

THE ORIGINS OF THE CASHLESS SOCIETY: CASH DISPENSERS, DIRECT TO ACCOUNT PAYMENTS AND THE DEVELOPMENT OF ON-LINE REAL-TIME NETWORKS, C.1965-1985

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This article explores the technological choices made at the dawn of the massification of retail finance. We describe and analyze the early development of electronic banking and the foundations of the cashless society through the experiences of organizations with similar governance in two different competitive environments — Swedish and British savings banks. We document how the adoption of direct-to-account wage deposits and the subsequent deployment of networks of cash dispensers interacted with the adoption of on-line real-time (OLRT) computing, and distinguish on-line and OLRT communication as distinct stages in the evolution of computer networks. We emphasize the role of middle managers in the selection of alternative technologies and show how delivering a cashless society proved more difficult than anticipated.

By the mid-1960s bankers in Europe and North America were already familiar with the idea that the interconnection of computer systems could deliver a cashless society.¹ Simultaneously, they had to deal with the practical problems of managing an increasing number of customers because, at the time most “bank customers were paid weekly and at Friday lunchtime they flooded into branches to raise money for the weekend. The result was often chaotic with long queues and delays and the need for extra cashiers.”²

Almost half a century later, it is claimed that not even the homeless in Sweden accept cash.³ A cashless society requires the digitalization of activities inside and outside financial institutions. Initial steps in the digitalization of retail payments and the massification of retail finance relied on an ensemble of organizational processes and emergent technologies, in particular the successful deployment of direct-to-account payments and cash dispensers. This article maps the early development of these technologies in two competitive environments: Sweden and the United Kingdom.

One reason for considering these two countries is that Richard Grossman selects them as worthy of in-depth analysis in his history of commercial banking.⁴ In this paper we take stock of Grossman’s approach while also departing from the predominant view in financial history, which documents the experiences of commercial banks, by exploring organizational changes associated with the automation of not-for-profit financial institutions in the UK and Sweden. In this regard and according to a contemporary account by Richard Sprague, the view of US regulators participating in the creation of an electronic fund transfer system in the mid-1970s was informed by developments in Europe and most notably those around the cash-dispenser networks of British and Swedish savings banks.⁵ Our approach thus enables an international comparison of the evolution of the same technologies and an organizational form with similar corporate governance in two distinct competitive environments. The result is a detailed account of how two loose federations came together to achieve scale and scope economies, contest retail banking markets and thereby overcome the apparent advantages of large, diversified financial institutions in the use and application of computer technology.⁶ We also contribute to the debate

concerning the impact of “thicker markets”, reduced transaction costs and greater relative income in the late twentieth century on the Chandlerian firm.⁷

Our comparison also departs from the predominant view in financial history, by contributing to a growing number of studies documenting the process of office automation of financial institutions. These studies emphasize the underlying infrastructure that supported computerization and digitalization of financial markets and institutions.⁸ However, little attention has been paid to the question as to how applications of computer technology were used for building networks of information within retail financial markets, and how this, in turn, promised to deliver a cash-free economy.

Here we follow the approach of Yates in studying organizations, rather than individuals, as users of computers.⁹ But we must not forget that organizations consist of people, and institutions exist within the minds of individuals and are reproduced and enacted in their daily interactions. Hence it is also important to consider the role of different occupational groups and practices in the evolution of computer use.¹⁰ This approach requires us to combine several distinct perspectives¹¹ and, in turn, highlights the importance of middle managers in shaping technological decisions. Here we follow Bernardo Bátiz-Lazo and Thomas Haigh in adopting what might be called “history from the middle out”, in which technical experts and junior managers located deep within the organizational chart of a large, chaotic network of small and medium-sized banks attempt to reshape their structure, culture and practices to their own advantage.¹² The introduction of computer technology provided a powerful tool for the rise of a new, technocratic class within British and Swedish savings banks. Managers in both organizational forms had similar incentives to adopt computer technology, but as will be evident below, each group found different solutions to similar challenges.

Also of importance to our story is the adoption of on-line real-time (OLRT) computing during the 1960s and 1970s in the context of a possible cash-free society (which was forecast on the back of emerging networks of cash dispensers during the 1970s and 1980s). OLRT systems are based on the notion of synchronous communication. The

predominant approach is to consider the development of OLRT systems in a single move but this process was less straightforward for banks, as Ian Martin shows.¹³ Computer technology (and specifically cash dispensers) decoupled the concurrence in time and space of humans as providers and recipients of retail financial services, by offering a device that was more than a simple calculating machine but could follow the same set of rules as the bank teller. However, early cash dispensers operated off-line or updated central records in batch processes,¹⁴ that is, they were at best on-line but certainly asynchronous computer systems. Such a proposition was unacceptable for the savings banks, because regulatory constraints inhibited their ability to offer overdraft facilities. Hence a growing customer base required savings banks to achieve full OLRT interconnection between cash withdrawal and central records at the moment of the transaction. Without this, cash dispensing involved some form of human intervention. Accordingly it is full OLRT that distinguishes the cash-dispensing machine from the automated teller machine (ATM).¹⁵ Therefore in retail finance there were important legal, accounting, organizational, and final-user implications of OLRT. As a result, our research suggests there are specific conditions inside banking organizations that require considering on-line (OL) and OLRT as two distinct stages of development in the adoption of computer technology. Our research also documents how European financial intermediaries were active in shaping technological change in the process of the diffusion of OLRT computing and cash dispensers.

The remainder of this paper proceeds as follows. The next section provides background material relating to the origins and growth of savings banks in Britain and Sweden. The third section details the computerization of savings banks, focusing on how the introduction of direct-to-account wage deposit was the trigger for the computerization of Swedish savings banks, while the decimalization of sterling was the key event in Britain. The fourth section describes the adoption of OLRT computing and cash dispensers. In documenting the adoption of computers and cash dispensers we describe events in chronological order, typically placing those in Sweden before those in Britain. Moreover, we document how these developments were intertwined with those of two engineering companies, namely Speytec (later purchased by

Burroughs) in the UK and Metior (later becoming Asea-Metior) in Sweden. The fifth and final section offers a comparison of similarities and differences between the Swedish and British experience, as well as our conclusions.

Common origins

Trustee savings banks

Savings banks date back to 1810 in Scotland, from where they expanded to other European nations during the nineteenth century while building upon ideas about creating habits of thrift within the proletariat.¹⁶ There were different forms of savings banks in the UK (including the National Security Savings Bank system and the Post Office Savings Bank, later called National Savings Bank), but our research only deals with the largest number of similar organizations, namely the so-called trustee savings banks (TSBs).

The governance of the savings banks was different from other corporate bodies because there was no ultimate owner, while deposits were invested in low-risk (government) securities rather than used to provide loans.¹⁷ The funds and operation of the savings banks were under the control of voluntary managers or trustees (hence the roots of the TSB acronym), none of whom was to derive any benefit from that office.¹⁸ There were 231 TSBs in the UK at the end of the nineteenth century.¹⁹ Most remained as a series of autonomous entities, many of them ‘unit banks’ (where the whole organization was encapsulated within the premises of a single retail office) as late as 1970.

Since 1817 in England (and 1835 in Scotland), accumulated deposits had to be invested in government debt (through the Commissioners for the Reduction of National Debt),²⁰ while the Savings Bank Act of 1891 curtailed early attempts to broaden their activities. It was not until 1965 that the TSB was allowed to issue current accounts, undertake the payment of utility bills and safeguard securities and valuables. Regulatory changes, therefore, limited the potential diversification of the British savings banks’ investment portfolios and curtailed opportunities for direct lending to retail customers, while their business remained in collecting low-volume deposits.

After World War Two, some TSBs began to open retail branches and sub-branches.²¹ These came from organic developments in close geographical proximity to ‘head-office’, responding to changes in local economic conditions while avoiding the sphere of influence of another savings bank.²² The emergence of a retail branch network for the whole movement was cautious in terms of the number of retail outlets: with 386 in 1911, reaching 1,505 in 1970 (30 for the Preston bank and 37 for the Belfast bank)²³ and peaking at 1,650 in 1981.²⁴ New and refitted branches would always be inaugurated with a ‘loud fanfare’, often accompanied by ‘an impressive civic opening ceremony’.²⁵

By 1960 the distribution in terms of the number of banks and size of assets was highly skewed. The north of England and Scotland had the largest number of banks and accounts, with the largest banks in terms of assets located in urban centers (namely London, Glasgow, Edinburgh and Belfast), and the largest concentration of assets located in the south east of England.²⁶ The TSB’s share of total sterling deposits made by UK residents diminished from 9.2 percent in 1962 (£16.5 million) to 6.2 percent in 1976 (£69.8 million).²⁷

As part of a change in government policy, the 70 or so remaining TSBs amalgamated into a single institution between 1970 and 1985. This entity was then floated on the London Stock Exchange as part of Margaret Thatcher’s privatization program in 1986. Given its unique governance the proceeds of the flotation were reinvested in their entirety as working capital. Nine years later in 1995, Lloyds Bank acquired the TSB Group, only to re-launch the brand as an independent bank while divesting itself of some 600 retail branches in 2013 as a result of a ruling by the European Commission.

