FACTORS AFFECTING THE ADOPTION OF TECHNOLOGICAL INNOVATION BY COMMERCIAL BANKS IN KENYA

BY

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DECLARATION

This research thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

To my father Prof. Sammy Shimenga Kubasu on whom I draw inspiration to scale greater heights.

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DEFINITION OF OPERATIONAL TERMS

Adverse selection	Possibility that though a banker may follow prudent lending
Bank	Financial institution that deals with taking deposits and issuing loans as its major business
Corporate banking	Serving corporations by fulfilling their banking needs
Diffusion	Process through which an innovation is communicated through a certain channel over time among members of a system
Disinter mediation	Entry of other institutions in banking business of taking and issuing loans
Financial institutions	Firms that deal in financial products; banks, insurance firms, building societies among others.
Moral hazards	Possibility that once a credit has been extended to a borrower the banker is not certain of its recovery.
Point of Sale (PoS)	Enable electronic transfer of money at points of operation/sale
Retail banking	Serving households by fulfilling their banking needs
Technology	The translation of scientific laws into mechanisms, innovations, procedures and techniques to accomplish tangible results or manipulate the environment for practical purposes.
Technological innovation	bundle /package of different technological elements such as improved varieties of products and services
Virtual bank	Bank that has no physical location but rather exists in cyber space

ABBREVIATIONS AND ACRONYMS

ACH	Automated Clearing House
ASCA	Accumulating Savings and Credit Associations
ATM	Automated Teller Machine
BCS	Bureau for Central Statistics
BIS	Bank for International Settlements
CASE	Computer Aided Software Engineering
CBK	Central Bank of Kenya
CD	Certificate of Deposit
EDI	Electronic Data Interchange
EFT	Electronic Funds Transfer
GDP	Gross Domestic Product
IB	Internet Banking
IMF	International Monetary Fund
ICT	Information Communication Technology
IS	Information System
LAN	Local Area Network
MFI	Microfinance Institutions
M& M	Modigliani and Miller
PTRM	Perceived Technology Readiness Model
NOW	Negotiable Order of Withdrawal
ROSCA	Rotating Savings and Credit Associations
SACCO	Savings and Credit Cooperative Societies
SME	Small Micro Enterprises
SMS	Short Messaging Service
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TB	Treasury Bill
UK	United Kingdom
USA	United States of America
WAN	Wide Area Network

ABSTRACT

This thesis focused on factors affecting diffusion and impact of internet banking. It was based on the theory that when a cost-saving innovation, such as internet banking, is initially introduced, large banks have an advantage to adopt it first and enjoy further growth in size. Over time, due to environmental changes (demand change, technology progress and banking deregulation); the innovation diffuses into smaller banks. As a result, the aggregate bank size distribution increases stochastically towards a new steady state, and there exists important interactions between the IB adoption and the average bank size. In 2006, 96 percent of banks with assets over Kshs 24 billion had a website, compared to only 51 percent with assets under Kshs 8 billion. These observations raise an important question: what explains these variations in adoption of IB. To answer the research questions, an empirical study of banks adopting technological innovation was conducted. The study applied a descriptive survey design. A structured questionnaire was administered to all financial managers in all 46 commercial banks with a response rate of 70%. The SPSS was used to run simultaneous-equation regressions on data. Factors driving adoption of IB include increase average bank assets, non adopters imitating early adopters and loan specialisation in consumer lending. Factors hindering IB adoption include competition among banks and average age of a bank. The study recommends to enhance IB adoption, banks should; strive to increase their average assets size, non adaptors to carefully study early adaptors, specialize in consumer lending, feed off competition by forming strategic alliances finally it's cheaper and convenient for new banks to install internet banking technology in a package with other computer facilities compared to old banks. The study is important because banks have been blamed for not adequately satisfying demand for financial services. The research contributes to the debate on how to enhance access to financial services in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Banking technology is generally a bundle or package of different technological elements such as improved varieties of products and services (processes). Banking technology consists of the two components; a hardware aspect, consisting of the tool that embodies the technology as a material or physical object such as machines; and software aspects, consisting of the information base for the tool such as technical knowledge and skills about how to use the hardware aspect of technology (Rogers, 1995).

Advances in information and communication technologies and the emergence of the internet have revolutionized business activities enabling new ways of conducting business referred to as electronic commerce (Zwass, 2003; Turban et al., 2004). Electronic commerce innovation in banks describes the process of buying, selling, transferring, or exchanging products, services, and/or information especially through computer, (the internet) networks (Turban et al., 2004). Integrated banking technology can be defined as "that innovation that enables the sharing of business information, maintaining of business relationships, and conducting of business transactions by means of telecommunications networks" (Zwass, 2003).

Technological innovation activities include the inter-organizational processes of market-based sell-buy relationships and collaboration (and consumer-oriented activities (business-to-consumer and consumer-to-consumer), as well as the intra-organizational

processes that support them (Zwass, 2003). Adoption of internet technologies as a way of doing business has significant advantages. Organizations are embracing e-commerce as a means of expanding markets, improving customer service, reducing costs, and enhancing productivity (Wenninger, 1999). Efficiencies are experienced in marketing and advertising; new technologies make disintermediation possible, eliminating the middleman (Turban et al., 2004). Other efficiencies include reduced inventory and round the clock access at no additional cost. Superior banking technologies enable higher customization (Choi & Whinston, 2000) allowing organizations to improve customer service. A vital benefit of an integrated banking technology is access to global markets which enables businesses to expand their reach. For instance, the internet allows for unconstrained awareness, visibility and opportunity for an organization to promote its products and services (Senn, 2000).

Technological innovation involves an improvement to something already existing. In the 20th century, innovations in semiconductor technology increased the performance and decreased the cost of electronic materials and devices by a factor of a million, an achievement unparalleled in the history of any technology (Rogers, 1981). The advances in information telecommunication technologies (IT) in the past 25 years have had a profound impact on the nature of banking and the way banks and other financial institutions are organized (Rishi & Sweta, 2004).

Technology transfer is the process, by which a body of knowledge from research is tested, reviewed, and evaluated at various stages in terms of practical usage. Technology

includes process innovations that are put in place to apply technology within the workplace, and resulting innovation in business strategy and financial products. Technology encompasses a wide range of phenomena. It is the translation of scientific laws into machines, tools, mechanical devices, instruments, innovation, procedures and techniques to accomplish tangible ends, attain specific needs, or manipulate the environment for practical purposes (Theodorson, 1969).

Technological efficiency can result in lower transaction costs and increased revenue for banks. For instance, technology can allow banks to cross-market new and existing products to customers. Technology can also generate a high rate of innovation in new financial products. Further, as Mushkin and Strahan (1999) note, information technology can make it easier for banks 'to screen out good from bad credit risks or to monitor corporations, thus reducing adverse selection and moral hazard problems that would otherwise impede the efficiency of financial markets. The inefficiencies occurring as a result of adverse selection and moral hazard can adversely affect the banks' balance sheet (through increase in non-performing loans) and make them vulnerable to external shocks. Such vulnerabilities could translate into full- blown banking crises in emerging markets (Kaminsky & Reinhart, 1999). From an accounting standpoint, technology can speed up the financial reporting process and timeliness with which banks make public disclosures via regulatory reports. Better quality public disclosures can translate into an overall improvement of the financial transparency. Such disclosures can also provide useful and accurate data to bank supervisors which in turn could enhance the oversight of banks. Finally, the use of technology can enhance systems administrative controls and better risk

management.

Roger (1995) defines innovation as an idea, practice, or object that is perceived as new by an individual or other unit of adoption. Diffusion is the process by which an innovation is communicated through certain channel over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. This newness of the idea in the message content gives diffusion its special character. The newness means that some degree of uncertainty is involved in diffusion. Uncertainty is the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives. Uncertainty implies a lack of predictability, of structure, of information. In fact, information is a means of reducing uncertainty. Information is a difference in matter-energy that affects uncertainty in a situation where a choice exists among a set of alternatives (Roger & Kincaid, 1981). Diffusion is a kind of a social change, defined as the process by which alteration occurs in the structure and function of social system. When new ideas are invented, diffused, and adopted or rejected, this leads to certain consequences and social change occurs.

A study of the technologies progress in the banking sector is important because banks play an important role in providing, financing and mobilising savings, especially in emerging markets as compared to mature markets (Rishi & Sweta, 2004). To be efficient and increase outreach, banks should adopt new ways of doing business. Innovation is

widely proclaimed as being of vital importance to achieve and maintain competitive advantage. At the same time, successfully internalising new technology is seen as essential for maintaining competitive position and adapting to changes in the external environment.

Although there are advances in information telecommunication technologies not all countries have benefited from these. There is a big gap in internet and other technologies adoption between the developed and developing countries (Licker & Motts, 2000); thus creating a digital divide. Digital divide is defined as the 'differential capabilities of entire social (or region) groups to access and utilize electronic forms of knowledge' (Sraub, 2000), segregating the 'haves and have-nots' in the information society.

Mbarika et al., (2005), state that much of the discussion on digital divides has focused on that which occurs among different social groups; they note the existence of international digital divide between countries. According to them, this digital divide is abundantly clear when comparing Sub-Saharan Africa with countries of the west like US or UK. The main obstacles that prevent developing countries from leveraging the technology are lack of adequate communication infrastructure, technical know-how, and information processing about the economy and environment. The lack of adequate banking infrastructure is also considered as one of the problems faced by developing countries in building technological innovation solutions (Khalfan & Akbar, 2006).

1.2 Statement of the Problem

In the Kenya, the internet era in the banking industry started in 2004 when Barclays Bank of Kenya Limited allowed its customers to access account balances online as the first internet-only bank (BBK, 2004). Ever since then, banks have steadily increased their presence on the web. A major driving force of adopting IB is the potential for productivity gains that it offers. On one hand, the internet has made it much easier for banks to reach and serve their consumers, even over long distances. On the other hand, it provides cost savings for banks to conduct standardized, low value- added transactions (e.g. bill payments, balance inquiries, account transfer) through the online channel, while focus their resources into specialized, high-value added transactions (e.g. small business lending, personal trust services, investment banking) through branches.

According to financial access study done in 2007, 35 percent of depository institutions reported a website address in 2002, rising to 75 percent in 2004. Moreover, 53 percent of depository institutions reported websites with transactions capability in 2005, rising to 62 percent in 2006. However, the adoption of IB varies significantly across commercial banks. Banks with large size tend to adopt IB earlier. In 2006, 96 percent of banks with assets over Kshs 24 billion reported that they had a website, compared to only 51 percent of banks with assets under Kshs 8 billion. These observations raise an important question: what explains these variations of diffusion rates across banking groups?

Meanwhile, the diffusion of IB has takes place in a continuously changing environment of Kenyan banking industry. Over the past decade, several reforms of Kenyan banking

regulatory framework have been introduced and are expected to affect the size distribution of banks. The CBK has allowed banks and bank-holding companies to freely establish branches across boundaries lines. This flexibility in branching regulation has opened the door to the possibility of substantial geographical consolidation in the banking industry. As a result, there has been a strong trend towards higher average bank size. This suggests further interesting questions: if bank size is an important factor in the adoption of IB, then how much has banking deregulation affected IB adoption? At the same time, how much, if any, has adoption of IB influenced the increase of average bank size?

Motivated by the aforementioned observations and questions, this research tries to provide a general framework to study, theoretically and empirically, the endogenous diffusion of internet banking. The theory suggests that when a cost-saving technological innovation, e.g. IB, is initially introduced, large banks have an advantage to adopt it first and enjoy further growth of size. Over time, due to environmental changes (demand change, technological progress and industry deregulation), the innovation gradually diffuses into smaller banks. As a result, the aggregate bank size distribution increases stochastically towards a new steady state, and there are important interactions between the IB adoption and growth of average bank size. Applying the theory to a panel study of internet banking diffusion across 46 banks in Kenya, this study examines the technological, economic and institutional factors governing the process.

