U.K. banking experts as decision-makers: a historical view on banking technologies

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ABSTRACT:

This paper looks into Technological Investment Decision-Making (henceforth TIDM), and aims to surface the influence of the historical evolution of expertise in the banking sector on such decisions. In so doing, the paper underlines that, in each era, the technological decision-making activity is strongly linked to the views of dominant expert groups in the industry. The paper proposes that TIDM, as viewed historically, has been highly contingent to both technological developments in banking and subsequent developments in banking expertise.To illustrate this, it explores the relationship between (1) the technological developments in UK banking, (2) the evolution and distribution of expertise in the sector and (3) the respective evolution of TIDM. The paper adopts a historical perspective spanning from the end of the 19th Century until today, and identifies patterns that connect the 3 historical processes through direct, albeit hidden, relationships. It illustrates that, counter to popular belief, TIDM is a socially constructed process as opposed to a normative exercise. Ultimately, this paper shows that history recognises no optimal method for TIDM. Rigour and accuracy of execution do not appear to define success. On the contrary, in each era, the "right way" to perform TIDM has always been underpinned by the standpoints and beliefs of specialist practitioners who dominated the UK banking industry and by the received wisdom of a community of expert professionals, administrators and think tanks, dictating "realities" on the state of the economy, the role of banks and the value of technologies.

Keywords: Banking technology history, technological investment, decision-making, credit crisis, banking expertise, banking policy, regulation.

INTRODUCTION

The pertinent role of technology has long been demonstrated in the history of banking, not only as a facilitator for operations and improving efficiency, but also as a determining factor defining the shape of the sector. Relevant research in the UK has most often dealt with the development of process and product innovations, the relation between technology and employment and the impacts of mechanisation on the industry (Batiz-Lazo & Boyns, 2003; Batiz-Lazo & Wardley, 2005; Booth, 2004; Consoli, 2005). While these research attempts offer a vivid picture of technological developments in UK banks and provide useful taxonomies of banking technology eras, they do little to discuss the relationship between expertise development in the sector and technological investment decision-making (TIDM). It is argued in this paper that examining this relationship will greatly contribute to further understanding the mutual shaping of banking technology and banking organisations.

The aim of this paper is to elucidate that relationship and argue that there are identifiable, though not always visible, historical patterns of TIDM that are directly connected to respective patterns of expertise in the sector. To make this point, the paper begins from a broad account of UK banking technology history and later focuses on the evolution of banking expertise that accompanied technological and other socio-economic occurrences. It finally zooms-into the core subject of how historical patterns of TIDM in UK banking developed in conjunction with the respective patterns of expertise and other social, political and economic conditions.

The paper is laid-out in a spiral, where the successive review of (1) the technological developments in UK banking, (2) the evolution and distribution of expertise in the sector and (3) the respective evolution of technological investment decision-making (TIDM) complements, step by step, the picture to unpack the hidden connections towards the conclusion. It begins with a brief account of the history of technology in UK banking. This sets-out the landscape of the investigation, by underlining the connections between socio-economic, political and technological factors that shaped the trajectory of banking technology through time. That is complemented by a parallel account of the professional composition of the industry in the UK, where also connections are drawn with respective technological developments. Last, the above two historical iterations are enriched by a third parallel review that focuses on technological decision-making. Starting from the observation that TIDM has been dynamically redefined through different eras, this review establishes its relationship with the other 2 historical processes (technological development and the evolution of expertise). By examining the changes in expertise and formal structure of UK banks, and relating them to the changing role of technology in banks' activities, the paper suggests that there is a strong relationship between the political development of expert groups (partly as outcomes of technological development), and the ways that technological decisions are made under the auspices of these expert groups. The key finding of this work is that TIDM, as mirrored through the history of technology and expertise in UK banking, is a process determined, in each era, by the proclaimed role and importance of technology, as perceived by dominant banking experts, prominent scientific strands and the aggregate view on the valuation of technology echoed by a community of received wisdom. (Samakovitis, 2006a).

1. THE NATURE AND HISTORY OF BANKING IN THE UK: THE ROLE OF TECHNOLOGY

A history of banking technology must be carried out with reference to its wider context that includes economic, regulatory, political and other industry-specific dimensions. Only in this way can one appreciate the full role of banking technology and, in turn, recognise the evolution of TIDM practice. This type of historical account for banking technologies is provided in the next few paragraphs.

The first uses of communication technology in banking are recorded as early as 1846 in the U.S., with the application of telegraph messaging (Garbade & Silber, 1978). Despite the expansion of such applications from New York to London, with the installation of transatlantic cables in 1866, this innovation had little impact on the way that commercial banking was performed in the UK (Batiz-Lazo & Wood, 2002). The history of banking technology largely mirrors that of the computerisation of financial institutions. That is because no other class of technologies has produced a noticeable impact in the industry, probably because of the service nature of banking that relied on accuracy, consistency, reliability and sophistication - features that computer technology was introduced in all business areas to accommodate.

The use of accounting machines, as they became known at the beginning of the 20th century, signalled the start of the mechanisation of banking. These machines, such as Felt & Tarrant's Comptometer and Burroughs's calculator, were from the 1890s used in banking as desktop adding machines (Cortada, 1993, pp. 39-41). In the late 19th century, banking applications were merely general purpose uses of desktop adding machines[1]. The then current understanding of the nature of banking business reflected the view that technologies should be applied with the aim of achieving speedier and less error-prone performance of clerical tasks. For this reason, such engines were viewed before the 1920s as standalone applications, rather than as parts of a system (Cortada, pp.3, 44). Even with the prevalence of limited liability banking, a regulatory requirement that later led to the development of nationwide branch networks (Batiz-Lazo & Wood, 2002, p. 7), branches remained technologically isolated units, rather than under central control from the headquarters.

