.html.

[20] See Bartels, A, "The Difference Between e-Business and e-Commerce," *Computer World*, October 2000, 41.

hard to incorporate Internet and Internet technology into existing systems and new information systems designs. Firms must adjust constantly to new technologies.

The latest waves of Internet technologies that facilitate "electronic commerce" have direct antecedents: LAN applications within firms and EDI[21] networks among firms and their business partners in many industries. Although the term e-commerce is fairly new, large firms have been conducting e-commerce for decades by networking their systems with those of business partners and clients. The banking industry has been using electronic funds transfer (EFT) to transfer money between accounts since the 1970s, for example, and EDI has been around since the early 1980s.[22]

There are a number of benefits of bringing a business to the Internet. An e-business can offer personalized, high-quality customer service and improved management of distribution channels and the processes that support them. There are many business models being pursued by firms on the Internet. The following discussion will review three business-to-consumer (B2C) models—the storefront model, the auction model, and the portal model—and the most common business-to-business (B2B) e-commerce model—the exchange site.

The storefront model is the basic business-to-consumer (B2C) e-commerce business model. Amazon.com is an example of a firm that pursues that business model. It combines the transaction processing, security, online payment, and information storage that firms need to sell their products online. To conduct storefront e-commerce, firms need to create online catalogs of products and be able to take orders through their Internet sites, accept secure payments, fulfill customer orders, and manage customer data. They must also market their site to potential customers. One e-commerce application that facilitates that business model is the shopping cart, an order-processing application that allows customers to accumulate items as they shop. Supporting the shopping cart is a product catalog, hosted in a database on the merchant web site. The database server stores all product offerings and customer information such as names, addresses, credit-card data, and past purchases. While shopping cart technology offers consumers the convenience of easy transactions, it creates problems regarding privacy and online security.

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[21] EDI requires a fixed format, with individual data elements defined. No two firms defined the record format the same way, and few firms even defined the data elements similarly. EDI works very well for firms with large volumes of information, but even for large firms the task of maintaining multiple EDI standards for individual business partners is daunting. EDI involves five main processes: extracting data from a computer system; translating the data into a transmittable format; transmitting the message; translating the message at the receiving end; and downloading the data into the receiving computer application. EDI standards define the techniques for structuring data into an electronic message. EDI translates messages as they move from standard to internal formats and vice versa.

[22] Because of its use of "vintage" technologies, EDI has been viewed as vulnerable to alternative strategies for e-commerce. Perceived as the lower cost model for e-commerce, the Internet is threatening to displace EDI. EDI networks, however, greatly surpass Internet-based business-to-business e-commerce in terms of business volume. For example, in 1998, business-to-business (B2B) e-commerce in the US totaled $671 billion, of which Internet-based transactions only represented $92 billion. Internet-enabled EDI transactions in 1999 were less than 10 percent of all EDI traffic. See Giga Information Group press release, "Old E-Commerce Plus New E-Commerce to Drive Economic Value of Electronic Transaction to $3. 8 Trillion by 2002," February 8, 2000.

Auction websites pursue distinct B2C business models and act as forums through which Internet users can act as either buyers or sellers. E-bay.com is an example of a company that pursues the auction business model. Sellers post items on the site that they wish to sell, the minimum price, and a deadline to close the auction. Buyers search the site for items, view current bidding activity, and place bids. There are many different forms of auction sites. A reverse-auction site allows the buyer to set a price that sellers compete to match or beat. Although a commission is generally assessed on any sales, most auction sites function only as a forum for negotiating the transaction and do not involve themselves in payment or delivery of the goods purchased. Fulfillment of the transaction is negotiated between the buyer and seller.

Portal sites give visitors a wide variety of information in a single place. They may offer news, sports, business, and weather information as well as the ability to search the Internet. Search engines are horizontal portals, or portals that aggregate information on a broad range of topics. Yahoo.com is an example of a horizontal B2C portal.

Portals may also provide access to online shopping. Firms that operate a B2C portal site generally link their search engine to online shopping. B2C portals that link consumers to online merchants, shopping malls and auction sites have some competitive advantages. Those portals help visitors to use their search engines to acquire information on items and allow users to browse a variety of sites while maintaining the convenience of paying through their portal account. Most portals attract visitors because of their search engines.

The term B2B refers to the relationship(s) between two or more companies. Online or offline, the term B2B can be applied to the simple relationships between a single buyer and a single seller, as well as to complex distribution and fulfillment systems that link many suppliers and manufacturers. B2B business models are pursued to facilitate those relationships. While business-to-business activity exists both online and offline, the acronym B2B has primarily been used to describe the online variety. Most B2B business models are based on the technology of vertical portals, which are those that offer a great deal of information pertaining to a single area of business or interest.

B2B exchange sites provide a method of buying, selling, bartering, and partnering in a standardized environment. The typical B2B exchange site allows manufacturers, wholesalers, retailers, and consumers to engage in commerce over the Internet. B2B e-commerce and the use of exchange sites allow businesses to reach their markets faster and more efficiently. Firms can arrange shipment of supplies at the exact time they are needed, reducing inventory expense. In fact, the increasing number of firms offering business-specific computer software and technology services is a factor for firms deciding whether or how to bring a traditional business to the Internet. It is generally far easier and less expensive to develop business relationships with firms that have established technologies and to license or purchase turnkey business applications than to develop those systems in-house.

Dynamic-pricing business models generally combine the portal search engine with innovative pricing structures and almost always are B2C. Some of those models

allow buyers to name their own price for goods and services (for example, Priceline.com). Others combine search engines with the ability to search multiple sites for the lowest available price (for example, bottomdollar.com), and some allow buyers to shop in large groups to obtain group discounts (for example, shop2gether. com pursues a group purchase model for educational institutions). Others allow for bartering goods and services (for example, intagio.com provides a B2B website to barter goods and services between firms), provide rebates for purchasing goods and services (for example, ebates.com and coupons.com), or offer free products and services, relying on advertising revenues to fund the site (for example, 2000freebies.com and killerfreebies.com). Specifically, those business approaches can be characterized as name-your-price, comparison-price, demand-sensitive, barter, rebate, and free-goods-and-services models.

Choices Required by B2C e-Business Models

For established firms, exploring the advantages and disadvantages of developing an Internet presence requires determining whether they should develop the new channel to enhance their traditional bricks-and-mortar approach—that is, convert to a bricks-and-click business—or whether they should create an Internet-only business. Internet-only firms face challenges not faced by bricks-and-click firms. Those include name recognition and customer satisfaction as well as the challenge of customer relations. That is particularly true for online firms offering B2C services. Exchange or return of merchandise is awkward, requiring shipping and delivery. A bricks-and-click business model allows customers to shop online and pick-up the ordered goods at a retail location. Online purchases can also be returned to the retail location.

There are circumstances where it is more economical to operate as an Internet-only business. The overhead costs of Internet-only businesses are generally lower than those for a traditional retail business. There are pitfalls, however. The cost of computer equipment and the maintenance expense of a 24-7 Internet-only business can be high, especially if incorrect technology decisions are made. Additionally, recent experience of consumer behavior in online commerce suggests that some transactions, generally those involving high priced items, are not easily consummated online. Many consumer surveys indicate that online shoppers prefer face-to-face communication before completing a major financial transaction.

Issues in Managing Multiple Business Models

All technological revolutions create winners and losers. As suppliers leapfrog existing business partners, there are unanswered questions about the future relationships among current partners and how to manage the process of change. It is important to keep in mind that the advent of the Internet era is not the first time that the development of alternative channels of distribution has resulted in channel conflict. In the transportation industry in the 20th century, for example, trucks displaced the railroad, which had displaced river barges and inland shipping, in delivering goods to market. When firms bring goods and services to market, they begin by using a distribution network. Over time, large customers develop, providing an incentive for the firm to “go direct” and by-pass the existing channel. That immediately concerns the distributor who helped build

the sales with those customers. Additionally, the firm and the distributor must deal with the need for the distributor to support existing, smaller customers who do not warrant direct service. What is the motivation for the distributor to build future customer volume, if it means that the firm will directly approach those customers?

It is not always the case that the alternative distribution channels have to work in opposition to each other. In many cases, the alternative channels may support each other. With the Internet, customers can gather a significant amount of information about products and services, and then consummate the final transaction through a local firm. In that case, the Internet and the retail outlet are working in conjunction with each other. As long as the ultimate sale is completed with the firm, the firm does not care through which channel the customer gathered information before deciding to buy. The main reason why firms are pursuing Internet channels is to move the transaction to the medium that provides the greater overall margin, either by commanding a higher price and/or by incurring lower costs. It is not as critical that the Internet sale generates an incrementally larger volume of sales, as it is that the business be conducted through the highest-margin channel. Many firms are consciously attempting to use alternative channels to serve different market segments. The expense of developing the Internet distribution channel, however, is daunting for many established firms.