Several studies have looked at internet and related technology diffusion in industries. Courchane, Nickerson and Sullivan (2002) developed and estimated a model for IB

adoption at the early stages when there is considerable uncertainty about consumers' demand. They find that relative bank size and demographic information predictive of future demand positively influence IB adoption. Furst, Lang, and Nolle (2000) estimate a logit model for the determinants of IB adoption in a sample of banks. They find that larger banks are more likely to adopt IB as well as banks that are younger, better performing, located in urban areas, and members of a bank holding company. Some other studies analyze the reverse effect of technology on bank performance but obtain mixed results. Sullivan (2000) studies performance characteristics, including costs and profitability, of early adopters of IB and finds little difference from non-adopters. Berger and Mester (2003) posit that banks enjoyed rising profits during the 1990s, and attribute this to banks' increasing market power gained by adopting new technologies. However, few of the existing studies have explicitly considered the endogenous interactions between technology adoption and bank performance measures. Using the theory to construct a simultaneous-equation estimation that applies to a dataset of IB diffusion across 46 commercial banks in Kenya, the empirical results were able to identify factors that cause variations in IB adoption across commercial banks in Kenya.

1.3 Objective of the Study

The main objective of the study was to describe factors that affect adoption of internet banking across commercial banks in Kenya. The specific objectives were:

i. To find out the effect of average assets size on the adoption of internet banking.
ii. To find out the influence of early adopters on non adopters to adopt internet banking.

iii. To find out the influence of competition among banks on the adoption of internet banking

iv. To find out the effect of average age of a bank on the adoption of internet banking.

v. To find out if bank loan specialisation has an impact on internet adoption.

1.4 Research Questions

i. What is the effect of average assets size on the adoption of internet banking?

ii. What is the influence of early adopters on non adopters to adopt internet banking?

iii. What is the influence of competition among banks on the adoption of internet banking?

iv. What is the effect of average age of a bank on the adoption of internet banking?

v. What is the impact of bank customer base and loan specialisation on internet adoption?

1.5 Significance of the Study

This study identifies and describes factors affecting adoption of internet technologies in commercial banks. Managers can use this information for benchmarking the performance of their companies against that of their peers. Regulators will find the information of interest in their efforts to formulate policies relating adoption of technology. Further, the study is important to researchers as it details literature on innovation in commercial banks thus encourage more research on technological innovation in financial institutions.

Finally, there is richness of information on the nature and scope of technological

innovation, but there is scarcity of evidence about factors affecting technological innovation by commercial banks in developing countries particularly in Africa. This study attempts to fill gaps on this issue, especially with respect to Kenyan banking market.

1.6 Scope and Limitation of the Study

This study targeted commercial banks in Kenya. These are institutions that accept deposits, extend credit and risk management services. The study considered all the 46 commercial banks. The success of the study solely depended on the co-operation of bank officials. However, due to the veil of secrecy placed upon operation of financial institutions, certain respondents were reluctant to provide required information. However, the researcher assured them that information submitted was to be treated confidentially and used for academic purpose only, this minimised non-response.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Technology diffusion is an indispensable process through which technological potential of innovative activities can be actually turned into productivity. Various characteristics of the economic environment in which diffusion takes place may affect the pace of diffusion, while the diffusion itself may also have feedbacks on the environment. To better understand this process, many important questions have to be answered. Among them, economists are most curious about the following: who are the early adopters of technological innovations, what factors determine the various diffusion rates across adopter groups, and what feedbacks, if any, the diffusion may have on the economic environment. The ongoing diffusion of Internet Banking (IB) provided a good opportunity to look closely at these questions.

Technological innovation can be considered as a package of innovations (Zwass, 2003; Molla, 2006); various authors have applied innovation theory to study adoption of IT innovations (Kamal, 2006; Aguila-Obra & Padilla-Melendez, 2006; Kuan & Chau, 2001). Rogers (1983) defines organizational innovation as the development and implementation of ideas, systems, products, or technologies that are new to the organization adopting it. The adoption of innovations is a process that includes the generation, development, and implementation of new ideas or behaviours (Rogers, 1983). The innovation does not necessarily have to be new in terms of discovery or invention; it only has to be perceived as new by the organization (Zaltman, Duncan & Holbek, 1973).

2.2 Overview of Banking Industry

Currently there are 46 registered commercial banks in Kenya. Seven banks control approximately 70% of the market share. The implementation of financial sector reforms within the Structural Adjustments Program framework in the early 1990s marked the end of controlled interest rates. The suspension of donor funding meant that government relied on domestic borrowing, this action led to the rise of Treasury bill rate (T.B) to 76% in 1993. High bank interest rates persisted much of last decade. However the decline in TB rates to less than 2% in 2003 resulted in marked reduction in bank interest rates hence banks' profitability. The monetary authority increased the minimum core capital investment requirement from Kshs.375 million and Kshs. 200 million to Kshs. 500 million and Kshs. 250 million for banks and non-bank financial institutions respectively (CBK 2006). Cash ratio was also reduced from 8% to 6%. Banks are also required by the monetary authority to provide information on their average lending rates, commissions and other charges to CBK which then publishes this information in the local press every end of the month for public consumption. Finally bank financial institutions are required by law to publish their half year financial performance. These regulations imply that banks have to operate within central banks limits with little room to increase their performance.

The major forces shaping the structure of the industry and competitive advantage are; increased competition from new market entrants, competition from non-traditional sources like co-operatives and micro-finance institutions, changes in customer tastes, the

CBK (amendment) Act 2000 (Donde bill) and changes in technology (Internet Banking, Short Messaging Services (SMS) banking.

There are combinations of pressures operating on the industry, and some of these pressures challenge the very core of banking business: information and delivery. A dominant pressure derives from new technology with respect to information, trading and delivery of financial services. Industrial history shows that the development of new technology has a major impact on any industry and has often done so. Technology affects the core of the banking business of information processing and delivery. In this respect, banking is no different from other industries. It is largely innovation, and what follows from it, that will transform the banking and financial services industries (Cooper, 1998).

In many countries, financial systems in general, and the banking sector in particular, are passing through a period of substantial structural changes under the combined and inter-related pressures of: internal competition; declining entry barriers; changes in regulation; new information; trading and delivery technology; global competitive pressures; and fast-evolving strategic objectives of banks themselves and their existing and potential competitors (Channon, 1998). A series of universal trends have become evident all of which have major implications for the competitiveness of banks. The impacts of these forces are varied in timing and degree between countries though many of the secular pressures on the industry are universal. Global pressures are likely to dominate country-specific factors in the future evolution of national banking systems.

Financial institutions around the world face formidable challenges. For instance, they are

losing some of their past monopolies and comparative advantages which have underpinned their dominant position in the financial system. In particular, as entry barriers into banking services are eroded, banks are increasingly facing competition from a wider range of actual and potential suppliers of banking services: the capital markets, money markets and non-banking financial institutions. In addition, the development of electronic banking has in some countries enabled foreign banks to enter hitherto relatively closed domestic retail banking markets. In some cases, large corporate customers have been internalising some of their banking operations through 'in-house banks'. In many countries banks are shedding staff and closing branches with the introduction of new technology and alternative delivery systems. At the same time, squeezed by inroads into their traditional businesses and stiff competition, banks are expanding into new areas: insurance, life assurance, unit trusts and other services (Cooper, 1998).

These trends are emerging in the context of major structural changes in financial systems: the relative growth of financial markets, the increasing institutionalization of saving and investment business, the growing role of institutions in other functions of the financial system, the rise in the role of institutional funds managers in the financial system, diversification of financial firms and the steady erosion of traditional distinctions between different types of financial institutions; the entry of new types of supplier of financial services, a substantial growth in the variety of new and complex financial instruments, and the globalisation of financial markets (Channon, 1998).

2.3 History of Financial Innovation

History of financial innovation demonstrates that the creation of new financial products and processes has been an ongoing part of economies for at least past four centuries if not longer (Silber, 1975; Tufano & Sylvan, 2002). Since World War II, there have been persistent inflation and successive round of disintermediation spawned a series of economic 'incentives' and 'pressures' that have served as the driving forces in the process of financial innovation that has characterised our financial system (Eisenbeis, 1985; Miller, 1986).

These innovations have significantly altered not only the array of financial services available and the way they are provided to the public but also the portfolios and, hence, risk characteristics of financial institutions. These innovations include new instruments (such as CDs, NOW accounts, rising rate notes, financial futures, and variable-rate mortgages), new technological applications (such as ATMs, SWIFT, ACH, videotext, in-home banking, PoS, virtual banking and the use of computers to solve operations problems within financial institutions), new methods for supplying services through joint ventures and related financial arrangements (such as deposit sweep account, cash management accounts and shared EFT networks); new institutional forms such as bank holding companies, money market mutual funds, broker-banker and other financial congenerics and finally the growth and development of new markets for new instruments such as commercial paper, financial futures and the Eurocurrencies markets (Eisenbeis & Aspinwall, 1985; Duffie & Rahi, 1995).

2.4 Significance of Technological Innovation

A strong banking industry is important in every country and can have a significant affect in supporting economic development through efficient financial services (Van Horne, 2004). Kenyan banks, however, largely continue to conduct most of their banking transactions using traditional methods. In Kenya, the role of the banking industry thus needs to change, both at the procedural level and at the informational level. This change will include moving from traditional distribution channel banking to electronic distribution channel banking. Given the almost complete adoption of internet, SMS and other technologies by banks in developed countries, the reason for the lack of such adoption in developing countries like Kenya is an important research question that is addressed by this study.

Wang et al., (2005) claim that in the 1990s internet banking technology was under-utilized as business organizations used it only to market their products and services. Thornton and White (2001), who examined customer orientations and usage of financial distribution channels in the Australian financial industry, found that more recently most financial institutions, faced with competitive pressure after deregulation in 1983, have rethought their strategies to take full advantage of internet, cell phone and other modern methods of conducting business.

Tan and Teo (2000) note that the challenge to expand and maintain banking market share has influenced many banks to invest more in making better use of the internet and other related technologies. The emergence of internet and SMS banking had made many banks

rethink their Information Technology (IT) strategies in competitive markets. Lim et al., (2004) conducted a meta-analysis study on the relationship between IT investment and organizational performance, noting that previous studies examining IT investments return have shown inconclusive results. From an analysis of 3,883 subjects obtained from prior studies, they found strong support for return on IT investments.

Singh (2004) examined internet technology in the South African banking industry and highlighted that internet market potential is significant because banks have the opportunity to target most segments in the industry both locally and internationally. The Cedar group consulting firm (2004) survey reported that the technological innovation could play a major role in transforming the workplace to enhance productivity by reducing operational cost and improving employee relationships through improved service delivery. The investigators noted that as the transformation progressed in the workplace, the level of sophisticated services also increased. Bresenahan et al., (2002) examined the effect of IT on the organizational workplace by analyzing 300 responses and showed that IT has the potential to affect process and hence skill levels. This implies that the adoption of internet technology has implications for how a business organization communicates internally and with their customers and suppliers as well as how they respond to their customers.

As financial regulations became more burdensome financial institutions found that many of the old ways of doing business were no longer profitable, the financial services and products they were offering to the public were not selling (Mushkin, 2001). Many

financial intermediaries found that they were no longer able to acquire funds with their traditional financial instruments and without these funds they would soon be out of the business. To survive in the new economic environment, financial institutions had to research and develop new products and services that meet customer needs and prove profitable (Mushkin, 2001).

For a financial institution to be the preferred choice, innovation and instant responsiveness have to be the driving force. Any bank that desires to position itself as a market leader has to be at the cutting edge of technology, product architecture and service delivery. Banks have to endeavour to be a step ahead of the competition by constantly and proactively evaluating existing imminent customer needs and moving swiftly to address the same.

If the world were free of all 'imperfections' such as taxes, regulations, information asymmetries and transaction costs and if markets were complete in the sense that existing securities spanned all states of nature, we could arrive at an M&M-like corollary regarding financial innovation. There would be no incentives for financial institutions to undertake innovative activities (Duffie & Rahi, 1995). The processes of innovation occur due to the following factors:

2.4.1 Responses to Change in Customer Needs

The most significant change in the economic environment that altered the demand for financial products in recent years has been the drastic increase in the volatility of interest rates. In the 1950s, the interest on three- month Treasury bill fluctuated between 1.0%

and 3.5%, in the 1970s; it fluctuated between 4.0% and 11.5%. This volatility became even more pronounced in the 1980s, during which the three-month T-bill rate ranged from 5% to over 15% (Mushkin, 2001).

