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Towards Improving Efficiency in Banking Sector using Information Technology

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Abstract

The aim of this paper is to examine the causes and impacts of IT Investment on the financial performance of bank system. The analysis considers cost and profit efficiency in bank sector, using various econometric techniques such as the frontier approach, panel least squares. This paper summarizes the main findings of the research, discusses some of the implications, outlines the major limitations that could undermine the results, and identifies areas of future research.

Keywords: Banking System, Banking Sector, IT Bank System.

I. Information Technology

Since the end of the twentieth century and the beginning of this century the world has witnessed large-scale changes and improvements as a result of the tremendous advances in the field of Information Technology (IT). This is reflected in all aspects and activities of bank Sector, and has created a competitive environment that makes it difficult for banking institutions to maintain their viability and increase their market share.

Information Technology occupies an important place in the function of many businesses, thanks to this technology and the emergence of global communication networks, which have made the world more open and less isolated from each other. It has also increased competition beyond national borders. The emergence of globalization, coupled with significant changes such as the liberalization of trade and investment, the development of open markets, the establishment of major economic and political blocs, an increase in customer awareness, the demand for different products and services, has directed banks toward a broad base of retail customers, an area that is rich in opportunities for profitability once the necessary infrastructure of hardware and software is in place. The wheel of progress in this area will continue to turn, to achieve integration in banks' relationship with their customers (Alhawary, 2004).

II. The Concept of Technology and Information Technology

Technology is the knowledge and application of products and processes, methods, tools, and systems that create or produce goods and services. In practice it is the application of knowledge and capabilities that help humans (Khalil, 2000). Technology in general is composed of three parts, connected and correlated: Technology comprises: (1) Machines which are used in the implementation of the required tasks; (2) Software, or the knowledge of how to use devices for carrying out required tasks; and (3) The human mind, reason, that justifies the use of technology in a special way (know-how) (Khalil, 2000).

Technology can be followed in the three directions. The first is scientific knowledge: harnessing knowledge of human organisation and mental creative potential to provide a required operation and applications: an example is the human creative thinking that makes complex information storage and processing possible and makes retrieval appropriate and convenient. The second is discoveries and inventions: appliances and tools resulting from the application of scientific knowledge: for example, the invention of computers and the development of different applications by adapting and experimenting. The third is scientific application: obtaining results through the practical applications of appliances and tools: for instance, for the purpose of developing and improving performance in various types of computer applications. Figure 1 provides a sequential visualisation of the concept of technology.

Senn (2000) defines Information Technology as "the technology that represents a wide range of capabilities and components of various elements used in the storage, processing and distribution of information, in addition to its role in the creation of knowledge". On the other hand, Known (Lucas,) defines Information Technology on the

basis of the narrow definition as that part of the material of the devices, peripherals and local area networks and wide and global and intangible as programs of operations and administrative affairs, financial and various databases which is form the vessel's main structure of the organization.

Turban et al. (1996) define Information Technology as: "the technological aspect in information systems, which include the hardware databases, software, networks and other devices", while Carter and Sinclair (1997) define Information Technology as "the use of modern technology, which contributes in the process of data collection, retrieval and re-transmission to the concerned entities on the suitable time and shape". Carter and Sinclair (1997) defines Information Technology as "the equipment, software, networks, data bases and the technology of processing other information", and Martin and Brown (1999) define Information Technology as "the computer technology (hardware and software) that process and store information technology that is necessary to transmit information". UNESCO defines Information Technology as "the set of scientific knowledge, technology engineering and administrative methods used in handling, processing and applying informatio Information Technology n".

Other definitions include Guendhilji's (2005) perception of Information Technology as a wide range of capabilities and components and the various elements in the storage and data processing, retrieval and distribution of information, as well as the role of securing required knowledge, which is a blending of accounting systems, communication networks, and technological knowledge. Similarly, Laudon and Laudon (2006) define Information Technology as "all information systems and techniques that are applied in the PC and used by the organizations".

