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Information technology innovations and commercial banking: a review and appraisal from an historical perspective

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Abstract

Technological innovation in general and information technology (IT) applications in particular, have had a major effect in banking and finance. Following Garbade and Silber (1978), this research reviews the effects on banking organisations with reference to front office or external changes as described by the nature of product and service offerings. Following Morris (1986) and Quintás (1991), the research also considers innovations in the back office or internal (operational function) changes brought about to banking organisations. Outstanding IT-based innovations are considered and grouped into four distinct periods: early adoption (1864-1945), specific application (1945-1965), emergence (1965-1980) and diffusion (1980-1995). The research then discusses the potential impact of more recent innovations (i.e. electronic purses, digital cash and Internet banking). As a result, the research provides an historical perspective on the main drivers determining adoption of technological innovation in retail banking markets.

1. Introduction

Table 1 summarises two dimensions of technological progress in retail banking. These dimensions describe the nature of change brought about by technological innovation externally (product or service offerings) and internally (operational function) to banking organisations. Although other dimensions might offer a more comprehensive treatment of innovation in financial services, the dimensions portrayed below suffice to provide an historical perspective on the adoption of technological innovation in retail bank markets. Initially, change induced by innovations in information and communications technologies (IT) reduced price differentials in geographically distant markets. The next stage saw specific IT markets and then IT modified specific applications that modified the relations between previously isolated departments of banking organisations. Over time, IT applications produced alterations throughout the whole organisational structure in terms of internal operations and with respect to bank-client relationships. In brief, Table 1 outlines key technological innovations in retail finance as grouped into four distinct periods: early adoptions, specific application, emergence and diffusion.

Table 1: Dimensions of IT Innovation in Retail Banking, 1845-1995

	Use of Technology in the Organisation			
Impact on the Provision of Retail Finance	Early Adoption (1846-1945)	Specific Application (1945-1968)	Emergence (1968-1980)	Diffusion (1980-1995)
Innovation in Service Offering	• Reduce inter-market price differentials.	• Conversion from branch to bank relationships. • Automated bank statements. • Cheque guaranty cards.	• Growth of cross border payment. • ATM introduced.	• Supply of non-payment products like insurance, mortgages and pensions.
Operational Function Innovation	• Increased co-ordination between head office and branches.	• Reduce cost of labour intensive activities (i.e. clearing system).	• Automation of branch accounting. • Real time control begins.	• Growth of alternative distribution channels, such as phone banking and EFTPOS.

Sources: Morris (1986) and Quintás (1991)

The dimensions of technological innovation in retail banking portray the internal structure of banks as being determined by a combination of changes in banks' external environment and advances in information technology. Pugh (1973, p. 28) was one of

the first contributions to document widespread empirical support on the effect on organisations of the environment, relative to competitors' size and technology. According to this view, managers are passive in the adoption of the boundaries drawn around their organisation, while the rate of adoption of new technology is contingent on the organisation's circumstances. However, empirical studies do recognise that despite the limitations imposed by the context in which organisations perform, managers have plenty of leeway to make their influence felt in the pursuit of competitive advantage (*idem*). In other words, the research considers that managers of banks have little influence over the development of technological innovation while, simultaneously, the actions (or omissions) of managers in banking organisations in adopting technology are considered critical to determine how technological innovations modify competition in bank markets.

In what follows, the discussion of technological innovation that altered the provision of financial services will cover external changes over methods of undertaking transactions (between customers and bank) and changes up to the point at which customers enter the banking system. The discussion will also cover technology-induced changes in internal procedures. In particular, changes over operational functions and process innovations are explored. These changes and innovations will be identified as changes in:

- national payment systems (i.e. distribution of cash and coins between the central bank and individuals rather than bank assets as substitutes for cash balances);
- the delivery of deposit lending and settlement transactions; and
- the storage and retrieval of accounting information.

The research, therefore, presents a summary of major IT-based innovations and an analytical framework with which to structure an historical review of how IT innovations were adopted in retail bank markets. The discussion will focus on how the performance of retail banks changed through the applications of new information and telecommunications technologies and resulted in product and operational (process) improvements. This historical review defines participants in bank markets following Klein (1971, p. 206), Baltensperger (1980, p. 1), Swank (1996, p. 193) and Radecki (1998, p. 4). In other words, throughout the paper commercial banks are defined as

financial intermediaries that accept deposits without explicit payment of interest (sight accounts) and which create assets that are generally acceptable means of exchange (paper and electronic payment instruments).

Alongside the general review of the absorption of IT innovations in banking, particular attention will be given to IT innovation in United Kingdom (UK) bank markets in general. The UK and England in particular, are used as the benchmark because they have had a large and highly competitive wholesale banking markets, and have preceded other developed countries in the introduction of changes regulating financial markets (Bank of England, 1991). UK participants in bank markets also seem to have adopted key technology innovations before counterparts in North America (Bátiz-Lazo, 1998, p. 277). Focusing on the UK bank markets will also provide an opportunity to explore whether technological change has enhanced the importance of computer systems within the strategic compass of commercial banks. Specifically, this research will determine whether the introduction of IT applications supported changes in banks' strategic goals and modified the principal-agent relationship between bank and customer, so that client-bank relations depended less on subjective loyalty or service quality considerations (approached as idiosyncratic investments) and more on current and prospective levels of financial margin.

The document proceeds as follows. The second section considers the effects of outstanding IT-based technical innovations as grouped into four distinct periods defined as early adoptions (1864-1945), specific application (1945-65), emergence (1965-80) and diffusion (1980-98). In the third section the discussion turns to the potential impact of more recent innovations in payment systems, the so called ‘electronic purses’ and Internet banking as well as their likely effects on competition within bank markets. The fourth and final section discusses the implications of IT-based change for the corporate strategy of commercial banks.

2. Information Technology Innovation and Banking

2.1. Early Adoption Period[i]

The introduction of telecommunications into bank markets dates to 1846 when the telegraph reduced stock price differentials between New York and regional stock markets (Garbade and Silber, 1978, p. 823). The 1866 introduction of the trans-Atlantic cable equally enabled greater integration of securities trading in New York

and London (*idem*, p. 827). Greater integration took place as the completion of the cable reduced the time delay to execute a trade in New York, which had been initiated in London from six weeks to only one day. According to Garbade and Silber (1978), early innovations such as the trans-Atlantic cable were accompanied by statistically significant evidence that the introduction of primitive forms of telecommunication substantially reduced or even eliminated foreign exchange and security price differentials between geographically distinct markets.

However, evidence has yet to develop and support the possibility that market integration increased or continued during the years that followed the emergence of individual new communication innovations. Evidence in Garbade and Silber (1978) suggests that new communication innovations represented (proportionally) smaller reductions in price differentials. This evidence suggests that the adoption of telegraph or telephone facilities primarily produced the same kind of information asymmetry amongst market participants. However, greater use of telegraph or telephone facilities also resulted in price related information becoming homogeneous by linking the head office with branches in different domestic and international locations or by providing dealers and banks with the same price information in a timely manner. It is no surprise, then, that the statistical significance of the enhanced market integration was greatest for early developments, that is, those financial transactions where information delays were greatest prior to the introduction of telecommunication applications (*idem*, p. 831).

The early introduction of telecommunications into bank markets did little to modify front office procedures, that is, methods of conducting transactions between customers and bank remain largely the same. For instance, the amalgamation process that swept UK banking after the introduction of limited liability banking during the late nineteenth century resulted in financial intermediaries with nationwide retail branch networks. However, it was not until the 1950s that UK commercial banks actively pursued the aim of becoming depository institutions for excess funds or began to develop non-deposit products for mid-income customers (more below).

During the early adoption period, bank customers entered the banking system directly through retail bank branches or indirectly through agency representatives (such as savings banks, mortgage specialists and even retail outlets). Telephone conversations

between bank managers and customers have been recorded in use as early as the 1890s, but, in spite of this, service remained largely unaffected by technology with the front office relationship unchanged and controlled locally through asynchronous, analogue systems such as paper-based records and pass-book control.