It is expected that increase in interest rate risk leads to increase demand for financial products and services that reduce that risk. This change in the economic environment would thus stimulate a search for profitable innovations by financial institutions that meet this new demand and thus spur the creation of new financial instruments that help lower interest-rate risk. One financial innovation in the banking sector that appeared in 1970s confirms this prediction was the development of adjustable-rate mortgage (Mushkin, 2001).

2.4.2 Responses to Changes in Technology

The most important source of the changes in supply conditions that stimulate financial innovation has been the improvement in computer and telecommunication technology (Mushkin, 2001). These changes have made it profitable for financial institutions to create new financial products and services to the public. When computer technology that substantially lowered the cost of processing financial transactions became available, financial institutions conceived new financial products and instruments dependent on this technology that might appeal to the public, including the bank credit and electronic banking facilities. Bank credit and debit card, electronic banking facilities (ATM) have arisen due to banks desire to meet their customers demand. With the decline in the price of personal computers and their increasing presence in homes, there is further innovation

in the home banking area, the appearance of new type of banking institution, the virtual bank (Mushkin, 2001)

2.4.3 Avoidance of Existing Regulations

Financial innovation occurs in response to changes in demand and supply conditions. However, because the financial industry is heavily regulated than other industries, government regulation is a greater spur to innovation in this industry (Mushkin, 2001).

Government regulation leads to financial innovation by creating incentives for firms to skirt regulations that restrict their ability to earn profits. Kane (1986) describes this process of avoiding regulations as 'loophole mining'. The economic analysis of innovation suggests that regulatory constraints are so burdensome that avoiding them can make larger profits; loophole mining and innovation are more likely to occur. Two sets of regulations have seriously restricted the ability of banks profits; reserve requirement and restrictions on the interest rates that can be paid on deposits. These regulations have been among the major forces behind financial innovation in recent years (Mushkin, 2001).

The reason why the reserve requirements affect financial innovation is to recognize that they act in effect as a tax on deposits. Because the Central Bank does not pay interest on reserve, the opportunity cost of holding them is the interest that bank could earn by lending the reserves out (Mushkin, 2001). Just as taxpayers look for loopholes to lower tax bills, banks seek to increase their profits by loophole mining and by producing financial innovations that allow them to escape the tax on deposits imposed by reserve requirements (Mushkin, 2001).

Legal and regulation changes in the direction of less restrictiveness and less protectionism deregulation have reinforced these technological improvements, yielding high levels of competition throughout the financial sector. Increased competition from new market entrants due to lower minimum capital requirement from Ksh 500 million and Ksh 375 million to Ksh 250 million and Ksh 200 million for bank and non- bank financial institutions respectively. Also due to entry of non-traditions sources like the Savings and Credit Co-operative Societies (SACCOs) and micro-finance institutions (CBK, 2004). The banking Act Cap 488 restricts interest being paid on current account. This implies that banks cannot invest funds on chequing accounts thus banks developed the 'Sweep account' or overnight lending whereby banks 'sweep' on overnight basis idle current account funds of their customers into interest-bearing securities (Tufano, 2002).

2.5 Theories of Technological Change

Innovation is defined as the use of new knowledge to offer a new product or service that customers want (Abernathy et al., 1998). The new knowledge refers to technological or market knowledge. Technological knowledge is knowledge of components, linkages between components, methods, processes and techniques that go into a product or service. Market knowledge is knowledge of distribution channels, product applications and customers' expectations, preferences, needs and wants (Afuah, 1998). No matter how the paradigm shifts due to external factors like technology and environment, the process of innovation cannot be separated from a firm's strategic and competitive context.

The Utterback/Abernathy model (1978) attempted at detailing the dynamic processes that

take place within an industry and its firms during the evolution of a technology. The model described three phases in an innovation's life cycle – the fluid, transitional and specific phases. The fluid phase technology is in a state of flux and firms have no clear idea whether, when or where to invest in R&D. Custom designs are common, with the new product technology often crude, expensive and unreliable but able to meet the requirements of some market niches.

The evolution then enters the transitional phase when, as producers learn more about how to meet customer demands through producer customer interaction and through product experimentation, standardization of components, market needs and product design features takes place. A dominant design emerges, signalling a substantial reduction in uncertainty, experimentation and major design changes. The design commands a high percentage of the market share. Automated teller machines (ATMs) represent one such dominant design in the banking industry. In the specific phase, products built around the dominant design proliferate and there is more and more emphasis on process innovation, with product innovations being largely incremental. Cost becomes the basis for competition. The pattern described repeats itself when a new technology with the potential to render the old one obsolete is introduced. This results in a discontinuity, plunging the innovation cycle back to the fluid phase.

The Tushman/Rosenkopf technology adoption lifecycle (1992) is similar to the Utterback/Abernathy model (1978) in many aspects. However, it addresses another important and unanswered question in the dynamics of innovation. To what extent can a

firm influence the evolution of the innovation? For example, to what extent can a firm guide its design to an industry standard, or dominant design? Tushman and Rosenkopf (1992) argue that this depends on the amount of technological uncertainty which in turn, depends on the complexity of the technology and the stage of evolution.

The more complex an innovation, the greater is the role of non-technical factors such as complementary assets and organizations in the local environment during the innovation's life cycle. Moore (2001) built on Tushman and Rosenkopf's model to come up with the revised technology adoption lifecycle. Companies often stumble when it comes to making the transition from the visionaries to the pragmatists (Moore, 2001). Most high technology innovations that manage to gain early market support falter beyond this phase, and 'fall into a chasm'. Since most of the revenue from an innovation comes from the pragmatists, who make up the bulk of the mainstream market, crossing the chasm is an organizational imperative. Moore (2001) argues that the key to crossing the chasm lies in using the technology to develop a whole product, tailored to the needs of a specific market niche.

Diffusion theory of innovation defines innovation as the process by which an innovation is adopted and gains acceptance by members of a certain community. A number of factors interact to influence the diffusion of an innovation. The four major factors that influences the diffusion process are the innovation itself, how information about the innovation is communicated, time, and the nature of the social system into which the innovation is being introduced (Rogers, 1995). Diffusion research, in its simplest form,

investigates how these major factors, and a multitude of other factors, interact to facilitate or impede the adoption of a specific product or practice among members of a particular adopter group.

2.5.1 Critical Review of Theories of Technological Change

Diffusion theory is not one, well-defined, unified, and comprehensive theory. However, it combines large number of theories, from a wide variety of disciplines, each focusing on a different element of the innovation process, combined to create a meta-theory of diffusion.

The most likely reason why there is not a unified theory of diffusion/adoption of new technology is that the study of innovation diffusion is a fairly recent field (Surry, 1997). Rogers (1995) points out that a 1943 study by Ryan and Gross provided the genesis of modern diffusion research. The Ryan and Gross' (1943) study, from the field of rural sociology, used interviews with adopters of an innovation to examine a number of factors related to adoption. The interview-based methodology used in the Ryan and Gross study has remained the predominant diffusion research methodology ever since (Rogers, 1995). A number of researchers from rural sociology (e.g., Fliegel & Kivlin, 1962) and other disciplines (e.g., Weinstein, 1986) have built on the Ryan and Gross' work to conduct studies and develop theories related to the diffusion of innovations.

According to Surry (1997), Rogers did the most significant work in synthesizing most the significant findings and compelling theories in 1960. Rogers (1995) presented the closest any researcher has come to presenting a unified theory of diffusion. Four of the theories

discussed by Rogers are among the most widely-used theories of diffusion: Innovation decision process; individual innovativeness; rate of adoption; and perceived attributes.

2.5.1.1 Innovation Decision Process

The Innovation Decision Process Theory (Rogers, 1995) states that diffusion is a process that occurs over time and can be seen as having five distinct stages. The stages in the process are knowledge, persuasion, decision, implementation, and confirmation. According to this theory, potential adopters of an innovation must learn about the innovation, be persuaded as to the merits of the innovation, decide to adopt, implement the innovation, and confirm (reaffirm or reject) the decision to adopt the innovation. This theory has been so widely cited in banking technology literature that Sachs (1993) writes,

> "after looking at [the literature] in our field, one might get the impression that the only important thing we need to know about how to encourage the adoption of innovations or how to be better change agents is that there are five stages to the innovation adoption process".

While Sachs (1993) correctly concludes that although many other important theories of innovation diffusion are overlooked, the innovation decision process theory remains among the most useful and well- known.

2.5.1.2 Individual Innovativeness

The Individual Innovativeness Theory (Rogers, 1995) states individuals who are predisposed to being innovative will adopt an innovation earlier than those who are less predisposed. Figure 2.1 shows the bell shaped distribution of individual innovativeness and the percentage of potential adapters theorized to fall into each category. On one extreme of the distribution are the innovators. Innovators are the risk takers and pioneers

who adopt an innovation very early in the diffusion process. On the other extreme are the Laggards who resist adopting an innovation until rather late in the diffusion process, if ever.

2.5.1.3 Rate of Adoption

The third widely-used diffusion theory discussed by Rogers (1995) is the theory of Rate of Adoption. Rate of adoption theory states that innovations are diffused over time in a pattern that resembles an S-shaped curve. Rate of Adoption theorizes that an innovation goes through a period of slow, gradual growth before experiencing a period of relatively dramatic and rapid growth. An example of how rate of adoption might typically be represented by an s-curve is shown in Figure 2.2. The theory also states that following the period of rapid growth, the innovation's rate of adoption will gradually stabilize and eventually decline.

2.5.1.4 Perceived Attributes

The theory of perceived attributes (Rogers, 1995) states that potential adopters' judge an innovation based on their perceptions in regard to five attributes of the innovation. These

Figure 2.1 Bell shaped curve showing categories of individual innovativeness and percentages within each curve.

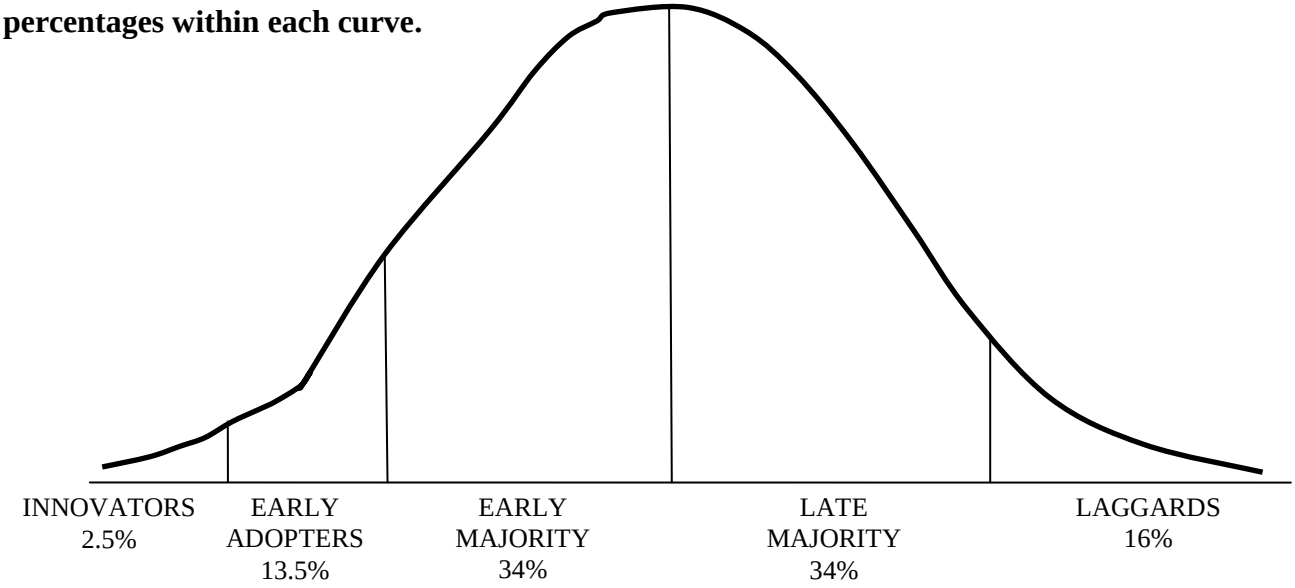
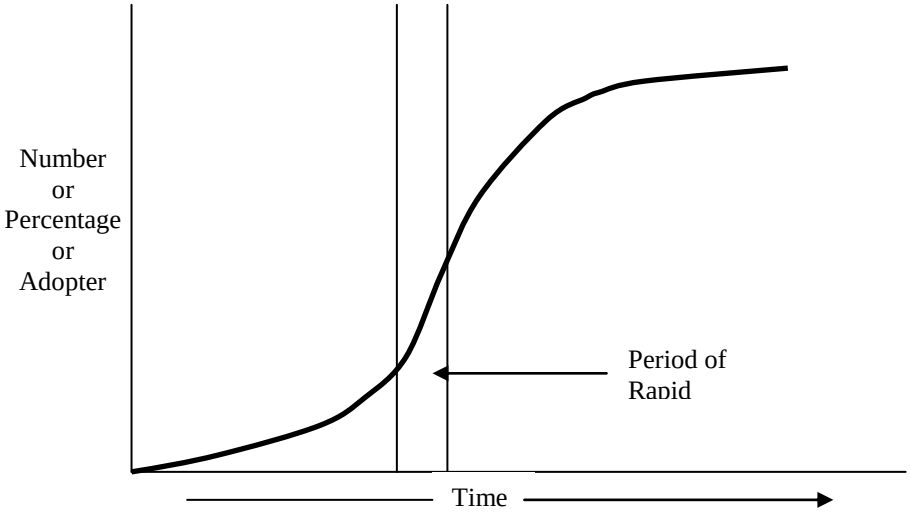