Managing online distribution channels is one of the most difficult issues facing firms today. While many firms are eager to sell through the Internet, the prospect of competing with existing channels is giving many firms pause. Coupled with the propensity of buyers to "channel surf"—scatter buying activity over many channels—firms are having problems estimating the effectiveness of their channel decisions, in particular their online channels. Additionally, companies are finding it is very difficult to merge their established channels with e-commerce. The future winners will be those firms that manage their sales activities across multiple channels and are able to balance commitment and investment between established and emerging channels.

The Internet and Industry Structure

By allowing non-traditional competitors to enter and exit markets easily, the Internet has potentially far reaching implications for the structure of many industries. Changes in and unbundling of business processes may eliminate competitors, suppliers and business partners, and create opportunities for new non-traditional competitors. The term disintermediation is often used to describe that phenomenon.[23]

For every distribution activity, from commodities to consumer goods, there are middlemen—wholesalers, financiers, insurers, transporters, and warehouse firms—that mediate between the producer of a good or service and the customer, either a firm or a

[23] The term disintermediation is also frequently used in a financial context. Financial intermediation is the placement of money with a financial intermediary (state and federally chartered financial institution, insurance company, brokerage firm) that invests in financial assets (stocks, bonds, mortgages and other loans, government obligations) to achieve a targeted return. Financial disintermediation refers to the removal of money from the financial intermediaries. For an in-depth discussion, see Tobin, James, "Financial Intermediaries," *The New Palgrave: A Dictionary of Economics*, McMillan Press, 1989.

consumer. Those middlemen are valuable only if they can perform functions more cheaply than the producer or alternative providers. Disintermediation in distribution refers to customers forsaking traditional means of distributing goods or services in favor of some alternative, more direct means of delivery of the value of those goods or services. For example, customers may use the Internet to order directly from the producer or through an integrator or consolidator.[24]

As technology and the Internet reduce transaction costs in the open market, the value added by using a middleman comes into question. If buyers and sellers can find each other inexpensively over the Internet, why use agents and distributors that cost more? Complex transactions are being disaggregated, and middlemen who do not provide sufficient value to the transaction are being displaced. The industries most at risk for disintermediation are those in which the market is moderately consolidated, purchasing decisions are not complex, and the cost of distribution is significant. It is postulated that the opportunity for disintermediation exists in direct proportion to the degree of concentration in an industry.[25] Similarly, in markets that are highly fragmented, new entrants are reintermediating the markets by serving as third-party information brokers or market makers.[26]

[24] See Cort, Stanton, "Industrial Distribution: How Goods will go to Market in the Electronic Marketplace," *Business Economics*, January 1999, 53-55, for a discussion of disintermediation in e-commerce.

[25] See Alsop, Stewart, "Is There an Amazon.com for Every Industry?" *Fortune*, January 1999, 159-160.

[26] See Spulber, Daniel, *Market Microstructure: Intermediaries and the Theory of the Firm*, Cambridge University Press, 1999 for an overview of intermediation theory and the role of intermediaries in the US economy.

IV. THE DEVELOPMENT OF NEW CREDIT RISK MANAGEMENT TECHNOLOGIES IN SINGLE-FAMILY MORTGAGE LENDING

The adoption of automated underwriting systems (AUSs) was the single most important technology development in the mortgage lending industry in the 1990s. Those systems, which use scoring technology to evaluate the credit risk of individual mortgages and loan portfolios, revolutionized the underwriting of prime conventional and later all single-family mortgages. They have also led to sweeping changes in how servicers handle delinquent loans.

The use of automated underwriting and the Internet, in combination, significantly reduce the costs of communicating and doing business among mortgage brokers, mortgage companies, Fannie Mae and Freddie Mac, and firms that provide settlement services for the mortgage or real estate transactions. Together, those two technologies have fostered new visions of how single-family mortgage lenders and secondary market entities can manage credit risk, communicate, and do business. This chapter examines the use of scoring technology and automated underwriting in single-family mortgage lending. Chapter V examines the use of the Internet by the mortgage industry, including the role of AUSs in e-business mortgage lending models.

Scoring Technology

Early in the 1990s, the mortgage insurance industry developed and began using scoring technology. Scoring is the process of using statistical models to evaluate the credit risk of specific borrowers or loans.[27] Mortgage insurance firms developed scoring technology for two main reasons: to better evaluate the risks of loans they were underwriting for insurance and to position themselves to provide delegated underwriting to small to mid-sized mortgage lenders. Single-family mortgage lenders were slow to adopt that new risk measurement technique, however, and the volume of delegated underwriting by mortgage insurers was small. It was not until first Freddie Mac and then Fannie Mae introduced their AUSs in 1995 that lenders began to take scoring seriously.

There are three types of scoring models: credit-scoring models, mortgage scoring models, and mortgage delinquency models. All three of those models are used in mortgage lending; however, it is important to note that the models are evaluating different aspects of credit performance. Credit scoring models rank prospective borrowers in terms of their predicted performance on any type of consumer loan—a residential mortgage, a credit card, a home equity loan, or an auto loan. Mortgage scoring models rank specific residential mortgage loans in terms of their predicted performance. Mortgage delinquency scoring models rank specific delinquent mortgage loans in terms of their predicted performance. The latter two models use data present in credit bureau files combined with data collected directly from the credit applicant.

[27] See Office of Federal Housing Enterprise Oversight, "Use of Scoring in Mortgage Lending," in *1996 Annual Report to Congress* (Washington, DC: Government Printing Office, 1996), 22-29, for an analysis of scoring and its potential effects on single-family mortgage lending.

Credit bureau scores use credit history data of a potential borrower to measure the relative risk that the borrower represents to a consumer lender. There are three major credit repositories that prepare credit scores, called FICO scores, based on credit scoring models developed by Fair, Isaac and Company, Inc. They are Equifax, TransUnion, and Experian. Since FICO scores are calculated at the repository and are based solely on the data within that repository's files, the three repositories can generate different scores for the same borrower. Those scores can differ because no single bureau has all of the credit history of an individual (bureau files differ based on geographic area). Additionally, even though Fair, Isaac and Company developed the scoring models for the repositories, the computer systems weigh all information to determine scores according to proprietary algorithms that differ from Equifax to TransUnion to Experian. Consequently, secondary market and mortgage insurance firms generally require that two FICO scores be obtained per borrower and mandate the use of the lowest of the obtained scores.

Mortgage scoring models use credit bureau data and information from an application for a mortgage to measure the predicted performance of that loan. Mortgage scoring models weigh all information to determine the likelihood that the loan will perform as agreed, based on the way similar mortgages with comparable borrowers, properties, and loan characteristics have performed in the past. Mortgage scoring models balance the basic credit elements in a loan application (generally more than ten) to allow for a consistent assessment of the thousands of possible combinations that those elements can represent. Most mortgage scoring models are designed to handle risk combinations numbering in the millions.

Mortgage delinquency models use credit bureau data, information from the application for a mortgage that is now delinquent, and data on how the loan has performed in the past (especially when and how long it has been delinquent), to measure how the mortgage is likely to perform. Mortgage delinquency models are also known as behavioral scoring models because they take into account information on the past behavior of the borrower responsible for repaying the loan.

Automated Underwriting

In the mid-1990s, automated underwriting revolutionized how residential mortgages were underwritten. There are three basic components of single-family mortgage underwriting: 1) determining the ability of the consumer to make the monthly mortgage payment; 2) determining the willingness of the consumer to pay his debt in a timely manner; and 3) determining the value of the collateral underlying the mortgage. Automated underwriting replaced rules-of-thumb human underwriters and detailed underwriting guidelines with computer-assisted decision tools that more accurately assess the ability and willingness of consumers to repay their loans.[28]

The widespread adoption of automated underwriting was made possible by the dominance by Fannie Mae and Freddie Mac of the secondary market for conventional

[28] See Straka, John W. , "A Shift in the Mortgage Landscape: The 1990s Move to Automated Credit Evaluations," *Journal of Housing Research,* 2000, Vol. 11:2, 207-232, for a history of the development of AUS in mortgage lending.

fixed-rate mortgages (FRMs). During the 1980s, the thrift industry had desperately needed the liquidity provided by the Enterprises to continue to survive. As a consequence, originating FRMs that did not conform to Fannie Mae and Freddie Mac underwriting standards became unattractive, since such loans were simply less valuable. For that reason, mortgage originators, whether or not they intended to sell their loans to the Enterprises, adopted the business practice of structuring their loan programs to conform to Freddie Mac and Fannie Mae underwriting guidelines. As a result, Fannie Mae and Freddie Mac have for some time effectively determined terms and conditions of most conventional fixed-rate loans with principal balances that make them eligible for Enterprise purchase (so-called non-jumbo mortgages).

