
Technological Change & Financial Innovation in Banking

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Introduction

The commercial banking business has changed dramatically over the past 25 years, due in large part to technological change. Advances in telecommunications, information technology, and financial theory and practice have jointly transformed many of the relationship focused intermediaries of yesteryear into data-intensive risk management operations of today. Consistent with this, we now find many commercial banks embedded as part of global financial institutions that engage in a wide variety of financial activities.

To be more specific, technological changes relating to telecommunications and data processing have spurred financial innovations that have altered bank products and services and production processes. For example, the ability to use applied statistics cost-effectively (via software and computing power) has markedly altered the process of financial intermediation. Retail loan applications are now routinely evaluated using credit scoring tools, rather than using human judgement. Such an approach makes underwriting much more transparent to third parties and hence facilitates secondary markets for retail credits (e.g., mortgages and credit card receivables) via securitisation. Statistically based risk measurement tools are also used to measure and manage other types of credit risks- as well as interest rate risks- on an ongoing basis across entire portfolios. Indeed, tools like value-at-risk are even used to determine the appropriate allocation of risk-based capital for actively managed portfolios.

It will describe how technological change has spurred financial innovations that have driven the aforementioned changes in commercial banking over the past 25 years. In this respect, the analysis distinguishes itself by reviewing the literature on a large number of new banking technologies and synthesizing these studies in the context of the broader economics literature on innovation.

The various innovations in banking and financial sector are ECS, RTGS, EFT, NEFT, ATM, Retail Banking, Debit & Credit cards, free advisory services, implementation of standing instructions of customers, payments of utility bills, fund transfers, internet banking, telephone banking, mobile banking, selling insurance products, issue of free cheque books, travel cheques and many more value added services.

The Role of Finance and Financial Innovation

The primary function of a financial system is to facilitate the allocation and deployment of economic resources, both spatially and across time, in an uncertain environment. This function encompasses a payments system with a medium of exchange; the transfer of resources from savers to borrowers; the gathering of savings for pure time transformation and the reduction of risk through insurance and diversification.

The operation of a financial system involves real resource costs employed by financial intermediaries and by financial facilitators (e.g., mortgage brokers). Much of these resources are expended in the data collection and analyses in which financial market participants engage, so as to deal with problems of asymmetric information. There are also uncertainties about future states of the world that generate risks, which for risk-averse individuals represent costs. In this environment, new production process or new organisational forms.

Hence, a Financial Innovation as something new that reduces costs, reduce risks or provides an improved product/service/instrument that better satisfies financial system participants demands. Financial innovations can be grouped as new products (e.g., subprime mortgage) or services (e.g., Internet banking) or new organisational forms (e.g., Internet-only banks).

The Centrality of finance in an economy and its importance for economic growth naturally raises the importance of financial innovation – and its diffusion. Since finance is a facilitator of virtually all production activity and much consumption activity, improvements in the financial sector will have direct positive ramifications throughout an economy. Further, since better finance can encourage more saving and investment and can also encourage more productive investment decisions, these indirect positive effects from financial innovation and further to its value for an economy.

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Given its importance, an understanding of the conditions that encourage innovation would appear to be worthwhile. After all, observed streams of innovations are clearly not uniform across all enterprises, across all industries or across all time periods. The general innovation literature in economics has sought to uncover the environmental conditions that affect the stream of innovations-focusing on hypotheses concerning roughly five structural conditions: **the market power of enterprises, the size of enterprises, technological opportunity, appropriability and product market demand conditions**. Of course, when environmental changes occur, we expect to observe an initial wave of financial innovations followed by a new equilibrium flow consistent with the new environmental conditions. Over the past 25 years, each of these above environmental conditions was markedly altered – resulting in substantial changes to the commercial banking industry.

Financial Innovation and Banking

The literature pertaining to several specific financial innovations appearing over the past 25 years or so that were specifically driven by technological change. The major discussion is focusing on the lines of: new products & services, new production process and new organisational forms.