Figure 2.2 S-Curve showing the rate of adoption of an innovation over time.



Source: (Rogers, 1995)

attributes are: trialability; observability; relative advantage; complexity; and compatibility. The theory holds that an innovation will experience an increased rate of diffusion if potential adopters perceive that the innovation: 1) can be tried on a limited

basis before adoption; 2) offers observable results; 3) has an advantage relative to other innovations (or the status quo); 4) is not overly complex; and 5) is compatible with existing practices and values.

The theory of perceived attributes has been used as the theoretical basis for several studies relevant to the field of banking technology. Perceptions of compatibility, complexity, and relative advantage have been found to play a significant role in several IT-related adoption studies. Wyner (1974) and Holloway (1977) each found relative advantage and compatibility to be significant perceptions among potential adopters of banking technology in financial institutions. Eads (1984) found compatibility was the most important attribute among employees and bank administrators. Surry (2006) studied the perceptions on adoption of e-commerce by banks in Nigeria and found relative advantage; complexity and compatibility were important adoption considerations.

2.6 Empirical Literature

Rogers (1995) made an attempt to measure the relationship between firm size, market structure and the propensity to adopt specific ICTs. Hannan and McDowell's (1984) study of the adoption of automatic teller machines (ATMs) by retail banks in the United States leads them to conclude that larger banks, operating in more concentrated local banking markets show a higher probability of installing ATMs than smaller banks operating in less concentrated markets. The result, they claim, provides evidence for the Schumpeterian hypothesis. The 'Schumpeterian hypothesis' referred to in studies on ICT diffusion relates to the relationship between firm size, market structure and the adoption

of specific ICTs. The hypothesis emerges from Schumpeter's 1942 work, *Capitalism, socialism and democracy* in which he argues that the dominant firms in an oligopolistic market have greater incentives to invest in innovative activities due to the appropriability of their investments. Although Schumpeter was referring to large industrial firms and their R&D laboratories, the hypothesis of a positive correlation between firm size, a concentrated market structure and a propensity to innovate has been extended to firms operating in the services sector regarding their investments in ICTs. For example, Escuer et al., (1991), who have examined the relationship between ICT adoption and market concentration in the Spanish banking sector, and Ingham and Thompson (1993), who have looked for correlations between firm size and ICT adoption amongst UK building societies.

Cox et al., (2002), while undertaking studies on the patterns of innovation in UK- based industries; found that most firms engaging in innovation were concerned with economic factors. Direct costs of innovation and the costs of finance were the strongest perceived innovation constraints. This was followed by the excessive perceived economic risk of innovation. An enterprise's internal capabilities were regarded as less problematic. However, Khangati (2006) while undertaking studies on the patterns of innovation in Kenyan-based industries found that most firms engaging in innovation were concerned with economic and organization factors. Direct costs of innovation, costs of finance and enterprise's internal capabilities were the strongest perceived innovation constraints. Omondi's (2003) study of the adoption of automatic teller machines (ATMs) by retail banks in Kenya led him to conclude that larger banks, operating in local banking markets

show a higher probability of installing ATMs than smaller banks.

2.6.1 Critical Review of Empirical Literature

Most studies on innovation focus on perceived the relationship between size, market structure and the propensity to adopt innovations. For instance, Rogers (1995), McDowell's (1984), Khangati (2006) among other studies show a positive perceived relationship between firm size and propensity to innovate. However, these studies do not provide quantitative statistics on factors influencing technological innovation. Studies that have identified factors hindering innovation have either focused on other industries excluding banks or have not conclusively documented factors curtailing innovation. For instance Cox et al., (2002), while undertaking studies on the patterns of innovation in UK- based industries found that most firms engaging in innovation were perceived to concern with economic factors. Based on these short comings, this study aims to conclusively and quantitatively describe factors affecting adoption of IB by commercial banks.

Various authors have applied innovation theory to study adoption of banking innovations (Kamal, 2006; Aguila-Obra & Padilla-Melendez 2006; Kuan & Chau, 2001). Rogers (1983) defined organizational innovation as the development and implementation of ideas, systems, products, or technologies that are new to the organization adopting it. The adoption of innovations is a process that includes the generation, development, and implementation of new ideas or behaviours (Rogers, 1983). The innovation does not necessarily have to be new in terms of discovery or invention; it only has to be perceived

as new by the organization (Zaltman, Duncan & Holbek, 1973).

Various studies have classified the factors influencing innovation adoption (Kim & Galliers, 2004). Rogers (1983) grouped the factors under characteristics of innovation. Tornatzky & Fleischer (1990) identified three different categories of factors – organizational, technological, and environmental factors – that influence the technological innovation decision. Kimberly and Evanisko (1981) identified three groups of predictors of innovation: characteristics of organizational leaders, characteristics of organization, and characteristics of environment. In summary, four categories of factors can be found in technological innovation literature: (1) managerial; (2) organizational; (3) technological; and (4) environmental. However, all these identified factors are based on perception, lacking quantitative backing.

Researchers have identified the following common environmental factors relating to technological adoption pressure from competitors, customers or suppliers; the role of government (incentives); partners' alliances; technological infrastructure; technology consultants; image of internet technology; and users' expectations (Aguila-Obra & Padilla-Melendez, 2006) technological factors include complexity, compatibility, relative advantage, ease of use and usefulness (Davis,1989; Rogers, 1983). The technological factors are related to barriers to technology adoption and its perceived benefits. The perceived benefits for managers could be direct, such as cost savings or income generation, or indirect, such as potential opportunities in new markets, marketing, or publicity (Poon & Swatman, 1999). Thus, when adopting an innovation, organizations

must perceive the positive effects of the adoption – and hence its potential value – before starting the process (Vadapalli & Ramamurthy, 1997). The organizational factors that have been mostly cited in literature include: IT users' community; organizational structure; firm's processes; firm size; technological capabilities of the organization's members; the technological and financial resources available; the culture of the organization; process of selecting and implementing the new technological innovation; management backing and support for the project; and the project leader (Aguila-Obra & Padilla- Melendez, 2006).

Some researchers have integrated these factors into one model (Kamal, 2006; Kuan & Chau, 2001; Mehrtens et al., 2001) allowing for the treatment of all these factors and their interaction in one dynamic framework. Such framework can explain marked differences in the performance of organizations in identical contextual situations (Montealegre, 1996). Kamal (2006) integrated findings from studies that investigated various factors impacting on innovations and proposed a model of technological adoption. The factors were classified into perceived technology factors, organizational factors, external factors, collaboration factors, and support. Kuan & Chau (2001) suggested a model of EDI adoption based on a technology–organization–environment framework. Other studies (Mehrtens, Cragg & Mills, 2001) have used innovation, organizational, and environmental factors to explain differences in technological adoption. However, most of the studies are based on developed countries.

Thornton and White (2001) incorporated the concept of technology readiness into the

technology organization- environment framework and proposed a perceived technology readiness model (PTRM). They defined ‘‘perceived technology readiness’’ as an organization’s assessment of the technology, managerial, organizational, and external situations in making decisions about adopting technological innovation.

2.8 Research Model

In this section, a theoretical model is constructed to study the diffusion and impact of a cost-saving technological innovation in the internet banking context.

2.8.1 Environment

The industry is composed by a continuum of banks which produce a homogeneous product (banking service). Banks behave competitively, taking market prices as given. It is assumed banks are heterogeneous in the cost of production, which causes size difference across banks. At a point of time *t*, the aggregate demand takes a simple form that the consumers are willing to pay P_t for the total amount Q_t of the output. Over time, the demand P_t and Q_t might be shifted by economic forces, such as changes in population, income or substitute services.[1]

2.8.2 Pre-Innovation Equilibrium

Before the IB arrives, the industry is at a steady state. Taking prices as given, each individual bank maximizes profit using the existing technology:

[1] For simplicity, it is assumed consumers have inelastic demand so that P and Q are exogenously determined.

$$\pi_0 = \underset{yo}{Max} Py_0 - \propto y_0^{\beta}$$

where π_0 is profit, P is price, y_0 is output, and $\alpha > 0$ and $\beta > 1$ are cost parameters.

Solving the maximization problem, leads

$$y_0 = (\frac{P}{\propto \beta})^{\frac{1}{\beta - 1.}} \tag{1}$$

Given individual bank's heterogeneity of productivity, e.g.$\propto$, there is a bank size distribution *G.* historically, bank size y_0 fits well with a log logistic distribution whose cdf function is given as (Wang 2005):

$$G_{y0}(x) = 1 - \frac{1}{1 + b_1 x^{b2}} \tag{2}$$

With the mean E(y_0) and Gini coefficient g given as

$$E(y_0) = b_1^{-1/b2} \Gamma(1 + \frac{1}{b_2}) \Gamma(1 - \frac{1}{b_2}), \qquad g = \frac{1}{b_2}$$

Where Γ denotes the gamma function $\Gamma(\mu) \equiv \int_0^{\infty} t^{\mu - 1} \exp(-t) dt.$

The log-logistic distribution is used because not only does it serve as an easily tractable representative of the larger group of positively skewed distributions, but also because it connected study to the typically observe logistic diffusion curves (Wang, 2004).

Rewriting the log-logistic into a more intuitive form, leads to

$$Gy_0(x) = 1 - \frac{1}{1 + (\eta x / E(y_0))^{1/g}} \tag{3}$$

Where $\eta = \Gamma(1 + g) \Gamma(1 - g).$

At equilibrium, aggregate demand equals supply, so that

$$N\int_0^{\infty} y_0 dG(y_0) = Q$$

where *N* is the total number of banks.

Notice that the assumption of log-logistic size distribution is robust to changes of the market environment. For example, any shocks to the price *P* and the mean bank productivity[2] $E(\propto^{\frac{1}{1-\beta}})$, only affect the mean of the size distribution but nothing else; any shocks to the total demand *Q* only affect the number of banks *N* through entry and exit, but not the size distribution (Olmstead & Rhode, 2001).