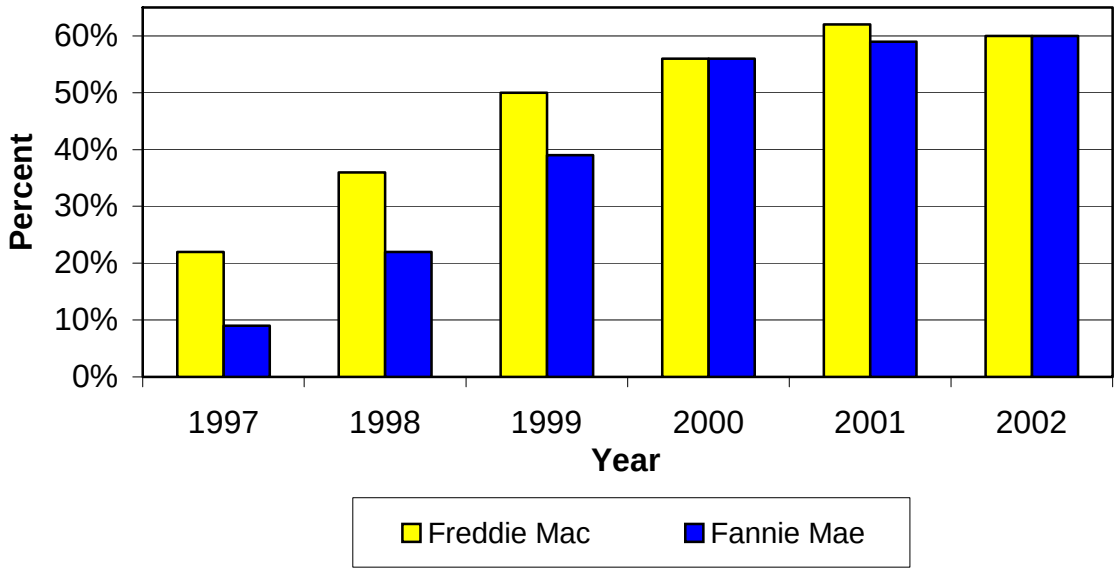
In 1995 Fannie Mae and Freddie Mac each began using a proprietary AUS to assess the credit risk of single-family mortgages prior to purchase. Each Enterprise uses a version of its AUS to evaluate at acquisition any mortgage that was not evaluated using the system prior to purchase. In 2002, 8.2 million loans purchased by Freddie Mac were evaluated using its Loan Prospector system, an amount that comprised 60 percent of the business of Freddie Mac, compared to 62 percent in 2001 (see Figure II-4). More than 10 million loans were processed through the Fannie Mae Desktop Underwriter system in 2002, representing 60 percent of purchased loans, up from 59 percent in 1999. Each Enterprise also allows some large lenders to use their own AUSs to evaluate mortgages before selling them to the Enterprise. As a result, those data understate the proportion of loans purchased by the Enterprises that were evaluated using automated underwriting prior to purchase.

Once Fannie Mae and Freddie Mac began to use scoring and automated underwriting in their internal business operations, it was not long before each Enterprise required the single-family lenders with which it does business to use such tools. The Enterprises did so by including the use of those technologies in the conforming guidelines for their seller/servicers.[29] For example, Freddie Mac, which started researching the use of scoring for internal credit risk management purposes in the early 1990s, required lenders to collect FICO scores in new Seller Guidelines published in February 1995. In general, when the Enterprises adopt new standards and technologies in their business operations, they seek to have originators and services in the primary market adopt them in order to maximize the benefits realized in terms of increased business volumes and better risk management.[30]

[29] In this paper, the term seller/servicer refers to a mortgage lender approved to sell loans to or service loans for an Enterprise.

[30] See Van Order, Robert, "The Structure and Evolution of American Secondary Mortgage Markets, with Some Implications for Developing Markets," *Housing Finance International*, September 2001, 16-31, for an extensive discussion of why the secondary market requires lenders to adopt secondary market standards and technology.

Figure IV-1
Percent of Mortgages Evaluated by Enterprise Automated Underwriting Systems Prior to Purchases*



Source: Inside Mortgage Technology, Volume 7, Issue 2
*** Based on recently originated mortgages not included in structured transactions**

The ability of Fannie Mae and Freddie Mac to establish underwriting terms and conditions for conventional single-family mortgages has allowed them to become the most significant providers of AUSs and related credit risk management technology in the primary mortgage market. For example, in 2002 more than 90 percent of the largest mortgage lenders (who controlled 95 percent of 2002 mortgage originations) had implemented an AUS, with an estimated three-quarter of all 2002 mortgage originations being underwritten through an AUS.[31] The Desktop Underwriter system of Fannie Mae was implemented on 69 percent of lender systems, whereas the Loan Prospector AUS of Freddie Mac was implemented on 73 percent of lender systems in 2002. The Assetwise system of Residential Funding Corporation (RFC), a large non-GSE mortgage conduit, and the CLUES system of Countrywide, the largest independent mortgage company, were a distant third and fourth with 14 percent and 13 percent, respectively.[32]

Lenders are increasingly using automated underwriting as a filter to help streamline work processes and risk management decisions. Workflow processing improvements from using an AUS can occur, for example, where borrowers with high credit or mortgage scores are exempted from documentation requirements. Conversely, borrowers with low credit or mortgage scores may receive more attention when applying for a mortgage. Devoting less scrutiny to loans judged to pose low risk and increased scrutiny to loans posing higher risk may result in lower overall underwriting costs.

[31] See *MORTECH 2002, Management Summary*, MORTECH, LLC, Chester, CT, 64-69.
[32] *Ibid.* 68.

Automated underwriting has also improved quality control reviews for lenders, allowing their auditors to do more comprehensive reviews of files with low scores. Fannie Mae and Freddie Mac have modified their AUSs to allow streamlined documentation for low-risk borrowers.

A consequence of the use of scoring and automated underwriting has been the extension of mortgage credit to some households traditionally viewed as higher-risk and to markets previously underserved by the mortgage lending industry.[33] Single-family mortgage lenders can now quantify mortgage credit risk and the values of many properties with a higher degree of consistency and objectivity. Credit scores and mortgage scoring models provide a wealth of data that lenders, mortgage insurers, and secondary market entities use to estimate statistically the risks associated with combinations of specific borrower, mortgage, and property characteristics.

Other Innovations in Credit Risk Management

Two other innovations—the use of behavioral scoring models in the management of delinquent loans and the use of automated valuation models (AVMs)—are changing how single-family mortgage lenders measure credit risk, manage loans in portfolio, and originate loans.

Fannie Mae and Freddie Mac are using behavioral scoring as a loss mitigation tool. Each Enterprise has developed a scoring software application that ranks a delinquent mortgage by both the credit risk of the borrower and the collateral risk of the property. Fannie Mae's product is called RiskProfiler, and Freddie Mac's product is called EarlyIndicator. Both of those products capture contemporaneous values for the credit risk of the borrower and the collateral value of the home. The applications allow servicers to grade a delinquent loan as a low, medium, or high risk in order to prioritize which loans need earlier intervention. That capability has allowed servicers to reduce expenses and focus their attention on the riskiest loans.

AVMs employ property-level databases and sophisticated modeling techniques to estimate the market values for properties. AVMs provide an alternative to property appraisals and, when used in the underwriting process, can reduce the cost of mortgage transactions. The incorporation of AVMs into AUSs to evaluate the collateral backing residential mortgages has allowed for reduced documentation in the appraisal process. Properties that can be valued by AVMs—when there are rich data on similar properties in the local market, for example—often are subject only to a "drive-by" inspection that verifies the current exterior condition of the property and guards against fraud involving non-existent properties. Fannie Mae and Freddie Mac have each modified its appraisal standards to accept streamlined appraisals when AUS and AVM evaluations have determined that a prospective loan poses a low level of risk.

[33] See Straka, John W., "A Shift in the Mortgage Landscape: The 1990s Move to Automated Credit Evaluations," *Journal of Housing Research*, 2000, Vol. 11:2, 207 –232.