The introduction of the punched card tabulating machine in the 1920s marked a new era for banking technologies. Three reasons contributed to that: First, tabulating machines pioneered a systems rationale in banking technology: The use in banking of dedicated equipment like the Hollerith tabulator, a massive mechanical device that had been around since the 1880s, had been the first application of systems-based technology (Cortada, 1993, p.44). Established perceptions about banking were that the branch-based business could only be technologically facilitated through improvements in the accounting function: this was largely a task of the massive application of calculators for speeding up and offering accuracy in clerical tasks. Such office configurations, though, were not developed in a systems rationale, but were mere ordered aggregations of identical office equipment. Second, banking applications for tabulating machines marked the first sign of the industry's perception of its data processing intensity and the subsequent potential for technological applications aiming at cost reduction. That had largely gone unnoticed for the 30 years that tabulating machines

[1] The literature of computing history suggests that this accuracy-driven purpose of early computers was the perceived paradigm for the industry of adding and calculating machines. That was one of designing better machines for manipulating large volumes of numeric data (Cortada, 1996, p. 14).

existed[2]. Technological inventions were, until the 1920s, clearly geared to supporting the accounting function (Cortada, 1993, p.51). That is also evident from looking at the spectrum of applications of tabulating machines that ranged from census tables and sales statistics to billing in the railway business and cost accounting in insurance. Third, tabulators were the first technology that appeared to challenge the established labour structures in banks: Tabulating machines were by the 1910s already viewed as less skill-demanding devices, and hence had raised controversy amongst accounting professionals who saw them as a threat to their expertise. In turn, that aspect of tabulating technology further fuelled the gender-based division of labour in UK banks, where unskilled female staff were largely recruited to operate tabulators (Booth, 2004).

The witnessed gradual adoption and adaptation of tabulating machines in banking is explained by a number of factors and events: the deteriorating economic conditions, the increased scope of banking business, the emergence of several service innovations in the industry, the realisation of the urgent need for reducing cheque-processing costs are some such factors. Tabulating machines, notably, were transformed until the mid-50s from single-function engines to unified systems comprising data entry, sorting and other management functionality. (Cortada, 1996, p.45)

Simultaneously, developments in the data processing industry made the technology more usable by standardising several functions into failsafe protected processes. That further contributed - in conjunction with pressures for lowering labour costs - to a rise of employment of unskilled women as bank clerks. As indicated in the case of Midland Bank (Booth, 2004, p.281) male employment was reduced in relative terms during a period (1939-69) where overall numbers rose significantly. As late as the 1950s, banks' traditional employment pattern remained unchallenged, with males dominating the management side, while women were recruited for clerical tasks. By 1962 more women were leaving banks for more attractive careers, causing often severe problems for bank staffing. Interestingly, the role of technology was critical in this pattern: stagnant innovations in the area of banking applications of tabulating machines and office equipment led banks to deal with higher data volumes and capacity by increasing the size of existing infrastructure. High equipment costs further justified that choice as against investing in new infrastructure. This size explosion had an economic impact on banks with regard to their abilities for cost-justification of technological investments: the need for buildings adjustment to accommodate bulky machinery often made technological investments indefensible. Because high-street property was the most valuable asset of banks by that time, limitations imposed by adaptation costs, often made many, otherwise crucial, retail outlets unsuitable for the already technology-heavy intended use[3].

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[2] Cortada (ibid, p.45) observed that the data processing industry, where tabulating machines were developed, was of relevantly minor business significance before the 1920s. It was the identification of the mass-processing capacities of tabulating machines that made firms realise that business potential.

[3] The concept of "reverse salients" (Hughes, 1983) is visible in these developments. As technological innovations in developing smaller and more 'intelligent' machines stagnated, the only path to coping with growing processing demand was the increase in system size (i.e. aggregating more machines and thus taking more space). This undeniably led to either banks having to abandon or expand their existing high-street property to accommodate bulky technology. Giving rise to a significant economic problem, the industry need was automatically created for banks to seek technological solutions of less space and higher processing power.

The transition from standalone equipment to mechanical systems was furthered during the 1950s and 1960s with developments in electronic technologies, such as the commercial introduction of the computer in 1948 by IBM (Campbell-Kelly, 1989) and the development of MICR[4]. Despite the technical superiority of electronic over mechanical processing, the rationale of systems' usage in banking largely remained unaltered: computers were introduced to deal with specific technical problems of effectiveness in volume processing. Subsequently, the speed of transaction processing delivered by electronic equipment contributed to the success of this mass-market expansion. At that stage, electronic technologies were implemented in existing departments to deal with existing problems (Morris, 1986), rather than assuming the role of transforming business processes. One of the major banking-related computing innovations was batch processing, i.e. the sequential reading of data related to different automated activities. That enabled the fast simultaneous processing of transactions, standing orders and other internal clerical tasks (Fincham et al., 1994) to achieve scale economies.

Computer technology in banking in the UK was operationally restricted to the 'back-office' – and considered as a class of applications suited to speeding-up existing tasks and providing cost-savings on labour. The extreme cost of that equipment further contributed to the perception that computer technology could only be economically viable in centralised massive processing tasks. However, two key developments furthered the role of information technology in banking: First, the newly introduced hardware called for specialised programming skills, which triggered a shift towards banks developing in-house solutions and the expertise that came with them (Fincham et al., 1994, p. 153). That trend, combined with the lack of universal programming languages in the early years of computerisation imposed significant costs on implementing banks in recruitment and training, whilst reusability of the skills was very low across different hardware platforms. Second, the local-only character of early computer technologies had a significant impact on upgrading the strategic role of the branch: driven by increased technical capability, branches - the main points of customer service – gained flexibility as computers enabled them to perform tasks previously performed by the bank's headquarters only. This upgrade necessarily came hand-in-hand with increased power of branch managers, thus reinforcing a status established in the 1920s.

The period between 1965 and 1969 saw the introduction of EDP (Electronic Data Processing systems) and DBMS (Database Management Systems) in UK banks, triggering a series of important changes. First, on the operational side, EDP and DBMS promised integration and accumulation of existing customer and other data, with a view to consolidating disparate and otherwise unused bits of information, centralising their control and, ultimately, distributing it selectively where it was needed. Again, the rationale for such expensive systems remained focused on the high volume and complexity of existing customer data (Batiz-Lazo & Wood, 2002). Second, on the organisational side, DBMS applications in particular allowed the centralisation of information handling and the resulting redistribution of responsibilities and, therefore, of power: given the established branch-based structure, the shift from regional to central control of sensitive customer information resulted in a loss of control from existing hierarchies. Finally, on the technological side EDP and DBMS were the first steps in the development of intra-bank networks (as opposed to the technological 'culture' of standalone equipment that prevailed in banking up to then) and the foundation of

[4] The acronym MICR stands for Magnetic Ink Character Recognition, an application first developed by the Stanford Research Institute in 1956, later used for cheque sorting and data capturing (Batiz-Lazo & Boyns, 2002, p. 14). Steiner & Teixeira, (1990, p. 33) report that early computers (such as the NCR 315/316) as well as later ones (such as IBM 360) applied MICR technology.