2.8.3 Post-Innovation Equilibrium

2.8.3.1 Individual Bank Decision

At time T, the technological innovation, internet banking, becomes available. Thereafter, at each period an individual bank maximizes profit and decides whether to adopt the innovation or not (0 = do not adopt, 1=adopt):

$$\pi = Max\{\pi_0, \pi_1\}$$

With $\pi = 0 \quad \underset{y_0}{Max} Py_0 - \propto y_0^{\beta}; \qquad \pi_1 = \underset{y_1}{Max} Py_1 - \frac{\propto}{\gamma} y_1^{\beta} - k$

Where γ is the cost saving by adopting the innovation, *k* is the period cost of adoption. Solving the maximization problem, results:

[2] Given β>1, $\propto^{\frac{1}{1-\beta}}$ decreases with ∝. Hence, $\propto^{\frac{1}{1-\beta}}$ can be interpreted as a productivity measure.

$$y_0 = (\frac{P}{\propto \beta})^{\frac{1}{\beta-1}}; \pi_0 = \frac{\beta-1}{\beta} P y_0;$$

$$y_1 = (\frac{\gamma P}{\propto \beta})^{\frac{1}{\beta-1}}; \pi_1 = \frac{\beta-1}{\beta} P y_1 - k.$$

An individual bank will adopt IB if $\pi_1 \geq \pi_0$, and there is a threshold size y_0 for adoption:

$$\pi_1 = \pi_0 \Rightarrow y_0^* = \frac{k}{P(\frac{\beta-1}{\beta})(\gamma^{\frac{1}{\beta-1}} - 1)}.$$

The size requirements for adoption suggest that large banks have an advantage in adopting the innovation (Wang, 2005).

2.8.3.2 Aggregate Adoption

Given the log-logistic bank size distribution G defined in Equation 3 and the threshold y_0^* for adoption, the aggregate adoption rate of the IB innovation is:

$$F = 1 - G_{y0}(y_0^*) = \frac{1}{1 = (\eta y_0^* / E(y_0))^{1/g}}. \quad (4)$$

The size requirement for adoption suggests that large banks have an advantage in adopting the innovation.

Recall:

$$y_0 = (\frac{P}{\propto \beta})^{\frac{1}{\beta-1}}; \qquad y_0^* = \frac{k}{P(\frac{\beta}{\beta-1})\gamma^{\frac{1}{\beta-1}} - 1)}$$

Then proposition 1 follows.

Proposition 1 *The adoption rate F increases with consumer demand P, mean bank productivity* $E(\propto^{\frac{1}{1-\beta}})$*, cost saving* γ*, but decreases with adoption cost k.*

Proof. Equation 4 suggests that $\partial F/\partial P > 0$, $\partial F/\partial E\ (\propto^{\frac{1}{1-\beta}}) > 0$, $\partial F/\partial \gamma > 0$ and $\partial F/\partial k < 0$.

2.8.3.3 Average Bank Size

Notice E(y_0) is not something directly observable. The observed mean bank size is indeed

$$E(y)=\int_0^{y_0^*} y0dG(y_0+\int_{y_0^*}^{\infty} y_1 dG(y_0)=E(y_0)+[\gamma^{\frac{1}{\beta-1}}-1]\int_{y_0^*}^{\infty} y_0 dG(y_0)\,.$$

Given that y_0 takes a log-logistic distribution *G*, we have

$$\int_{y_0^*}^{\infty} y_0 dG(y_0)=[1-\beta(1+g,1-g;G(y_0^*))]$$

where β is the incomplete beta function defined as

$$\beta(a,b;x)\equiv\frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)}\int_0^x t^{a-1}(1-t)^{b-1}dt \text{ with } a>0,b>0,x>0,$$

$$\beta(a,b;0)=0 \text{ and } \beta(a,b,1)=1.$$

Therefore, the observed mean bank size can be derived as follows:

$$E(y)=E(y_0)\{1=[\gamma^{\frac{1}{\beta-1}}-1][1-\beta(1+g,1-g;1-F)]\} \quad (5)$$

Given the results of Proposition 1, it is straightforward to get Proposition 2.

Proposition 2 *the mean bank size e(y) increases with consumer demand P, mean bank productivity E ($\propto^{\frac{1}{1-\beta}}$), cost saving γ, but decreases with adoption cost k.*

Proof. Given Proposition 1, Equation 5 suggests that ∂ E (y) / ∂P > 0, ∂E 9y) / ∂>0, ∂E(y)/ ∂E($\propto^{\frac{1}{1-\beta}}$) >0 and ∂E(y)/ ∂k<0.

2.8.3.4 Industry Dynamics and Long-Run Equilibrium

Equations 4 and 5 describe the post-innovation industry equilibrium at any point of time. Notice that so far time subscripts of all variables have been omitted. The industry dynamics are made explicit. As a result, it is seen that the diffusion path closely follows a logistic curve. In fact, over time, consumer demand Pt may change with income or substitute services, and mean bank productivity E ($\propto^{\frac{1}{1-\beta}}$), IB cost saving γ_t and IB adoption cost k_t may change with banking deregulation and technology progress. Taking

these time changes into account, results in a simple law of motion with constant growth as follows:

$$P_t = P_0 e^{z_p t;} \quad E(\propto_t^{\frac{1}{1-\beta}}) = E(\propto_0^{\frac{1}{1-\beta}}) e^{z^{\alpha} t}; \;\; \gamma_t^{\frac{1}{\beta-1}} - 1 = (\gamma_0^{\frac{1}{\beta-1}} - 1) e^{z_{\gamma} t}; \;\; k_t = k_0 e^{z_k t.}$$

Then, the diffusion path of IB can be derived from Equation 4.

$$F_t = \frac{1}{1+(\eta y^*_{0,t} / E(y_{0,t}))^{1/g}} = \frac{1}{1+(\eta y^*_{0,0} / E(y_{0,0}))^{1/g} e^{\frac{1}{g}\{z_k - z\propto - z\gamma - \frac{\beta}{(\beta-1)} z_p\} t}}. \tag{6}$$

The diffusion formula derives here may be compared with the traditional logistic model. The logistic model, based on a behavioural assumption of social contagion, assumes that the hazard rate of adoption rises with cumulative adoption (Wang, 2005).

$$\frac{F_t}{1-F_t} = vF_t \Rightarrow F_t = \frac{1}{[1+(\frac{1}{F_0} - 1)e - vt]} \tag{7}$$

Where Ft is the fraction of potential adopters who have adopted the product at time t, and v is a constant contagion parameter.

Comparing Equation 6 with Equation 7, one realizes that the diffusion formula is equivalent to the logistic model under very reasonable assumption. In particular, the diffusion parameters traditionally treated as exogenous terms now have clear economic meanings: the contagion parameter v is determined by the growth rates of consumer demand, industry deregulation, technology progress; the initial condition *F*0 is the fraction of banks that find it profitable to adopt the innovation at the initial period:

$$v = (\frac{\beta}{(\beta-1)} z_p + z_y + z_{\propto} - z_k) / g; \quad F_0 = \frac{1}{1+[\eta y^*_{0,0} / E(y_{0,0})]^{1/g}}.$$

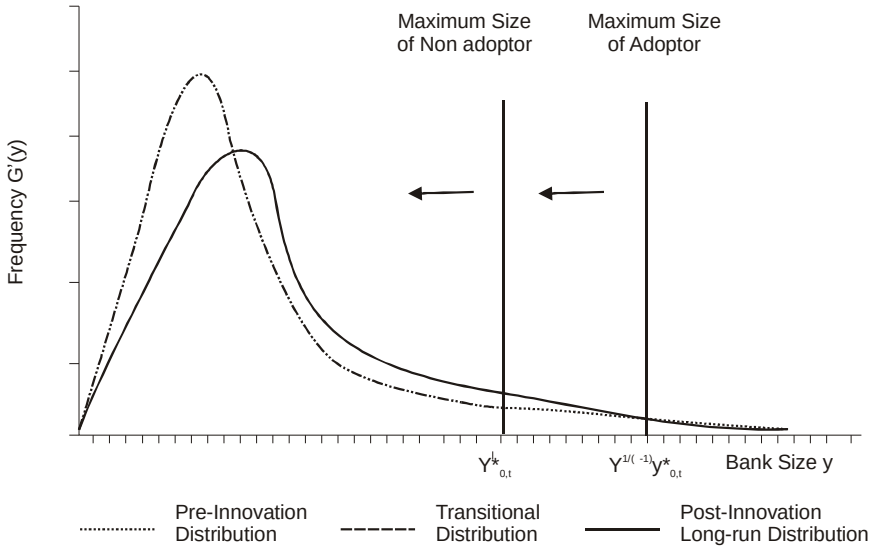
Over time, as more and more banks adopt the innovation, the mean bank size keeps rising and the aggregate size distribution of banks increases stochastically to a new steady state. In the long run, as all banks adopt the innovation, the cumulative distribution of bank size

converges to Gy1, t(x) which is still a log-logistic distribution but with a higher mean.

$$G_{y_{1,t}}(x) = 1 - \frac{1}{1 = (\frac{\Gamma(1+g)\Gamma(1-g)}{E(_{y1,t})} x)^{1/g}}; \quad E(y_{1,t}) = E(y_{0,t})\gamma^{\frac{1}{\beta-1}}.$$

Figure 2.3 illustrates the industry dynamic path. Before the IB innovation arrives, the banking industry stays at a pre-innovation size distribution, drawn with a dotted line. After the IB innovation, in the long run, the banking industry converges to a post-innovation long-run size distribution, drawn with a solid line. In between, the banking size distribution is at a transitional path, drawn with a dashes line. During the transition, at a point of time *t*, there is a critical size requirement $y^*_{0,t}$ which splits the size into two parts. For banks with size $y_{0,t} \geq y^*_{0,t}$ distribution resembles the post-innovation long run distribution for the range $y_{1,t} > \gamma \frac{1}{\beta - 1} y^*_{0,t}$, while for banks with size $y_{0,t} < y^*_{0,t}$ the size distribution resembles the pre-innovation one. Over time, $y^*_{0,t}$ falls due to environmental changes (demand change, technology progress and banking deregulation). As a result, the IB innovation diffuses into smaller banks and the bank size distribution gradually converges to the post-innovation long-run distribution.

Figure 2.3: Illustration of the Industry Dynamics.



Source: (Wang, 2005)

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Research Design

To answer the research questions, an empirical study of banks adopting technological innovation was conducted. The study applied a descriptive survey design.

3.2 Population and Sample Size

Commercial banks in Kenya made up the population of the study. All the forty- six banks formed the target population. The reason for the choice of the years 2007 and 2008 is because 2007 is the first year when depository institutions were required to report their transactional websites.

3.3 Simultaneous Equations

The diffusion impact of IB can be characterized by a simultaneous equation system, which includes an adoption equation and a size equation as follows (Wang, 2005).

Recall Equation 1

$$F = 1 - G(y_0^*) = \frac{1}{1 + (\eta y_0^* / E(y_0))^{1/g}}.$$

It can be rewritten into a log-linear form:

$$gIn(\frac{1}{F} - 1) = In\eta + In\frac{\beta}{\beta - 1} + Ink - InP - In(\gamma^{\frac{1}{\beta - 1}} - 1) - InE(y_0). \quad (8)$$

Recall Equation 2

$$E(y) = E(y_0\{1 + [\gamma^{\frac{1}{\beta-1}} - 1][1 - \beta(1 + g, 1 - g; 1 - F)]\},$$

$$a_0 = (In\eta + In\frac{\beta}{\beta - 1}) / (1 + b_1); a_1 = 1 / (1 + b_1).$$

An empirical approximation of Equation 2 can be written as

$$InE(y) = InE(y_0) - b_1[gIn(\frac{1}{F} - 1)] + b_2 In(\gamma^{\frac{1}{\beta-1}} - 1). \quad (9)$$

Therefore, Equations 8 and 9 imply:

$$gIn(\frac{1}{F}-1) = a_0 - a_1 InE(y) + a_1[(b_2 In(\gamma^{\frac{1}{\beta-1}}-1) - InP + Ink] \quad (10)$$

where

$$a_0 = (Im\eta + In\frac{\beta}{\beta-1})/(1+b_1); a_1 = 1/(1+b_1).$$

Also, Equation 1 suggests

$$y_0 = (\frac{P}{\propto\beta})^{\frac{1}{\beta-1}} \Rightarrow InE(y_0) = \frac{1}{\beta-1} InP - \frac{1}{\beta-1} In\beta + InE(\propto^{\frac{1}{1-\beta}})$$

Hence Equation 9 can be written as:

$$InE(y) = b_0 - b_1[gIn\frac{1}{F}-1)] + b_2 In(\gamma^{\frac{1}{\beta-1}}-1) + \frac{1}{\beta-1} InP + InE(\propto^{\frac{1}{1-\beta}}) \quad (11)$$

Where $b_0 = \frac{1}{1-\beta} In\beta.$

The two Equations 10 and 11 are determined simultaneously and have to be estimated with simultaneous-equations regressions. Since the variable k is in Equation 10 but not Equation 11, and $E(\propto^{\frac{1}{1-\beta}})$ is in Equation 11 but not Equation 10, they can be used to define exclusion restrictions and identify structural parameters (Wang, 2005; Olmstead & Rhode , 2001).