V. SINGLE-FAMILY MORTGAGE LENDING AND THE INTERNET

The evolution of the Internet as a low-cost business medium and the use of automated underwriting systems and other automated credit risk management tools by lenders have had a major impact on the current state of the single-family mortgage lending industry. Many single-family mortgage lenders and other firms that provide services used in mortgage lending are pursuing e-business models. For some of those entities, the e-business model is their only business channel. For others, the Internet is viewed as one of many approaches to interacting with consumers or business partners.

The many e-business models being pursued by single-family mortgage lenders can be characterized generally as business-to-consumer (B2C) or business-to-business (B2B). B2C models focus exclusively on mortgage originations and the settlement services that are necessary to close the real estate or mortgage transaction and bring automated underwriting to the point of sale. The most common B2B e-commerce models attempt to support back-office functions—servicing and secondary marketing. In addition, there are B2B e-business models that focus on supporting the mortgage origination process.

The deployment of automated underwriting technology by Fannie Mae and Freddie Mac complements and enhances efforts by single-family mortgage lenders to move to e-business models. Each Enterprise has announced its intention to move its technology to the Internet in order to provide their customers with the option of conducting their business activities through the Internet. This initiative is promoting greater electronic connectivity for all industry participants and will facilitate the shift toward Internet-based lending models.

This chapter examines how single-family mortgage lenders and Fannie Mae and Freddie Mac are responding to the emergence of the Internet. The chapter discusses the Internet-related initiatives of Freddie Mac and Fannie Mae, the different types of e-business models that lenders are pursuing, and why the industry is taking advantage of the Internet more slowly than other industries. The chapter also discusses the collaborative efforts by the mortgage industry to define common data and communications standards and facilitate inter-firm electronic communication.

The Opportunities and Challenges for Mortgage Lenders Created by the Internet

For the typical single-family mortgage lender, advances in technology are creating opportunities to increase the volume of mortgage loans that can be managed with the same staff, reduce error rates, lower the number of times a file has to be handled, reduce fraud, reduce the time required to process and close loans, and make the collection and analysis of data much more efficient and effective. The challenge facing the industry today, however, is achieve processing efficiencies while at the same time meeting the changing expectations of consumer.

The Internet era has changed what financial services the consumer wants and how he or she wants them to be delivered. Surveys of consumer expectations indicate that

consumers want personalized services and solutions for his or her individual financial situation, not off-the-shelf, one-size-fits-all financial products. The home is no longer the "castle" to many homeowners, but a financial asset, one of many in the household's portfolio. Consumers view financial products, including mortgages, to be commodities with only the price differentiating product offerings.[34] And many consumers have ready access to price information via the Internet. Market research shows that consumers are becoming impatient with firms that fail to provide convenience and access to innovative products and that lack the ability to execute transactions quickly.[35]

Although the consumer wants personalized service from a single-family mortgage lender, originating a single-family mortgage is still a very complicated transaction. The lending process includes many steps that require many additional agents--title companies, flood certification companies, credit bureaus, home inspectors, appraisers, mortgage insurers, pest control inspectors, and real estate agents (if the transaction involves a home purchase). When considering alternative business models and organizational forms, lenders have traditionally focused on their own needs and those of their business partners. The shift in consumer expectations is forcing them to focus on consumer needs as well.

In the new customer-influenced world, mortgage lenders must both satisfy consumer expectations while at the same time adapting a technology infrastructure that has been primarily designed to process transactions and to meet the needs of investors. The emergence of the Internet and web browser applications is producing that change in the technology focus of mortgage firms. The need to incorporate the Internet as another distribution channel has opened the eyes of management to the convergence of digital technologies and has begun to change the concept of how the firm should be structured.

A useful way to think about the impact of the Internet on single-family mortgage lending is in terms of the value-chain formed by lenders and their business partners.[36] Outsourcing of functions previously performed by a lender is increasingly possible and offers a low-cost "off the shelf" option for both large and small firms. Disintermediation of firms—residential appraisers and settlement service providers, for example—by new business models is beginning and is likely to radically change the residential mortgage finance delivery system. The competitive advantage of proprietary software applications such as loan origination systems or servicing applications is disappearing, and the influence of e-commerce is changing competitors into suppliers of service.

e-Commerce requires current mortgage lenders to enhance the capabilities of existing software applications or develop new applications to meet the new demands for

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[34] See National Association of Realtors, *Real Estate and Technology*, November 1999 for a presentation of surveys of consumers' changing search behavior for real estate and mortgage services. See also www.realtor.com/research for surveys on the home buying and selling processes. A recent survey by the Mortgage Bankers Association of consumers' mortgage shopping behavior on the Internet during 2000 had the same findings. See *Real Estate Finance Today*, April 20, 2001, 1.

[35] There are many surveys documenting consumer desires and behavior. See the American Online/Roger Starch Worldwide Adult 2000 Cybersurvey, available online at http://media.aoltimewarener.com.

[36] Porter, Michael, *Competitive Advantage*, New York, NY, The Free Press, 1985 is widely credited for coining the phrase "value chain" while explaining the concepts of competitive advantage. In manufacturing, the equivalent term is supply chain.

information. Unlike the dot.com, online-only lenders, which started out in e-business mode, established lenders must undergo a number of transitions in order to become e-businesses. Lenders can choose to run in-house software developed and hosted by application service providers (ASPs); however, it is sometimes more cost- and technology-efficient to outsource. Outsourcing is an increasingly popular option for firms that do not have the resources to invest in developing their own computer technology.

Inter-company coordination is the heart of all e-business models. The Internet provides the perfect communications channel for information, decisions, transactions, and processes. B2B e-business models involve sharing operational and planning information with strategic business partners to coordinate the successful completion of activities. The widely held belief that the Internet-empowered consumer has changed the way financial services will be shopped for and delivered has changed the types of business models mortgage lenders are pursuing**.**

Enterprise Technology Initiatives That Support e-Business Mortgage Lending

A number of initiatives by Fannie Mae and Freddie Mac are increasing connectivity among single-family mortgage lenders and their business partners and making it easier for lenders to develop e-business lending models. Each Enterprise has developed a private electronic network to help lenders automate the mortgage process beyond the underwriting decision. Freddie Mac offers a private network—LoanProspector.com—that provides access to the Enterprise's own applications and to a virtual mall of mortgage settlement services, including appraisal, title search and insurance, and mortgage insurance.[37] Fannie Mae, through MORNETPlus, has linked with two major settlement service providers (REAL EC and First American) and several AUS providers (Countrywide, First Union, GE Capital, and GMAC/RFC). Each of those systems can underwrite FHA-insured, VA-guaranteed, and non-conforming conventional (both jumbo non-conforming and subprime) mortgages. MORNETPlus also allows lenders to order mortgage settlement services directly from providers. Industry analysts believe that the Enterprises' online initiatives will be a means by which the greater efficiency of the secondary market, which is already wringing excess costs out of the lending process, will result in savings in origination costs.[38]

Fannie Mae and Freddie Mac have each indicated that it intends to bring all of its business activities to the Internet. Each Enterprise offers a suite of lender-directed, Internet-based technology products. The central feature of each suite is online access to their automated underwriting system and greater electronic connectivity for mortgage brokers and lenders. A primary objective of the initiatives of Freddie Mac and Fannie

[37] Goldworks, an electronic network introduced by Freddie Mac in 1995, was intended to be a communications vehicle for the mortgage industry, not an applications platform. Goldworks currently can only be accessed through a dial-up connection or leased-line through AT&T, the technology service provider and host for that network.

[38] See Hodges, Michael, Gregory Hall, and Lawrence Rosenberg, *Home Run: Taking a Closer Look at Internet Mortgage Finance*, Goldman Sachs, November 1999; and Inside Mortgage Technology, *eLending: The Stampede to the New Mortgage Frontier*, March 2000.

Mae is to give lenders an incentive to do business with that Enterprise by enabling the lender to use their AUS and take advantage of the business opportunities afforded by the Internet.

Fannie Mae and Freddie Mac are also attempting to bring automated underwriting technology to the point of sale, providing connectivity between the mortgage broker (or other originator) and the lender. The mortgage broker enters the application data into a proprietary loan origination system and either electronically submits a data file to the lender or directly to Desktop Underwriter (DU) or Loan Prospector (LP) for an underwriting decision. Currently, the broker may only send data to DU or LP if a lender that is an Enterprise approved seller/servicer sponsors it. If the data file is submitted directly to the lender, the lender can underwrite the loan in-house or submit the loan file to an Enterprise AUS. In the latter case, after the lender receives the underwriting recommendation and documentation/appraisal requirements from the Enterprise AUS, it forwards them electronically to the mortgage broker.