Swedish savings banks

The first Swedish savings banks were inspired by the Scottish model and established in the early nineteenth century as non-profit organizations with the purpose of encouraging thrift amongst poor people. The number of savings banks increased rapidly until 1926 when they reached a peak of 497.²⁸ The Swedish savings banks were originally thought of as conservative strongholds, but after the democratic breakthrough they became more aligned with the labor

movement.²⁹ This was clearly manifested in 1945, when the savings banks gave striking metal workers respite from loan repayments.³⁰ Over time, it also became increasingly common to find union officials on the boards of savings banks.

The Swedish savings banks association (*Svenska sparbanksföreningen*) was established in 1900, some ten years after a similar organization had been established in the UK (1887). Like its US and Spanish counterparts,³¹ the Swedish association played an important role in elevating the public image of thrift and from the 1920s onwards, lobbying government on behalf of its members.³² In 1925 the savings banks association established a department for propaganda, later named *Sparfrämjandet*, to serve as a publishing house and a central purchasing unit.³³ In 1943 it became an independent company comprising three departments, namely publishing, external relations and central purchasing. As will be evident below, *Sparfrämjandet* played a key role in the computerization of Swedish savings banks - a process rooted in the introduction of direct-to-account payroll deposit services in that country.

The decades that followed the end of World War Two were characterized by overall economic growth, increased affluence and expansion of the welfare state in Sweden. This era also saw increased competition in the banking sector as the commercial banks began to attract a variety of new customers, including wage-earners. Handelsbanken and other commercial banks used the contacts developed while financing the working capital of manufacturing companies to offer these companies direct payroll deposit services. In a similar move, the birth of direct payroll services in Britain took place in 1958 when clearing (i.e. joint-stock commercial) banks were allowed to offer payment by checks or bank credit to any worker who specifically requested or sanctioned it.³⁴

The savings banks were initially hesitant in responding to this new service, but a group of younger managers pushed for a more aggressive corporate strategy.³⁵ Throughout the 1950s these young managers, under the leadership of Sven G. Svensson, director of *Sparfrämjandet*, were united by the idea that the savings banks had to adjust to ongoing social change.³⁶ They were convinced that the savings banks should meet the challenge of Handelsbanken, not by demanding protection from the state

but by introducing better services. Many of their ideas were implemented as Svensson's followers reached influential positions.³⁷ As a result the Swedish savings banks evolved from small-scale savings institutions to 'modern' business-oriented retail financial intermediaries. During this process the emphasis on thrift was downplayed while the savings banks began to view depositors more like customers than savers.

In 1960, most of the bigger savings banks had introduced direct payroll accounts and over the course of the decade, the savings banks had, partly by using their close contacts with trade unions, acquired a dominant role in the retail banking segment. Between 1962 and 1970 the number of accounts at the Swedish savings banks increased five-fold (from 143,000 to 870,000).³⁸ This development was much more dramatic in Sweden than in the UK.³⁹ However, competitive success was associated with rocketing costs. In order to keep up with the commercial banks, the savings banks had to expand their workforce. Expressed as a share of deposits, administration costs increased by 40 percent between 1962 and 1967. In the same period, the number of transactions (withdrawals and deposits) of the four largest savings banks increased by 125 percent, whereas their total funds increased by 64 percent.⁴⁰ At the same time, British savings banks were losing deposits faster than they could acquire them.⁴¹

Adoption of computer technology

Establishing joint on-line systems around Spadab in Sweden⁴²

By the end of the 1950s, the use of mechanical and electro-mechanical accounting machines was widespread among the Swedish savings banks.⁴³ At the same time, rising administrative costs and an increasing number of accounts in the late 1950s and 1960s required Swedish savings banks to take action, and the then-emerging application of computers to business seemed to offer a solution. A major step towards computerization was taken in 1958, when the Swedish savings banks association formed a Technical Committee. This occurred after a delegation had visited the USA in 1957 with the aim of observing the use of so-called electronic computing machines by Savings and Loans.⁴⁴ The delegation suggested similar machines might be useful for the Swedish

savings banks, but within a timeframe of five to ten years. One of the delegates stated: “there is, however, reason to be skeptical whether these systems will work as supposed”.⁴⁵ At the time, there was also widespread skepticism that a large number of savings banks could work together on solving technical issues and making joint capital equipment investments.

In 1959, Per Olov Rinvall took the position of chairman of the Technical Committee. His first decision was to form a sub-committee tasked with recommending the automation of bookkeeping procedures. The sub-committee scanned the market for suppliers of computing machines, receiving quotes from IBM, Ericsson, Bull, RCA and NCR. At this time, most of the major commercial banks had already purchased computers while some savings banks had started to use private computer service bureaus. The work of the sub-committee led in late-1961 to the formation of a jointly-owned computer and data-processing company that was later to be called Spadab.

Spadab’s first large investment was a Stockholm computer center which opened for service in early 1963. It housed a Bull Gamma 30 computer. A second center in Gothenburg soon followed.⁴⁶ By the end of 1963, 16 savings banks used the Stockholm center and 15 banks the Gothenburg center. A third center was opened in the south at Linköping. Each center was sub-divided into three main areas: the mainframe room, the punching room and a room for the distribution unit. The Stockholm Savings Bank had developed its own computing facilities, which became the fourth computing center in the Swedish consortium in 1966. A fifth and final center was opened in Malmö in 1967. The engineering group in Malmö carried out some explorations of computer technology outside of Spadab, and, following development at the Malmö center, OLRT services really took off in 1974 when 15 savings banks were connected in a nationwide on-line network.

Catching up and overtaking in England

British savings banks were “late” adopters of computer technology when compared to developments in automating passbook-based accounts in Sweden and even the USA.⁴⁷ Contrary to developments in Sweden or Spain, their industry association failed to grow in strength and offer support as well as resolve scale disadvantages in computer adoption. By

the mid-1960s, the mechanization of the British savings banks was largely incipient: most TSBs had just started to use mechanical and electro-mechanical equipment to speed up internal processes such as the accounting function.⁴⁸

Table 1 summarizes the process of computerization of the savings banks in Britain. This started with an early experiment by banks in and around London to develop a clearing center in Surrey. Yet the big incentive to roll out the computer revolution across all TSBs was the decimalization of sterling in 1971, while using the bureau service offered by a subsidiary of the Post Office, the National Data Processing Service (NDPS), to deal with the cost of capital investment and the lack of technical skills. Most English and Welsh banks were mapped to this bureau service. During this period, transactions at the branches were collated onto paper tape at regional offices and then processed overnight on NDPS machines. However, this form of batch processing, strictly speaking, broke the law, which required that information in the customer's passbook match that in the bank's ledger at all times. The TSBs wanted to develop some form of communication whereby the computer record was updated immediately, as the transaction took place at the retail branch.

After decimalization, operations were brought in-house and replaced by nine processing centers servicing 48 banks and some 1,550 retail bank branches.⁴⁹ At the same time, however, some banks decided to go it alone (such as those around Manchester, in the West Midlands and in Northern Ireland). Yet as the British savings banks amalgamated into a single entity, they managed to maintain heterogeneity across banks in administrative processes and other computer-related applications.⁵⁰ This apparent high degree of standardization was influenced by the nature and type of work at the savings banks. Their 1,524 retail branches in 1971 were large in number by US standards, but small compared with British commercial banks. For instance, Lloyds Bank (the smallest of the big four commercial banks in terms of assets) had 2,384 retail branches and 34,368 employees in the UK.⁵¹ By 1971 most clearing banks had developed computer expertise in-house, notably within accounting and

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Table 1
Computerization of the trustee savings banks in the UK, 1960-1985