Integrated Banking Technology Standards (Consoli, 2005). Notably, the prevalence of database-driven design rationales for banking systems gave precedence to new perceptions of the economics of networks and important new applications that shaped the global banking industry[5]. However, the EDP / DBMS era was characterised by the persistence of a culture of isolated (as opposed to integrated) technological efficiency targeting, economic justification of technology on the basis of labour cost minimisation, and a view of technology as a means for automating existing processes. Despite the improved labour cost structures that were introduced because of the increased computing power of banks, the economic justification of technologies remained cost-saving in the head office, with minor and expensive branch efficiency improvements and other potential technological gains sought at local level only.

High degrees of diffusion of DBMS applications nearly coincided with the growth of another major banking technology: Automated Teller Machines (ATMs). Following developments in MICR technology and the launch of the first credit card in the UK by Barclays in 1966[6], ATMs were first introduced in the British market by the same bank two years later, primarily to exploit the extreme popularity of cash withdrawals from credit card accounts (Ackrill & Hannah, 2001, p. 187). Although they were characterised by heavy investment and extremely demanding infrastructure and maintenance needs, ATMs turned out to be a 'killer' application. Figures 1 and 2 demonstrate the recent growing presence of ATMs in the UK. The economic justification for them was primarily advocated on the basis of labour savings and the savings from not having to acquire premises for branch expansion for cashier positions (Ackrill & Hannah, 2001, p. 338). Despite their ubiquity by the late 1980s, ATMs were, however, not always seen as a clearly profitable investment, since their financial appraisal was difficult: the ambiguity in the way that cost improvements were calculated primarily stemmed from the fact that ATM prevalence caused an increase in the number of transactions[7], which made financial calculations difficult (Steiner & Teixeira, 1992, p. 93). However, the development of network technologies that detached ATMs from branches had significant impact, not only to the spread of such machines but also to the shift in focus of banks' investments from acquiring new branches (a necessary investment to expand their ATM network) to achieving technology efficiency.

The period from the late 1960s until the 1980s has been characterised as one of high penetration of hardware and software technology in banking, with banks emerging as key customers of the computing industry with ATMs and EDI (Electronic Data Interchange) systems prevailing in banking data processing (Fincham et al., 1994). Advances such as the development of Euromarkets – primarily driven by new technological capabilities and with

[5] The literature refers to a number of initiatives based on early DBMS technologies, such as BACS and Girobank (Batiz-Lazo & Wood, 2002) and other applications relevant to the automation of the UK Clearing System and retail money transfer. See Fincham et al. (1994), Morris (1986), Mandell (1990) and Consoli (2005) for more detailed accounts.

[6] The first ATM application was operated with a paper voucher that was issued by the bank as a £10 token, later to be replaced by plastic punched cards and later by magnetic stripe cards (Consoli, 2005).

[7] Usage patterns of ATMs reportedly altered completely the logistics of - mainly - cash withdrawals in terms of both volume and number of transactions daily. ATMs favoured smaller and more frequent transactions, while significantly increasing the volume of data processing. Coupled with their reduced cost per transaction, ATMs typically 'disturbed' the established ways for financial appraisal (Ackrill & Hannah, 2001: pp. 335-338; 214-217; 327; 353)

the contribution of other socio-economic factors – brought London to the centre of international banking and altered the recruitment patterns of the industry (Morris, 1986)[8].

Full automation of branch operations and the accompanying shift of technological focus from processing to communications and MIS (Management Information Systems) were some of the key events of this period. The newly instilled culture of EDP and DBMS gradually led to the establishment of networking as the primary technological characteristic of UK banking, with IT permeating the customer-bank interface. Strategic aims were focused on effective service provision rather than expanding the customer base, or even creating customer value.

The 15 years following the close of the 70s were marked by great technological changes, namely the emergence of the personal computer (PC), developments in digital data telecommunications (Fincham et al., 1994, p. 155) and advances in programming such as RDBMS (Relational Database Management Systems) and Object-oriented Programming (OOP). Termed the era of 'Information Revolution in Financial Services' (Batiz-Lazo & Wood, 2002), this period saw an unprecedented demand for secure transmission of financial information related to large volumes of mainly international payments. Furthermore, events such as the Lending Crisis (1978-82) contributed to the so-called institutionalisation of banks: retail banking broadly ceased being a professional activity relying on the more personal branch manger relationship with customer and shifted towards a more hierarchical institutional manager-driven business (Morris, 1986). On the technological front the key impacts of new developments were the higher standardisation of processes, the lowering of entry barriers to the industry through diminishing prices of equipment and the shift of technology strategies from efficient performance of tasks to full integration of systems and information. Much of that change can well be attributed to the introduction of the PC, as a standalone, portable, flexible programmable device with networking capabilities. Its benefits ranged from location-independence to flexibility in training needs because of the PC's universal programming ability. Together with the introduction of relational databases (RDBMS) the adoption of the PC altered the patterns of employment in the industry: with RDMBS hugely quickening the pace of training (Consoli, 2005) and computer skills being less industry-depended, cross-industry migration of IT skills became easier, more standard and cheaper. The aggregate effects on the industry obviously benefited bank customers, as the strategic trend returned to consumer-oriented innovations. That shift may well be attributed to better integration through IT, more complete standardisation of processes with the aid of improved communication and IT standards, and, ultimately, a rather saturated retail market. Thus banks returned to seeking competitive advantage from differentiating on the product offerings and quality of service, rather than on time and cost-efficient processing through IT.

The period from 1980 until 1995 was, on aggregate, one of major – though more subtle – changes for UK banking, mostly driven by technology. With information acquiring a key role in financial transactions, many technological applications aimed at improving quality, security and speed of financial information. On the front of customer-facing technologies, the ability to detach ATMs from branches and the institutionalisation of banks totally altered the significance and role of the branch, from a traditional point-of-sale (PoS) one to a more service and marketing-centred role. This pattern was closely followed and stably augmented in later years. Together with other economic incentives, that technological ability contributed to the reduction of branch numbers.