At the time, financial intermediaries observed little in the way of systematic product and customer group diversification. The main function of the head office was to manage and provide services such as cheque clearing, relations with the central bank and to manage the bank's liquidity and balance sheet through treasury operations. Head office was also in charge of policing performance through financial control and draconian inspection methods. Long-term relations of individual customers with the bank retail branch were needed to secure services such as loans or establish credit ratings and as a result, managers of retail bank branches were persons of independent authority and standing in their local communities. Meanwhile, individual banks performed international transactions such as clearing bills of exchange through networks of correspondent banks abroad rather than through open markets.

During the late 1930s the first tabulating machines were purchased to address the growing volume of transactions and enhance working conditions and productivity of senior staff. This trend was reinforced through the purchase of additional adding and listing machines that supported the growing network of branches and agents. However, the potential of these machines, as well as punch-hole 'accounting' machines, as mechanisms for recording and updating transactions were not fully exploited until after the late 1940s and early 1950s. Increasing the size of the branch network and divesting under-performing agents then became a priority. Performance indicators primarily measured growth in size (such as assets per employee and investment referrals) rather than efficiency or effectiveness (such as financial profitability and credit risk exposure). Moreover, during this period, financial performance of the branch network and individual retail branches was examined only at random and when specifically commissioned by the Board or the Finance Committee.

The characteristic provision of financial services in retail markets was to change with the commercial use of computer power. According to Locke (1999, p. 5) and Leslie (2000, p. 49), the most important IT applications had their origins in US government-

sponsored research in the first half of the twentieth century. Interactive IT applications would never have existed without a long and expensive gestation period in which computer power and telecommunication applications were devoted to help the US gain the initiative in science and technology. Indeed, the British experience with computer hardware development would tend to confirm Locke´s and Leslie's view of a defence-based technology push. The first stored-program computer in the world was developed in 1948 by academics at Manchester University (Anonymous, 1998). However, lack of funding resulted in Freddie Williams and Tom Kilburn being unable to continue with their project. Government sponsored research in the US was therefore the force behind the development of highly sophisticated hardware and software as well as the networks which linked computers together.

In brief, early adoptions of telecommunications and computer applications had greatest impact in organised high value wholesale bank markets, that is, those activities that had traditionally been further away from volume transactions through retail bank branches. Banks absorbed the new technology on the back of a growing market for retail bank services, which expanded as middle income individuals became a growing proportion of the population. However, it was government sponsored research in the US rather than bank initiatives that provided the force behind the original innovations that would result in interactive IT applications during the 1970s.

2.2. Specific Application Period

The second wave of IT innovation in retail finance begins in the late 1950s and lasted up to the late 1960s. Banks introduced computers to keep up with growth in business volume while, at the same time, solve very specific problems and automate existing practices of specific departments (see further Seeger *et al.*, 1974; Morris, 1986; BBC, 1995). The introduction of computer power relied on US-based suppliers of accounting machines such as IBM, Xerox and Burroughs (later Univac and Unisys). Initially, computer manufacturers responded quickly to the demand for hardware but failed to make much concession to users' software requirements (Fincham *et al.*, 1994, p. 153), or to recognise the new strategic possibilities reduced information costs provided. The lack of ready-made software products forced user organisations to devise their own solutions to this problem until high-level programming languages emerged from joint collaboration of users and computer manufacturers (*idem*).

At the time, banks aimed to develop the capacity to handle more complex and higher level service tasks with their existing 'high street' skills and resources. This resulted in the branch network quickly turning into the main point of contact with retail customers while, internally, there was a growing need to supply top management with prompt (i.e. quarterly) financial information. A process-directed automation thrust dominated the specific application period and aimed at undercutting the cost of administrative tasks such as the labour-intensive cheque clearing system. During this period, the typical financial sector computer installation consisted of a central mainframe (Fincham *et al.*, 1994, p. 154), dedicated to sequential batch processing of computer readable instructions dealing with separate processes such as providing a service for handling customer transactions, standing orders and other clerical procedures. Computer applications were therefore concentrated on back-office operations (Morris, 1986, p. 77), because controlling a growing mountain of paperwork provided the potential for economies of scale. There was also an incentive to automate at the individual branch bank level and to improve market-wide processes.

As mentioned previously, US-based providers of hardware solutions had achieved a position of advantage from their head-start in the development of the first digital computer in the 1940s. This position of advantage was maintained throughout generous funding underwriting, the retrospectively somewhat illusory, technological competition with the former Soviet Union during the 1950s and 1960s. The delay before bank markets benefited from this new technology reflected the time needed for US government-sponsored research programmes to produce a critical mass of skilled IT professionals who were willing and able to get involved in commercial IT applications (more below).

By 1965, most major banks in the US and UK had been introduced to electronic data processing and many of them had seen the arrival of their first computer installation. Towards the end of the decade, with the introduction of a second or third computer, a major redistribution of organisational responsibilities followed. Organisational change tried to solve the apparent paradox between greater efficiency associated with automation (i.e. greater centralisation) and enhanced service offerings to customers associated with devolution of discretion to customer facing staff at retail branches (i.e.

greater decentralisation). Greater automation and improved communications, such as automatic internal switchboards, resulted in the establishment of central accounting units and in centralisation of customer account control so that regional and branch managers lost autonomy to centralised senior managers. Centralisation on the back of computer applications, therefore, created a space for a standardisation of service offering and the potential to reduce cost structures of traditional activities.

The increasing complexity and volume of financial transactions eventually led to the development of Database Management Systems or DBMS (Fincham *et al.*, 1994, p. 154). The role of the DBMS was to overcome the limitations of conventional filing systems by providing a generalised, structured and integrated body of data that could be read and updated in a controlled, efficient, and reliable way (*idem*). Two key applications built on DBMS and took place in 1968. First came an interbank voucher-less payment facility called the Bankers' Automated Clearing System or BACS (Morris, 1986). The second innovation involved the installation of the National Girobank, the automation of retail national and international money transfer through forms handled by Post Office outlets (Thomson, 1968).

A payment clearing system had existed in London since the 1770s and was known as the Banker's Clearing House (Bank of England, 1987, p. 392). The system emerged as representatives of note-issuing banks met informally to exchange cheques drawn on their various banks and to settle up by netting their positions and transferring money between accounts at different branches and banks or from their account at the central bank (e.g. Perry, 1975, p. 63). The system grew organically into a limited liability company known as the Bankers' Clearing House Ltd. (established in 1864). The company was owned and controlled by a group of banks called the 'Committee of London Clearing Banks', and built upon banks that regarded the provision of current account facilities and money transmission services as their core business (Cooper, 1984, p. 50).

By 1900 ten clearing banks captured 46 per cent of total deposits in England and Wales and by the end of the first world war, five major clearing banks captured 97 per cent of total deposits (Holmes and Green, 1986, p. 121). The number of major banks remained stable during the next 50 years and in 1960 the system of clearing was extended to credit transfers and standing orders of payment (Perry, 1975, p. 75).Non-

members could also provide current account and other facilities but required members (known as clearing banks) to act as agents to settle their cheques, transfers and standing orders.

From 1967 to 1973, mergers reduced yet again the number of clearing banks. These *new* institutions together with Midland Bank and Lloyds Bank were, at the time, the five biggest retail banking groups in the UK. In 1975 the Co-operative Bank and the Trustees Savings Bank (TSB) also became clearing banks and the National Girobank joined them in 1983 (Bank of England, 1987, p. 392). More recent membership of clearing facilities was issued to building societies turned banks such as Abbey National in 1989.

Alongside changes in the membership of the clearing committee, clearing banks established in 1968 their first computer-based intra-organisational network while aiming to exploit the cost advantages of electronic data interchange or EDI. This network emerged in the form of an electronic transfer system of payments (called BACS) to which non-clearing banks could subscribe but again, only through a clearing member acting as agent. The BACS system grew to be the world's largest automated clearing house, with a total staff of approximately 200 handling 262 million items by 1976 (Cooper, 1984, p. 53). The development of BACS created an interbank facility in an attempt to bring under control rising costs associated with the huge growth of cheque transactions during economic life-style improvement in the post-war recovery years (Gardener and Molyneux, 1990, p. 84). In 1967, the National Board for Prices and Income reported on bank changes and recommended various ways for increased competition. Following legislation introduced after the 1967 review of banking, from 1972 onwards BACS also aimed to create new sources of bank business by moving wage payment away from cash and into bank accounts (Price Commission, 1978, p. 33).