The previous definitions agree that IT relies mainly on computer technology, software, databases and networks. These applications are represented in various stages (as shown in figure 1): gathering, organization, and processing, storing and re-transmitting data.

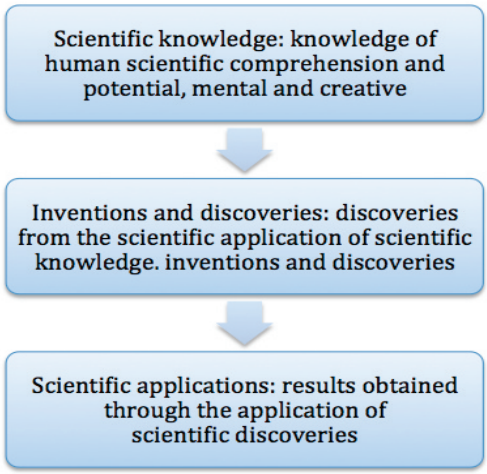

Fig. 1. Sequential and coherent vision of the concept of technology. Source Guendhilji (2002).

Accordingly, the researcher would define IT as "The technology that is necessary to gather, classify, analyze and re-transmit data to provide valuable output for the end-user, on the suitable time and place in order to improve performance".

A.Investment in Information Technology

IT has always been of great interest to scholars and researchers evaluating its effect on improving the performance of organizations, such as by the analysis of benefits that can be achieved from investment in IT. Organizations bear heavy costs to establish IT. Bharadwaje and Konsynski (1990) state that the amount invested in IT, communication and software in US companies in 2005 amounted to $1.8 trillion USD. This shows companies' strong interest in investing in various fields of IT.

In addition, investment in IT increased compared with the total investment in business: 1:3 in USA in 2005. Table 1 shows the size of investment in IT in USA during 2010. The total amount spent on IT was over 800 billion USD, with the highest portion spent on consultation services, at 180 billion USD (0.22) of total expenditure, followed by software (165 billion USD, representing 0.20). The least spending was for the internet (32 billion USD, representing 0.40) of general spending for IT components, followed by management of databases (70 billion USD).

These considerable amounts show the importance of investment on IT. The study conducted by Weill (1991) supports this claim, based on the collection of data on spending on IT in the valve industry in USA in six consecutive years. Bharadwaje and Konsynski (1990) agree that the infrastructure of IT (the size of investment in hardware, networks, databases and software) is decided by the size of annual spending to purchase tools, updates and continuous development to make IT more efficient.

TABLE I. AMOUNTS SPENT ON IT IN USA IN 2010

IT Components	*Amount/ million USA*	*Percentage %*
Computer Maintinance	109	13
Processing systems	100	12
Corporate Software applications	165	20
Management of databases	70	9
Networks and communication	155	19
Internet	32	4
Consultation services	180	22
Total	811	100

Financial spending to build IT is one of the consultation decisions that require study and analysis to choose a suitable project, since such decisions may bring with them various risks given the high cost of investing in IT. Decisions include determining the capacity of the system, strategic issues such as building systems that support the business plan, the architecture of IT, the methods used in processing, and access to external support (2002). Laudon and Laudon (2006) define the cost of IT investment as the sum of a number of items such as hardware, software, installation, training, support and maintenance. There is no ideal method to decide on a system and necessary capacity, but the process of benefit analysis and costing the project help.

It is necessary to express benefits and costs to make a comparison, taking into account that most benefits achieved from IT are intangible ones; nevertheless, it is vital to express them in a financial way to enable comparing them with financial costs. There are other the risks that accompany investment in IT (Alter, 2002), such as not achieving the expected benefits, terminating the project later than planned after much expenditure, lack of technical performance, and low acceptance by the user.

B. Investment Requirements in Information Technology

Brynjolfsson and Hitt (1998) state that achieving positive results in IT investment require a number of conditions: long-term investments to make the organizational change; preparing all requirements to make the most possible use of IT; and creating new job opportunities. The outputs of IT are represented by the emergence of new fields for development, such as new software for intelligent systems, industrial/ artificial intelligence, databases, internet and laptops.