[8] This was further facilitated through the significant decrease of equipment costs during the 1970s and 1980s 9Ackrill & Hannah, 2001, p. 338)

The latest stream of developments in the history of banking technology in the UK is attributed to two major events that signalled the furthering of alternative channels use in retail banking services. One was the introduction of call centres, the forerunner of contemporary integrated CRM[9] and telephone banking systems and the other was PC banking, namely direct service provision through the customer's own computer. Both applications introduced the notion of Home Banking and, with it, a novel perception on service provision and disintermediation of branch-based banking. These applications came to the fore at the same time as a number of developments related to general computing and the all-expanding networking technologies. With an economic and social environment that was receptive to new technological initiatives, the years 1985 to 1990 saw unprecedented growth in the hardware and software industries, especially following the diffusion of the IBM-compatible PC. The resulting spilllover of generic programming skills to the home user and at the individual level appears to have played a role in the familiarisation of employees with computer technologies. At the same time, while all industries invested heavily in computer technology, mainly to support the customer service end, the migration of both software applications and expertise became easier and more transparent. Developments in software techniques (such as Object-Oriented Programming) made application development a more uniform and standardised task, reducing the need for specialisation. The new definition of programming as designing processes by interfacing between reusable objects, in turn, reflected a wider business rationale: re-engineering business operations through process redesign.

Overall, since the early 1990s innumerable IT applications permeated UK banking organisations. Diminishing costs of technological infrastructure and standardisation have facilitated the innovation-laden, dynamic environment that followed the 'Big Bang' of the British financial sector. Key technological feats which allowed these developments include high-speed data communications, database integration, the emergence of the Internet and security technologies and the legislative and regulatory impacts that they had. The emergence of applications on CRM, e-commerce, smart cards, EFTPOS and, most important, Internet Banking can largely be attributed to these broader instances. Interestingly, as happens in most instances of technological progress, technical barriers in banking technology have often been overcome long before the relevant technical solutions were implemented. Such were the cases of ATM connectivity (fully achieved in 1999 in the UK) and the development of small payments clearing mechanisms. The full potential of technological capability is, historically, only exploited when ample economic benefit can be reaped from interested parties.

At this stage, the broad historical account of banking technology is concluded. The discussion now focuses on analysing the context and meaning of these significant events in UK banking technology history, which will serve as a guide to understanding the essence of technological investment decision-making. This is because, this work argues, technological decision making is an inherently historical activity, and that historicity is revealed through locating, among events, patterns of human or group behaviour, perceptions of reality, techno-economic conditions, power relations and organisational structures that dictate patterns of decision-making and that occur in a repeated, or even cyclical, manner. A discussion on these aspects will be provided in the final part of this paper.

The different roles that technology assumed at different historical instances, shaped the understanding in the sector of what technology can deliver for banks and, thus, altered the perception of what aspects of it should be measured to assess its capabilities. That greatly influenced TIDM perceptions through time and gradually led to the understanding that is

[9] Customer Relationship Management systems.

currently established. Furthermore, instances of technological change in UK banking were often marked by respective changes in the banking labour structure and, most important, in the structure of expertise residing with the bank. It is the argument of this paper that this expertise shift also played a significant role in defining what TIDM is and how it should be done, at different eras. It is, finally, the leading technological advances of the 1990s in the sector that caused significant changes to the nature and characteristics of banking activity in the UK. It is on the basis of these technological changes that Internet retail banking developed and gathered momentum.

2. TECHNOLOGY AND EXPERTISE: ANTECEDENTS TO TIDM AND THE ROLE OF BANKING EXPERT GROUPS

This section is devoted to the professional and economic sides of banking technology assessment. It contends that the appraisal of technological investments and TIDM at large, greatly relies on the development and establishment of expert groups in banking. These evolve either within the banking industry or outside it but still within areas that are very relevant to it. There is therefore a direct relevance between the pattern of expertise development in UK banking and the pattern of TIDM practices as these can be historically observed.

The approach is based on the historical account provided earlier, with a new focus on locating instances, patterns and cycles in the evolution of UK banking technologies that link expertise development to established perceptions on the value of technology. In order to systematise the account, use is made of familiar taxonomies of the history of banking technology. Such taxonomies are provided by a number of scholars (Morris ,1986; Batiz & Wood,1997; Consoli, 2005) and are broadly based on major technological innovations in the sector and consequent changes in banking business. A summary of two such historical categorisations is provided in Table 1. These cover the periods until 1995, while the last period (1995 – now) is introduced in this work.

Table 1: Periods of banking history (adapted from Morris (1986) & Consoli (2005))

Years	PERIOD (Morris)	PHASE (Consoli)	Key Features
1864 – 1945	Early Adoption	Electric to Electronic communications	Reduce inter-market price differentials Increase coordination between Head Office and branches
1945 – 1968	Specific Application	Processors to Databases	Conversion from branch to bank relationships. Automated bank statements Cheque Guarantee Cards Reduce cost of labour-intensive processes
1968 – 1980	Emergence	Automated machines to local networks	Growth of cross-border payments ATM introduced Automation of branch accounting Real-time control begins
1981 – 1995	Diffusion	Standardisation vs. customisation	Supply of non-payment products like insurance, mortgages and pensions. Growth of alternative distribution channels (phone, EFTPOS)
1995 - now	Generic (Open Platform) Application		Internet gains momentum in business applications Object oriented programming & visual languages Integration of banking across all levels (STP) Convergence of ICTs & computing CRM

Instead of simply following the taxonomies as compartmentalised pieces of history, this section will look across them and identify instances or patterns by which banks have addressed technologies with respect to their economic viability, their potential benefits and, overall, their perceived value. This will allow an investigation of the linkage between, on the one hand, the roles of technology in banking and the technology's practical treatments and, on the other, the respective roles of established expert groups. The intent is to establish that there exists a close relationship between the expertise backgrounds of key decision makers and the established attitudes of the organisation towards technological appraisal..

This is part of a wider contention that patterns of expertise in any industry are part of the broader business paradigm that dictates the background of decision-makers, sustains their dominance, adheres to their understanding of reality and rewards actions that are considered rational under this paradigm. This framework, ultimately, informs the formal and practical approaches to valuation of any aspect of business, technology being one of them. This framework suggests that normative definitions of TIDM are only contingent to the actors who participate in it (Samakovitis, 2006a). Expertise is seen as one of the key intellectual features of these actors and, hence, it is given great importance in this discussion. Along these lines, this section seeks the sources and rationale of TIDM, to conclude that attitudes to technologies are determined by the established viewpoints of dominant expert groups. TIDM rationale and practice therefore becomes, it is proposed, a question of expertise dominance in respective eras, marking different paradigms of investment appraisal.

This section addresses expertise and TIDM perceptions in two parts. The first discusses the evolution of expertise by looking at historical periods of UK banking technology. In the second, discussion is focused on locating and analysing aggregate attitudes of financial institutions to technological investments. The final paragraphs of the section draw connections between expertise and investment valuation of technologies..