Mortgage Originators Are Pursuing B2C e-Business Models

Single-family mortgage originators are pursuing four types of B2C e-business models. The first is the online full service lender. Examples of full service lenders that have Internet sites include Countrywide, Washington Mutual, Chase, IndyMac, Wells Fargo, Bank of America, and ABN AMRO. Those lenders have incorporated the Internet as part of their retail channel. They also maintain wholesale and correspondent relationships with mortgage companies and mortgage brokers. The firms use their Internet sites to pre-qualify mortgage applicants, allowing for application entry, processing, and approval. Completion of the origination, as well as funding, securitization, and servicing, are still done off-line.

Other firms are pursuing multi-lender B2C models. Those firms act not necessarily as lenders but as referral sites. Firms pursuing that e-business model include Priceline.com, LendingTree.com, and MortgageIT.com. Those firms pre-qualify and accept applications but do not approve and close loans, instead referring consumers to lenders.

Pure Internet lender sites are another type of B2C business model. Examples of those firms would include E-Loan, FiNet.com, and mortgagebot.com. Those sites pre-qualify applicants, accept applications, and, in some cases, process and approve applications online. Closing is still performed off-line.

The last B2C business model being pursued is the mortgage value network, which is a portal business model that links consumers to online lenders. Firms that are pursuing that model include AOL, HomeAdvisor, Intuit, and Yahoo! Those sites can pre-qualify and accept applications online; however, processing and closing are performed off-line.

B2B e-Business Models Exist in All Segments of Mortgage Lending

B2B business models range from mortgage exchanges to electronic partnership networks. Mortgage exchanges can allow for online trading of whole loans and structured mortgage products. They also can support an online marketplace for the search, comparison, pricing, and locking of mortgage loan transactions. Examples of mortgage exchanges include IMX Exchange and Lion Choice. Those firms concentrate on the sale and securitization of mortgage originations.

An application service provider (ASP) either provides connectivity or products and services. ASPs that provide connectivity include Ellie Mae, eMagic.com, Ocwen, Fannie Mae (MORNETPlus), Freddie Mac (Goldworks), and various loan origination system (LOS) vendors. Ellie Mae provides pre-qualification and application capability. eMagic.com and LOS vendors can also provide processing and approval. ASPs that provide products or services would include First American, eOriginal, FNIS, BridgeSpan, and ALLTEL. First American provides computer applications for the processing and approval of mortgage loans, while eOriginal and FNIS provide closing and funding services. Fidelity provides servicing services.

The Internet initiatives of Fannie Mae and Freddie Mac are B2B e-business strategies. The Enterprises provide connectivity to lenders to facilitate the origination, sale, securitization, and servicing of mortgages. Both LoanProspector.com and MORNETPlus can be classified as B2B exchanges designed to allow lenders, servicers, and other business partners to reach their markets more quickly and efficiently. Neither Enterprise provides products or services directly to consumers; rather, each Enterprise provides a technology platform that allows its business partners to provide those services to consumers. Freddie Mac does, however, provide services directly to mortgage brokers, whereas Fannie Mae does not.

Single-Family Mortgage Lenders Are Slow to Shift to e-Business Models

Despite the extraordinary innovation in computer and communication technologies over the past decade and the wildly excited media attention to online single-family mortgage lending initiatives in recent years, the industry has been slower to adopt new technology than other financial service industries.[39] Mortgage lenders have been reluctant to shift to e-business business models and have not been aggressive in adopting Internet technologies to their operations. Mortgage lender investment in Internet technology can be described as defensive and done only to keep pace with competitors. For example, large lenders view other large lenders as their competition. Wholesale lenders view other wholesale lenders as their competition. The demise of pure-Internet competitors during 2000 and 2001 has lowered both lenders' fear of new competitors displacing them and

[39] See Inside Mortgage Finance Publications, *Mortgage Business on the Internet: The Migration to E-Markets*, 2000; and Inside Mortgage Technology, *eLending: The Stampede to the New Mortgage Frontier*, 2000. See also, Baghai, Pooneh, and Beth F. Corbet, "The Virtual Reality of Mortgages," McKinsey Quarterly, 2000, 61-69.

the level of their investment in Internet technologies. Among the many reasons cited for that view are:[40]

- Lenders have little capital to invest in newer technologies;
- The mortgage industry is in transition, with large originators and servicers increasing market share and the task of integrating multiple technology solutions across acquired firms and loan portfolios becoming a major headache;
- There are high transition costs to converting existing systems to new standards;
- There is volatility in mortgage demand induced by local and regional economic cycles, such that uncertainties in the business dictate that mortgage firms operate with flexible scale and controlled overhead;
- The mortgage industry still does not have technology and operating standards;
- The mortgage industry provides a relatively small market for technology vendors, which limits the capital invested in developing new applications;
- With the exception of Fannie Mae and Freddie Mac, the mortgage industry is sufficiently fragmented such that no firm has the power to set prices or mandate technology or operating standards; and
- During periods of sustained booms in the market, such as the refinance boom of 2001-2003, resource demands make it very difficult to deploy new technologies while sustaining volume demand.

MORTECH surveys have consistently found that the mortgage industry is highly fragmented and that most firms suffer from a lack of capital to invest in leading-edge technology. Those surveys have found that the technology vendor market is highly fragmented, lacks marketing expertise, and suffers from poor coordination and ineffective communication. In addition, the mortgage technology market is not large and is shrinking with consolidation, which is inhibiting capital flows into technology development.

The rate of technology adoption by the mortgage lending industry is very uneven. For example, *MORTECH 2002* found that 64.2 percent of lenders indicated they had implemented a proprietary Internet site for their firm, and nearly all were using their site to provide information on loan products and services and refer potential customers to

[40] See MORTECH 2000 for more detail. MORTECH's annual surveys are based on interviews of top mortgage executives from mortgage banks, thrifts, and commercial banks that originate or service single-family mortgage loans.

their call center or retail channel. However, only 43 percent could process applications through their Internet channel, and less than 15 percent could close a loan on their site.

Respondent lenders that indicated they had integrated the Internet into their business were asked how they were using the Internet. Nearly all (97 percent) of the respondents indicated that they used the Internet to distribute product or company information, 56 percent reported that they use the Internet to prequalify buyers, 43 percent reported that they use the Internet to process applications, and 45 percent reported that they use the Internet to communicate loan status.

The Need to Define Data and Communication Standards

An important impediment to the development of e-commerce in single-family mortgage lending is a continued lack of industry-wide data and communication standards. For most of the time that mortgage records have been computerized, there were no common definitions (or computer formats) for demographic data or information about the property, mortgage products, payment status, or settlement services across firms. Moreover, there often were no common formats between the origination and servicing departments of the firm. For example, the origination department might have allocated 15 characters for a borrower's street address, 10 characters for the city, and 10 characters for the state in their origination software, while the servicing department might have combined street and city in one field, allocated 20 characters for that field, and provided a two-digit numerical code for the state. To use the origination data, the servicing department would have either had to go through a laborious data translation process or reenter the data manually into its own format.

The evolution in the attitude toward data and communication standards by the single-family mortgage industry has been gradual. As businesses began to adopt computer networks in the late 1980s, the first task that network administrators faced was establishing firm-specific data and communication standards. At that time, the objective was to increase internal firm productivity by, for example, creating a common standard across the firm in order to pass data among software applications. Little thought was given to establishing standards in common with other firms in the industry or with business partners. EDI, first developed in the 1980s, has become the primary computer data interchange by which large data sets are transferred within a firm. The largest mortgage lenders, Fannie Mae and Freddie Mac, and mortgage insurers were quick to adopt EDI for internal operations, but there was no attempt to develop an industry standard for data definitions.

The experience of the mortgage industry with EDI has been mixed. EDI requires a fixed format, with individual data elements defined. No two firms defined the mortgage record format the same way, and few firms even defined the data elements similarly. EDI works very well for firms with large origination and servicing volumes, but even for large firms the task of maintaining multiple EDI standards for individual business partners is daunting. EDI is used extensively in the servicing and secondary market functions of mortgage lending. Mortgage insurers and large mortgage servicers have established EDI trading relationships with each other, and Freddie Mac and Fannie

Mae have each established EDI links with seller/servicers to transmit and accept electronic mortgage records. Mortgage brokers and lenders also have many channels through which to transact their business. If they standardize their information systems with a single EDI partner, it becomes difficult to do business with other "incompatible" partners.

Lenders who specialize in third-party mortgage originations also use EDI. Wholesale lenders and those lenders who rely on correspondents for their loan origination volume generally communicate with their business partners using EDI. The EDI data format is structured so that it corresponds to standards adopted by each partner. EDI is designed for fast transmission of information, and often a third-party service provider (VANS or value added network services) hosts the business application and manages the communications.