A second key development in the UK during the specific application period was the establishment of the National Giro Centre (later Girobank) in 1968. Girobank introduced another important innovation in the British money transmission system. Girobank was the first full computer-centred financial intermediary (Thomson, 1968, p. ix). Its original purpose was to help update the Post Office by making them the

distribution channel for low cost transactions (Girobank, 1993), that is, offering a money transmission service through 21,000 post offices in the UK.

Internationally, the UK was a latecomer to this service. Austria pioneered postal giro in 1883 and automated giro systems in 1962 (Thomson, 1968, p. 209). In the UK version of the giro system it was possible to maintain current accounts and by 1977 Girobank attracted 580,000 customers all but 30,000 of whom were individuals, representing about 3 per cent of the personal account banking market (Price Commission, 1978, p. 45). Developments in the UK, however, were below expectations. It was readily recognised that external factors had little influence on Girobank's slow penetration of the personal market (*idem*, p. 46). This was because Girobank tended to rely on recruiting Post Office personnel, most lacking the professional skills of the banking sector. A complex system that resulted in higher than average tariffs for money transmission was also mentioned as contributing factor. Nonetheless, the UK's Girobank was a sign of things to come with regards to:

- Its specialisation in terms of activity (money transfer) and market segment (low income banking and benefit payment);
- Its creation of an alternative retail money transfer system utilising an existing non-dedicated distribution channel already in place (Post Office counters);
- The competitive challenge it offered through focussed operations that lowered cost to process payment orders and bank cheques (internal allocation to process postal payment orders and bank cheques was 12 and 20 per cent, respectively).

Succinctly, during the specific application period computer-based applications emerge and take place in isolated departments of the banking firm. During this period the first IT applications in the bank-client transactions were introduced. Enhanced computer power allowed banks to process the growing volume of paper-based transactions in central locations with the added effect of modified labour costs. This would suggest that greater use of IT applications in banking reinforced the hierarchical and volume driven ethos of financial intermediaries serving retail markets while promising product diversification on the back of standardised service offerings and reduced cost structures. At the same time, computer power enabled managers of banks to look for more standardised (and cheaper) labour while a new set of IT-related capabilities

began to emerge as a necessary condition for competition in bank markets (Quintás, 1991 and Fincham *et al.*, 1994).

2.3. Emergence Period

The third wave of IT innovations in retail finance emerged hand in hand with advances in telecommunications. During the emergence period, banks became one of the world's dominant customers for computer-based applications, far exceeding other sectors such as capital goods manufacturers or transportation (Scherer, 1982; Quintás, 1991). Between 1968 and 1980 banks emerged as major customers of software and hardware as they became involved in applications which delivered significant cost reductions as well as increased business volume and variety. The main difference between this and the specific application period was that the impact of computers was felt throughout the organisation rather than in specific departments. The ability to achieve higher quality and lower cost in an unprecedented way established large scale-economies in banking which were not offset by organisational discontinuities (see further Walker, 1978).

Developments in hardware and software that found their applications in the private sector in general and in banking in particular, were further enhanced with the reduction of government expenditure that had supported the space exploration project. As a result, throughout the 1970s many highly qualified individuals formerly working at NASA found employment in investment banks and the treasury operations of US-based commercial banks. Changes were also observed in the recruitment strategies of banks outside of North America. In the UK, highly skilled university graduates were attracted and prepared for future responsibilities as senior staff at banks and non-bank financial intermediaries. This was a departure from the traditional practice of ‘internal job markets’ developed in the 1920s, that is, the recruitment and in-house training of low-skilled and risk adverse individuals, who had few ambitions beyond the security of job ‘for life’ employment offered by banks and would require little motivation (Parker, 1981, p. 147).

Early adoption of EDI in the UK as well as the change in recruiting practices were critical to secure the pre-eminence of London-based banks throughout the growth of euro-currency and euro-bond markets. In the Euromarket banks accept deposits and issue loans denominated in currencies other than that of their country of origin.

Through Euromarket transactions participants minimise their exposure to sovereign risk and, in the process, segregate that exposure from currency risk.

Euromarkets date to the post-war years when surplus pools of dollar denominated funds emerge related to significant balance of payments deficits between the US and Europe, trade with East-Block countries and the cap on the level of US domestic interest rates (Regulation Q). The Bank of England's encouragement for London-based banks financing of multinational companies was also important. In June of 1963 the first eurobond issue was launched, signalling the re-birth of London as a major centre for international finance. The event also marked the beginning of the Euromarkets because both sides of the market (currencies and financing) became active in a single transaction.

During the 1970s, the growth of the Euromarket was fuelled by the demise of fixed exchange rates to the dollar, excess liquidity in oil exporting countries and the emergence of a secondary market in Eurobond issues. The creation and development of a secondary Euromarket gave depth and liquidity to any placement, standardised dealing practices and promoted transparent pricing guidelines. By the mid-1970s the Euromarkets were firmly established. Absence of a governing body resulted in rates and volumes fluctuating according to issuer needs and lender disposition, producing a free and boundary-less market. Euromarkets were thus situated as the pre-eminent market to place great-volume funds, as a response to the increasing integration of world trade.

Information technology and innovations in telecommunications helped to achieve greater use of the Euromarkets by actively reducing the cost of placements, reducing the distance between syndicates, issuers, lenders and the secondary market; as well as through improvements in banks trading rooms and back-offices. IT-led innovation was thus critical to re-incorporate transactions in other financial centres (more below).

Other distinctive characteristics of banking organisations during the emergence period included the introduction of full automation to branch accounting, real time operation and control of branches by the central office. In the UK, Clydesdale Bank was the first to network every teller and cashier position, that is, to provide the possibility for each transaction to have direct access to the bank's on-line transaction-processing services (Fincham *et al.*, 1994, p. 154-5). Concisely, the immediate result of innovations

during this period was that customers were able to bank at any point in the retail branch network while the previous arrangement limited several transactions to the customer's own branch. Indeed, the regional manager for a major UK provider reported at the time that:

> '…the [bank's] computer will provide to all branches an "on-line" enquiry service. Account balances and redemption figures will be immediately available ensuring a much speedier service to members and professional contacts.'[ii]

Panel A in Table 2 illustrates the growth of one of the most successful applications that emerged during this period. It took place in 1967 when Barclays Bank (UK) introduced the first Automated Teller Machine (ATM) in the world (Barclays, 1982), while IBM introduced the magnetic stripe plastic cards in 1969 (Bátiz-Lazo *et al.*, 2001, p. 867). Together these innovations marked the birth of electronic banking.

Table 2: Growth of ATMs in the UK and elsewhere, 1974-1995

Panel A: Bank Branches and ATMs in the UK, 1974-1994

Year	*Branches*	*ATMs*
1974	14,908	N/A
1984	14,058	6,106
1989	13,131	12,253
1994	10,724	15,180

Source: Collett and Maher (1997)

Panel B: Cash Dispensers and ATMs in Four OECD Countries, 1988-1995

	1988	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Number of machines per million inhabitants:								
Belgium	85	92	94	105	109	119	313	360
France	206	231	255	284	305	325	356	395
UK	245	275	296	314	324	328	342	358
US	296	306	321	331	342	367	418	467
Number of transactions per inhabitant:								
Belgium	5.7	6.8	7.1	8.1	8.8	9.1	11.9	14.2
France	8.0	9.0	10.0	11.0	12.0	13.3	14.2	15.7
UK	13.2	15.4	17.3	18.8	20.2	21.3	22.9	25.2
US	18.4	20.6	23.2	25.3	28.2	29.8	31.8	36.9
Average value of transactions (USD):*								
Belgium	94.4	94.2	113.2	117.4	113.2	110.3	125.2	137.5
France	75.3	72.3	81.4	83.4	95.5	77.0	76.5	81.3
UK	68.0	65.0	77.0	81.0	84.6	72.5	74.6	77.3
US	66.0	64.7	66.0	67.0	66.9	68.2	67.2	67.7

*Converted at yearly average exchange rates *Sources:* Bank for International Settlements (1989, 1996)

Barclays introduced credit cards to the UK by importing systems (including computer applications) from Bank of America (US) at the end of 1965 (Bátiz-Lazo *et al.*, 2001, p. 865). Barclay's early adoption of ATMs was no coincidence because cash withdrawal through ATMs is a major use for credit cards. Indeed, the emergence of the ATM marked the beginning of self-service banking as services provided by the bank teller could be performed on a 24-hour schedule and at the customers' convenience rather than during banking hours. Panel B in Table 2 shows how ATMs expanded rapidly in the UK and elsewhere as other institutions followed Barclays' lead. By 1974 there were 3,140 cash dispensing machines in the US, owned by 534 banks (Walker, 1978, p. 68). More recently, according to 1990 figures, the UK had some 294 ATMs per million inhabitants (Maudos and Pastor, 1995, p. 8).