Year	Equipment	Location	Observations
Early 1960s	IBM 1401	Bureau service stage (External operations) Surrey (south east England)	Clearing center for London banks. Stationary developed for this center was later adopted across most banks.
Late 1960s	ICL System 4	n/a	Bureau service supported by the National Data Processing Service (NDPS), a subsidiary of the Post Office in preparation for decimalization in 1971.
Operations brought in-house			
1970	An undisclosed Burroughs mainframe and TC700 terminals	Belfast (Northern Ireland)	Based in Belfast it serviced 40,000 of the Irish consortium's 560,000 deposit accounts and provided instantaneous communication to 26 of the 42 retail branches. ⁵²
1971	An undisclosed Burroughs mainframe	Glasgow (Scotland)	Most Scottish banks built a center around the Savings Bank of Glasgow.
1971 - 1972	ICL System 4 mainframe	Manchester	Manchester and District Bank built a computer center in Strangeways, Manchester, and called it Manchester and District Computer Accounting Project (MADCAP).
1974	n/a	n/a	The eight-bank consortium went on-line (i.e. operates real-time terminals at retail branch counters and allowed for the input of information at the point of origin)
1979	ICL System 4 mainframe and a Sperry Univac	Wythenshawe, Manchester	Supported by 1,000 Olivetti terminals at retail branch counters and 3,500 Burroughs modular transaction control terminals spread out through some 1,000 retail branches. ⁵³
1983	n/a	Milton Keynes and Wythenshawe	Activities in the South East of England (which until then had remained off-line) amalgamated with those in a new center in Milton Keynes operating in tandem with Wythenshawe (which already had within its remit operations in the North East, North of Wales, Cornwall and Devon). ⁵⁴
1984-1985	n/a	Milton Keynes and Wythenshawe	Remaining independent savings banks in England, Wales and Scotland amalgamated into a single organization with all the remaining off-line branches linked to the Wythenshawe/ Milton Keynes computer centers.

operations and methods departments.⁵⁵ To develop similar capabilities, savings banks had to recruit from the market, especially engineers with experience in on-line systems such as airlines and television.

Although the savings banks had a large number of accounts, their daily volume of transactions was low relative to the number of accounts.⁵⁵ At the same time, there was little variety in the type of accounts as individual banks essentially offered the same products and services. More than fifty standing-order payments per account stretched the system to its limits.⁵⁶ However, at that time, only Lloyds had seriously approached the idea of an OLRT system, while the other three large commercial banks (i.e. Barclays, Midland NatWest) delayed for at least a decade until they brought all retail branches on-line.

The process of computerization of the savings banks was neither free of mishaps nor straightforward. For instance, speaking at the Association's annual meeting in May 1975, the chairman of the then recently-formed TSB Computer Services Ltd. expressed his frustration at failing to secure a single national system and cautioned that commercial banks were taking the lead in on-line technology.⁵⁷ A greater challenge came in 1979 when a system built around an ICL System 4 mainframe and an undisclosed Sperry Univac (both housed at the computer center in Wythenshawe, Manchester) was to replace all remaining independent operations with a single OLRT system.⁵⁸ At the time, few outside of the TSB technical area and the banking and computer marketplace believed such a move could be possible. A manager in charge of the joint computer center recalls: "IBM's attitude was you can't do it. IBM wanted us to stop our system and transfer everything across to a new system off-line".⁵⁹ Moreover, a report on the "cost-effectiveness and human aspects of computerization" commissioned by the savings banks from a group of academics considered that the OLRT system would be more expensive than the off-line alternative.⁶⁰ However, the view of computer specialists inside the savings banks was that both the report and the marketplace were overlooking the productivity gains that could be achieved. The implementation went ahead and the savings banks' engineers were proved correct. One contemporary observer in the US opined that the computing success of the TSBs was noteworthy to the extent that:

The TSB ... [has] one of the most advanced on-line networks serving both teller windows and ATM's in the UK. Competition is doing very well in all parts of the United Kingdom and the clearing banks are in for some rude shocks unless they awaken to the situation.⁶¹

After-hours cash-dispensing networks

Building the Metior cash dispenser in Sweden⁶²

The roots of cash-dispensing technology in Sweden can be traced to 1960, when Hans Rausing and the Rausing Company developed at the insistence of, and sold through, *Sparfrämjandet*, coin-sorting machines for the savings banks.⁶³ These machines resulted from discussions between the saving banks and *Sparfrämjandet* about the possibilities of automating cash dispensing to rationalize the handling of cash by human bank tellers. There was also a need to distribute cash out of hours and, as had been the case in the UK, after the banks closed retail branches on Saturdays.⁶⁴ Yet in contrast to Britain where banks introduced cash dispensers in 1967 and then bowed to labor union demands to end Saturday opening hours in 1969,⁶⁵ Swedish savings banks first terminated the Saturday service and then introduced cash dispensers.

Sparfrämjandet wanted some type of machine able to dispense bank notes, and discussed the issue with Metior. This was a manufacturer of automatic petrol pumps that had taken over the Rausing Company's (now called Restello) production of coin-sorting machines.⁶⁶ Of particular interest to *Sparfrämjandet* was Metior's experience in the development of automatic passage systems and the use of personal identification number (PIN) codes.⁶⁷ After some time the proposed cooperation was not successful. Metior then approached the commercial bank Handelsbanken while looking for a new partner in the development of a cash dispenser.⁶⁸ However, the then-CEO of Spadab, Bengt Wetterholm, reopened contact with Metior on behalf of the savings banks after learning about the interest of Handelsbanken.⁶⁹ Surviving records suggest that Metior mainly interacted with *Sparfrämjandet*, and that this was the organization that had the greatest influence on the design of the first generation of cash dispensers in Sweden. For example, in December 1966 when Metior was about to demonstrate its first prototype, Metior invited representatives from *Sparfrämjandet* and other organizations but none from Spadab.⁷⁰ Nevertheless, according to a former manager at Metior, it

maintained good relations with Spadab while together with IBM, Spadab was, as mentioned, directly involved in developing on-line technology for the savings banks' computer centers.⁷¹

Metior's first cash dispenser was shown to the press and broadcast on television on July 6, 1967 in Uppsala.⁷² This was only nine days after the first British cash dispenser was rolled out by Barclays Bank and De La Rue, and a couple of days before Handelsbanken showed their first Metior machine. After some more testing, the general public started to use the 24-hour-a-day cash dispenser in Uppsala in September 1967.

Metior had assembled five machines by early 1968, but still referred to them as "prototypes". Of these five machines, the savings banks had two and the commercial banks three. In the spring of 1968, serial production began after *Sparfrämjandet* ordered 20 machines. This order included a number of specific requirements that modified Metior's prototypes, indicating that the savings banks actively contributed in shaping the new technology.⁷³ By February 1970, Metior had produced 178 cash dispensers, of which 37 were destined for the domestic market (24 were delivered to the savings banks) and 141 were for export.⁷⁴

The first cash dispenser went under the name *utbetalningsautomat* and later *Bankomat*, which became a brand name for cash dispensing in the Baltic Sea region. However, Handelsbanken, together with other commercial banks, soon acquired the copyright to this brand name for their dispensers. During its initial years Metior developed four generations of cash dispensers.⁷⁵ The first generation was not sold commercially. The second and third were developed for the savings banks and the fourth was designed for the commercial banks and the French market.⁷⁶

The cards used to activate Bankomat Mark 2 and Mark 3 were made of steel and had punched holes for identification, and were used together with a PIN-code, similar to Chubb's plastic cards.⁷⁷ The Mark 2 and Mark 3 limited each card to one withdrawal per day, but this was unsatisfactory as it left open the possibility of someone making a withdrawal immediately before and immediately after midnight.⁷⁸ The Mark 4 abandoned the punched-hole cards and replaced them with information embedded in a magnetic stripe that had been developed by the French Société Générale d'Automation. This technology ensured that withdrawals were made only from accounts with positive balances as demanded by French banks.⁷⁹

Whereas some of the UK banks had been determined to deploy machines only after the resilience of their security devices had been tested,⁸⁰ the first Swedish machines were used with only basic safeguards. Sometime after deployment someone discovered the algorithm used to associate card numbers with the PIN-code. During an Easter vacation period, this person travelled around Sweden withdrawing money from each and every machine he/she encountered, with the banks unaware until after the vacation. This incident served to strengthen the collaboration of the savings banks. Before the Easter vacation fraud, each savings bank was individually responsible for losses due to malfunctioning machines. After the fraud, the banks shared the risks associated with the new technology. Firstly, the savings banks began to share losses resulting from malfunctioning machines. The Easter incident also damaged confidence in Metior. In order to restore it, the ownership of the company was transferred to the weapons manufacturer Bofors in 1969, and to the electronic engineering company ASEA in 1973.⁸¹

It is worth noting that Metior had harbored ambitions to work with on-line technology since the very early stages of the design. According to the original plan, the Uppsala machine of 1967 would have been connected on-line if IBM had delivered an interface that enabled the Bankomat to link to a computer.⁸² Instead, a claim to the world's first commercial application of on-line cash-dispensing technology came on May 6, 1968, when a dispenser in Malmö was set up to service 1,000 accounts. On-line teller terminals located on the counters of retail branches were connected through conventional telephone lines using modems to the center in Malmö, which was equipped with a third-generation IBM 360/40 computer.⁸³

The procedure to turn the Metior cash dispenser into an on-line device involved checking the PIN locally inside the Bankomat. When verified, the customer's card number and the amount requested were transmitted via the IBM 360 to Spadab's computer center in Stockholm. If the account had a sufficient balance the return signal was positive, enabling the Bankomat to dispense the money. The Bankomat had an internal counter to dispense the correct notes, and when complete it would send an end-of-transaction message back to Spadab.⁸⁴ Subsequent versions of the Bankomat were fitted with batch features to "call" the system while the Bankomat Mark 4 was able to connect on-line via a modem.⁸⁵ However, in spite of the possibility of

OLRT computing, most cash dispensers at the Swedish savings banks operated as stand-alone, off-line devices.