Due to the variety of IT applications in various sectors and organizations, there is a need to classify its various tools to enable efficient dealing in accordance with the type of the function required. In this regard, Khazanchi (2005) notes the factors that should be considered when adopting and applying IT suitable for an organization: the internal and external environment of the organization, the effect of financial factors, and productivity. Thatcher and Pingery (2004) indicate that both the structure of the market and costs play an important role in deciding the relationship between investment in IT and the economic measure.

Finally, Edwards (2002) shows that the success of investment in IT requires complementary factors, including research and development, education and adequate infrastructure.

C. Uses of Information Technology

Edwards (2002) defines the uses of Information Technology in three fields:

Availability of the necessary information: IT organizations use information mainly in order to support tasks from the calculation of salaries to the design of verbal presentation models to the construction of websites where clients can orders or ask for the services they desire to purchase.

Enhance creation: IT helps to increase the ability of an organization to find creative ways to implement work

electronically. For example, FedEx created a parcel delivery program where clients can ask – electronically – for the services of the company, follow their consignments during shipment, and learn when they will be received. It has provided the company with the ability to use computers and apply a new type of task to improve their operations.

Save time and space: Information Technology is a tool that eliminates time and space limitations. CD-ROM can store large quantities of information. In addition, there are new generations of storage tools such as flash memories and others, which can store as much as or more than the capacity of a PC. An organization can use different tools (IF) to overcome time limitations, including high transfer speed; a PC can implement 200 million instructions in just one second.

With such advances, investment in Information Technology has become important for both public and private organization, and studies confirm the importance of spending to create and establish IT because of the benefits achieved for companies and the economy in general. To increase the benefits of IT, an organization should consider the factors related with in investment, in order to own the suitable IT.

This paper defines IT resources as (a) IT infrastructure, (b) IT human resources, (c) IT technological knowledge, and (d) customer relationship.

1) Information Technology Infrastructure

Information Technology infrastructure in today's large organizations use ever more advanced hardware, software, and applications to provide data and information through networks and access for organizational use. Earl and Kuan (1994) identify eight core IT infrastructure capabilities:

Reliable electronic communication, information sharing, and data transfer capabilities.

Reliable and available data processing systems.

Effective systems interoperability.

Effective systems performance.

Effective user relationship management.

Available support services, training, and consultation on technology use.

Available support services and consulting for data management.

Available support services, advice, and consulting for new technology.

Existing IT applications and platforms may not keep up with a rapidly changing environment, so upgrading the infrastructure may be the key to improving an organization's effectiveness.

Organizations are increasingly recognizing the importance of an effective IT infrastructure (Byrd & Turner, 2000). The effectiveness of infrastructure can be evaluated using criteria such as reliability, flexibility, and upgradeability. Kayworth et al. (2001) conclude that "a firm with high infrastructure flexibility could make rapid changes to information systems in support of changing business needs while firms with low flexibility infrastructures will be unable to imitate the IT innovations of its competitors." IT infrastructure can link entire organizations, suppliers, and customers.

2) Information Technology Human Resources

Superior firm performance depends on a firm's ability to effectively utilize its resources. Human resources include training, education, judgment, intelligence, relationships, creativity, and insights of individuals, all of which help to sustain a competitive advantage (Barney, 1991). Firms must have more efficient and effective human resources to implement new strategies to achieve high performance. Keen (1991) argues that "IT successes generally reflect an effective relationship between business managers and information services managers and their staffs". Bharadwaj (2000) states that human IT resources include technical and managerial skills in planning and developing reliable and cost-effective IT applications for a long-term competitive advantage. It may take years for a firm to build its technical and management IT skills while it continues to keep up with technological changes and new systems.

Skills and experience enable firms to coordinate activities and make use of their resources. Different firms may have differential technical IT skills and experiences that enable them to manage their IT investment risk better. According to Wernerfelt (1984), a firm's experience improves the quality of products and services and lowers its

costs. Limited skills and experience within an organisation will typically limit responses to rapid environmental change (Couger et al., 1995; Lee et al., 1995). In a study by Barney (1991), of analysts' forecasts, it was clear that as an analyst's experience increases, his or her forecasting errors decrease.