2.1 Patterns in UK banking expertise

The nature of expertise in banking has traditionally been dictated by the professional background of practitioners who performed it. As such, investigating banking expertise in historical terms requires that we begin with the professional groups which pioneered banking and the trajectories they followed through time. Early banking in the UK was practised by London goldsmiths, a class of professionals enjoying high social esteem, financial wealth and political clout (Backhouse, 2002; Galbraith, 1987) Being a profession characterised by trust, confidentiality and reliability, the goldsmith expert group was a natural fit with the nature of the business it was pioneering.

The history of banking from the 1600s until the late 1800s shows that banking demanded a combination of skills for mathematical precision, administration, legal knowledge and business negotiation. Later, the high relevance of banking to the state's affairs added political persuasion to the composition of banking expertise. At the stage where historians of technology address banking as an application field, the British banking sector constituted primarily professionals with backgrounds in Accounting and Economics. Both these expert groups were strongly underpinned by well-established academic traditions[10].

[10] Contrary to popular belief, this disciplinary background was relevant to mathematics only in the case of accounting. Economics were largely non-quantitative until the beginning of the 20th century. The mathematisation of Economics is attributed to Walras, while the first scientist trained in rigorous mathematics to pursue a career in Economics was reportedly Irvine Fischer (Backhouse, 2002, pp.170, 198).

1864 marks the beginning of the first period of banking technology history, identified as the Early Adoption era. This era saw the introduction of accounting machines and tabulators, used to perform faster and more accurate day-to-day clerical tasks such as paper cheque handling, ledger keeping or issuing and handling letter correspondence between branches and the Head Office or customers (Morris, 1986, p.44). One of the main characteristics of this period was the division between managerial and clerical labour in banks, with managerial roles involving individuals whose position was due to their high educational, political and financial status. On the other hand, bank clerks in the early 20th Century constituted an initially unskilled labour force that received formal training in specialised clerical posts in the bank, most often maintained as lifetime jobs.

The nature of this on-site skill acquisition culture was reinforced with the replacement of the traditionally male clerical labour force during WW I (and later WW 2) with young women due to men's involvement in active military service (Ackrill & Hannah, 2001, p. 77). During the inter-war years, the pattern of recruitment was to demarcate managerial from routine job specifications at one level and temporary from permanent at another. The introduction of accounting machines in UK banks, in 1914, had an impact on banks' clerical staff numbers as late as the end of 1920s, when London banks replaced multiple ledger functions, typically operated by large numbers of clerks, with clusters of such engines, operated primarily by women typists. Accounting machines were introduced to improve the performance of managerial staff (Batiz-Lazo & Wood, 1998); however, their introduction also had a slowly evolving impact on the nature of clerical tasks by requiring skills in typing and operating mechanical devices. By the late 1930s trained bank clerks, typically part of the permanent staff, came to be seen as valuable workforce and remunerated generously, since much time and effort was invested in their training. After the early 1930s, a large number of the perceived efficiency problems were addressed with technology, which turned most banks' management attention to the discontinuity between managerial and clerical staff (Ackrill & Hannah, 2001, p.79) and led to pioneering efforts for promoting permanent staff members to higher positions. That pattern, however, was not visible before the close of the era of Early Adoption in 1945.

In the following period, Specific Application (1946 – 1967), banking expertise begin to shape into a more profession-related skillset. With advances such as the introduction of electronic equipment and the maturing and post-war expansion of existing technologies across branch networks, there were two main changes to the nature of the business: One, the role of the branch network changed, from its previous limited one of customer recruitment and relationship management, to one where more of the previously headquarters-based technical tasks could be addressed at local level (Batiz-Lazo & Wood, 1008). Two, programmable automation pioneered internal skill development by enabling banks to pursue local solutions to technological infrastructure issues. These two events had a significant impact on the composition of the labour force. On the one hand, the post war surge in business volumes[11] led to mass recruitment that expanded the clerical base of banks. On the other, the new technological capabilities, and technical developments such as batch processing, EDP and, later, DBMS, created an increasing need for expertise development in software design, programming and implementation (Fincham et al, 1994, p. 153). However, despite the development of internal technological expertise within UK banks, it was not until later on that this expertise was formalised under recognisable skill sets and job specifications.

[11] This was primarily driven by the increase in the proportion of middle-income individuals, a market that was newly addressed by UK banks after WW 2 (Collins, 1988). Mass recruitment was, however, also boosted by the post-war UK government demands from banks for maintaining a high and stable level of employment (Ackrill & Hannah, 2001, p. 115).

Instead, during this period, the expertise base in the UK banking industry remained firmly with professional groups who held expertise on the quantitative sides of accounting, statistics, economics and advanced mathematics, a class of experts that primarily populated the insurance industry and that had a long-established tradition with quantitative analysis tasks..

The next era was the Emergence period (1968-80). Driven technologically by numerous feats in communication and data processing, such as data networking, ATMs and the emergence of MIS (Management Information Systems), this period was characterised by a major expertise spillover into the financial services sector. This resulted from the ending of many military projects, primarily in the US, that led to the release of large numbers of highly skilled programmers and scientists onto the labour market. This labour force was now availing itself not only to programming posts in banks but also to a market for financial managers, economic and financial forecasting specialists and other non-technological banking expert jobs. That change largely contributed to an altered perception of banking job descriptions, expressed in the UK through a shift in banks' recruitment patterns: since technological advantage was increasingly considered a major competitive asset, highly skilled university graduates were now seeking careers in UK banks. This altered the hitherto dominant pattern of internal job markets discussed above (Batiz-Lazo & Wood, 1998, p. 13). Developments such as London's upgraded role in international finance (with the successful implementation of Euromarkets in the 1970s) and the impact of applied Management Science through the formalisation of business analysis attracted large numbers of young qualified graduates mainly with positive science or Economics backgrounds who now viewed banking as an attractive, high-paid, promising and motivating sector.

The last of Morris's identified periods (1981-95), the Diffusion period, is marked by the information revolution in financial services (Batiz-Lazo & Wood, 2002), mainly expressed through major internal integration of banks' systems and high standardisation of IT applications with the proliferation of the PC. Further IT applications like RDBMS quickened the pace of internal skill acquisition which, in turn, meant increased organisational flexibility through reduced training cycles (Collins, 1988, p. 78). The consequence for expertise development was that existing specialisations could be cross-fertilised, giving rise to a new class of internally trained employees of diverse skills who would later assume managerial roles. The high degree of institutionalisation of UK banks contributed to explicit departmental subdivision, which brought both costs and benefits. On the upside, establishing role-specific departments was necessary for efficiently addressing the high complexity of banking activity in all fields, from risk management to technology implementation. The downside, however, was that the high degree of specialisation isolated the speciality groups, leaving the communication between them and the integration of their knowledge and skill to higher management levels. It can be argued that this has been a source of disagreements, fierce debates and often conflicts on issues of organisation, valuation and decision-taking.