Noticeable changes in bank internal organisation started to take place alongside the growth in ATM adoption complementing retail bank branch distribution. Initially the heavy investment required to build an ATM network was seen as a major source of competitive advantage for large banks, so interconnection was slow to develop. However, managers of banks eventually realised that few financial organisations had access to the financial resources and IT skills to develop widespread ATM networks. Banks then increasingly sought critical mass through strategic alliances.

For example, the Co-operative Bank was notoriously slow to introduce 'on-line' systems. Only in 1987 was the bank able to offer on-line banking rather than the pass-book system through its agencies in Co-operative stores. To solve the IT problem, the Co-operative Bank pursued several collaborative solutions. One was to become a founding member of the LINK Group in 1984. The bank had 50 ATMs in its 78 branches but, through LINK, bank customers could access around 400 ATMs. This number grew to 1,000 in 1988 and then to 3,500 when the Matrix Group joined LINK (also in 1988). By 1995, LINK allowed access to over 8,500 ATMs in the UK alone, with the Co-operative Bank contributing 119 ATMs (managed by IBM under a £13 million outsourcing contract signed in 1994). Hence, 30 years after the introduction of the first ATM, the absurdity of terminals connected to different networks located side by side and long after terminal density had reached saturation point, eventually resulted in a single interconnected network in 1999 for the UK (Bátiz-Lazo *et al.*, 2001, p. 865).

During the emergence period, the introduction of management information systems or MIS also took place (Fincham *et al.*, 1994, p. 155). These systems initially aimed to use the computational power of transaction-processing capabilities to provide regular reports and analyses of business activity. In this way MIS offered managers of banks the possibility to increase the scope for monitoring, controlling and planning of operational procedures. Although MIS increased line management productivity, MIS systems proliferated throughout the organisation but without any fundamental change in the nature of managers' activities (*idem*).

In summary, during the emergence period technological change spread to many internal aspects of the banking organisation and permeated bank-client relationships. These changes started to modify how, when and where customers could enter the banking system but banks had yet to be considered multi-delivery channel organisations in their service offering or in their ability to direct all their information to any point of customer contact. It is during this period that the convergence of telecommunications and computer power resulted in true IT applications as the emphasis of technological innovations shifted from data processing to communications. At the same time, cost effective supply of financial services rather than customer value creation continued to predominate the design of banks' internal organisation and strategy development.

2.4. Diffusion Period

The *diffusion* period of the information revolution in commercial banking saw the spread, within organised markets, of new and powerful applications developed to handle the security required by high-volume payments. IT-related change became critical to support unprecedented increase in the speed, quantity and quality of information about cross-border transactions in organised markets such as those taking place in the Euromarkets. Reforms in the US during the mid-1970s effectively allowed US-based off-shore activities and by end of the decade New York regained its position as a significant international market place. The 1980s also saw the emergence of Tokyo, Hong Kong, Bahrain, Nassau and Singapore as secondary financial centres specialising in non-European-currency denominated bonds like Australian dollars and Korean wons.

A very important event for organised markets is the lending crisis in the less developed countries (LDC-debt), which originated between 1978 and 1982. Firstly, banks were forced to make substantial provisions against bad debts, triggering the need for banks to become more selective in lending and forcing regulatory authorities to re-examine capital adequacy levels. Secondly, big non-bank corporations based in industrialised nations found themselves with better credit ratings than banks which, in turn, allowed them to finance directly from markets rather than through traditional intermediaries (bank disintermediation). Banks were pleased to arrange this process since it eliminated a burden on their capital. At the same time, in emerging and non-industrialised Western economies governments turned to domestic debt markets to finance the increasingly burdensome service of foreign debt.

The result of these processes was tremendous growth (in terms of issues and financing) of organised markets. According to Hayes and Hubbard (1990), between 1965 and 1967 lead managers in Eurobond markets placed an average of 10 issues per annum (each of $300 million dollars approximately). By 1976-1978 lead managers placed an average of 70 eurobond issues per annum (equivalent to approximately $3,000 million dollars). Between 1982 and 1986 lead managers had an annual average of 500 issues, each valued around $ 40,000 million dollars.

Meanwhile, the most important consequence of the drive towards mass delivery of retail financial services during the *diffusion* period was that banks effectively moved from being places of decentralised personal relationships to ones run by institutional managers[iii]. During the *diffusion* period, the information revolution in commercial banking saw the spread of IT to all aspects of banks' internal organisation and market relationships thanks to the introduction of personal computers (PCs) in clerical and managerial roles. During this period, consumer-oriented innovations were widespread as information technology provided support to all points of contact between customers and bank, prompted by major overhauls of incompatible legacy systems undertaken in response to the perceptions of a major Y2K threat. PCs offered a flexible way of providing and enhancing computer resources for a wide range of applications. Simultaneously, widely available packaged software reduced the need to devote in-house resources for the development of general application systems. Incorporating, standardising and exploiting IT-based innovations became a key issue in banks' long-

term strategies. Moreover, IT applications offered banks greater anticipated advantage thanks to expectations of enhanced control of financial and strategic resources.

During the *diffusion* period, banks began to create relationship databases instead of using skilled personnel at all points of contact with customers (BBC, 1995). For example, Lesley Taylor (Head of Direct Banking, Royal Bank of Scotland) claimed that current technology allowed one person to develop in 3 or 4 weeks the skills that previously required 5 years in the job (BBC, 1995; Morris, 1986, p. 97). Information technology applications, therefore, promised higher organisational flexibility to those banks that could effectively implement technical changes.

The second effect of technical innovations on banks' approach to business during the diffusion period pertained to distribution capabilities. The branch network reduced its importance as the point-of-sale for financial services. This development was facilitated with the advent of digital communications technologies and networks, which allowed the performance and reliability required for organisation-wide integration of data resources as well as more effective extra-organisational networks.

The integration of services around digital networks (ISDN) and greater use of electronic data interchange (EDI) protocols were at the heart of new distribution channels such as electronic fund at point of sale terminals (EFTPOS), telephone transfer systems and smart cards. Card technology evolved to provide individual customers with border-less services, primarily under the trademarks of VISA and MasterCard International networks.

New distribution channels allowed banks to supply more services and this had dramatic effects in banks' cost structures. For example, Bauer (1995, p. 94) claims that by emphasising IT systems Citibank (New York) was able to serve 85 per cent of its customers by telephone and electronically. For Citibank, automation represented lowering the overall cost rate from 70 per cent to 55 per cent with announced reductions of 30 per cent in branch staff costs (*idem*, p. 95). The move from more to less expensive distribution channels was possible because the same information or transaction could be delivered in a number of ways. However, cheaper processes were an insufficient condition for reduced cost structures. For instance, providing an account's balance costs less through an ATM than at the teller but only if the total volume of requested balances remains unchanged will the total cost of ATM-supplied

balances be less than that provided through branches. Technology, therefore, opened the way for banks to improve their cost structures provided customers changed their behaviour according to banks' expectations. Table 3 illustrates the growth in the adoption of point of sale terminals and in turn, this growth reflected how IT applications were used instead of cash registers and telephone credit authorisations. Other innovations included cheque verification terminals and fund transfer terminals.