Two very important events, which became turning points in the Swedish history of cash dispensers, took place in 1971. The first of these was the decision by Swedish commercial banks to end their independent attempts to develop cash-dispensing technologies, by joining forces with *Kungliga Postverket* (the Post Office) and the Federation of Swedish Rural Credit Societies to create *Bankomatcentralen* (the Automatic Cash Dispenser Center).⁸⁶ The mission of *Bankomatcentralen* was to install and run cash-dispensing equipment for the consortia, including decisions regarding location, marketing (under the Bankomat brand), and administration of card registration, data-processing, clearing and statistical information. As a big player in the market for cash-dispensing technology, *Bankomatcentralen* could and did influence the design of cash dispensers. For example, it demanded that Metior abandon its original (and otherwise ineffective) dispensing mechanism, which contained detectors that measured the thickness of each bill, so that two or more bills could not stick together causing wastage or stoppage.⁸⁷ An alternative solution was developed by the inventor Leif Lundblad in the early 1970s, such that the bills were first counted in the machine and then dispensed in bundles.⁸⁸ *Bankomatcentralen* considered Lundblad's solution superior, and influenced Metior engineers in adopting it.⁸⁹

The second important event in the development of Swedish cash dispensers began when a newly appointed director of Spadab, Jan Rydh, attended the Automated Teller Machine Conference in Chicago in 1971. Rydh reminisced that, during discussions focusing on investments in off-line dispensers on the conference fringe, on impulse he made the sudden decision to regard investments in off-line machines a sunk (i.e. irrecoverable) cost.⁹⁰ The decision was communicated to colleagues attending the conference, and to the rest of the staff upon their return to Sweden. This left engineers at Spadab free to start what became known as the "Minuten project". The aim was the large-scale adoption of on-line cash dispensers by the savings banks. In searching for potential suppliers, contacts were made with a number of manufacturers, and ultimately three companies competed for the project. These were the Swedish company Asea-Metior, the British company Chubb and the US-based company Docutel. In 1975 the savings banks finally

abandoned Metior by choosing Docutel as their supplier of ATM devices (that is, on-line cash dispensers), with the Swedish company Datasaab responsible for installation and service.⁹¹

There are at least three explanations as to why the savings banks abandoned Metior. The first relates to Metior's previously mentioned problems with security. The second concerns the weakness of the US dollar against the Swedish krona, making the Asea-Metior dispenser expensive relative to the Docutel machine.⁹² The third explanation is that the early 1970s saw the swift and widespread adoption of on-line terminals at retail branches across many countries. Independent producers of cash dispensers, such as Asea-Metior, faced difficulties as customers demanded wholly integrated systems⁹³ such as those offered by Burroughs, IBM or NCR, which could deliver a central computer, teller terminals and cash dispensers.

The savings banks were the first to use this new generation of cash dispensers, known as mini-banks or *Minuten*. The first machine was installed on May 24, 1977, and the fleet eventually grew to 600 units. From the outset all the *Minuten* were connected to a central computer in OLRT mode. Then in 1982, Spadab searched the market for a new generation of ATM, looking to deploy 1,000 machines. By this time Asea-Metior had withdrawn from the market, and Datasaab offered an ATM of its own, developed in collaboration with Leif Lundblad's Inter Innovation Company and benefiting from Docutel technology. However, this machine failed to fulfill the demands of Spadab. Instead, the savings banks chose the offer made by Ericsson (Sweden) and Omron (Japan) to deliver 900 ATM, thus ending the presence of Swedish innovators within their home market.

Deploying the on-line real-time ATM network in England

The introduction of cash-dispensing technology in the TSBs took place when the West Midlands made a Chubb MD2 operational at its Shrewsbury branch in June 1970.⁹⁴ Chubb & Son's Lock and Safe Company Group plc (Chubb) had been one of the pioneering firms in cash-dispensing technology in the UK thanks to its collaboration with Smith Industries and two large clearing banks, Midland Bank and Westminster Bank.⁹⁵ The MD2 was a stand-alone machine requiring customers' records to be updated following each transaction, through the mediation of a human teller. The West Midlands' adoption of an MD2 followed similar moves by the clearing banks,

at a time when Chubb became the dominant technology in British retail finance during the early 1970s.⁹⁶

In a separate move, and four years after the Burroughs mainframe was installed in 1970, the first two “on-line” cash dispensers, the Burroughs RT 2000 model, were made operational in Belfast in 1974.⁹⁷ In this case OL meant that the central computer was informed of withdrawals after the cash had been dispensed; otherwise the transaction would have been too time-consuming for the customer. There was no opportunity to confirm the availability of funds prior to dispensing cash.

However neither of these two early experiments seems to have had widespread repercussions for the TSBs. Instead, the roots of what Sprague described as the “first community-wide ATM network”⁹⁸ in the UK date back to the deployment of the English Electric (i.e. ICL) System 4 mainframe of the Manchester and District Computer Accounting Project (MADCAP).⁹⁹ Around 1970, David Wilson pointed out to the programmers that they needed to sort out a way to communicate effectively between the mainframe at MADCAP and Olivetti terminals (positioned on the counter of retail branches) that could be over 10, 20 or even 30 miles’ distance, and then back again. In the absence of random access memory and database management systems, MADCAP engineers came up with “Modus 11”. This was not encryption, but a mathematical calculation that converted the account number to a specific address in the file on the disc. In this way, a specific query resulting from a passbook inserted into a teller terminal could go straight in and straight out while the signal travelled through dedicated, copper wire telephone lines.

“Modus 11” then became the key for a trial system of 10 Chubb cash dispensers. After having seen developments in London and the USA, it was decided that one of the “on-line” banks would move forward with the project. The General Manager of what was now the Manchester Regional Area Central Bank volunteered. There was an advantage to the trial being in Manchester because that was where the computer center was located, with the added convenience that engineers at MADCAP could respond promptly to any call.

The first experiment with OLRT cash dispensers took place in 1974 and involved six branches wired to the Manchester computer center.¹⁰⁰ Initially there were greater difficulties in making the Chubb machines functional than

in communication using conventional telephone lines. Soon, however, customers with an account in the Manchester Regional Area could make withdrawals from these cash dispensers. Customers were no longer tied to their specific bank or branch. They could withdraw from any cash dispenser and their account was debited immediately. Customers could also make balance inquiries.

Yet despite the success of the trial, adoption by savings banks elsewhere was slow. As late as 1978, only very few retail branches were equipped with cash-dispensing equipment. Although some other banks also installed Chubb cash dispensers, when the TSBs wanted to embrace the technology fully, they found that Chubb was unable to supply the machines.¹⁰¹ Moreover, there was resistance from the South region and from Scotland, where the banks used off-line systems. This was to change in 1979, when the South-East Regional Area ordered from Burroughs two B6800 large-scale computer systems and 800 TD730 display terminals worth \$7 million.¹⁰²

Managers had also resisted deployment on the grounds of cost, as they thought that cash-dispensing technology was expensive. Indeed, in 1977 a top-of-the-range RT 5000 Burroughs cash dispenser (a direct competitor of the IBM 3624 and featuring a printer and up to 4,000 bills of one or two denominations) ranged from \$25,000 to \$40,000 each (or a rent ranging from \$860 to \$1,400 per month based on a one-year contract).¹⁰³ Moreover, an internal cost-accounting exercise at the TSBs suggested that cash-dispensing technology would be ineffective unless it was associated with a sharp decrease in the number of transactions through and off the teller's counter. The situation remained at an impasse until the end of 1978, when two of the leading clearing banks (namely Barclays and NatWest) deployed large numbers of NCR 770 cash dispensers.¹⁰⁴ TSB managers then panicked and pressed for cash dispensers to be rolled out throughout all regions.