Developments since 1995 have seen the UK banking sector enter a new era, both with regard to technological applications and to expertise evolution. Expanding on Morris's taxonomy, the author terms this period (1995 – present) the period of Generic (or Open Platform) Application, based on the shift of technological applications onto platforms that are universally designed and then tailored to specific needs. The key such platform is the Internet. The era of Generic Application is characterised by reduced costs of incremental infrastructure building and a shift of technological implementation focus from designing dedicated systems to integrating or bundling software and hardware units over universal platforms. This changed perception of technology has influenced the composition of banking expertise in the UK. The beginning of the 1990s found UK banking institutions (which now included building societies and insurance companies after the Big Bang deregulation in 1986) under the unchallenged dominance of those expert groups that developed from the 1970s

'new generation of City bankers', who primarily came from Economics, Finance, Accounting or Mathematical Sciences educational backgrounds. Other expert groups that developed throughout the 1980s, such as Information Systems and IT managers were assuming only local, and at most times dispersed, influence (Fincham et al., 1994). Higher level decision-making thus remained at the exclusivity of traditional experts with technology groups playing only an advisory and largely complementary role.

Since 1995, the change in the composition of expertise in UK banking can largely be explained by the shift of focus of IT that challenged the established norms. Banking technology, as it developed during the high technological growth era of the 1980s was of an overly dedicated character in both software and hardware terms; applications were tailor-made to cover banks' needs, often following principles that were very specific to individual institutions. This contingent expertise structure was challenged by generic applications for universal platforms that allowed easy migration of programming and wider IT expertise across industries, a pattern that was previously inconceivable. Such cross-fertilisation among industries, this work proposes, may be partly held responsible for the evolution of new types of professional groups, indicated by a number of IT-savvy banking experts that currently appear in Boards of Directors in UK banks (Samakovitis, 2006a).

2.2 Patterns of technological investment valuation

The account of banking expertise development that preceded is now complemented by an account of the perceptions of technological value, as these appear through UK banking history. The discussion underlines the point that expertise dominance in each era influences the corresponding understanding of the purpose, potentials and value of implemented technologies.

Beginning with the Early Adoption era (1864 – 1945), historical evidence suggests that the introduction of accounting machines in banking was justified on the basis of speed and homogeneous, legible and properly filed record-keeping (Collins, 1988, p. 45). Because technology at that stage was introduced to deal with growing business volume, the whole justification was influenced from appraisals that were made on the use of this technology in other sectors[12]. Early perceptions were focused on producing more output without using extra labour, rather than achieving cost savings by replacing labour (Morris, 1986; Batiz-Lazo and Boyns, 2003). This pattern, observed in the 1920s, can be linked to the fact that, traditionally, bank performance was measured in terms of business growth rather than efficiency, and only reported on request from the Board of Finance. Additionally, such measurement was only made at the branch level (Batiz-Lazo & Boyns, 2003, p.8). Interestingly, the same practice of 'measurement by size growth' occurred during the introduction of computers in building societies in the early 1960s (Yavitz, 1967), most probably due to the fact that growth had been the target for these institutions in that period..

Technological appraisal patterns appeared to change following the Second World War, when UK government intervention forced banks to maintain high employment levels and buy the more expensive British technology to support the local computing industry (Batiz-Lazo & Boyns, 2003, p. 10). These conditions created a driver for UK banks to emphasise cost reduction. During the 1950s and 1960s, primarily driven by established accounting practices used by equipment developers[13] it became common practice to measure

[12] According to Cortada (1993) accounting machines were widely used in processing census data in the US with extremely high success.

[13] Evidence suggests that equipment manufacturers played a crucial part in establishing both standards of banking equipment and approaches to evaluating the benefits arising from their introduction (Cortada, 1993; 1996).

banking technologies' performance by the number of staff it would dispose of. By the end of the Specific Application period, the measure widely used in evaluating computer installation propositions was Payback (Yavitz, 1967, p. 46), a technique mainly inherited from US banking computer implementations. The primary driver of technological investment valuation during that period was the perception that computer applications provided economies of scale and financial benefit when used in the back-office to handle large volumes of paperwork. However, EDP and DBMS applications that were later widely used in UK banking systems modified labour costs and altered the overall cost structures of banking business.

A major change in perceptions about technological value was bound to occur during the period following the 1960s. The Emergence period (1968-80) saw the spillover of Information Technology applications across the bank and its benefits and side-effects were felt in almost all departments. In that respect, there was a recognised inability of established metrics to cope with assessing or predicting the widespread impacts of computers. The examples of Management Information Systems (MIS) and many implementations of ATMs during that period underlined this gap, since many financial institutions were assessing the value of equipment on unsafe assumptions. Most importantly, the migration of IT from the back office to the bank-customer interface necessitated the introduction of estimations on customer uptake, behaviour and response to the technologies. These were aspects that were never before addressed in economic appraisal and, especially in cases of ATMs, were largely miscalculated. During both this and the next period (1981 – 95), technological investment valuation processes borrowed technical aids from other expertise groups, such as Finance, Accounting and Economics, to facilitate decision-making. These expertise areas, both within the banking profession and academic disciplines, exhibited in these years a rich production of methodologies and quantitative techniques for asset valuation that were applied to technological investments. This pattern was facilitated by the aforementioned surge of highly skilled new banking professionals in the 1970s. Despite an abundance of sophisticated techniques, however, the assumptions on which technologies were evaluated were still based on the rationale of 'machines replacing humans' (Batiz-Lazo & Wood, 2002, p. 18). However, developments in network technologies in conjunction with the mass-commercialisation of the PC as a generic-purpose engine totally shattered the cost structures of banking business into patterns that were hitherto unknown.