Table 3: Growth of EFTPOS Terminals in Four OCDE Countries, 1988-1995

(Number of terminals per million inhabitants)

Country	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Belgium	1,925	2,477	2,828	3,213	4,034	5,246	6,294	7,174
France	2,154	2,842	3,180	3,568	5,594	7,435	7,574	9,394
UK	426	1,311	1,916	3,299	3,806	4,639	5,993	8,647
US	183	200	240	348	450	759	1,440	2,107

Source: Bank for International Settlements (1989, 1996)

Nevertheless, not all substitutes of the bank branch enjoyed the same success (McNamara and Bromley, 1997). For example, growth of the most sophisticated EFTPOS terminals was hampered by conflicts between retailers and banks about the inadequacy of cash and cheques. A related issue was who should receive the ‘lion's share’ of the profit. As a result, by the end of the 1980s, EFTPOS had yet to fulfil its potential and develop into a major new source of profit for banks' fee income (e.g. Wood, 1989, p. 3; Channon, 1988, p. 317).

All types of financial institutions invested heavily in the integration and standardisation of internal systems during the 1980s. Progress, however, was uneven because banks had traditionally operated through their own closely controlled retail branch networks while the use of second and third parties as distributors was more popular in the building society or insurance sectors. At the same time, high transaction costs resulted in low international interconnectivity of payment systems. The established framework handled urgent high value payment well, but achieving potential economies of scale in small payments was deterred by some countries lagging in the use of automated clearing systems, regulation or concentration in bank markets (Wood and Erturk, 1996, pp. 15-16).

In brief, during the diffusion period IT applications resulted in customers acquiring several options when engaging in financial transactions with their main bank but also competing banks. Together with regulatory change and theoretical advances to price risk, technological innovations put a premium on financial information rather than on banking on a set of transaction processing capabilities. Developments in IT were instrumental in lowering entry barriers to bank markets by providing scale benefits to the smallest providers. Applications of information technology also threatened to turn retail bank branch networks into sunk (i.e. irrecoverable) strategic costs. During this period IT developments augmented the range of financial services and product availability by increasing the threat of substitution and by lowering the cost of imitation. Moreover, during the diffusion period, digitisation and standardisation of IT applications helped to explain the development of markets for second and third party processing. Unfortunately, most potential opportunities opened by technology were slow to develop because, although technology allowed new entrants to contest markets for financial services, these challenges took place only in the most profitable segments of bank markets (such as credit cards or unsecured lending).

3. Historical Experience and the Most Recent Applications

3.1. Technological Innovation and New Competitors

New technology allowed the introduction of new services and in turn, new retail bank products brought the bank service away from the branch and closer to the customers by delivering customer information at the point of sale. Banks had no proprietary hold on this technology and at the same time, retailers started to offer their own credit services with store payment (account) cards and credit cards. A classic example of an originally non-financial firm offering financial mediation services was the experience of Sears, Roebuck & Company (see further Ghemawat, 1984 or Christiansen, 1987). In 1982 the US-based firm was the world's largest retailer (Ballarín, 1985, p. 117). As part of its diversification strategy, Sears purchased an investment house (Dean Witter Reynolds) and a real estate broker (Coldwell Banker). Sears tried to provide full financial services through in-store sites (called Sears Financial Centres) by pulling together its new acquisitions with previous finance business including own-brand credit card (Discover Card) and insurance (Allstate Insurance Co., established in 1931).

The company expected synergy to arise from developing products in one business and selling them in another and from sharing customer information and administration, floor space in stores, training programs, costs in communications and data processing. In other words, Sears tried to create a one-stop department store by integrating:

- different retail sales and financial services
- customer support of sales in volume-oriented financial markets
- the strong brand name of Sears, and
- Sears' corporate culture.

However, by 1984 outsiders began voicing doubts about the strategy (Ballarín, 1985, p. 122). The expected synergy had not materialised while the core retail operation had lost competitiveness and market share. At the end of 1992, Sears with 824 department and storage outlets, lost a record US$160 million dollars and was short of the annual 15 per cent return on equity (ROE) goal. As a result in June 1993, the financial-services group was sold piecemeal for a total of US$4 billion dollars. The divestiture provided Sears with much needed debt relief, reducing its outstanding debt to US$17 billion dollars[vi].

The divestiture of the finance side ended Sears' attempt to capture financial products with retailing. It could be argued that Sears was making the same mistake as banks by delivering exclusively through branches (Crane and Bodie, 1996, p. 115). Alternatively, it could be argued that conflicts in corporate culture were a barrier to synergy (Ballarín, 1985, p. 122). However, either explanation was challenged by the success of a more focused approach to retail finance by retailers like Marks and Spencer or by the synergies with branches and supermarket stores explored by US banks like Wells Fargo or Banc One (Channon, 1996, p. 5). In other words, despite its failure to consolidate, Sears' case was the first attempt to achieve a supermarket in financial services and the prime example for the blurring demarcations in the functions of banks and non-financial intermediaries. Moreover, Sears' entry strategy was not necessarily that of a price cutter. Instead, Sears' managers expected synergy to develop by building financial services around an established customer base.

In brief, technology has provided several alternatives for customers to enter the banking system. But at the same time, banks lack sole property rights over the most

important IT developments while internal IT expertise varies widely from one organisation to the other (Fincham *et al.*, 1994, pp. 155-6). A direct consequence of banks lacking property rights over IT innovations is the successful entry of non-finance providers to bank markets. Information technology applications have allowed non-finance providers that abide to detailed regulatory schemes to supply financial services while exhibiting a low-cost structure relative to established participants in bank markets (Channon, 1988, p. 359). In other words, actual and potential competition of non-finance providers would suggest how low sustainability of competitive advantage for banks' 'traditional' distribution strategies and low or no creation of competitive advantage to banks' widespread use of IT in developing new distribution channels.

3.2. Telephone-Based Delivery of Retail Financial Services

If Sears represented an attempt at early broad-spectrum distribution strategies during the late 1980s and early 1990s, the most successful new delivery channels for financial services happened in telephone banking operations. Telephone banking evolved to complement ATM networks and physical branches. Telephone banking created a multi-channel distribution system for banks based on an integrated customer account and information system (Gardener, 1995, p. 4).

Distributing retail financial services through the telephone was unsuccessfully pioneered in 1979 by Banc One Corp. of Ohio, USA (Myers and Kanter, 1989, p. 3). Despite Bank One's experience, phone-banking pilot schemes continued and by 1982 telephone transfer systems operated in a small number of Californian banks (Channon, 1986, p. 387). In 1984, Sanwa Bank (Japan) received 40 per cent of deposits and performed 70 per cent of card transactions through full on-line banking services (*idem*, p. 312). At that time, Sanwa was also developing push-button telephone interfaces (*op.cit.*).

In 1986, The Bank of Scotland and Nottingham Building Society jointly introduced the first major telephone banking system in Britain (Hughes, 1994, p. 36). The system (called HOBS) aimed at home and office banking. HOBS was swiftly followed by TSB's Speedlink system in 1987. A more advanced version of these systems was developed in October 1989, when Midland Bank established a 24-hour telephone

service under the separate identity of First Direct. This was the first British phone-based, branch-less retail bank.

Since 1989, the proportion of transactions over the phone has grown to a considerable share of total transactions. In the US, transactions represented 24 per cent of total transactions in 1995[vii]. However, customers in European countries prefer other forms of retail finance services as in 1995 telephone-based transactions represented 4 per cent of total transactions in the UK, 3 per cent in Sweden, 2 per cent in Germany and 1.5 per cent in France [viii].