As it works in a rapidly changing environment, a firm must continually upgrade its technological ability to adapt to changes and explore new opportunities (Prahalad & Hamel, 1990). According to Barney (1991), IT training which emphasises a firm-specific IT can produce embedded skills that benefit organisation capabilities. According to Mata et al. (1995), IT managerial skills enable firms to control the risks of IT investment. They suggest that these skills depend on the ability of IT managers to work with other functional managers, suppliers, and customers; the skills are often developed through the accumulation of experience: by trial and error. They describe these skills as the ability to understand business needs, to co-ordinate IT activities, and to anticipate future needs.

3) Information Technology Technological Knowledge

Technical knowledge refers to the know-how needed to build and use IT applications, including, for example, knowledge of computer languages, computer programming, operating systems, communication protocols, and products (Mata et al., 1995). Firms with superior knowledge are able to coordinate their resources and capabilities to sustain their advantage (Grant, 1996).

Mata et al. (1995) demonstrate that managers must have up-to-date technical and management knowledge to coordinate their resources if they are to properly implement IT. Such knowledge enhances a firm's ability to discover and exploit new opportunities (Cohen & Levinthal, 1990).

4) Customer Relationships

The internet provides constant access between activities, to suppliers and customers, and enables firms to provide detailed specifications of products and services to global customers. Bitner's (2000) study of contemporary customers' interactions with technological interfaces finds that technology allows firms to know more about their customers and to attract customers in highly customized, unique ways, such as sending personally relevant information to customers or providing rewards that would be highly valued by a particular customer. Responding to customers' needs is perhaps the most important strategy for creating superior customer loyalty. Customers have so many choices available to them that they can be more demanding than before, and firms need to have the ability to track and predict changes in customer preferences, and provide timely responsiveness (Narver & Slater, 1990).

The term (infrastructure) of Information Technology, in its classical definition, refers to the networks that specifically provide fixed telephones, which fulfil the major need to communicate across remote distances (ESCWA, 2003). However, in the new millennium, the surprising development in the latest types of technology has enriched and deepened the term and provided it with new, unimagined dimensions. The infrastructure) of IT no longer includes a fixed phone network, but instead relies on a large variety of equipment and facilities on which the provision of its services depend (e.g. telephone and internet); and these have become a necessary prerequisite in dealing with and participating in an information-hungry society.

Thompson and Cats (2003) define the infrastructure of Information Technology as "a set of PCs, networks, applications and software to process and distribute information".

Laudon and Laudon (2006) define the infrastructure of Information Technology as "the common technological resources that provide the platform for the application of IT at a company". The researchers state that the infrastructure of IT includes investment in hardware, software, and services such as consultation, education and training. Turban et al. (1996) define the infrastructure of IT as consisting of hardware, software, databases, networks, and other devices. This is consistent with the perception of Martin et al. (1999) and O'Brien (1999). Laudon and Laudon (2006) clarify this by listing the infrastructure of IT as hardware, operation systems, software, networks, communications, consultants, data management, storing and internet.

III. Frontier Efficiency Analysis in the Banking Sector

Banks are increasingly using benchmarking technologies to identify operations needing improvement, by comparing their performance with other banks in the industry. Accounting-based ratios are a traditional tool to measure efficiency (De Young, 1997). An important class of benchmarking methods used in the banking market

is frontier efficiency analysis. DeYoung (1997) argues that frontier efficiency analysis is superior to accounting-based efficiency analysis because with frontier efficiency analysis there is no need to construct peer groups of banks with similar characteristics. Rather, it uses linear programming and statistical techniques to remove the effects of differences in input prices and other exogenous market factors affecting standard performance ratios (e.g. return on assets [ROA], return on equity [ROE]) so that a better estimate of the underlying performance of managers may be obtained. Bauer et al. (1998) point out that frontier efficiency analysis is more useful for regulatory, financial institution managers and industry consultants to assess banks' performance. It may be used in a number of ways to help a bank evaluate whether it is performing better or worse than its peer group in technology, scale, cost minimization, and profit maximization; management efforts can then be directed to the area's most needing improvement.