A1. Products:

Mortgage loans are one suite of products that have experienced a great deal of change over the past 25 years in the United States. In 1980, long-term fully amortizing fixed-rate mortgages were the norm and this product was offered primarily by thrift institutions. Moreover, these loans required substantial down payments and a good credit history and the accumulated equity was relatively illiquid.

These characteristics have markedly evolved. The first big change occurred in the early 1980s with the widespread introduction of various types of adjustable-rate mortgages (ARMs), which had previously been banned by federal regulators. The Tax Reform Act of 1986, which ended federal income tax deductions for non-mortgage consumer debt, spurred substantial growth in home equity lending. One mortgage innovation more directly tied to technological change is subprime lending, which was originally predicated on the use of statistics for better risk measurement and risk-based pricing to compensate for these higher risks. However, the subprime mortgage crisis has uncovered significant shortcomings in the underlying statistical models.

* **Subprime Mortgages:** Subprime mortgage lending, broadly defined, relates to borrowers with poor credit histories or high leverage as measured by either debt/income or loan-to-value. This market grew rapidly in the U.S during the first decade of the twenty-first century – averaging about 20% of residential mortgage originations between 2004 and 2006. At the end of 2007, subprime mortgages outstanding stood at \$940 billion; down from over \$1.2 trillion outstanding the previous year (Inside Mortgage Finance 2008).

Since the onset of the subprime mortgage crisis, research has attempted to identify various sources of the problem. Mayer, Pence and Scherlund (forthcoming) provide an overview of the attributes of subprime mortgages outstanding during this time and investigate why delinquencies and defaults increases so substantially. These authors, as will as Gerarbi, Lehnert, Sherlund, and Willen (forthcoming), point to significant increase in borrower leverage during the mid-2000s, as measured by combined loan-to-value (CLTV) ratios, which was soon followed by falling house prices.

A2. Services:

Recent service innovations primarily relate to enhanced account access and new methods of payment-each of which better meets consumer demands for convenience and ease. Automated Teller Machines (ATMs), which were introduced in the early 1970s and diffused rapidly through the 1980s, significantly enhanced retail bank account access and value by providing customers with around the clock access to funds. ATM cards were then largely replaced through the 1980s and 1990s by debit cards, which bundle ATM access with the ability to make payment from a bank account at the point of sale. Over the past decade, remote access has migrated from the telephone to the personal computer. Online banking, which allows customers to monitor accounts and originate payments using "electronic bill payment," is now widely used. Stored-value, or prepaid, cards have also become ubiquitous.

* **Debit Cards:** Debit cards are essentially "pay-now" instruments linked to a checking account whereby transactions can happen either instantaneously using online (PIN based) methods or in the near future with offline (signature based) methods. Consumers typically have the choice of using online or offline methods, and their selection often hinges on the respective benefits. Online debit allows the cardholder

also to withdraw cash at the point-of-sale, and offline provides float. According to ATM & Debit News (2007), there were approximately 26.5 billion debit transactions in the U.S. during 2006. This is up from 6.5 billion transactions in 1999 – a four-fold increase.

* **Online Banking:** As households and firms rapidly adopted internet access during the late-1990s, commercial banks established an online presence. According to De Young (2005), the first bank websites were launched in 1995; and by 2002 nearly one-half of all U.S. banks and thrifts operated transactional websites. As of 2007, bank call report data suggests that 77.0 percent of commercial banks offer transactional websites (and these banks control 96.8 percent of commercial bank deposits).

The primary line of research relating to online banking has been aimed at understanding the determinants of bank adoption and how the technology has affected bank performance. In terms of online adoption, Furst, Lang, and Nolle (2002) find that U.S. national banks (by the end of the third quarter of 1999) were more likely to offer transactional websites if they were: larger, younger, affiliated with a holding company, located in an urban area, and had higher fixed expenses and non-interested income. Turning to online bank performance, De Young, Lang, and Nolle (2007) report that internet adoption improved U.S. community bank profitability – primarily through deposit-related charges. In a related study, Hernando and Nieto (2007) find that, over time, online banking was associated with lower costs and higher profitability for a sample of Spanish banks. Both papers conclude that the internet channel is a complement to – rather than a substitute for – physical bank branches.