A recent survey by Holmsen *et al.* (1998) confirmed the growing trend of the use of alternative distribution channels as a percentage of total transactions. New distribution alternatives have reduced the importance of the bank retail branch as the main point of contact for sales, service and relationship management. Reduced importance of 'traditional' bank distribution was evident as 18 per cent of retail bank customers in Canada and the US used electronic only means to contact their bank, 61 per cent of those customers used more than one channel and 21 per cent used only the bank branch (*idem*, p. 84). Of those customers that used more than one channel, 46 per cent relied in combinations chiefly involving ATMs, 28 per cent the bank branch, 20 per cent the telephone, 3 per cent postal deposits and 3 per cent PC-based applications such as electronic commerce (*op.cit*).

The result of greater importance of IT applications in all aspects of the way banks add value has questioned how bank managers would account for customer revenues. In particular, bank managers have had to address tough operational issues to measure the individual profitability of customer segments, product/service lines and distribution channels.

Allocating strict accountability standards would imply tracking key economic drivers for individual distribution channels, service/product offerings, customer group and individual customers. According to Bátiz-Lazo and Wood (1999, p. 24), bank managers would expect software and hardware developments to enable them to achieve close control of the main profitability drivers. This as only a handful of banks in the world posses IT applications that provide detailed profitability reports (Holmsen *et al.*, 1998, p. 85). In the meantime, most managers at commercial banks seem to prefer withstanding an element of cross-subsidisation because of its associated

stability (Bátiz-Lazo and Wood, 1999, p. 25). As a result, it is likely that most banks continue to allocate individual customer profitability to the retail bank branch or the product/service line regardless of the channels actually used by that customer.

Succinctly, alternative distribution channels to the retail bank branch have attained a considerable share of total transactions. The effect of this type of change has forced managers at commercial banks to evaluate new organisational structures and resolve operational issues in terms of individual customer risk and profitability. However, the move away from the branch-centred organisation will require new IT applications. Another challenge to managers of banks will be the development of the right mix of acquired and internally grown IT applications. Hardware and software are expected to provide the platform that will improve banks' multi-channel management while reducing the cost of co-ordination. But at present, it is uncertain whether the solution to banks' operational problem will result in

- no-change for the banking organisation;
- the creation of networks of stand alone product/service groups, stand alone distribution channels and stand alone treasury operations; or
- a combination that allows product/service and channel managers to negotiate deals independently.

3.3. Emergence of Smart Cards

The establishment of so called ‘electronic cash’ facilities have been the latest major IT development in bank markets. The main difference between e-cash and previous applications is the possibility for individuals to engage in economic transactions but without recourse or claim over bank liabilities. Smart cards are the latest stage in the evolution in the use of plastic cards. Smart cards (e.g. Mondex and Visa Cash) and some applications of electronic commerce over the Internet are innovations that have emerged as means of payment and the substitution of notes and coins issued by central banks by electronic data interchange applications.

The first British credit card was established in 1965 after the proven success of credit cards in the US (Scholes, 1984, p. 746). Barclays Bank established a wholly owned subsidiary named Barclaycard which introduced a card of the same name. The launch of Barclaycard allowed individuals to purchase in retail outlets with plastic cards

instead of cash or cheques. Retail outlets would cash their receipts through an intermediary (merchant acquirer) who, in turn, is reimbursed by the card issuer (e.g., Barclaycard). The card issuer then immediately transfers the balance to the current account of the individual cardholder (debit card) or requests payment for the accumulated balance at the end of the month (credit card).

Credit cards would enhance the convenience of retailers and individuals. Convenience increased because cards offered more stable value than cheques (which are easier to forge or risk failure because of insufficient funds) and are more portable than cash (i.e., higher value to bulk ratio). Cards did not and have not displaced bank issued money for two reasons. First, because card-based transactions involve the payment of commissions to both the merchant acquirer and the card issuer. This payment typically involves a percentage of the transaction's value and thus, introduced the need for a minimum transaction value so card payments would be cost effective for card issuers. Secondly, card receipts are redeemable only by the merchant acquirer or the card issuer rather than payable on demand.

As mentioned above, an added characteristic of credit cards was a magnetic stripe which provided electronic means of supplying card details. Magnetic stripes would contain information for verification of cardholders' personal identification through an ‘off-line’ transaction by a card-reading terminal. During the 1980s credit card transactions evolved to allow the transaction to finalise at the point of sale through EFTPOS terminals. This innovation encompassed a direct link (i.e., ‘on line’) or telephone link between the card-reading terminal and the bank. From very early on, however, the magnetic stripe would allow individuals to use cards as entry points to the banking system through ATMs.

In 1973 an alternative developed to a direct link between the credit card transaction and the bank. Roland Moreno designed a plastic card with integrated circuit technology (i.e., a microchip) instead of a magnetic stripe (Tomkin and Baden Fuller, 1998, p. 2). This was the first ‘smart card’ as the microchip could store much more information than the magnetic stripe. Full exploitation of smart card technology started in 1982 when Mr. Moreno persuaded France Telecom to introduce prepaid telephone cards using smart card technology (*idem*). The French government sponsored initial trials and by 1985 smart card technology was available in public

telephones. Smart cards became widespread only after the cost of individual cards fell from FFr125.00 in 1982 to FFr 15.00 in 1988 and the equipment to read information from the card became small and manageable (*op.cit.*).

According to Stuber (1996, p. 3), the production cost of magnetic stripe cards can be as low as 30 Canadian cents while the cost of the card reader is above $450.00 Canadian dollars (approximately FFr90.00 or £190.00 sterling at 1999 exchange rates). At the same time, the manufacturing of multifunction smart cards starts at $4.00 Canadian dollars while the cost of single-purpose payment cards equals $2.00 Canadian dollars. Moreover, the normal life of smart cards averages five years as compared with two and half years for magnetic stripe cards. However, it was expected that common use of smart cards would bring scale benefits and hence, reduce the unit cost of smart cards and its card-reading technology.

3.4. Smart Cards and Electronic Cash

The potential cost effectiveness of smart cards was one of the incentives for payment managers at NatWest Bank (UK) to develop a multi-purpose, prepaid smart card (Tomkin and Baden Fuller, 1998, p. 3). Tim Jones and Graham Higgins initially designed a prepaid card with enhanced protection against fraud which, at the same time, resulted in a cost effective alternative to account for individual transactions. In 1988 a card was developed under the name of ‘Red Switch’ project. This card facilitated a variety of small-value retail transactions but it was a card that could also be a substitute for central bank issued notes and coins.

What formally is known as the Mondex card involves monetary value to be loaded onto the card with a corresponding debit to the cardholder at a point of entry to the banking system (i.e., retail branch, ATM or purposely build devices). In a retail transaction, monetary value would be transferred from the purchaser's card into the merchant's terminal in an off-line mode. The value of consumer purchases would then accumulate in the merchant's terminal and would be transferred to the merchant's account at a financial institution from time to time through on-line transactions. Uniquely the Mondex system permitted fund transfers to remain anonymous and monetary value to be stored in any up to five separate currencies. More importantly, some card holders could choose to acquire an electronic Mondex wallet so that

monetary value could be transferred between cards without passing through a financial intermediary.

The Mondex project required NatWest to invest an accumulated £2 million pounds by 1992. In this process the NatWest team worked closely with no less than four major Japanese electronic firms to develop card and peripheral components. NatWest also engaged in strategic alliances to exploit the product commercially. In 1992 British Telecom (BT) joined with the given advantage of being the largest provider of telephone equipment and telecommunication services in the UK. BT had also worked with NatWest in previous projects while being one of NatWest's largest customers (Tomkin and Baden Fuller, 1998, p. 3). Also in 1992, Midland Bank joined Mondex as there was also a history of working with NatWest on the development of other card products and shared ATM networks.

The alliance increased the scale of potential applications for the Mondex card and allowed participants to share a £50 million sterling investment over the next three years. Thus, in 1995 a two year trial run was launched in Swindon (a town in the South of England). This pilot trial involved converting ATMs and telephones to enable monetary value being recharged onto the Mondex card as well as providing card-reading technology to outlets such as retailers, buses, petrol stations, etc. 30 per cent of the 40,000 strong target customer base at Swindon adopted Mondex technology while 70 per cent of targeted retail outlets were converted. Table 4 suggests that the apparent initial success of Mondex provided the incentives for other banks, technology specialists, local governments, postal delivery services and telephone companies to engage in tests of advanced card technology. In the following years banks, non-banks and non-finance companies launched several pilot projects in almost all regions of the world (although, some with disappointing results).