The Use of XML to Transmit Data Among EDI Systems

The task of maintaining multiple EDI standards generally stretches the limited information technology resources of a mortgage lender. Not only are the technical requirements difficult to manage, they are expensive to maintain. That challenge is being addressed by the increasing use of the Internet to transfer data and eXtensible Markup Language (XML) to improve compatibility between disparate EDI standards. The Internet allows firms to connect. XML provides a common language that enables every application to exchange data. That solution sounds like a magic bullet to allow for seamless data interchange between applications. However, achieving the ultimate objective—a universal data exchange standard that would enable all industry participants to send data in a common language and format—is not that simple.

The reality is that XML does not, by itself, solve the data interchange problem. XML is a data description language. It provides common ground rules for how data is represented, but does not specify the contents or structure of that data. XML standardizes many things, including tagging, hierarchies, nesting, variable coding, and more. Those standards provide a core level of commonality across all implementations of XML.

XML is a development technology similar to HTML (Hypertext Markup Language). HTML is a language used to format the content and appearance of web pages and has been the de facto web development standard since its creation. XML takes the language one step further and defines the meaning of data. XML was made extensible to support the evolving needs of future applications. Developers are able to create their own tags—and the relationships between those tags—to suit their individual business needs. That information is represented in document type definitions (DTDs) that are included with XML. Think of DTDs as rules by which to validate an XML data file.

Two XML examples of ways to specify the first name of a borrower (John) are:

<BorrowerFirstName>John</BorrowerFirstName>

or

<BORROWER _FirstName="John" />

Since XML's standardization by the World Wide Web Consortium (W3C) in 1997, the number of different DTDs has increased phenomenally, creating competing DTDs to describe the same industry. To facilitate interoperability among industry participants, individual industries have created consortiums to solve the Tower of Babel problem of competing DTDs.[41]

Moving data from EDI to XML and back to EDI for use in installed mainframe computer systems requires data transformation. To accomplish data transformation, several scripting languages have been developed that define the specific transformation procedures and embed that script directly into the XML itself. In that manner, different EDI standards used by trading partners—mortgage insurers, flood certification firms, title insurers, and originators, for example—can be made transparent. Once translation between different EDI standards has been scripted, it is a manageable process to deal with multiple trading partners on a single mortgage transaction across private EDI networks. XML data mapping tools can also provide a relatively quick and cost-effective way to convert data between older software applications of a firm, which are often known as legacy systems. In addition to being a data-mapping tool that combines, parses, or recalculates data elements and values, XML can allow for integration with event schedulers and the creation of metrics that allow the firm to track the process to retain data integrity.

Mortgage industry firms that are business partners are creating electronic partner networks (EPNs) to facilitate the exchange of data in multiple formats using EDI and XML. By forging partnerships, companies can strengthen their own organizations and strive towards seamless transactions. EPNs are electronically interconnected businesses that depend on one another for essential services. An EPN may be defined as "an electronic interconnected environment that enables collaboration and synchronization around business processes."[42] EPNs represent a convergence of several factors:

- the proliferation of B2B activity;
- the availability of hosted applications running on the Internet; and
- the growing adoption of XML.[43]

Part of what makes EPNs so effective is that the host vendor creates and maintains all electronic connections to service providers, in whatever data format the service providers need—Web to Web, XML to XML, or EDI to EDI. The advantage is that business partners can operate within their own operating environment with the EPN host handling all the data communication and translation.

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[41] In the single-family mortgage industry, the consortium is called the Mortgage Industry Standards Maintenance Organization (MISMO). MISMO's roles are discussed in the following section of this chapter and in Chapter VI.

[42] See Graham, Gig, "Electronic Partner Networks," The Giga Information Group, April 2000, available online at www.ncommand.net/html/EPN040620001.pdf, Accessed 4/15/2001.

[43] See Wright, Anthony, and Lani Porter, "Electronic Partner Networks Create Digital Infrastructure," *Secondary Marketing Executive*, April 2001, 12-14, for an excellent presentation.

Defining XML for the Mortgage Industry

Most single-family mortgage lenders have multiple relationships with mortgage settlement service providers and other business partners. That is, they have relationships with appraisers, title companies, flood certification companies, Ginnie Mae, Fannie Mae, Freddie Mac, private mortgage insurers, and frequently with other lenders, either as a servicer, a wholesaler, or as a correspondent. Many of those relationships require exchanging data through EDI standards that are different for each relationship. Each Enterprise, for example, fashioned its proprietary file structures. To deliver loans to either Freddie Mac or Fannie Mae, one must use the proprietary standards developed by that Enterprise. Those proprietary formats are different from the EDI standards that mortgage lenders have with private mortgage insurers.

In 1999, the Mortgage Bankers Association announced the formation of the Mortgage Industry Standards Maintenance Organization (MISMO) to develop universal standards for single-family mortgage lending. The mission of MISMO, which is a coalition of mortgage lenders, mortgage settlement service providers, and Fannie Mae and Freddie Mac, is to develop, promote, and maintain voluntary electronic commerce standards for the mortgage industry. MISMO publishes a Logical Data Dictionary and a version of XML DTDs for four different business areas: origination, mortgage settlement services, secondary marketing, and servicing.

MISMO's organizational structure is designed to enable industry participants to be actively involved in the development of data standards across the mortgage industry. MISMO supports free and open access to download and customize electronic commerce standards at www.mismo.org. MISMO's Logical Data Dictionary provides business definitions for each of the data elements included in the XML DTDs. The XML DTDs encompass data exchange among business partners in different segments of the lending process, and the open architecture of those DTDs allows organizations to map their individual firm data into the published DTDs. Figure V-1 shows the DTDs that MISMO is developing for the four identified business areas.

XML standards for the single-family mortgage lending industry have the potential to reduce redundant data entry through the better transfer of data between applications and to reduce data errors because of more clarity in the definition of data in the data dictionary. Significant XML implementation challenges exist at the firm level, however. There are increased costs and time to implement and maintain a more complex data language and a need to convert existing HTML documents to XML based documents. Once those documents have been converted, however, there are significant returns to the investment.

Figure V-1
Document Type Definitions (DTDs) Being
Developed For Single-Family Mortgage Lending

Originations	Real Estate Services	Secondary Marketing	Servicing
Application	Appraisal	Bulk Pool Transfer	Cash Transmissions
Closing	Credit	Commitment	Credit Reporting
Underwriting	Escrow & Settlement	Funding	Default Management
	Field Services	Pricing & Discovery	Escrow
	Flood Insurance	Product Development	Insurance Claims
	Mortgage Insurance	Securitization	Investor Reporting
	Taxes	Shipping & Delivery	Loss Mitigation
	Title		Modifications
			Reclassifications
			Remittance Processing
			Special loans
			Transfer & Setup

Source: MISMO

VI. THE PROMISE AND CHALLENGE OF e-MORTGAGE LENDING

Despite all the changes that have occurred in the single-family mortgage industry in recent years, the lending process can still be characterized as complex and confusing, encompassing many steps that are still paper-driven (see Box 2). The previous chapter detailed how mortgage lenders are slow adopters of technology, have been reluctant to shift to e-business models of lending, and have not been aggressive in adopting Internet technologies in their business activities. In 2003, after four straight years of record levels of originations, lenders continue to face huge transition costs to convert legacy systems to new standards and are stretched just to keep pace with the current demand for mortgages. They have no time to install new processes or systems, test the new systems while continuing to run their primary systems, and train existing staff on what ultimately will be more efficient and productive technology platforms.

Those shortcomings have not stopped the single-family mortgage industry from looking to the future, however. Beginning in the late 1990s, a number of lenders, Fannie Mae and Freddie Mac, and technology providers began to advocate the concept of an entirely electronic mortgage that would all but eliminate the need for paper in the mortgage lending process. Interest in creating an electronic mortgage has increased significantly since the National Conference of Commissioners on Uniform State Laws (NCCUSL) approved the Uniform Electronic Transaction Act (UETA) for adoption by the states[44] in July 1999, and the Electronic Signatures in Global and National Commerce Act (E-Sign) was enacted in June 2000.

An electronic mortgage envisions the use of a combination of new and existing technologies to provide an entirely paperless closing transaction, resulting in a loan evidenced solely by electronic records and signatures, often referred to as an e-mortgage. An e-mortgage is a mortgage where the critical loan documents are created, executed, transferred, and ultimately stored electronically.[45] The technologies required to facilitate that would include digital signatures; sophisticated encryption, authentication and security strategies and standards; and data exchange with trusted systems through the Internet or a private-network connection among lenders, data repositories, closing agents, county recording offices, and investors.