3.4 Empirical Specifications

The empirical study, estimated the following simultaneous equations based on Equations 10 and 11 using commercial banks in Kenya panel data 2007-2008, where each bank is indexed by j and each year is indexed by *t*:

$$g_{j,t} In(\frac{1-F_{j,t)}}{F_{j,t}}) = a_0 + a_1 In(E(y)_{j,t}) + \sum_i a_i In(X_{i,j,t}) + \sum_l a_1 In(I_{l,j,t}) + \varepsilon_{j.t}, \text{ (Adoption)}$$

$$In(E(y)_{j,t}) = b_0 + b_1[g_{j,t} In(\frac{1-F_{j,t}}{F_{j,t}})] + \sum_i b_1 In(S_{l.j.t}) + \mu_{j,t} \quad \text{(Size)}$$

- F is bank-level adoption of IB (All websites and transactional websites separately); *g* is the Gini coefficient of bank size distribution;
- E (y) is a measure of average bank size;
- X are variables shared in both equations, e.g. variables affecting k only.
- I are variables only in the adoption equation, e.g. variables affecting k only;
- S are variables only in the size equation, e.g. variables affecting $E(\propto^{\frac{1}{1-\beta}})$ only.

The dependent variables in the two equations are as follows (Detailed explanations and sources of empirical variables are summarized in table 1 in the Appendix).

(1) Log odds ratio for IB adoption adjusted by the Gini coefficient, constructed using the following variables. TRANSACT – Adoption rate for Transactional Websites; WEBAVE – Adoption rate for All Websites (informational and transactional); GINIASST – Gini coefficient for bank assets;

(2) Average Bank Size, constructed by ASSTAVE – Bank assets.

As it is seen in the theory, there are three groups of exogenous variables: mean bank productivity $E(\propto^{\frac{1}{1-\beta}})$ IB cost saving and IB adoption cost k. The following relevant empirical variables were found to proxy them.

(1) Mean Bank Productivity $E(\propto^{\frac{1}{1-\beta}})$; AGEAVE – Average age of banks;

(2) IB Cost Saving γ: INETADOPT – Household access rate for the internet;

(3) IB Adoption cost *k*; IMITATE – Years since the first bank adopted transactional Website; WAGERATIO – wage ratio of computer analyst to teller.

3.5 Data Collection Procedures

Both banks that use and do not use IB were identified by examining their websites; after which managers and executives were approached and asked to participate in the research. Data were collected by means of survey questionnaires.

3.6 Document Analysis

According to Van Horne (2004), in order to get deeper understanding of phenomena under study, information about it should be collected from various sources. Thus information about IB and related technologies was gathered from documents such as banks' annual report, journals, and industry magazines. This provided better understanding of the research problem and findings. Books about banking industry were searched and provided broader view and a deeper understanding of the industry. Also, web pages of banks were accessed from internet in order to get latest information about the banks' activities, services offered and future services being planned.

3.7 Data Analysis and Presentation

The study applied a simultaneous equation system regression, which includes an adoption equation and a size equation on data collected. The results of the analysis were presented in tables. The independent sample t tests was used to analyze data .The t test assesses the statistical significance of the difference between two independent sample means. The t test is used to test the null hypothesis that the means of two populations are the same. An alternate hypothesis is that the means of the two groups are significantly different.

CHAPTER FOUR

ANALYSIS RESULTS AND DISCUSSIONS

4.1 Introduction

A simultaneous- equation regression was run on a sample dataset. The sample consists of all commercials banks in Kenya as at 2007. Table 7.2 in the Appendix shows summary statistics for all empirical variables. As theory suggests the Gini-adjusted log-odds ratio was used as the independent variable. For most empirical variables used in the estimation, log transformation was used and prefix the variables with "In" in the notation. To get robust estimates, a regression using various definitions of dependent variables was conducted as well as different model setups.

4.2 Data and Estimation Details

The analysis presented mainly refers to results in tables 7.3-7.5, which used transactional websites and bank assets as dependent variables. For regressions, three different setups including a simultaneous-equation model on a pooled cross-section and time-series data, a random-effect simultaneous-equation panel model, and simple OLS regression on two structural equations were estimated. Tables 7.3- 7.5 in the Appendix report regression results with three models setups using transactional websites and bank assets as dependent variables; tables 7.6- 7.8 use all websites (informational or transactional) and bank assets as dependent variables; tables 7.3(dep) -7.8 (dep) repeat the regressions in tables 7.3- 7.8 but use bank deposits instead of bank assets as the measure of bank size. Results in other tables are similar, and was used as supporting evidence whenever necessary. Tables 7.3- 7.4 present the results of simultaneous-equation techniques applied

on the survey data. The main results are similar in the two tables. Table 7. 3 presents results estimating the model using instrumental variables where the IB adoption rate was measured with transactional websites.

4.3 Estimation Results

Table 7.5 reports simple OLS regression results on two structural simultaneous equations without taking care of the potential simultaneity problem. The results of analysis show coefficients of IB adoption (InTRANODDS*GINIAVE) of (-0.5603) and bank size (InASSTAVE) of (-0.13439). The coefficients of IB adoption and bank size are both found to be statistically significant. It confirms the hypothesis that IB adoption and bank size are simultaneously determined, and suggests that OLS estimates may be inconsistent (Furst, Lang and Nolle, 2000). To obtain consistent estimates, simultaneous-equation techniques were used and results (Tables 7.3 -7.4). The overall structural models indicate a fit with an R-square of 72% for adoption equation and 78% for the size equation (Table 7. 3).

First, the research sought to find the relationship between an increase in a bank's average assets and odds ratio for adoption of transactional websites. The results of analysis on the structural equation for IB adoption shows the coefficient on fitted value of InASSTAVE of (-0.1445) (Table 7.3, column 3). Most of the signs of estimated coefficients, and all of those that are statistically significant, are consistent with theoretical predictions. On the relationship between banks' average assets and adoption rate of transactional websites. The results of estimation on the structural equation for IB adoption indicate a coefficient

on the fitted value of InASSTAVE of (- 0.1445) (Table 7.3, column 3). An increase in average bank assets is associated with a fall in the odds ratio for transactional website adoption. This observation is consistent with the theoretical model, which implies a rise in the adoption rate. In the structural equation for average bank assets (Table 7.3, column 4), the coefficient on the fitted value of lnTRANSAVE*GINIASST is also negative, as expected, though not statistically different from zero. However, there should be confidence with the negative effect. Since the simple OLS regressions in Table 7.5 have shown that zero effect is not consistent with the data and consistently negative coefficient estimates are gotten using all alternative regressions. Moreover, when adoption rates are measured using all websites (informational or transactional), the coefficient turns statistically significant (Table 7.6, column 5).

Estimates show strong persistence in the asset size distribution across banks adopting internet banking. The estimated positive coefficient on lnASST98 (Table 7.3, column 4), which is statistically different from zero, implies that the average bank assets in 1998 is a good predictor of average assets in 2007 and 2008.Fifth, the research sought to find out if the average bank assets in 1998 are a good predictor of average banks assets in 2007 and 2008.

Second, the research sought to find out if non adopters' imitated early adopters' of internet banking. The results of analysis indicate a negative coefficient on InMITATE (Table 7.3, column 3). The result implies that the longer early adopters have had a

transactional website, the higher the non- adopters' internet banking adoption rate. According to (Comin & Hohijn, 2004), leadership of the early adopters may have helped prepare other banks and customers to use internet banking through lowering the adoption cost, financially or perceptionally.

On the relationship between a bank's specialization in consumer lending and bank assets, the estimation results indicate a negative coefficient on InLNSPAVE in the asset equation (Table 7.3, column 4). However, the relationship between bank specialization in consumer lending and website adoption, the results of estimation show a significant negative coefficient on InLNSPAVE in the website adoption equation. The significant negative coefficient on lnLNSPAVE in the asset size equation (Table 7. 3, column 4) implies that greater specialization of banks in consumer lending is associated with a smaller average bank assets. Perhaps banks achieve greater average size with lending focused on other areas, such as commercial loans. The significant negative coefficient on lnLNSPAVE in the website adoption equation suggests that greater specialization of a bank in consumer lending is associated with a higher adoption rate. This is consistent with previous findings that early bank websites offered services aimed at retail customers and later added features useful to businesses (Sullivan, 2004).

The research sought to find out if competition between banks had an influence on IB adoption. Estimate of InDEPINTST shows a negative coefficient (Table 7. 3, column 3). However, when adopter rates are measured using all websites (Transactional and

Informational), a coefficient of (-0.2444) was reported (Table 7.6, column 4). Estimates suggest that competition among banks has a negative influence on IB adoption. Although the effect is not statistically significant, it turns significant when adoption rates are measured using all websites (informational or transactional) (Table 7.6, column 4).

Furthermore, the research sought to find the relationship between the average age of a bank and website adoption and asset size. The results of analysis indicate a positive coefficient on InAGEAVE. The average age of a bank is significantly related to both website adoption and asset size. The positive coefficient on website adoption equation implies that as the average age of a bank rises then the adoption rate falls. This result is consistent with previous findings that denovo banks were more likely to adopt internet banking than other banks (Furst, Lang & Nolle, 2000); Sullivan, 2000)). New banks may find it cheaper to install internet banking technology in a package with other computer facilities compared to older banks who must add internet banking to legacy computer system. Many new banks may also pursue consumers with demographics that favour internet banking and therefore, adopt appropriate technology (Wang, 2005).

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of the study was to describe factors that affect adoption of internet banking across commercial banks in Kenya. The study concludes:

i. On effect of average assets size on adoption of internet banking. Results of the study indicate that an increase in the average bank assets has a positive influence on the adoption of internet banking.

ii. On the influence of early adopters on non adopters to adopt internet banking. The results of the study implies the longer the early adopters have had a transactional website, the higher the non- adopters internet adoption rate.

iii. On whether loan specialisation in consumer lending has an impact on internet adoption. Loan specialisation in consumer lending is associated with a higher rate of interne adoption.

iv. On the influence of competition among banks on the adoption of internet banking. Estimate results suggest that competition among banks has a negative influence on the assets size of the bank and internet adoption rates.

v. Finally, on the effect of average age of a bank on the adoption of internet banking. The study that, as the average age of the bank rises then the adoption rate falls.

5.2 Recommendations

i. The average assets size of a bank has a positive influence on the adoption of internet banking. The study therefore recommends that non adopter banks should

strive to increase their average assets size in order to enhance their chances of taking full advantage of internet banking.

ii. The longer the early adopters have had a transactional website, the higher the non- adopters' internet adoption rate. The study recommends that leadership of early adopters help prepare other banks and customers to use IB through lowering the adoption cost, financially or perceptionally.

iii. Bank loan specialisation in consumer lending is associated with a higher rate of IB adoption. The study recommends that banks wishing to successfully adopt IB should specialize in consumer lending.

iv. Competition among banks has a negative influence on the assets size of the bank and internet adoption rates. The study recommends that commercial banks can feed off competition by merging or forming strategic alliances to spur IB adoption.

v. As the average age of the bank rises then the IB adoption rate falls. The study recommends that it's cheaper and convenient for new banks to install internet banking technology in a package with other computer facilities compared to older banks which must add IB to a legacy system. Also new banks may pursue consumers with demographics that favour internet banking and therefore, adopt appropriate technology.