The Mondex project, although still young, suggested that e-cash technology had customer appeal. Profit opportunities related to offering a better proposition than central bank issued notes and coins. Cash currency, however, remained the cheapest, simplest and quickest current means of making low monetary value payments. Hence, e-cash technology seems likelier to succeed by drawing on:

- unattended locations (such as telephones, transport, vending, etc where operational savings are high and customer benefits evident);

- customer segments who do not have a plastic card but desire one;
- closed schemes with multiple functions (such as university campus cards or social security payments); and supporting infrastructure of electronic commerce (this assuming e-commerce develops to support a significant proportion of total economic transactions).

Table 4: Selection of Consumers Tests for the Acceptance of E-Cash, 1995-1996
(Trial Projects of Non-Disposable, Rechargeable Smart Cards)

Year	Country	Participants					
		Mondex (Mastercard)	Visa	Commercial Banks	Savings Banks	Local Telephone Company	Other
1995	UK	✓		✓		✓	
1995	Belgium	✓		✓			
1995	Australia		✓				✓
1996	Australia	✓		✓			
1996	Canada			✓	✓		✓
1996	Canada	✓		✓		✓	
1996	Canada		✓	✓	✓		
1996	The Netherlands			✓			✓

Source: Stuber (1996) and own estimates.

The final success of the Mondex alternative relied on making e-cash almost as widely accepted as central bank issued notes and coins. This means that consumers will not be prepared to pay much for the facility, especially as notes and coins are perceived to have very low transaction costs. At the same time, retailers and merchants would expect a payment mechanism that is cheaper than existing arrangements.

The potential commercial weakness of Mondex produced a competitor network which displaced central bank issued notes and coins. In late 1997 a pilot project was launched in Leeds (a city in the North of England) by Visa International and called 'Visa Cash'. This project developed through an alliance with ZKA and Semerpa

(Financial Times, 23 June 1998). ZKA is the German parent of Geldkarte or Germany's most widely accepted credit card. Semerpa is a joint venture in Spain with the Confederation of Spanish Savings Banks (i.e., CECA).

The Visa Cash initiative aimed at improving the interoperability of established 'electronic purses', that is, smart card technology through which retailers can only redeem accumulated monetary balances with a financial institution. The Visa Cash project seeks to develop a standard by bringing together the functional requirements of a centrally-accounted system. The potential benefits of Visa Cash emerge from linking systems that are already in place with the added benefit of low risk of disintermediation for commercial and central banks. The potential weakness is that Visa Cash remains a pre-authorised debit card rather than a card which allows individuals to exchange monetary value directly and without reference to balances in financial institutions.

In summary, previous IT developments succeeded to the extent that customer convenience was enhanced by introducing new ways to make payments. Securing the acceptance of retailers, merchants and other outlets will be key for e-cash technology to develop. Equally important will be for individuals to change their purchasing patterns and meet banks' expected consumer behaviour. At the same time, the challenge for e-cash applications such as Mondex, Visa Cash and some types of e-commerce over the Internet will be to establish widespread adoption of new ways of making payments. In particular, payment systems free of bank deposit transfers. E-cash, therefore, has the potential of re-introducing individual bank notes as it can be privately issued currency.

3.5. Increasing the Service Offer

Table 5 summarises some of the most important recent IT applications in retail finance markets, namely ATMs, telephone banking and 'electronic' banking. Partial success of most of these applications questions whether technological change in the Digital Age[iv] (as opposed to those in the Information Age[v]) offers new forms of competition and business models in bank markets. On the one hand, commercial banks have coped with technological innovation and accomplished managers' intended objectives with varying success. Technology has opened the way for banks to improve their cost structures provided they could induce customers to change their

behaviour according to banks' expectations. At the same time, there have been uneven effects from the same technological innovation across distinct geography.

Table 5: Key Technological Innovations in Electronic Retail Finance, 1979-2001

Year	*Name*	*Characteristic*	*Contribution*
1979-1985	Telephone banking (US, UK)	Branch-less retail intermediaries	Multi-channel distribution system for banks based on an integrated customer account and information system.
1988-1996	Mondex cards (UK)	Debit card with re-writable micro-chip	Facilitate small-value retail transactions with the potential to substitute central bank issued notes and coins. Formalise ways to collecting broad array of information from customers.
1989-1998	DigiCash (NL)	Electronic only medium of exchange and unit of account	Payment systems and products that depend exclusively upon high-speed communications done through computers
1995-2001	Security First Network Bank (US)	First intermediary working through the Internet	Technology opens new opportunities for bank growth and offers managers of banks possibilities to achieve high organisational flexibility.

Source: own estimates.

On the other hand, as noted by Pennings and Harianto (1992), the propensity of banking organisations to adopt technological innovation evolves around the match between the new application and the resources, capacities and capabilities that organisations have accumulated over time. Banks have had no proprietary hold on most of their technology and this has been notably the case with the technology fuelling the growth of the latest applications (such as Internet banking or middle-ware solutions). Some established participants in bank markets have responded by offering non-traditional services like holiday travel (e.g. Midland and Thomas Cook) and real estate agencies (e.g. Lloyds' Black Horse Agencies). However, the vast majority responded through new service offerings in core areas and by increasing the diversity in their products in terms of markets and customer groups. A reduced number of banking organisations (such as HSBC, BBVA, BSCH, ABNAmro, Deutsche Bank

and Citigroup) also increased their geographical scope, but most other banks found little joy in cross-border and foreign operations that failed to match the returns available in home markets. Participants in bank markets have thus tried to use technological applications and IT in particular to integrate retail and financial services into 'one-stop' shopping, support volume-oriented sales, and strengthen their brand name and corporate culture.

As suggested by empirical research documented in Bátiz-Lazo and Wood (1999, p. 25), focus on traditional markets and the creation of new customer groups within geographical markets, reflects commercial bank managers' preference to accept a degree of cross-subsidisation because of its associated stability. Although managers of banks expect software and hardware developments to enable close control of their bank's main profit drivers (*idem*, p. 25), only a handful of participants in the world have developed IT applications that provided detailed and reliable profitability reports. Diversification and greater asset size, therefore, are a solution to managers' inability to track key economic drivers for individual distribution channels, service/product offerings, customer group and individual customers.

Concluding that greater diversification and scale are the way forward for financial service organisations in general and banks in particular is reasonable, given that managers of banks have failed to take full advantage of opportunities created by IT innovations. However, there is an apparent paradox when greater diversity and asset size are pervasive despite technological change, because the expectation that IT innovation should result in greater specialisation being the typical business model for participants in bank markets.

The successful use of digital media by wholesale payment systems and the potential for retail transactions to follow suit, led many (e.g. Taylor, 1998; Browne and Cronin; 1999; Zimmermann and Koerner, 1999; Koerner and Zimmermann, 2000) to conclude that the '*virtual bank*' would be the typical organisational form for financial intermediaries. Although the 'virtual' bank is still a broadly defined concept, there is some general assumption for 'virtual' to reflect a tendency towards the prominence of non-proprietary, computer-based networks that enable a total digitalisation of financial transactions. As a result, non-finance providers would acquire a low sunk (i.e. irrecoverable) cost capability to disintermediate established providers in bank

markets. Table 6 summarises elements which explain the apparent inability of IT innovations to engineer increased specialisation.