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[44] As of June 2003, forty-eight states had enacted UETA. However, there are distinct differences by state. See http://www.bmck.com/ecommerce/uetacomp.htm for a state-by-state listing of actions on UETA. UETA is intended to create uniform statutes across all states relating to the use of electronic communications and records in contractual transactions. The intent was to provide a consistent legal framework to support transaction processes utilizing existing and future electronic or computerized technologies.

[45] A distinction should be made between making segments of the lending process paperless and making the whole process paperless, i.e., moving to e-mortgages. Some mortgage firms are now using comprehensive imaging systems to create paperless records of closed loans for use in servicing, for example. It is unclear at what point paperless mortgages will become electronic mortgages or how firms currently using imaging technologies will transition to electronic storage in the future.

Box 2:
Documents Required to Originate Single-Family Mortgages

There are many parties involved in the origination of a single-family mortgage, each creating documents that are part of the record of the transaction. Today, many of those documents require signatures, are paper-based, and generally are processed manually. Despite the continual complaints about the burden of paper from both lenders and consumers, an argument can always be made for the need for each individual document in the loan package. Taken together, however, the amount of documents in the typical mortgage loan file seems very hard to justify.

What is generally included in a mortgage loan file, no matter where in the country the loan is being made? First, there are security instruments such as the deed of trust and the mortgage note. There may be additional addendums and riders to the note and riders to the security instruments. The Federal Truth In Lending Act requires an itemized good faith estimate, a notice of the right to cancel the transaction for a refinance loan, and a truth in lending disclosure. The Real Estate Settlement Procedures Act (RESPA) requires a HUD-1 settlement statement, which may also include addendums. There is an initial escrow account disclosure, a servicing disclosure, and notice of assignment, sale or transfer of servicing rights, if applicable. If affiliated businesses are part of the loan transaction, there must be disclosure as well. If the loan is subject to the Home Owners Equity Protection Act, there are additional disclosures required. The Equal Credit Opportunity Act requires a Fair Lending Notice as well as disclosure of the right to a copy of the appraisal.

There are other documents customarily required by the broker, lender, or investor. A signature/name affidavit is required, as well as a notice of flood hazard area and a flood hazard determination. Lenders customarily require documents for closing cost disbursement, payment letter, errors and omissions agreements, occupancy affidavit, request for copy of tax form, request for taxpayer identification and certification, hazard insurance authorization, and a copy of the final loan application. If the loan is government-insured or -guaranteed, there are a variety of required addenda.

There are also documents created during the origination process that are part of the final loan package: the initial loan application (Form 1003), the appraisal, mortgage credit analysis worksheets, as well as verifications of income and sources of funds. Lender and investor due diligence concerns also create document requirements, including pest and environmental inspections, septic well inspections, and title insurance binders. That list is by no means exhaustive. Many state regulations for mortgage and real estate transactions include seller disclosure of property defects as well as the disclosure of the presence and remediation of lead-based paint.

Widespread adoption of e-mortgages will require an extensive long-term effort in business-process reengineering by the single-family mortgage industry and changes in consumer preferences. It will require a series of small steps forward as industry participants embrace new technology, plan to change the way they do business, and collaboratively develop standards for a common e-mortgage infrastructure. Failure to develop common industry standards will result in proprietary and incompatible technologies that will hamper industry and consumer adoption.

This chapter examines the potential benefits of electronic mortgages and identifies some major obstacles that must be overcome in order to make e-mortgage lending a reality. The chapter also summarizes the collaborative efforts by the mortgage industry, conducted through MISMO, to meet those challenges and suggest to many that electronic mortgages will be achieved.

Potential Benefits of e-Mortgage Lending

Electronic mortgages would provide benefits to all functional areas of single-family mortgage lending. In loan production (origination), for example, an e-mortgage infrastructure could reduce total origination time and errors by sharing data between processing, underwriting, document preparation, and third parties without the need to enter data by hand multiple times into different systems; minimize interest rate exposure by reducing origination time; reduce the facility costs of storage, warehouse management and document transfer; and improve the lending experience of the consumer. An e-mortgage infrastructure would also ease the process of adding new business relationships among brokers, lenders, and other parties to the real estate or mortgage transaction.

In servicing, e-mortgage lending has the potential to lower costs by reducing the shipping, storage, and manual tracking of paper documents in post-closing, new loan setup, sales or acquisition of servicing, payoff and lien release, repurchases and foreclosure, and in customer relations. Secondary market operations could reap benefits as well. The time between closing and receipt of the collateral package by the investor could be reduced to hours. Electronic documents would eliminate the need for manual handling, inspection, and verification of paper mortgages, and could cut costs associated with post-closing manual processing of the collateral package.

Not unlike the Internet, electronic mortgages promise to yield both a competitive advantage and savings for lenders that adopt them. Doing so is daunting to many lenders, however, given the amount of inefficiency still present in the current lending process. There are many areas where competing standards paralyze decisions and choices. Should the firm transmit data through XML or EDI? Which document format should be used? If an e-mortgage infrastructure is successfully built, will the consumer accept it? Consumers, already feeling anxiety about obtaining a mortgage, may be uncomfortable with a process without paper, so the capability of printing records must be provided. Can the mortgage lending industry convince consumers that they, as well as the industry, will benefit from a paperless mortgage process?

Impediments to e-Commerce and e-Mortgages

Back-office fulfillment—the steps necessary to prepare an originated loan for funding—is a major impediment to supporting current e-commerce initiatives and moving to e-mortgage lending. For many lenders, the use of the Internet is a veneer on the traditional process. Those firms are still using legacy systems and, with the rapid consolidation in the servicing market, are having difficulty integrating multiple servicing software applications for portfolios purchased in recent years. When those firms are pursuing B2B activities, technology is being used to solve integration problems rather than connectivity problems.[46]

Many mortgage lenders' back offices are inefficient, primarily because there is sparse electronic delivery of mortgage loan packages; the process is still paper-based, rather than automated, and is redundant. When automated, the systems generally are outdated and inflexible, making changes to the process difficult, and there is little connectivity to the origination side of the firm. Those are real impediments to moving to an e-commerce business model, let alone moving to a world of electronic mortgages. For example, those inefficiencies make it very difficult for firms to cross-sell additional financial products or to differentiate themselves by brand.

Implications of e-Mortgages for Industry Structure

Once an acceptable software/hardware platform to support e-mortgage lending exists, the structure of the single-family mortgage industry may change significantly. It is not difficult to envision a future where not only financially strong, technologically savvy financial services firms, but also well-capitalized firms from other sectors of the economy, are attracted to mortgage lending. An e-mortgage platform would allow non-financial firms to perform virtually all the origination and funding segments of the lending process through outsourcing and Internet-based services. Only servicing and secondary market operations would initially remain in the province of current mortgage lenders, since those operations require specialized skills.

Efforts to reform regulations that implement the Real Estate Settlement Procedures Act (RESPA) and the Truth-in-Lending Act will also have a major influence on the future structure of the industry. While it is unclear what form of bundling of real estate and mortgage settlement services will eventually be permitted, what is clear is the desire by consumers for one-stop-shopping for settlement services. There is overwhelming evidence that consumers find the current real estate and mortgage settlement process to be overly complex, frustrating, and time-consuming. Electronic mortgages will go a long way in meeting consumer expectations.

[46] See, for example, "Lenders Cautious to Buy, Vendors Anxious to Sell," *Inside Mortgage Technology*, Vol. 7, March 24, 2003, 2-3.

Outlook for the Future

There is widespread optimism in the single-family mortgage industry that the technological, standards, legal, and consumer education challenges to widespread adoption of e-mortgages will eventually be overcome. The financial benefits to all parties would be great, and many are optimistic that the industry will continue to work collaboratively to address the security and standardization issues. The efforts of the industry since the early 1990s to implement a centralized system for the electronic recordation of the ownership of single-family mortgages[47] and ongoing work by MISMO to create mortgage industry standards that would support e-commerce have encouraged that belief among most industry analysts.