The years since 1995 – termed the Generic Application period – inherit many of the characteristics of previous eras, with the significant difference that the traditional labour savings assumptions no longer hold, mainly on the basis of experience from the introduction of call centres in the 1980s. Despite this, no clear new assumptions appear to have been formed, since precise measurement of expected benefits is becoming more complex. Furthermore there are a number of other characteristics that make technological investment valuation a complex task: First, costs and benefits of technology are not always conveniently demarcated into departments, functions or business areas. Second, the newly introduced ability for incremental building of technological infrastructure is a complex multi-parameter task for which existing valuation patterns are ineffective. Third, the long-established organisational structures of banks appear to be challenged by banking technology, an occurrence that necessitates newer approaches to technology valuation. **Table 2** summarises the prevailing perceptions about the value of technology, as they appeared in each of the historical periods provided in Table 1.

Table 2: The perceptions of technological value in UK banking, by historical period.

Years	PERIOD (Morris)	PHASE (Consoli)	Perception of Technological Value
1864–1945	Early Adoption	Electric to Electronic communications	Labour efficiency (doing more with the same resources) Banks measured by growth
1945–1968	Specific Application	Processors to Databases	Labour savings driven by post-WW2 cost-reduction rationales Developments in Management Science on automation and efficiency
1968–980	Emergence	Automated machines to local networks	Customer behaviour gets in the equation. Customer uptake and retention measures appear Major developments in Finance lend technical aid to banking Still labour-saving rationale prevalent
1981–1995	Diffusion	Standardisation vs. customisation	Economics of networks Similar TIDM approaches as before First 'failures' of Finance for appraisal of IT
1995–now	Generic (Open Platform) Application		Emergence of IS/IT research strand Recognition of need for strategic appraisal Development of large number of alternative assessment methods

Although no clear-cut patterns of correspondence between expertise and perceptions on technological value can be drawn in the modern history of banking, a number of observations can potentially associate these two dimensions. To begin with, in Early Adoption years until WW2, understanding of technological value was very limited and largely based on perceptions imported into banking from technology providers, or imposed by governmental authorities. In addition, there were few choices to be made as only a few providers existed, meaning that technological investment valuation was a rather straightforward task. In terms of the role of expertise, demand for technological valuation appeared as early as the 1920s when banks needed to assess their investment in technology firms. However, the combined technical knowledge and forecasting skills needed to accommodate such needs were almost non-existent in Britain (Ackrill and Hannah, 2001, p. 93), and no particular internal expertise appears to have dictated technological valuation until the Second War. The period following the War brought a better integration of professional skills in banks, caused primarily by the gradual collapse of the class barriers between bank management and clerical occupation. At the same time, the educational backgrounds of employees and in-house training converged to define a set of desirable skills for future bankers: that of the highly qualified, quantitative sciences graduate. The nature of banking activity, largely defined as quantitative, assisted the establishment of this expertise framework. That overall setting, in its turn, attracted professionals from Accounting, Finance, Economics, Mathematics and Engineering, all highly skilled in mathematical knowledge and comfortable with manipulation of numerical data. It was arguably on the basis of this framework of professionals that the introduction of methodologies like Cost-Benefit Analysis, Payback and later-on NPV occurred in technology valuation processes. The dominance of these expert groups in higher managerial posts apparently influenced the

trajectory of technological investment valuation in the 1980s and early 1990s by establishing quantitative assessment as primary decision practice. Along these lines, the increasing complexity of new technologies was to be addressed through the application of further sophisticated techniques, yet again coming from the Finance, Statistics and Mathematical Economics grounds, and focusing on accuracy of calculation rather than on readdressing the context of implementation.

The period that followed the mid 1990s and extends to the present is, in terms of the 'expertise – valuation' relationship, one of complex and ambiguous developments. On the one hand, the invasion of the newly empowered IT professionals into Boards of financial institutions signalled the conscious recognition of IT's role in shaping the banking business. In particular, it rationalised the hard numbers perception of technology valuation by formalising alternative viewpoints on assessment of IT, such as the strategic appraisal (Ballantine and Stray, 1998; Nair, 1995; Irani et al., 1997). On the other hand, the paradigm of quantitative assessment as decision-driver, though still persisting, is negotiating its way with developments such as Real Options Valuation to embed strategic value into the world of quantitative metrics (McDonald & Siegel, 1986; Copeland & Antikarov, 2001). On top of these advancements, the debate on assessing technological value has shifted to how we should adjust our faith in numbers, according to the economic and business conditions that prevail each time (Porter, 1995). The changing landscape of expertise appears to be gradually influencing the banks' perception and practice on technological appraisal rather deeply. The author views the primary expression of this influence being the shift from sophisticated quantitative assessment, to understanding that banks need to reassess the value of technology by working at the higher organisational level. Possibly the realisation that technological infrastructure and IT at large is being transformed, from a configuration of facilitating constructs, into the backbone of the financial institution, alters entirely our perception of what constitutes banking technology and whether we are able, or indeed need to, economically appraise it in separation from the organisation itself.

3. CONCLUSIONS

Banking in Britain has been an important force for economic growth and also a field of innovation and high achievement. As proposed in this paper, the implementation of technology in British banking from the early years was based on the inherently innovative nature of the UK banking business. That was not only because of the nature of the business itself, but also because of the particular regulatory or other conditions that permeated Britain's social, political and economic framework in the 20th century. The history of UK banking technology can largely be seen as a parallel to the history of computers which, from early accounting machines to modern CRM systems, were at the centre of developments in the industry. The evolution of UK banking technology happened around a series of events that reflected prevailing socio-economic or political conditions. Under these conditions, in some instances a number of bottlenecks, or reverse salients, to use Hughes's term (Hughes, 1983), gave the impetus to British banks to move on to new stages of technological development. In other instances, such impetus was provided by identified opportunities that UK banks needed to address to grow or survive. Yet again, other instances saw banks mobilising technological innovations to cope with regulatory or other government intervention in order to maintain their business interests.

Most frequently, technology has been introduced in UK banking to address clearly circumscribed problems. In many cases, this 'solution by technology' has opened new perspectives in the way that the banking business itself was focused and, in the extreme case of the late 1990s, it has challenged the traditional organisational structures. Ever since the

first accounting machines were used, new technology has not only played the role of introducing new forms of automation or processing, but also an enabling role for older, more mature technologies. Mostly generic technologies, such as ICTs, RDBMS and the Internet have brought specific mature banking technologies, such as ATMs, call centres and home banking to new dimensions: EFTPOS kiosks, integrated CRM systems and Internet Banking systems respectively, were such new applications. This role of technology presents a recurring pattern within discontinuous technological trajectories, as the role of enablers is arguably played each time by revolutionary concepts that prompt breakthrough developments in more industries.