5.3 Further Research

The main objective of the study was to find out factors affecting internet adoption by commercial banks in Kenya. This study focused only on the endogenous diffusion of internet banking in commercial banks. Thus, areas of further research are:

i. The replication of the study in other industries.

ii. A study should be done on performance characteristics, including costs and profitability, of early adopters of IB to find any differences from non-adopters.

iii. A study should be carried out to analyze the reverse effect of technology on banks performance.

Such studies could help in generalizations about internet and related technologies adoption in Kenya.

REFERENCES

Abernathy W. J. and J. M., (1998). Patterns of industrial innovation, *Technology review*, Vol 80.

Aguila-Obra, A.R.D., & Padilla-Melendez, A., (2006). Organizational factors affecting Internet technology adoption. Internet Research.

Akbulut, A.Y., (2002). An investigation of the factors that influence electronic information sharing between state and local agencies. Proceedings of 8th Americas Conference on Information Systems, Dallas, Texas, USA.

Beatty, R. C., Shim, J.P., & Jones, M. C., (2001). Factors influencing corporate web site adoption: a time-based assessment. *Information and management*, 38.

Barras R., (1986). Towards a theory of innovation in Services, *Research Policy*, vol. 10.

Channon D.F., (1998). The strategic impact of IT on the retail financial services industry, *The journal of strategic management information systems*, Vol. 7.

Choi, S. & Winston, A., (2000). Benefits and requirements for interoperability in electronic marketplace. *Technology in Society*, 22.

Chung, W. and Payter, J., (2002). An evaluation of internet banking in New Zealand. Proceedings of the 35th Hawaii International Conference on systems sciences.

Chwelos, P., Banbasat, I. & Dexter, A.S., (2001). Research report: empirical test of an EDI adoption model. *Information systems research*, 12(3).

Clarke, G.R., (2001). How enterprise ownership and foreign competition affect internet access in Eastern Europe and Central Asia. World Bank policy research working paper.

. Cohen, W., & Levinthal D., (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quaterly*.

Craig, P.B. & King, M., (1993). Small-firm computing: Motivators and inhibitors. *MIS quaterly*, 17(1).

Cooper J. R., (1998). A Multidimensional approach to the adoption of innovation, *Management Decision*, Vol. 36.

Cox et al., (2002). Patterns of innovation in UK based industries. *Journal of economics.*

Damanpour F. and Gopalakrishnan S., (2001). The dynamics of the adoption of product and process innovations in organizations. *Journal of management studies*.

Davis, F.D., (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quaterly,* 13(3).

Denzin, N. K., (1970). The research Act: A theoretical introduction to sociological methods. Chicago: Aldine.

Dixon, B. R., Bouma, G. D. and Atkinson, G. B. J., (1988). A handbook of social science research: A comprehensive and pPractical guide for students. Oxford: Oxford University Press.

Eads, G. M., (1984). Manipulation of innovation attributes and impact on attitude formation. dissertation abstracts international, 45, 2325A. (University Microfilms No. 84-26, 311). Ellul, J. (1964). *The technological society. New York: Vintage*

Eisenbesis R.A and Aspinwall R.A., (1985). Handbook for banking strategy. Library of Congress.

Fichman, R.G., (2000). The diffusion and assimilation of information technology innovations. In R.W. Zmud (Ed.) Framing the domains of IT management, Projecting the future through the past, (p. 105-127). Cincinnati: Pinaflex.

Fliegel, F. C., & Kivlin, J. F., (1962). Differences among improved farm practices as related to adoption. University Park, PA: Pennsylvania. *Agricultural experiment station research bulletin 691*.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W.C. (2004). Multivariate data analysis. New Jersey: Prentice Hall.

IMF., (2003). *Public Information Notice*.

Kamal, M.M., (2006). IT innovation adoption in the government sector: identifying the critical success factors. *Journal of Enterprise Information Management, 19(2), 192-222.*

Kaminsky G. and Reinhart C., (1999). The twin crises: The causes of banking and balance of payment problems. *American Economic Review*.

Kamel, S., (2006). Electronic business in developing countries, Opportunities and

challenges. Hershey: Idea Group.

Khangati N., (2006). Patterns of innovation in Kenya based industries (Unpublished MBA Project)

Khalfan, A.M. & Akbar Abdullah., (2006). Adoption an implementation obstacles of E-banking services: An empirical investigation of the Omani banking industry.

Kim, C. & Galliers, R.D., (2004). Towards a diffusion model for internet systems. internet research, 14(2).

Kimberly, J.R., & Evanisko, M.J., (1981). Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technology and administrative innovations. *Academy of management journal, 24(4).*

Kuan, K.K.Y., & Chau, P.Y.K., (2001). A perception-based model for EDI adoption in small business using a technology-organization-environment framework. *Information and Management, 38.*

Landau, S. & Everitt, B.S., (2004). A Handbook of statistical analyses using SPSS. New York: Chapman & Hall

Lacovou, C., Benbasat, I., & Dexter, A., (1995). *Electronic* data interchange and small organizations: Adoption and impact technology. *MIS Quaterly.*

Licker, P., & Motts, N., (2000). Extending the benefits of e-commerce in Africa: Exploratory phase. Proceedings of the First Annual Conference of the Globa IT Management Association, Memphis, Tennessee, USA.

May, T., (1998). Social research: Issues, methods and process. (2nd ed.). Buckingham: Open University Press.

Mbarika, V.W., Okoli, C., Byrd, T.A, & Datta, P., (2005). The neglected continent of IS research: A research agenda for Sub-Saharan Africa. *Journal of the association for information systems, 6(5).*

Mehrtens, J., Cragg, P.B., & Mills, A.M., (2001). A model of internet adoption by SMEs. *Information and management, 38.*

Mohr, L.B., (1969). Determinants of innovation in organizations. *The American political*

science review, 63, 111-26.

Molla, A., & Licker, P.S., (2005) e-commerce adoption in developing countries: a model and instrument. *Information and management, 42.*

Montealegre, R., (1996). Implications of electronic commerce for managers in developing countries. *Information technology for development, 7(3).*

Mushkin S. Frederic., (2001). "The economics of money, banking and financial markets", 6th Ed. Addison Wesley, US.

Mushkin F. and Strahan P., (1999). What will technology do to the financial structure? *Brookings- Wharton papers on financial services.*

Olmstead, Allan and Paul Rhode, (2001). " Reshaping the landscape: Impact and diffusion of the tractor in America Agriculture 1910-1960". *The Journal of economic survey.*

Omondi J., (2003). Adoption of automatic teller machines by retail banks in Kenya (Unpublished MBA Project)

Onwuegbuzie, A.J., & Leech, N.L., (2005). Taking the "Q" uut of research: Teaching research methodology courses without the divide between quantitative and qualitative paradigms.

Onwuegbuzie, A.J., & Teddlie, C., (2003). A framework for analyzing data in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.) *Handbook of mixed methods in social and behavioral research,* (p. 351-383). Thousand Oaks, CA: Sage.

Orlikowski, W.J., (1993). CASE tools as organizational change: Investigating incremental and radical changes in systems development. *MIS Quaterly, 17(3*).

Palacios, J.J., (2003). The development of e-commerce in Mexico: a business-led passing boom or a step toward the emergence of a digital economy? *The Information society, 19(1).*

Rai, A., & Patnayakuni, R., (1996). A structural model for CASE adoption behavior. *Journal of Management Information Systems, 13(2).*

Rogers, E.M., (1995): Diffusion of innovation (4th ed.) New York: The Free Press.

Rogers, E.M. and Kincaid, L., (1981): Communications networks toward a new paradigm for Research. New York: The Free Press.

Ryan, B. & Gross, N. C., (1943). The diffusion of hybrid seed corn in two Iowa communities. Rural Sociology (8) 15-24.

Sachs, S. G., (1993). The diffusion of innovations: The overlooked literature. Paper presented at the meeting of the Association for Educational Communications and Technology, New Orleans, LA.

Senn, J., (2000) Business-to-business e-commerce. Information systems management, Spring.

Shore, B., (1998). IT Strategy: The challenge of over-regulation, culture, and large scale collaborations. *Journal of global information technology management, 1(1), 1-4.*

Spanos, Y.E., Prastacos, G.P. & Poulymenakou, A., (2002). The relationship between information and communication technologies adoption and management. *Information and Management, 39, 659-675.*

Stiglitz, J.E., (1998). Economic organization, information, and development. In H. Chenery, and T.N. Srinivasan (eds.), Handbook of development economics.

Straub, D.W., (2000). Social and international issues. In foundations of net-enhanced organizations. New York: Wiley.

Stroh, M., (2000) Qualitative interviewing. In D., Burton (ed.) Research training for social scientists: A Handbook for postgraduate researchers. London: Sage Publications.

Silber, W. ,1975. *Financial innovation* (Lexington Books, Lexington, MA).

Surry W., (1997**)** Theory and instructional technology, New Mexico

Theodorson, G.A. and A.G. Theodorson, 1969: Modern dictionary of sociology. New York. Thomas Y. Crowell.

Thong, J., (1999). An integrated model of information systems in small businesses. *Journal of management systems, 15(4).*

Tolbert, P.S. & Zucker, L.G. (1983). Institutional sources of change in the formal structure of organizations: the diffusion of civil service reform, 1880-1935.

Administrative science quaterly, 28.

Uchupalanan K., (2000). Competition and IT-based innovation in banking services, *International journal of innovation management* Vol. 4.

Tufano P. Sylvan C., (2002). Financial innovation, *Harvard Business School*.

Turban, E., King, D., Lee, J., & Viehland, D., (2004). Electronic commerce: A managerial perspective. New Jersey: Pearson/Prentice Hall.

Vadapalli, A. & Ramamurthy, K., (1997). Business use of the internet: an analytical framework and exploratory case study. *International journal of electronic commerce, 2(2).*

Van Horne J. 2004.Financial innovation and excesses, *Journal of finance* Vol.40.

Wang Z., (2005) "Technology innovation and market turbulence: The impact and diffusion of the tractor in America agriculture 1910-1960". *The journal of economic history."*

Wyner, N. B. (1974). A study of diffusion of innovation: Measuring perceived attributes of an innovation that determine rate of adoption. Dissertation abstracts international, 35, 3583A. (University Microfilms No. 74-26, 628).

Zaltman, G., Duncan, R., & Holbek, J. (1973) Innovations and organizations. New York: John Wiley

Zwass, V., (2003) Electronic commerce and organizational innovation: Aspects and opportunities. *International journal of electronic commerce.*

APPENDICES

Appendix 1 Questionnaire for Bank Managers

I am a Master of Science (Finance) student at Kenyatta University carrying out research on "Factors hindering the Adoption of Technological Innovation among selected Commercial banks in Kenya".

You are humbly requested to answer the questions outlined here below as truthfully as you can. Please be assured that the information submitted will be treated in strict confidence.

Organization……. Institution No…….

Date of interview……..

A. Personal Information

(Tick where appropriate)

1. Level of Education

   O-Level ( ) University ( )

   College ( ) Post-Graduate ( )

   Others (Specify) _____

2. What is your position in the bank? …….
3. What is the age of your bank? …….
4. State the year when your bank first adopted informational website …….
5. State the year when your bank first adopted transactional website ……..
6. What is the total amount in cash transacted by the bank through the internet in the year 2007 Kshs……. and 2008 Kshs……
7. What the average wage per month for a teller in your bank? Kshs……
8. What the average wage per month for a computer analyst in your bank? Kshs….
9. What were your bank's total assets in the year 2007 Kshs…….. and in 2008 Kshs…….
10. What is your bank lending specialisation to consumers (consumer loans, family mortgages/ total loans)
11. What were your total deposits in the years 2007 Kshs…….. and 2008 Kshs……..