* **Prepaid cards:** As the name implies, prepaid cards are instruments whereby cardholders "pay early" and set aside funds in advance for future purchases of goods and services. (By contrast, debit cards are "pay-now", and credit cards are "pay later"). The monetary value of the prepaid card resides either of the card or at a remote database. According to Mercator Advisory Group, prepaid cards accounted for over \$180 billion in transaction volume in 2006.

Prepaid cards can be generally delineated as either "closes" systems (e.g., a retailer-specific gift card, like Macy's or Best Buy) or "open" systems (e.g., a payment-network branded card, like Visa or MasterCard). Closed-system prepaid cards have been effective as a cash substitute on university campuses, as well as for mass transit systems and retailers.

A3. Production Processes

The past 25 years have witnessed important changes in banks production processes. The use of electronic transmission of bank-to-bank retail payments, which had modest beginnings in the 1970s, has exploded owing to greater retail acceptance, online banking and check conversion. In terms of intermediation, there has been a steady movement toward a reliance on statistical models. For example, credit scoring has been increasingly used to substitute for manual underwriting – and has been extended even into relationship-oriented products like small business loans. Similar credit risk measurement models are also used when creating structured financial products through "securitization". Statistical modelling has also become central in the overall risk management processes at banks through portfolio stress testing and value-at-risk models – each of which is geared primarily to evaluating portfolio value in the face of significant changes in financial asset returns.

* **Asset Securitization:** Asset securitization refers to the process by which non traded assets are transformed into the U.S., securitization is widely used by large originators of retail credit – specifically mortgages, credit cards and automobile loans. As of year-end 2007, federally sponsored mortgage pools and privately arranged ABS issues (including private-label mortgage-backed securities) totalled almost \$9.0 trillion in U.S. credit market debt outstanding.

By contrast, as of year-end 1990, these figures were \$1.3 trillion, respectively. One recent innovation in the structured finance/securitization area is the introduction of collateralized debt obligations (CDOs). According to Longstaff and Rajan (2006) these instruments, which were first introduced in the mid-1990s, are now in excess of \$1.5 trillion. Like ABS, CDOs are also liabilities issued by financial-institution-sponsored trusts, which essentially pool and restructure the priority of cash flows associated with other types of risky financial assets, including senior and mezzanine ABS, high-yield corporate bonds and bank loans.

* **Risk Management:** Advances in information technology (both hardware and software) and financial theory spurred a revolution in bank risk management over the past two decades. Two popular approaches to measuring and managing financial risks are stress-testing and value-at-risk (VaR). In either case, the

idea is to identify the level of capital required for the bank to remain solvent in the face of unlikely adverse environments.

* **Organisational Forms:** new bank organizational forms have emerged in the United States over the past few decades. Securities affiliates (so-called "section 20" subsidiaries or the creation of "financial holding companies") for very large banks and Subchapter S status for very small banks, were the by product of regulatory/legal evolution. Indeed, only one new organizational form, the internet-only bank, arose from technological change. These institutions, which quickly emerged and disappeared, may represent an interesting laboratory for the study of "failed" financial innovations. We believe that understanding such experimental failures may hold important insights for understanding the keys to successful innovations.

Conclusion

Over the last three decades the role of banking in the process of financial intermediation has been undergoing a profound transformation, owing to changes in the global financial system. It is now clear that a thriving and vibrant banking system requires a well developed financial structure with multiple intermediaries operating in markets with different risk profiles. Taking the banking industry to the heights of international excellence will require a combination of new technologies, better processes of credit and risk appraisal, treasury management, product diversification, internal control and external regulations and not the least, human resources. Fortunately, we have a comparative advantage in almost all these areas. Our professionals are at the forefront of technological change and financial developments all over the world. It is time to harness these resources for development of Indian banking in the new century.

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