In addressing perceptions on the value of technology, as these are historically recorded, a key role is given to the evolution of expertise in UK banking. British banking has come a long way from being dominated by noble businessmen with no homogeneous or relevant educational background, to today's Boards of Directors, composed of people of a diverse, but rather specific to the trade, range of expertise on Finance, Accounting, Technology, Law and Banking. The development of expert groups in UK banking was in the early days driven by a tradition that segregated banking clerical labour from managerial activity, a tradition that had to break in light of both the enabling effects of technologies that decentralised management tasks and the identified efficiency gaps. Notably, professionals of particular backgrounds on Banking, Finance, Accounting and Economics dominated the higher managerial levels of financial institutions as late as the 1970s, when the effects of both the recruitment of well-educated graduates and specialist scientists were felt. This development followed an equally high rate of scientific advancements in Mathematical Economics, Forecasting and Finance. Technological expert groups did not appear among the practitioners until quite late. That was, first, because of the dispersed nature of banking technologies early on, which didn't call for centralised technological skills. Second, the appearance of technological expertise had to wait until the attitude of banks to Information Systems changed, until banks were institutionalised with role-specific departmentalisation taking effect, and until dominant expert groups of Bankers, Actuaries, Accountants and Economists began relying heavily on technologies.

The impact of the evolution of banking expertise on established perceptions on technological investments is not always transparent. This paper proposes that there is a subtle relationship that results from the negotiation between dominant expert groups on how the bank should evaluate technological investment. In all reviewed respects, what is ultimately at the centre of TIDM approaches, are the power interests of expert groups. On that account, professional communities of practitioners negotiate the development of constructs through which decisions are taken. They arguably do this with view to imposing their own expert knowledge as key to managing and controlling these constructs and, through them, justify decisions of their own preference. TIDM techniques are, in that respect, serving the role of a channel through which professional groups promote their collective interests; objectifying this channel is what provides dominance over decision-making.

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5. APPENDIX 1: FIGURES

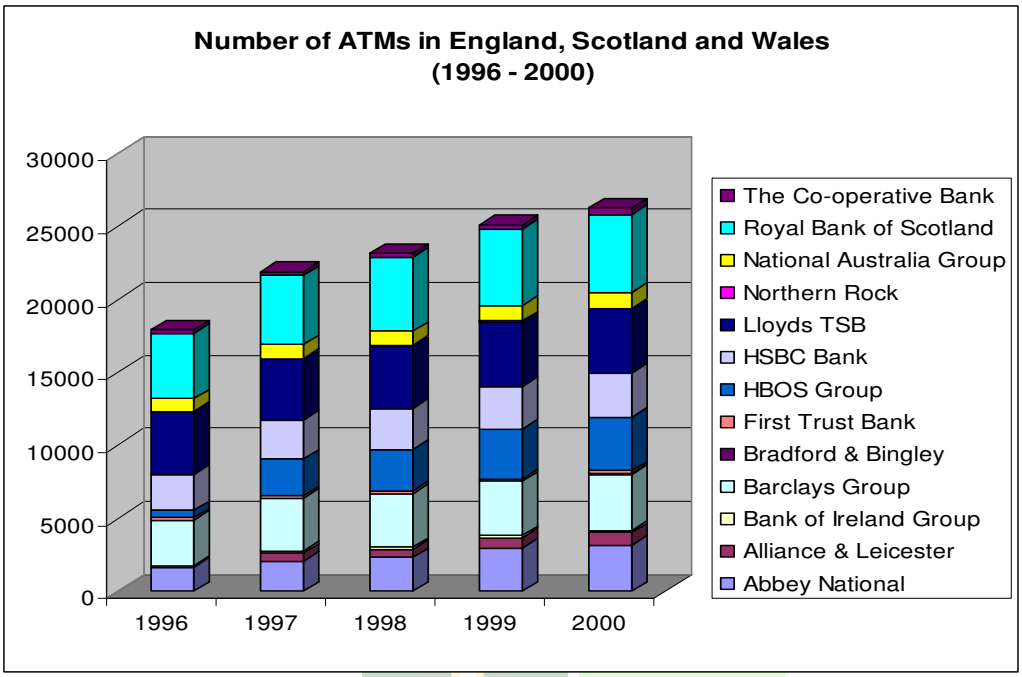

Figure 1: Number of ATMs in England, Scotland and Wales (1996 – 2000). Source: Reuters Business Insight.

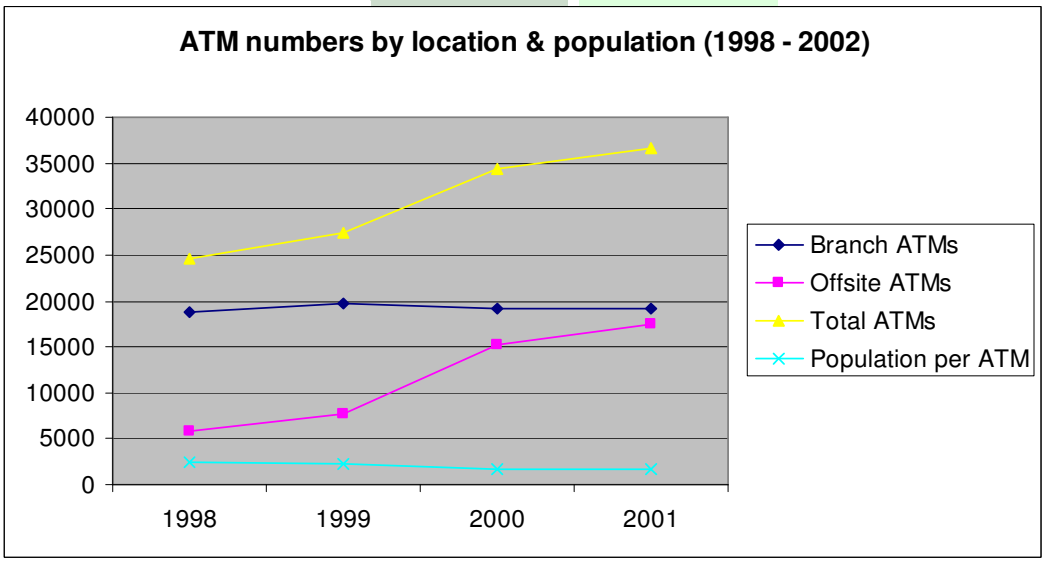

Figure 2: ATM numbers by location and population (1998 - 2002). Source: Datamonitor.