Research into potential providers to service the TSBs by the Computer Research and Development Unit resulted in a large order of cash dispensers placed with Burroughs, despite the belief of some senior managers that Burroughs' technology was inferior.¹⁰⁵ The architecture of the Burroughs cash dispensers was based on a system developed to the specification of the Midland Bank by a small engineering firm called Speytec (which later became part of Burroughs operations in Britain).¹⁰⁶ At the time, Midland Bank's order for 500 cash dispensers (worth £1.5 million in 1969) had been

the only sizable British transaction for Burroughs.¹⁰⁷ The US computer manufacturer was keen to keep the custom of British financial intermediaries:

... they went away and came back with another machine. It was the RT650. [We thought of it as] the TSB's because [Burroughs] modified it to work with us. The beauty about it was it was a very simple machine. We looked at NCR and they had an excellent machine but it was too sophisticated to talk to the system we were operating, we wanted something simple the system would do it straight the way you see and it was a bit more expensive so that was put aside.¹⁰⁸

As indicated in the quotation, in order to secure the sale Burroughs modified its equipment to suit the workings of the TSBs' computing and administrative procedures. As a result of the modifications, the day-to-day operation of the RT650 was not challenging for human tellers at the TSBs.¹⁰⁹ The modifications forfeited any need for special training, as any of the cashiers was able to service the cash dispenser for the purposes of routine transactions after a brief explanation.

Currency dispensing worked well once individual customers overcame their fear of the activating card not being returned, or their dislike of interacting with a machine rather than a human teller. There were of course instances where the cash card would slip through the wrong slot or the machine failed to dispense the correct amount (easily resolved if the customer returned at the end of the working day and the balance in the machine equaled the amount he/she claimed had not been dispensed). Yet in general, during the early 1980s, the Burroughs cash dispensers appear to have been free of specific errors or malfunctions. The TSBs benefited from the adoption of a tried and tested technology, after the clearing banks had endured the "teething problems"¹¹⁰ with early currency dispenser prototypes.

In summary, the TSBs became the first UK retail financial institutions to adopt a full OLRT system. Through this process, the savings banks created the largest network of computers and introduced leading-edge software applications for the detection of fraud and the management of cash dispensers (eventually replacing Burroughs RT650 with NCR 1780 equipment in the late-1980s). British savings banks, therefore, explored cost-efficient ways of

using readily-available technology to attract deposits from geographically-remote customers. This included the opening of retail branches by the largest banks. However, tight regulation and under-developed strategic and risk management skills amongst the top echelons of management limited possibilities for all but a handful of individual organizations to exploit the new technology to its full potential.¹¹¹

Conclusion

In this article we document the creation of electronic data-processing networks in British and Swedish savings banks in the early years of the digital economy. In particular, we consider how the first step towards a cash-free economy involved the digitalization of customer accounts and direct-to-account payments, but in the absence of a fully deployed infrastructure, and in order to contain costs, there was a need to develop automatic cash-dispensing technology.

We explore how groups of otherwise independent providers came together to achieve economies of scale while adopting OLRT computing, and we detail their attempts to influence the design of cash dispensers. Independent organizations with common historical origins through different trajectories attained leading positions in the field of cash dispensing. While the Swedish savings banks were prime movers, their British counterparts could watch and learn from the mistakes made by clearing banks.

In both countries the networks were held together by umbrella organizations, but the common structure of the Swedish savings banks (already in place prior to the post-war period¹¹²), allowed active participation in the development of new technology in the decades that followed the end of World War II. As shown in the paper, managers at jointly-owned companies for purchases (*Sparfrämjandet*) and data processing (*Spadab*) played key roles in the adoption of computers, cash dispensers and OLRT systems in Sweden. The British network of savings banks was looser, but cooperation was strengthened over time, partly as a consequence of technological change but also responding to a change in government policy that drove their amalgamation into a single organization.

The technological changes we study appear to have been demand-driven by the savings banks in both Sweden and the UK, but the incentives for the two networks to demand and shape new technological solutions were

somewhat different. In the Swedish case, competition with commercial banks over direct payroll accounts gave banks strong incentives to mechanize tasks, including cash dispensing. In the race to gain market shares and cut costs, Swedish banks initially accepted technical solutions with security flaws. In spite of early experiments with OLRT, the Swedish banks also began to build a network of cash dispensers that was not connected on-line.

In the British case, the involvement of banks in wage payments came later, and the TSBs were less successful in the competition with commercial banks. The TSBs were initially more hesitant over computerization, and used bureau services and established technologies. For example, the TSBs first introduced cash dispensers at least three years after the clearing banks and their Swedish counterparts. The decimalization of sterling in 1971 was a major turning point and encouraged the TSBs to bring computer operations in-house. The computer center of the Manchester and Midlands region played a key role in the development of on-line cash dispensers in the 1970s, but the adoption of the technology was slow until the big clearing banks launched a fleet of new cash dispensers in 1978. Nevertheless, within a few years and while benefiting from newer technology and no legacy investments, the TSBs acquired a leading position in the use of computers, cash dispensing and OLRT.

We make a perhaps unusual distinction between on-line and OLRT systems. This distinction begs the question, when is on-line not real-time processing? When considering the processing of data within the central processing unit then on-line is always OLRT. Indeed banks with a geographically-concentrated retail branch network and a relatively low volume of transactions took steps to link terminals and cash dispensers with their computer center (either physically or through modems and conventional telephone lines). This was the case for savings banks on the East coast of the USA,¹¹³ as well as savings banks in Manchester and Malmö. However, we also present several European examples where on-line terminals inside retail banks and cash dispensers were not OLRT. In such cases the cash dispenser updated the customer's record after the transaction had taken place, avoiding long delays and minimizing customer inconvenience. Alternatively, organizational procedures were such that transactions were stored and batched together, so that central files were updated once or twice per day. The on-line system at the TSBs also revealed how early computer technology could reach

capacity quite easily (at least as far as the transaction volume requirements of banks were concerned). These transactions were also characterized as relatively simple and standard.

Our research also departs from the common assumption within economic history that the nature of the response of retail financial intermediaries to regulatory change and new technology is rather deterministic.¹¹⁴ We document how managers, especially middle-management, dealt with organizational change (or its absence) within groupings of the same organizational form in different geographies. As noted by Guerreiro Wilson¹¹⁵, in approaching new technology managers of British and Swedish savings banks required the machine to fit the work and not the other way around. Indeed, we document evidence stating how, in an effort to retain the custom of European banks, computer and cash dispenser manufacturers were ready to modify their equipment to suit the technical requirements and specifications of the savings banks. This further highlights the importance of European financial intermediaries to US computer manufacturers: when compared to the atomistic nature of American retail banking, large volumes of transactions and retail branch networks in Europe resulted in low-frequency but high-value orders of computer equipment. This evidence does not negate the importance of developments in computer technology in USA (particularly of manufacturers such as IBM and Burroughs, which were both suppliers of systems for the US military), but it does challenge naïve assumptions about the origins of technological change in financial services which acclaim the “... fact that many financial innovations originate in the US ...”.¹¹⁶

In summary, we explore the first steps in the emergence of self-service technology and the changes it brought about for consumers and organizations active in retail financial market. We also develop an international comparison, with the purpose of researching technology and corporate strategy in their social and historical context, concerning the dynamics of the design, construction, development, implementation and use of specialized technology.

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NOTES

¹ Originally the terms paperless, checkless and cashless were, more often than not, used interchangeably. See further Bátiz-Lazo et al., 2013.

² Donough O'Brien, 2013.

³ Katrina Gustafsson and Niklas Magnusson, 2013.

⁴ Richard Grossman, 2010, pp. 169 and 197.

⁵ Richard E. Sprague, 1977, p. 29; David L. Stearns, 2011.

⁶ See also Bernardo Bátiz-Lazo and J. Carles Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b; Bátiz-Lazo and Peter Wardley, 2007; Bátiz-Lazo, 2004; Bátiz-Lazo and Gustavo Del Angel, 2003; Susan Scott and Markos Zachariadis, 2012; Scott and Zachariadis, 2013.

⁷ Naomi R. Lamoreaux et al., 2003; Richard N. Langlois, 2003.

⁸ For instance, Martin Campbell-Kelly, 1992. James W. Cortada, 1993. Lars Heide, 1994; Heide, 2008; Heide, 2009; Charles W. Wootton and Barbara E. Kemmerer, 2007. Bátiz-Lazo and Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b. Alan E. Booth, 2001; Booth, 2004; Booth, 2007.

⁹ JoAnne Yates, 2006.

¹⁰ The early establishment of identities, practices, and division of labor in administrative computing is explored in Thomas Haigh, 2001.

¹¹ David Edgerton, 1999; Thomas J. Misa, 2007.

¹² Bátiz-Lazo and Thomas Haigh, 2012.

¹³ See also the case study on the travails to develop OLRT by Barclays documented in Ian Martin, 2012.

¹⁴ Bátiz-Lazo, 2009; Bátiz-Lazo and Robert J.K. Reid, 2008.

¹⁵ The human intervention as the key distinction between cash dispenser and automated teller machine (ATM) was first introduced in Bátiz-Lazo, 2009.

¹⁶ H. Oliver Horne, 1947.