Single-family mortgage lenders and Fannie Mae and Freddie Mac generally view MISMO as the key organization working to meet the challenges to e-mortgages. In January 2001, MISMO formed an e-mortgage working group with the goals of (1) building on and extending existing MISMO mortgage standards and (2) developing requirements and recommendations for fully electronic mortgage processing.[48] MISMO released e-mortgage guidelines and recommendations in February 2002. It established SMART (Securable, Manageable, Achievable, Retrievable, and Transferable) document[49] specifications in September 2002, and finalized version 1.0 guidelines for using these specifications in January 2003. Those steps represented important milestones in the long process of achieving that goal. Fannie Mae and Freddie Mac are preparing to accept SMART documents in electronic deliveries.[50] Despite that progress, a great deal of work remains to be done to develop common data and technology standards for single-family mortgage lending and adopt and implement those standards industry-wide. The broader financial services industry is also working to develop cross-industry model standards and procedures for the presentation of information electronically that are necessary for expansion of e-commerce in single-family mortgage lending and the development of electronic mortgages (see Box 3).

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[47] The Mortgage Electronic Registry System (MERS) was created by the mortgage banking industry to eliminate the need to prepare and record assignments when trading mortgage loans. Lenders record MERS as the mortgagee for the lender in the county land records and electronically track changes in servicing and beneficial ownership rights over the life of the loan on the MERS System. See www.mersinc.org.

[48] MISMO defines an eMortgage as a truly paperless mortgage with electronic signatures that includes both data and a document view allowing the ability to recreate exactly what the consumer digitally signed.

[49] The term SMART document actually refers to a technical framework for representing documents in an electronic format. MISMO has developed SMART document specifications, in XML, for the representation of mortgage documents in an electronic form. A SMART document may be either an electronic representation of an existing paper document or a new electronic document created to transfer information between parties in a mortgage transaction. MISMO's SMART document specification includes the capability to sign the document, including digital and other electronic signatures, and to sign certain sections of the file and/or the entire file, including external file references. The MISMO specification does not address the implementation, packaging, transmission, or storage of SMART documents. It does assume that requirements, specifications, and implementation guides will be developed to specify detailed requirements for negotiable instruments and recordable electronic records.

[50] Fannie Mae, for example, in Announcement 02-08, June 2002, established a framework for the sale and delivery of e-mortgages to Fannie Mae.

Box 3:
Financial Services Industry Efforts to Support e-Commerce

The financial services industry is working to develop cross-industry model standards and procedures for the presentation of information electronically. Development of those standards is necessary for expansion of e-commerce in single-family mortgage lending and the development of electronic mortgages.

Sponsored by the Electronic Financial Services Council, leading e-commerce and financial services companies in March 2002 kicked off the Standards and Procedures for electronic Records and Signatures (SPeRS) project, with a goal of creating model standards that would include electronic execution of signatures, record retention, and printing and delivery of information acceptable to business, government, and the public. The SPeRS project covers a range of issues: establishing the identity of users and employing procedures that limit exposure to identity theft and fraud, informing users about what they are "signing" online and about their rights and responsibilities under consumer protection laws, establishing intent to "sign" a transaction, making documents accessible online, and sending required notices electronically. Additionally, the SPeRS project is addressing the need to adopt standards for storing records to be reviewed or referred to later, making records available for printing, and protecting the integrity of records.

The SPeRS initiative is intended to help answer questions concerning the handling of routine aspects of electronic contracting and record signing. Five working groups have been established to address issues related to 1) authentication; 2) agreement to use electronic records and signatures (including E-Sign consent); 3) signatures; 4) agreements, disclosures and notices; and (5) record retention. Companies currently active in the SPeRS initiative include AIG/United Guaranty Insurance, Ensurance, Fannie Mae, Freddie Mac, GE Mortgage, Intuit Inc., the Principal Financial Group, Wave Systems, and Wells Fargo Home Mortgage.[1]

In addition to the Mortgage Industry Standards Maintenance Organization (MISMO) and SPeRS, there are other organizations developing standards to comply with the Uniform Electronic Transaction Act (UETA) and the Electronic Signatures in Global and National Commerce Act (E-Sign) that have clear ramifications for developing an e-mortgage infrastructure. One such organization has been formed to address electronic recording of real estate documents at local government agencies. A number of years ago, the National Association of County Recorders, Election Officials and Clerks (NACRC) and the International Association of Clerks, Recorders, Election Officials and Treasurers (IACREOT) jointly sponsored the Property Records Industry Joint Task Force (PRIJTF). In 2002, the PRIJTF established itself as an independent non-profit corporation known as the Property Records Industry Association (PRIA). PRIA is a public/private partnership whose members include Accutran, ALTA, American Society of Notaries, Digital Signatures Trust, Exigent Computer Group, Fannie Mae, InGeo, Landata, Lexus Document, the Mortgage Electronic Registration System (MERS), National Notaries Association, Orion Financial, Realty Data, and Stewart Title. One of PRIA's goals is to create standards to allow for electronic recording (e-recording)[2] and to be interoperable with the industry's private sector standards.

To that end, the PRIA XML Electronic Recording Workgroup has created alliances with MISMO and the courts system's LegalXML standards organization. The PRIA XML ER standard, in turn, connects to MISMO and Legal XML,[3] thus creating one seamless, uniform process that will allow electronic records to be automatically received, recorded, and indexed while returning the recorded electronic document to the sender, typically a title company or mortgage lender.

[1] Participation in the SPeRS project is open to any company desiring to participate (generally upon payment of a fee), and does not require membership in the Electronic Financial Services Council. See www.spers.org.

[2] e-Recording redesigns the method of presenting real estate documents to the County Recorder and returning the document to the closing agent, lender or mortgage servicer.

[3] LegalXML is a member section within the Organization for the Advancement of Structured Information Standards (OASIS), a not-for-profit, global consortium that drives the development, convergence and adoption of e-business standards. LegalXML produces standards for electronic court filing, court documents, legal citations, transcripts, criminal justice intelligence systems, and others.

No one expects e-mortgages to happen overnight. The transition to a fully electronic mortgage origination process will likely take years, with a hybrid process combining paper and electronic mortgage documentation existing side-by-side for some time. It is also widely expected that paper mortgages will ultimately be phased out because of their high costs and inefficiency.

One of the biggest unknowns is how consumers would respond to fully electronic originations. To date, there has been little attempt to educate consumers, and the industry is proceeding with the assumption that if you build it, customers will come. That cannot be taken as a given. It will be very important for the lending community to sponsor consumer education. It will be just as important for the consumer to realize tangible savings. To gain consumer acceptance, some of the cost savings from a complete transition to e-mortgages likely must be passed through to consumers immediately and not be used only to increase lender profits.

The future is always uncertain, but current trends suggest the following outcomes. The single-family mortgage lending industry will utilize the Internet as the primary medium for doing business. Mortgage lending will be process driven, consumer-centric, automated, and collaborative. Mortgage lenders will be adaptable, their systems scalable and able to assemble mortgage products to market demand. Many of the activities needed to complete the lending process will be performed outside the lender. Closing will occur at the point of sale—either the home sale or the origination of a refinance or home equity loan—using external parties to provide all the necessary services. Lenders will be able to create and support loan products in both their origination and servicing applications instantly. The computer systems ultimately will need to be efficient, seamless, and end-to-end, allowing for rapid increases in activity to be handled effortlessly. Making that vision a reality will require firms in the mortgage lending, real estate, and related industries to view the Internet not just as a sales channel, but rather as an integration and delivery platform, and will require a tremendous collaborative effort.

Acronyms Guide

AUS	automated underwriting system
AVM	automated valuation model
ASP	application service provider
B2B	business-to-business
B2C	business-to-consumer
DTD	document type definitions
DU	Desktop Underwriter underwriting system (Fannie Mae)
EDI	electronic data interchange
EFT	electronic funds transfer
EPN	electronic partner networks
E-Sign	Electronic Signatures in Global and National Commerce Act of 2000
FAS	Financial Accounting Standards
FHA	Federal Housing Administration
FICO	Fair, Isaac and Company credit score
FRM	fixed-rate mortgage
GMAC	General Motors Acceptance Corporation
GSE	government-sponsored enterprise
HTML	Hypertext Markup Language
LAN	local area network
LOS	loan origination system
LP	Loan Prospector underwriting system (Freddie Mac)
MBA	Mortgage Bankers Association
MBS	mortgage-backed security
MERS	Mortgage Electronic Registry System
MISMO	Mortgage Industry Standards Maintenance Organization
NACRC	National Association of County Recorders, Election Officials & Clerks
PC	personal computers
PRIA	Property Records Industry Association
PRIJTF	Property Records Industry Joint Task Force
REO	real estate owned
RESPA	Real Estate Settlement Procedures Act
RFC	Residential Funding Corporation
SMART	Securable, Manageable, Archivable, Retrievable, and Transferable
SPeRS	Standards and Procedures for electronic Records and Signatures project
UETA	Uniform Electronic Transaction Act
VA	Veterans Administration
XML	eXtensible Markup Language