Table 6: Contestability of Bank Markets and Technological Change, 1995-2001

(Likelihood the 'virtual' bank will be the typical organisational form)

Dimensions of IT Innovation	*Limitations for electronic-only retail commercial banking*	*Potential for electronic-only retail commercial banking*
Innovation in Service Offering	• Each new technological innovation accounts for (proportionally) smaller reductions in price differentials. • Bank customers remain unwilling to pay for interfaces for the new technology, while merchants expect to share the revenue of new payment media through lower commission charges. • Defection rates remain low thanks to the inertia of bank customers, which has been historically high[ix]. • Unknown brand name and associated high marketing expenditure (to attract long-term core deposits).	• Greater price transparency. • Greater convenience to customers (including congenial resolution of customer complains through electronic media). • Each customer segment interacts with the bank through the most cost effective distribution channel. • Innovations (such as smart cards and digital cash) that circumvent banks' proprietary networks with alternative distribution or payment systems. • Creation of new customer segments and improved relationship banking.
Operational Function Innovation	• The possibility of scale economies make it very hard for potential entrants to catch up, even with technically better systems. • Continued importance of contextual non-standardisable elements to assess risk • The potential for fraud, money laundering and systemic failure requires supervision, regulation and minimum capital requirement. • More specialised (and expensive) labour force.	• Enhanced financial performance due to reductions in overhead expenses (i.e. no retail branch network) which are not offset by reductions in revenue or increases in other expenses. • Standardisation of activities in payment and lending services eliminates the uniqueness of banks' proven expertise and ability to control losses from payment activities efficiently. • Access to a much wider base of depositors and high rates of asset growth.

Sources: Group of Ten (1997), McNamara and Bromley (1997), Radecki (1998), Bátiz-Lazo *et al.* (2001), DeYoung (2001), and Sebastián (2001).

Some elements which explain the apparent inability of IT innovations to result in greater specialisation have already been discussed throughout this paper and include:

- each new technological innovation accounting for (proportionally) smaller reductions in price differentials;
- possibilities of observing network economies, that is, suggesting that activities which are critical to develop a competitive advantage in bank markets will be very hard to match for potential innovations because once some players get started building proprietary payment networks it will be impossible to catch up, even with technically better systems.
- trials with smart cards and digital cash showing that bank customers are unwilling to pay for interfaces for the new technology, while merchants expect to share the revenue of new payment media through lower commission charges. In other words, the latest innovations have done little to modify the methods of conducting transactions between customers and banks. Moreover, they may circumvent banks' proprietary networks with alternative distribution or payment systems.

There are two other arguments to conclude that it is unlikely that the 'virtual' bank will be the typical organisational form for financial intermediaries. These relate to, first, the transferability of skills within banking and second, regulation. Transferability of skills refers to banks' proven expertise and ability to control losses from payment activities efficiently (Radecki, 1998, p. 21). Losses from payment activities emerge from fraud, bankruptcy and operational errors (unique to a bank or system wide). The control of these losses involves their prevention as well as recovering funds in the event of a loss. In other words, skills and capabilities associated with managing payment systems seem readily transferable to lending and would explain why banks provide both lending and payment services.

According to empirical evidence documented in McNamara and Bromley (1997), IT applications enabled standardisation of activities in payment and lending services. However, the same report suggests that superior financial performance could be achieved when managers were allowed to make discretionary judgements on lending decisions based on a combination of software driven risk assessments emerging from elaborate algorithms and other computer applications, with experience and skill-based judgement. The continued importance of contextual elements to assess risk suggests

that few banks could engage in volume transactions making indiscriminate use of technology in core activities.

Secondly, the potential for fraud, money laundering and systemic failure requires supervision, regulation and minimum capital requirement for organisations supplying wholesale and retail bank services through electronic media (e.g. Group of Ten, 1997). In the literature, regulation has been viewed as mitigating competition as well as the hindering the adoption of technological innovation (Baumol *et al.*, 1982). Hence, the result of regulation limiting the potential of non-banks to contest bank markets indicates a lengthy move to retail and wholesale electronic-only payment systems.

In brief, payment systems still rely on bank deposit transfers and central bank-issued money as a medium of exchange. This suggests that in the foreseeable future the complete substitution of notes and coins issued by central banks by digital systems running in high capacity communications media through computers is unlikely. Transactions involving e-commerce, m-commerce or WebTV have the potential of re-introducing privately issued currency, but generally banks are strongly positioned as administrators of local and international payment systems. However, the expected growth in the volume of payment and banks' lack of proprietary control of technology suggest that potential threats of entry to bank markets will persist.

4. Discussion

This review set out to determine whether technological change enhanced the importance of computer systems in the strategy of commercial banks. One early expectation was that banks' strategic goals would evolve and look to modify the principal-agent relationship between bank and customer, so the client-bank relations depend less on loyalty and service quality (i.e. idiosyncratic investments) and more on financial margin. There is evidence to suggest that on a historical perspective, technological innovation and, in particular, increasing applications of telecommunications in bank markets such as telephone banking, electronic cross-border payment systems or wholesale payment systems, have effectively modified the external and internal nature of the banking organisation.

However, the way in which future technological innovation is likely to modify the banking organisations, both externally (product or service) and internally (operational function), is at best uncertain. Externally banks are challenged to service the growth in the volume of payments through e-commerce, m-commerce and WebTV, but historical evidence suggests that very few IT applications have had an immediate effect or transformed business practice in bank markets. Indeed, some of the most promising innovations have failed significantly. Smart new software applications and innovative hardware interfaces which link new ways of making payments (e.g. Mondex or VISA Cash) with conventional payment systems are likely to co-exist and influence the way customers enter the banking system. Banks will continue to be pressed to resolve operational issues in terms of individual customer risk and individual customer profitability while, at the same time, continuing to increase size and diversity. The pre-eminence of conservatism in consumption patterns for retail financial services will continue to limit the success of the most promising technological developments.

Internally, technological innovations have increased the leverage of superior processing relative to capital and other physical resources. Changes in technology have lowered transaction costs for processing financial transactions and some banks have been very effective in implementing those innovations. In the future, hardware and software are expected to provide the platform that will improve banks' multi-channel management while reducing the cost of co-ordination. But at present, it is uncertain whether the solution to banks' operational problem will result in

- no-change for the banking organisation;
- the creation of networks of stand alone product/service groups, stand alone distribution channels and stand alone treasury operations; or
- a combination that allows product/service and channel managers to negotiate deals independently.

Throughout the technology innovation process, banks have shown that they lack full proprietary knowledge and capabilities to successfully develop new technological solutions. This suggests that alliances between banks and technology providers have greater chances of success than efforts unique to commercial banks or unique to

technology providers. Managers of banks are thus challenged to excel in the implementation of these IT-based strategies. Otherwise, poor execution will result in few '*ex post*' options and low sustainability of competitive advantage.

On the other hand, technology has helped non-bank providers to enter banking by reducing price differentials and increasing transparency in organised markets and creating new customer segments through relationship databases. Technology has also allowed managers of banks and non-banks to segment relationships by profitability as well as providing the basis for the development of new distribution channels (e.g. customer group diversification). However, the possibility to transfer capabilities between lending and managing payment systems encourages managers of non-banks, who wish to take advantage of the growth in the volume of payments, to create new capabilities as a way to gain entry in bank markets.

In brief, the full move away from the branch-centred organisation into *virtual banking* will require new IT applications, new managerial practices and new consumption patterns within the banks' most profitable market segments. Managers of banks (and non-banks wishing to enter bank markets) are now challenged to design internal systems that provide greater control of the profitability drivers and which enable their organisations to capture new synergy.

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Notes

[i] Unless otherwise stated, this section borrows freely from Cassell (1984, pp. 62-87) and archival search of the Board Meeting Minutes (1941 to 1965), Minutes of the Finance and General Purpose Committee (1941 to 1965), Minutes of the Annual General Meeting (1923 to 1962) and Notes to Meetings of the Board (1962 to 1976) from the Co-operative Permanent Building Society.

[ii] Notes to Meetings of the Board from the Co-operative Permanent Building Society, 19th August 1976.

[iii] With the effect that 'The banker as a man of stature had been lost.' (Interview with senior executive of Lloyds Bank Group, 3 March 1995).

[iv] Starting in 1977, with the introduction of the Apple personal computer.

[v] Starting in 1948, with the invention of the first programmable computer.

[vi] CFO, January 1994, pp. 26-33.

[vii] Financial Times, 3 May 1995.

[viii] *idem*

[ix] Even for credit cards where the formalities of changing suppliers are minimal customer retention rates have also been high historically. See recent surveys of the UK credit card market in Gilmore (2001) or Bátiz Lazo *et al.* (2001, p. 875).

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