¹⁷ See further Bátiz-Lazo and Mark Billings, 2012; R. Daniel Wadhvani, 2011.

¹⁸ Maixé-Altés, 2009.

¹⁹ Horne, 1947, p. 388.

²⁰ Guarantees to depositors introduced by Act of 1817 were reinstated in subsequent legislation enacted in 1833, 1863 and 1891. See further Horne, 1947, p. 72, Peter L. Payne, 1967.

²¹ Some of the branches came from converting the premises of ‘savings centers’ into actual branches, undertaken for the first time in Gloucester in 1948. See ‘National Savings Centers,’ *TSB Gazette* XVIII, no. 3 (July 1948), pp. 12-13.

²² ‘New Branches’, *TSB Gazette* XX, no. 2 (April 1950), pp. 1-5. At the end of 1949 there were still at least 30 urban districts and county boroughs with 40,000 or more inhabitants without a savings bank retail branch.

²³ ‘Opening of the 1500th Branch,’ *TSB Gazette* XXXIV, no. 4 (October 1964), pp. 159-160 and ‘New computer system for Belfast bank’, *The Irish Times*, September 9, 1970, p. 15.

²⁴ Lloyds Bank Group Archive (LBGA), London, ‘Branch and Staff Numbers’, circa 2009.

²⁵ H.R.Johnson. ‘The New Branch,’ *TSB Gazette* XIX, no. 3 (July 1948), pp. 7-10.

²⁶ Bátiz-Lazo and Del Angel, 2003, p. 355; Jack Revell, 1973, pp. 355-356.

²⁷ Committee of London Clearing Banks (CLCB), 1978, p. 56.

²⁸ There is also an unverified statement of 498 savings banks in 1928.

²⁹ Anders Sjölander, 2000.

³⁰ Anders Forsell, 2002.

³¹ See further Bátiz-Lazo and Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b; David L. Mason, 2004.

³² Note that membership of *Svenska sparbanksföreningen* was voluntary. See Forsell, 2002, p. 82.

³³ Torbjörn Hessling, 1990, pp. 68-69.

³⁴ 'Wages by cheque', *The Economist*, October 31, 1958, p. 444.

³⁵ Forsell, 2002, pp. 78-79, 89; Körberg, 2006, pp. 232-233.

³⁶ See further Bátiz-Lazo and Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b; Mason, 2004.

³⁷ Ingvar Körberg, 2006, p. 158. For example, Sven G. Svensson was appointed managing director of *Svenska sparbanksföreningen* in 1962.

³⁸ Forsell, 2002, pp. 78-79, 89; Hessling, 1990, p. 239.

³⁹ The number of Ordinary Department accounts in the British savings banks increased 16 percent from 8,635,637 in 1962 to 9,980,000 in 1967. Michael S. Moss and Iain Russell, 1994, p. 326.

⁴⁰ Körberg, 2006, pp. 210-212.

⁴¹ Moss and Russell, 1994, p. 327.

⁴² See also Thodenius et al., p. 2011.

⁴³ Körberg, 2006.

⁴⁴ See further Mason, 2004, pp. 192-194.

⁴⁵ Körberg, 2006, p. 203.

⁴⁶ Spadab, 1987.

⁴⁷ SCA, Spadab, 'Diverse,' May 6, 1965; CBI, Burroughs Corp, Ascension 90, Series 72, Box 10, 'Bankers Data Processing Inc.,' October 10, 1965; Sanders, 1963, p. 708.

⁴⁸ Bátiz-Lazo and Maixé-Altés, 2011a.

⁴⁹ Specifically: Manchester (6 banks); West Midlands-Kidderminster (6 banks); Bootle (near Liverpool, 8 banks); York (14 banks); Crawley in West Sussex (near Surrey, 5 banks); London (3 banks); Glasgow (4 banks); Belfast (one bank); and Falkirk (north of Edinburgh, one bank). See further Moss and Russell, 1994, 266.

⁵⁰ Bátiz-Lazo and Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b.

⁵¹ LBGA, 'Branch and Staff Numbers', circa 2009.

⁵² In 1970 only the savings bank in the Irish Republic using a computer was that of Cork and this was a bureau service based on an IBM 360/20. The other four savings banks in the Irish Republic were those of Dublin, Limerick, Monaghan and Watford. See Sinnott, 1970 and 'New computer system for Belfast bank', *The Irish Times*, September 9, 1970.

⁵³ CBI, Ascension 90, Series 72, Box 10, Folder 12, Item 20, 'Order for new financial system,' April 26, 1978. The exact part number was not disclosed in the press release. However, it was stated that the order was worth \$18 million to Burroughs and the machines were to be installed by TSB Computer Services.

⁵⁴ Harry Read (Director of TSB Computer Services, circa 1970-1988), interview by Bernardo Bátiz-Lazo, Milton Keynes, July 17, 2008; and Hayden Taylor (Computer Systems Controller and Director of the Computer Research and Development Unit, circa 1970-1988), interview by Bernardo Bátiz-Lazo, Milton Keynes, July 17, 2008.

⁵⁵ Clearing banks' internal labor markets also helped with internal recruiting and training of computer experts with banking knowledge. See among others Bátiz-Lazo et al., 2011; Alan E. Booth, 2004; Booth, 2007.

⁵⁵ Moss and Russell, 1994, p. 271.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Ibid. The computer at Wythenshawe was built in 1979.

⁵⁹ Read, interview

⁶⁰ Moss and Russell, 1994, p. 271.

⁶¹ Richard E. Sprague, 1977, p. 31.

⁶² See also Björn Thodenius et al., 2011.

⁶³ The Rausing Company later became the firm Restello, a company within the Tetra Pak group.

⁶⁴ Bátiz-Lazo and Reid, 2011, p. 4.

⁶⁵ Bátiz-Lazo, 2009, pp. 5 and 19.

⁶⁶ Metior was founded in December 1965 by Bevaknings AB Securitas and Vapor AB and its activities started two years later. Metior was originally based in Lund but moved to Malmö in 1967. The expertise in automated petrol distribution was also found amongst the first manufacturers of British cash dispensers (Bátiz-Lazo and Reid, 2011).

⁶⁷ Arfvidson, 2007. Vapor Securitas had introduced the first PIN code-based passage cards for gates – ‘Securicoll’ – in 1964. Metior applied the same technology on its petrol pumps and, later, on cash dispensers.

⁶⁸ Viggo Wentzel, 1996; Körberg, 2006, p. 348.

⁶⁹ Metior Archive. Körberg, 2006, p. 348.

⁷⁰ Elanders AB (EAB), Västerås, Sweden, Metior AB (MAB), Huvud- och dagböcker (HD) 1966-1971, (Series 1), Volume 8, December 20, 1966. Metior had also invited representatives from the police (Polistekniska rådgivningsbyrån) and a manufacturer of safes (most likely E A Rosengrens Kassaskåpsfabrik).

⁷¹ Arfvidson, 2007.

⁷² Ibid.

⁷³ EAB, MAB, HD, Vol 8, May 20, 1968.

⁷⁴ EAB, MAB, HD, Vol 10, February 1970. By 1971, Metior achieved a dominant position in Switzerland (where De La Rue had left the market), and was about to enter the French market in collaboration with Transac, a division of Compagnie Industrielle des Telecommunications (CIT). See further André Michaud, 2004.

⁷⁵ EAB, MAB, HD, Vol 15, 1971.

⁷⁶ 1,100 units of Bankomat IV were sold in France between 1969 and 1977. Of these 250 were manufactured in Sweden and the rest in France by Transac. See Michaud, 2004, p. 30.

⁷⁷ Bátiz-Lazo and Reid, 2008. Harper and Bátiz-Lazo, 2013.

⁷⁸ Arfvidson, 2007.

⁷⁹ EAB, MAB, HD, Vol. 9, January 24, 1969.

⁸⁰ Bátiz-Lazo and Reid, 2008; Bátiz-Lazo and Reid, 2011.

⁸¹ EAB, MAB, HD, Vol 10, 1970; EAB, MAB, HD, Vol 13, October 15, 1971; and EAB, MAB, PM Protokoll, Rapport, Vol 13, Sammanträde hos Bankföreningen, September 3, 1971 and Meddelande angående Metiors organization, 20 October, 1971. Metior had other problems that led to its takeover by Asea. For instance, in September 1971 technical problems resulted in the Swedish association of commercial banks questioning the benefits of further collaboration. As a rapidly expanding company Metior also

suffered from organizational problems. Its customers frequently complained about delayed correspondence. See also Arfvidson, 2007.

⁸² Ibid.

⁸³ The IBM machine was also connected to NCR series 4200 machines. These devices were connected via modem to an IBM 2701 data adapter. The class 4200 was an accounting machine and a cash register depending on the build of the device. It later became an electronic data input machine to output to punch tape and punch cards and then became an electronic calculating machine known as a Post-Tronic.