Similarly, Cummins and Weiss (1998) point out those frontier efficiency methods are useful in many situations. Firstly, frontier analysis provides guidance to regulators and policy makers regarding policies adopted, and the effect of adoption on bank performance. Second, frontier analysis informs management about the effects of policies, procedures, strategies and technologies adopted by the firm in relation to efficiency (performance). Third, they are important in testing some economic hypotheses in regard to both agency and transaction costs. Through such measurement, economists can predict whether the ownership structure of firms influences their economic behaviour. In particular, the measurement of efficiency can attempt to evaluate whether cost and profit inefficiencies are related to ownership structures (Altunbas et al., 2001). Finally, frontier analysis is useful to compare banks' performance (efficiency) across different countries. For example, in the case of bank efficiency, Berg et al. (1993) compare the relative efficiency of Nordic banks.

The parametric approach is an econometric technique used in many studies to estimate a bank's (firm's) cost and profit efficiency. It requires the selection of economic concepts (i.e. profit function or cost function), a pre-specified functional form for the relationship between inputs and an output (e.g. translog functional form), and a distribution assumption for the error term of the estimated frontier (Bauer et al., 1998). The parametric approach consists of deterministic and stochastic frontiers. This study uses Stochastic Frontier Approaches (SFA), which allow for a composite error term consisting of an inefficiency component and random error (random shocks outside the control of the producer) (Berger & Humphrey, 1997).

A. Bank Inputs and Outputs

When measuring efficiency by using frontier approaches, one first needs to specify inputs (Xi) and outputs (Yi) of the banks under consideration. This section outlines the choice of bank inputs and outputs typically used in the bank efficiency literature. Defining the outputs of a banking firm has been a challenging task for researchers. Unlike manufacturing firms, banks' outputs cannot be measured by physical quantities, as a bank is engaged in the intermediation of services between lenders and depositors. Banks provide a wide array of services such as low risk assets, credit and payment services, and investment portfolio management (Molyneux et al., 1996). In addition, banks are multi-product institutions; many of their services are jointly or independently produced (e.g. they offer different kinds of loans or investments). The precise definition of what banks produce and how their products should be measured has been the subject of much debate (Goddard et al., 2001); however, two main approaches used by researchers to identify banks' outputs and inputs are the production approach and the intermediation approach.

B. Efficiency in the Banking Sector

Early studies of the banking sector concentrated on scale and scope efficiencies (Berger et al., 1993). They summarized the previous results of scale economy studies in the banking industry and found that average cost had a relatively flat U-shape. Medium-sized banks with assets were more cost-scale efficient than small and big banks. These studies attempted to analyze the presence of scale economies (i.e. working at the minimum efficient scale) rather than cost/profit efficiency, and assumed that banks always operate on their minimum cost frontier, which means that frontier inefficiencies (e.g. cost inefficiency) do not exist (Sheldon, 1999; Drake 2003). Berger and Humphrey (1991) invalidate this assumption in their study of a sample of US banks, finding that frontier inefficiencies not only existed but were of more importance than the study of scale and scope economies. Berger et al. (1993) indicate that cost inefficiencies in banking account for approximately twenty per cent or more of banking costs, whilst scale efficiencies (when they can be accurately estimated) are usually found to account for less than five per cent of costs. Since the early 1990s, the analysis of efficiency within the banking sector has concentrated on cost and profit efficiency.

IV. CONCLUSION

In this paper we have conducted a research for the use of IT to manage resources, technical expertise, and capital, in enhancing performance. The results indicate that IT levels strongly affect bank performance at four levels: IT infrastructure, IT human resources, IT technical knowledge, and customer relationships. We look at the banking sector in isolation from the rest of the economy and examine whether IT investment in the banking sector is socially desirable.

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