⁸⁴ Leif Arfvidson (previous head of R&D at Metior), email message to Bernardo Bátiz-Lazo, June 12, 2012.

⁸⁵ EAB, MAB, HD, Vol. 11, June 1970; EAB, MAB, HD, Vol. 15, 1971.

⁸⁶ Unless otherwise stated this paragraph borrows freely from Ekebrink, 1974, pp. 10-12.

⁸⁷ Arfvidson, 2007.

⁸⁸ Swedish patent number SE 401048, filed August 29, 1974, issued August 2, 1979; US patent number 4020972, filed August 21, 1975, issued May 3, 1977.

⁸⁹ Arfvidson, 2007. Lars Arfvidson (previous head of R&D at Metior), email message to Björn Thodenius on May 5, 2012.

⁹⁰ Thodenius, 2008.

⁹¹ Datasaab was at the start of their collaboration with Leif Lundblad and his Stockholm-based Inter Innovation Company. Lundblad had developed its own cash-dispensing mechanism to accommodate the differences between dollar notes and European currencies (Wentzel, 1996). The experience of Datasaab with the Docutel machines, combined with Lundblad's dispensing mechanism, led to the decision to develop a Datasaab ATM. However, before a working machine had been presented, Datasaab became a part of Ericsson Information Systems. A number of machines were produced and installed around the world.

⁹² Thodenius, 2008, p. 22.

⁹³ Arfvidson, 2007.

⁹⁴ 'News from the Banks: West Midland,' *TSB Gazette*. XXXIV, no. 4 (October 1964), p. 158.

⁹⁵ Bátiz-Lazo and Reid, 2008, pp. 2-3.

⁹⁶ Bátiz-Lazo, 2009, pp. 7-8.

⁹⁷ B. R. Johnson 'First steps in self-serving banking,' *TSB Gazette* XXXVII, no. 3 (July 1967), pp. 74-80.

⁹⁸ Sprague, 1977, p. 31.

⁹⁹ Unless otherwise stated the remainder of this section borrows freely from interviews with Read and Taylor interviews (see note 54). The selection of Chubb and ICL as providers of equipment followed Harold Wilson's and Tony Benn's "buy British" policy rather than technical specifications and preferences of the TSBs' computer staff. See further Billings and Booth, 2011.

¹⁰⁰ Moss and Russell, 1994, p. 282. As noted above, at this point the TSB in Manchester was running a Sperry mainframe as the ICL/English Electric machine had been decommissioned.

¹⁰¹ Ray Neal (director, TSB Computer Services and TSB Trust, 1959-1984), interview by Bernardo Bátiz-Lazo, Leicester, March 16, 2008.

¹⁰² This transaction brought the total value of equipment ordered or installed at the TSBs by Burroughs during the previous 12 months to \$34 million. CBI, Ascension 90, Series 72, Box 10, Folder 13, Item 9, 'Large UK order,' February 8, 1979.

¹⁰³ CBI, Ascension 90, Series 72, Box 10, Folder 6, Item 57, 'RT5000,' November 3, 1976.

¹⁰⁴ Bátiz-Lazo, 2009.

¹⁰⁵ Neal, interview.

¹⁰⁶ See further Bátiz-Lazo and Reid, 2008; Bátiz-Lazo and Reid, 2011.

¹⁰⁷ 'Contracts 500 Cash Dispensers for Bank,' *The Times*, September 10, 1969.

¹⁰⁸ Taylor, interview.

¹⁰⁹ Unless otherwise stated the remainder of this paragraph borrows freely from Sarah Whitmore (retail branch staff, TSB, circa 1973-1980), interview by Bernardo Bátiz-Lazo, Leicester, February 8, 2008; Michael D McQuade, (branch manager and group manager, TSB, 1964-2000), interview by Bernardo Bátiz-Lazo, Leicester, March 6, 2008; Janet Shipley (retail branch staff, TSB, 1969-2008), interview by Bernardo Bátiz-Lazo, Leicester, March

11, 2008. This machine was marketed as RT6500 to US banks from 1981 onwards.

¹¹⁰ On the travails of the clearing banks with computer technology see further Margaret Ackrill and Leslie Hannah, 2001; Booth, 2004; Martin, 2012; Booth, 2007.

¹¹¹ Neal and Taylor interview.

¹¹² As has been documented for Spain in Bátiz-Lazo and Maixé-Altés, 2011a; Bátiz-Lazo and Maixé-Altés, 2011b.

¹¹³ Sanders, 1963, pp. 708-709.

¹¹⁴ See for instance Edward P. M. Gardener et al., 1999.

¹¹⁵ Wilson, 2008.

¹¹⁶ Scott W. Frame and Lawrence J. White, 2009, p. 2.

WORKS CITED

Ackrill, Margaret and Leslie Hannah. *Barclays: The Business of Banking 1690-1996*. Cambridge: Cambridge University Press, 2001.

Anonymous. "National Savings Centers." *TSB Gazette* 18 (3 - July 1948): 12-13.

Anonymous. "New Branches." *TSB Gazette* 20 (2 - April 1950): 1-5.

Anonymous. "Opening of the 1500th Branch." *TSB Gazette* 34 (4 - October 1964): 159-60.

Anonymous. "New Computer System for Belfast Bank." *The Irish Times*, September 9, 1970, 15.

Anonymous. "Contracts 500 Cash Dispensers for Bank." *The Times*, September 10, 1969.

Anonymous. "Wages by Cheque." *The Economist*, October 31, 1958.

Anonymous. "News from the Banks: West Midland." *TSB Gazette*. 34 (4 - October 1964): 158.

Arfvidson, Lars. "Teknikhistoria: den första Bankomaten i världen," Tekniska Museet, 2007. Accessed January 28, 2013. <http://www.tekniskamuseet.se>

Bátiz-Lazo, Bernardo. "Emergence and Evolution of ATM Networks in the UK, 1967-2000." *Business History* 51 (2009): 1-27.

Bátiz-Lazo, Bernardo. "Strategic Alliances and Competitive Edge: Insights from Spanish and UK Banking Histories." *Business History* 46 (2004): 23-56.

Bátiz-Lazo, Bernardo and Mark Billings. "New Perspectives in the Business History of Not-for-Profit Financial Institutions: Form, Performance and Governance." *Business History* 54 (2012): 309-324.

Bátiz-Lazo, Bernardo and Gustavo Del Angel. "Competitive Collaboration and Market Contestability: Cases in Mexican and UK Banking (1945-75)." *Accounting, Business and Financial History* 13 (2003): 1-30.

Bátiz-Lazo, Bernardo and Thomas Haigh. "Engineering Change: The Appropriation of Computer Technology at Grupo Ica in Mexico (1965–1971)." *IEEE Annals of the History of Computing* 34 (2012): 3-16.

Bátiz-Lazo, Bernardo, Thomas Haigh and David Stearns. "How the Future Shaped the Past: The Case of the Cashless Society." *Enterprise and Society* 15 (2014): 103-131.

Bátiz-Lazo, Bernardo and J. Carles Maixé-Altés. "Managing Technological Change by Committee: The Computerization of Savings Banks in Spain and the UK (Circa 1960-1988)." *Revista de Historia Industrial* 47 (2011a): 117-150.

Bátiz-Lazo, Bernardo and J. Carles Maixé-Altés. “Organisational Change and the Computerisation of British and Spanish Savings Banks, Circa 1950-1985.” In *Technological Innovation in Retail Finance: International Historical Perspectives*, edited by Bátiz-Lazo, Bernardo, J. Carles Maixé-Altés and Paul Thomes, 137-154. London and New York: Routledge, 2011b.

Bátiz-Lazo, Bernardo, J. Carles Maixé-Altés and Paul Thomes (eds.). *Technological Innovation in Retail Finance: International Historical Perspectives*. London and New York: Routledge, 2011.

Bátiz-Lazo, Bernardo and Robert J. K. Reid. “Evidence from the Patent Record on the Development of Cash Dispensers and ATM Technology.” In *IEEE History of Telecommunications Conference* (Paris: 2008).

Bátiz-Lazo, Bernardo and Robert J. K. Reid. “The Development of Cash Dispensing Technology in the UK.” *IEEE Annals of the History of Computing* 33 (2011): 3-15.

Bátiz-Lazo, Bernardo and Peter Wardley. “Banking on Change: Information Systems and Technologies in UK High Street Banking, 1919-1969.” *Financial History Review* 14 (2007): 177-205.

Billings, Mark and Alan E. Booth. “Techno-Nationalism, the Post Office and the Creation of Britain's National Giro.” In *Technological Innovation in Retail Finance: International Historical Perspectives*, edited by Bernardo Bátiz-Lazo, J. Carles Maixé-Altés and Paul Thomes, 155-72. London: Routledge, 2011.

Booth, Alan E. “British Retail Banks, 1955-70: A Case of “Americanisation”?” In *Americanisation in Twentieth Century Europe: Business, Culture, Politics*, edited by Matthias Kipping and Nick Tiratsoo, 309-323. Lille: Université Charles de Gaulle, 2001.

Booth, Alan E. "Technical Change in Branch Banking at the Midland Bank, 1945-75." *Accounting, Business and Financial History* 14 (2004): 277-300.

Booth, Alan E. *The Management of Technical Change: Automation in the U.K. And U.S.A. Since 1950*. Basingstoke: Palgrave, 2007.

Campbell-Kelly, Martin. "Large-Scale Data Processing in the Prudential, 1850-1930." *Accounting, Business and Financial History* 2 (1992): 117-139.

CLCB. *Evidence of the London Clearing Bankers to the Committee to Review the Functioning of Financial Institutions (General Memorandum of Evidence to the Wilson Committee - November 1977)*. London: Committee of London Clearing Bankers, 1978.

Cortada, James W. *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1856-1956*. Princeton, NJ: Princeton University Press, 1993.

Edgerton, David. "From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology." *History and Technology* 16 (1999): 111-136.

Ekebrink, Ivan. "Cash Dispensing: A Joint Venture in Sweden." *Magazine of Bank Administration* (1974): 10-12 and 63.

Forsell, Anders. *Moderna tider i Sparbanken: Om organisatorisk omvandling i ett institutionellt perspektiv*. Stockholm: Nerenius & Santérus förlag, 2002.

Frame, W. Scott and Lawrence J. White. "Technological Change, Financial Innovation, and Diffusion in Banking." Atlanta, GA: Federal Reserve Bank of Atlanta, 2009.

Gardener, Edward P. M., Barry Howcroft, and Jonathan Williams. "The New Retail Banking Revolution." *The Service Industries Journal* 19 (1999): 83-100.

Grossman, Richard. *Unsettled Account: The Evolution of Banking in the Industrialized World since 1800*. Princeton, NJ: Princeton University Press, 2010.

Guerreiro Wilson, Robbie. “‘The Machine Should Fit the Work’: Organisation and Method and British Approaches to New Technology in Business.” *History and Technology* 24 (2008): 321-333.

Gustafsson, Katarina and Niklas Magnusson. “Stockholm Homeless Accept Credit Cards as Cash Is King No More.” *The Independent*, October 28, 2013.

Haigh, Thomas. “The Chromium-Plated Tabulator: Institutionalizing an Electronic Revolution, 1954-1958.” *IEEE Annals of the History of Computing* 23 (2001): 75-104.

Harper, Tom and Bernardo Bátiz-Lazo. *Cash Box: The Invention and Globalization of the ATM*. Louisville, KY: NetWorld Media Group, 2013.

Heide, Lars. “Punched Card and Computer Applications in Denmark 1911–1970.” *History and Technology* 11 (1994): 77-99.

Heide, Lars. “Punched Cards for Professional European Offices: Revisitign the Dynamics of Information Technology Diffusion from the United States to Europe, 1889-1918.” *History and Technology* 24 (2008): 307-320.

Heide, Lars. *Punched-Card Systems and the Early Information Explosion, 1880-1945*. Studies in Industry and Society. Baltimore, MD: The John Hopkins University Press, 2009.

Hessling, Torbjörn. *Att spara eller inte spara - vilken fråga! Den sparfrämjande verksamheten 1920-1970*. Stockholm: Sparfrämjandet, 1990.

Horne, H. Oliver. *A History of Savings Banks*. London: Oxford University Press, 1947.

Johnson, B. R. "First Steps in Self-Serving Banking." *TSB Gazette* 37 (3 - July 1967): 74-80.

Johnson, H.R. "The New Branch." *TSB Gazette* 19 (3 - July 1948): 7-10.

Körberg, Ingvar. *Förnyelsen: Sparbankernas historia 1945-1980*. Stockholm: Ekerlids förlag, 2006.

Lamoreaux, Naomi R., Daniel M. G. Raff, and Peter Temin. "Beyond Markets and Hierarchies: Towards a New Synthesis of American Business History." *American Historical Review* 108 (2003): 404-433.

Langlois, Richard N. "The Vanishing Hand: The Changing Dynamics of Industrial Capitalism." *Industrial and Corporate Change* 12 (2003): 351-385.

Maixé-Altés, J. Carles. "Enterprise and Philanthropy: The Dilemma of Scottish Savings Banks in the Late Nineteenth Century." *Accounting, Business & Financial History* 19 (2009): 39-59.

Martin, Ian. "Too Far Ahead of Its Time: Barclays, Burroughs and Real-Time Banking." *IEEE Annals of the History of Computing* 34 (2012): 2-16.

Mason, David L. *From Buildings and Loans to Bail-Outs: A History of the American Savings and Loan Industry, 1831-1995*. Cambridge: Cambridge University Press, 2004.

Michaud, André. "Contribution à L'Histoire De La Société Transac — 1970-1982." In *7e Colloque sur l'Histoire de l'Informatique et des Télécommunications*, edited by Jacques André and Pierre Mounier-Kuhn. Rennes-Cesson (France): INRIA/Université de Rennes, 2004.

Misa, Thomas J. "Understanding "How Computing Changed the World'." *IEEE Annals in the History of Computing* 29 (2007): 52.

Moss, Michael S. and Iain Russell. *An Invaluable Treasure: A History of the TSB*. London: Weidenfeld and Nicolson, 1994.

O'Brien, Donough. "Antony Cleaver." In *Who?: The Most Remarkable People You've Never Heard Of*, edited by Donough O'Brien, 92-93. London: Bene Factum Publishing, 2013.

Payne, Peter L. "The Savings Bank of Glasgow, 1836-1914." In *Studies in Scottish Business History*, edited by Peter L. Payne. London: Cass, 1967.

Revell, Jack. *The British Financial System*. London: Macmillan, 1973.

Sanders, M. "Telefile - a Case Study of an Online Savings Bank Application." *Communications of the ACM* 6 (1963): 708-712.

Scott, Susan V. and Markos Zachariadis. "Origins and Development of SWIFT, 1973-2009." *Business History* 54 (2012): 462-482.

Scott, Susan V. and Markos Zachariadis. *The Society for Worldwide Interbank Financial Telecommunication (SWIFT): Cooperative Governance for Network Innovation, Standards, and Community*. London: Routledge, 2013.

Sinnott, Brendan. "Savings Banks Introduce Cheque Account." in *The Irish Times* (Dublin: 1970).

Sjölander, Anders. *Att reglera eller inte reglera: En undersökning av sparbanksfrågan i riksdagen 1882-1939*. Uppsala Papers in Financial History No 13, Uppsala: Department of Economic History, 2000.

Spadab. *Från fjäderpenna till microchip: Den tekniska utvecklingen I Sparbankerna*. Stockholm: Sparfrämjandet, 1987.

Sprague, Richard E. "Electronic Funds Transfer in Europe: Their Relevance for the United States." *Savings Banks International* 3 (1977): 29-35.

Stearns, David L. *Electronic Value Exchange: Origins of the Visa Electronic Payment System*. London: Springer, 2011.

Thodenius, Björn. *Teknisk utveckling i bankerna fram till 1985: Transkript av ett vittnesseminarium vid Tekniska museet den 12 november 2007*. Stockholm: Avdelningen för teknik- och vetenskapshistoria, KTH, 2008.

Thodenius, Björn, Bernardo Bátiz-Lazo and Tobias Karlsson. "The History of the Swedish ATM – Sparfrämjandet and Metior." In *History of Nordic Computing 3: Third Ifip Wg 9.7 Conference, Hinc 3, Stockholm, Sweden, October 18-20, 2010, Revised Selected Papers*, edited by John Impagliazzo, Per Lundin and Benkt Wangler, 92-100. Berlin & Heidelberg: Springer, 2011.

Wadhvani, R. Daniel. "Organizational Form and Industry Emergence: Mutual and Nonprofit Firms in the Development of the US Personal Finance Industry." *Business History* 53 (2011): 1152-1177.

Wentzel, Viggo. "Pengar på Mintuten." In *Tema Bank : Datasaab och bankerna*, edited by Hallberg, T. J. and B. Knutsson. Linköping: Datasaaabs vänner, 1996.

Wootton, Charles W. and Barbara E. Kemmerer. "The Emergence of Mechanical Accounting in the US, 1880-1930." *The Accounting Historians Journal* 34 (2007): 91-124.

Yates, JoAnne. "How Business Enterprises Use Technology: Extending the Demand-Side Turn." *Enterprise & Society* 7 (2006): 422-455.