Appendix 2 Data Tables

Table 7. 1
Empirical Variables Definitions

Variable name	Definition	Source
TRANSAVE	Adoption rate for transaction web sites	
TRANODDS	Odds ratio for adoption of transactional web sites	
WEBAVE	Adoption rate informational & transactional web sites	
WEBODDS	Odds ratio for adoption of information and transactional web sites	
GINIASST	Gini coefficient for banks assets	
ASSTAVE	Bank assets	
METROAVE	Ratio of banks with concentration in metropolitan areas	
LNSPAVE	Specialisation of lending to consumer customers	
POPDEN	Bank customer base	Call Report
IMITATE	Years since the first adopted a transactional web site	Online Banking Report
AGEAVE	Age of banks	Call Report
INETADOPT	Household access rate for internet	Statistical Abstract of Kenya
WAGERATIO	Ratio of computer analyst to teller wage	Bureau of Labour Statistics
DEPINTST	Ratio of bank deposits	Call Report
ASST98	Bank assets in 1998	Call Report
YEAR	Year	

Table 7.2
Summary statistics

	2007					2008				
VARIABLE	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
TRANSAVE	32	0.573	0.166	0.277	1.000	32	0.671	0.169	0.353	1.000
TRANODDS	32	0.898	0.577	0.000	2.615	32	0.592	0.428	0.00	1.831
WEBAVE	32	0.757	0.167	0.443	1.000	32	0.813	0.153	0.471	1.000
WEBODDS	32	0.391	0.346	0.000	1.259	32	0.282	0.287	0.000	1.121
GINIASST	32	0.618	0.153	0.298	0.922	32	0.620	0.153	0.307	0.914
ASSTAVE*	32	Ksh 837.9	Ksh1, 648.0	Ksh 78.3	Ksh 9, 485.8	32	Ksh 799.5	Ksh 1,292.7	Ksh 85.1	Ksh 6, 023.8
METROAVE	32	0.759	0.190	0.264	1.000	32	0.763	0.190	0.264	1.000
LNSPAVE	32	0.365	0.120	0.130	0.609	32	0.355	0.120	0.124	0.591
POPDEN	32	187	256	1	1165	32	188	258	1	1173
IMITATE	32	6.700	1.111	4	9	32	7.700	1.111	5	10
AGEAVE	32	36.6	23.3	5.1	52.7	32	56.7	23.7	5.9	57.4
INETADOPT	32	57.999	5.868	43.549	69.422	32	63.956	5.564	50.673	73.493
WAGERATIO	32	3.024	0.243	2.343	3.464	32	3.058	0.250	2.520	3.699
DEPINTST	32	0.278	0.187	0.002	0.741	32	0.328	0.201	0.003	1.000
ASST98*	32	Ksh 292.0	Ksh 504.4	Ksh 29.6	Ksh 2,451.2	32	Ksh 292.0	Ksh 504.5	Ksh 29.6	Ksh 2,451.2
YEAR	32	2007	0	2007	2007	32	2008	0	2008	2008

Notes: Sample includes only 32 out of 46 banks that agreed to take part in the study. See Table 7.1 for variable definitions and sources.
* In millions

Table 7. 3

Simultaneous Equation Model of Adoption of Transactional Websites and Bank assets
Instrumental Variables Estimates

	Reduced Forms		Structural Equations	
Dependent variable:	lnTRANODDS*GINIAVE	lnASSTAVE	lnTRANODDS*GINIAVE	lnASSTAVE
lnASSTAVE (fitted)				-0.1445*
			(0.0725)	
lnTRANODDS*GINIAVE (fitted)				-0.3662
				(0.9122)
IniMITATE	-0.5661*	0.1401	-0.4852**	
	(0.2255)	(0.4804)	(0.2298)	
lnWAGERATIO	-0.3157	2.2477*	0.1127	
	(0.3830)	(1.1528)	(0.4299)	
lnASST98	-0.1482	0.7778***		0.6761***
	(0.0926)	(0.1554)		(0.1920)
lnDEPINTST	-0.0812**	-0.1239*		-0.1628
	(0.0320)	(0.0662)		(0.1028)
lnMETROAVE	-0.2434	0.2373	-.1904	0.1074
	(0.2387)	(0.4001)	(0.1925)	(0.4787)
lnLNSPECAVE	-0.2341	-0.4953	-0.3419*	-0.7074*
	(0.1497)	(0.4449)	(0.1910)	(0.4045)
lnAGEAVE	0.3795***	0.4946**	0.4183***	0.6718**
	(0.1335)	(0.2353)	(0.1230)	(0.3310)
lnPOPDEN	0.0734	0.2693*	0.1314*	0.3156**
	(0.0677)	(0.1579)	(0.0664)	(0.1316)
	(0.1345)	(0.2655)	(0.1425)	(0.2891)
YEAR	-0.0897	0.3355**	-0.0588	0.2523
	(0.0792)	(0.1572)	(0.0830)	(0.1989)
CONSTANT	183.89	-679.88**	121.09	-510.85
	(159.48)	(315.25)	(167.23)	(401.16)
Observations	32	32	32	32
R-squared	0.77	0.79	0.72	0.78

Robust standard errors in parentheses. See Table 7. 1 for variable definitions.
*significant at 10%; ** significant at 5%; ***significant at 1%.

Table 7.4

Simultaneous Equation Model of adoption of Transactional Websites and Average Bank Assets

Random Effects Model using Generalised Least Squares

	Structural Equations	
Dependent variable:	lnTRANODDS*GINIAVE	lnASSTAVE
lnASSTAVE (fitted)	-0.1449**	
	(0.0626)	
lnTRANODDS*GINIAVE (fitted)		-0.2222
		(0.7756)
lnIMITATE	-0.4760*	
	(0.2747)	
lnWAGERATIO	0.1526	
	(0.4484)	
lnASST98		0.8148**
		(0.2272)
lnDEPENTST		-0.0586
		(0.0852)
lnMETROAVE	-0.1896	0.5202
	(0.25260	(0.7227)
ln AGEAVE	0.4013***	0.6698**
	(0.1329)	(0.2671)
lnPOPDEN	0.1256*	0.1512
	(0.0729)	(0.2174)
lnINETADPT	-1.6154***	-2.1535*
	(0.6180)	(1.2558)
YEAR	-0.0599	0.1995
	(0.0772)	(0.1771)
Constant	123.44	-402.09
	(153.95)	(353.27)
Observations	32	32
R-squared	0.72	0.76

Standard errors in parentheses. See Table 7. 1 for variable definitions and sources.

* Significant at 10%;** significant at 5%; *** significant at 1%

Table 7.5

Single Equation Model of Adoption of Transactional Websites and Average Bank Assets
Ordinary Least Squares Estimates

Dependent variable:	lnTRANODDS*GINIAVE	lnASSTAVE
lnASSTAVE	-0.1339**	
	(0.0555)	
lnTRANODDS*GINIAVE		-0.5603**
		(0.2537)
lnMITATE	-0.4850**	
	(0.2310)	
lnWAGERATIO	0.0962	
	(0.4221)	
lnASST98		0.6491***
		(0.1810)
lnDEPINTST		-0.1778**
		(0.0823)
lnMETROAVE	-0.1987	0.0434
	(0.1899)	(0.4182)
lnLNSPECAVE	0.4143***	0.7114*
	(0.1864)	(0.4038)
lnAGEAVE	0.4143***	0.7114***
	(0.1208)	(0.2340)
lnPOPDEN	0.1292*	0.3213*
	(0.0659)	(0.1358)
lnINETADPT	-1.6011***	-3.5946***
	(0.5312)	(1.2315)
YEAR	-0.0620	0.2237
	(0.0843)	(0.1576)
Constant	127.46	-452.36
	(169.87)	(316.69)
Observations	32	32
R-squared	0.72	0.78

Robust standard errors in parentheses. See Table 7.1 for variable definitions.
*significant at 10%; ** significant at 5%; ***significant at 1%.

Table 7. 6

Simultaneous Equation Model of Adoption of Informational or Transactional Websites and Average Bank assets
Instrumental Variables Estimates

	Reduced Forms		Structural Equations	
Dependent variable:	lnTRANODDS*GINIAVE	lnASSTAVE	lnWEBODDS*GINIAVE	lnASSTAVE
lnASSTAVE (fitted)				-0.2498**
			(0.0969)	
lnTRANODDS*GINIAVE (fitted)				-1.3587**
				(0.6613)
IniMITATE	-0.7578**	0.6417	-0.4311	
	(0.3371)	(0.5322)	(0.2710)	
lnWAGERATIO	-0.8403*	2.3330*	-0.1374	
	(0.4718)	(1.2836)	(0.4608)	
lnASST98	-0.3958***	0.8252***		0.2794
	(0.925)	(0.1637)		(0.2745)
lnDEPINTST	-0.1131***	-0.0923		-0.2444**
	(0.0381)	-0.0619)		(0.0990)
lnMETROAVE	0.2456	-0.2650	0.0059	-0.0596
	(0.2686)	(0.3894)	(0.2056)	(0.3855)
lnLNSPECAVE	-0.4597*	0.2990	-0.2441	-0.2741
	(0.2644)	(0.4228)	(0.2364)	(0.3705)
lnAGEAVE	0.5623**	-0.2981	0.3480	0.3646
	(0.2603)	(0.3564)	(0.2096)	(0.3946)
lnPOPDEN	0.0948	0.0210	0.0624	0.1352
	(0.0969)	(0.1357)	(0.0905)	(0.1061)
lnINETADPT	-1.7127**	-2.7048**	-2.6341***	-4.5636**
	(0.6644)	(1.2193)	(0.7277)	(1.6887)
YEAR	0.0431	0.2493	0.0934	0.2305*
	(0.0949)	(0.1517)	(0.0879)	(01278)
CONSTANT	-84.30	-494.01	-181.55	-450.68*
	(190.86)	(304.31)	(176.14.)	(256.47)
Observations	32	32	32	32
R-squared	0.86	0.85	0.86	0.87

Robust standard errors in parentheses. See Table 7. 1 for variable definitions.
*significant at 10%; ** significant at 5%; ***significant at 1%.

Table 7.7

Simultaneous Equation Model of adoption of Informational or Transactional Websites and Average Bank Assets
Random Effects Model using Generalised Least Squares
Structural Equations

Dependent variable:	lnWEBODDS*GINIAVE	lnASSTAVE
lnASSTAVE (fitted)	-0.2483**	
	(0.0716)	
lnWEBODDS*GINIAVE (fitted)		-0.6501
		(0.9309)
lnIMITATE	-0.3990	
	(0.2969)	
lnWAGERATIO	-0.1305	
	(0.4930)	
lnASST98		0.6611**
		(0.3060)
lnDEPENTST		-0.0649
		(0.0627)
lnMETROAVE	0.0039	0.1862
	(0.2558)	(0.7270)
lnLNSPECAVE	-0.2328	0.1087
	(0.2425)	(0.4685)
ln AGEAVE	0.3414*	0.1941
	(0.2007)	(0.4911)
lnPOPDEN	0.0549	0.0012
	(0.0877)	(0.2290)
lnINETADPT	-2.5128***	-2.8287
	(0.6658)	(1.7299)
YEAR	0.0690	0.1991
	(0.0851)	(0.1518)
Constant	-132.74	-395.12
	(170.62)	(303.41)
Observations	32	32
R-squared	0.86	0.87

Standard errors in parentheses. See Table 7. 1 for variable definitions and sources.
* Significant at 10%;** significant at 5%; *** significant at 1%

Table 7. 8

Simultaneous Equation Model of adoption of Informational or Transactional Websites and Average Bank Assets
Random Effects Model using Generalised Least Squares
Structural Equations

Dependent variable:	lnWEBODDS*GINIAVE	lnASSTAVE
lnASSTAVE (fitted)	-0.2863***	
	(0.071)	
lnWEBODDS*GINIAVE (fitted)		-0.9019**
		(0.1504)
lnIMITATE	-0.4128	
	(0.2619)	
lnWAGERATIO	-0.0632	
	(0.4412)	
lnASST98		0.4478**
		(0.1751)
lnDEPENTST		0.1977***
		(0.0672)
lnMETROAVE	0.0218	-0.1141
	(0.2037)	(0.3464)
lnLNSPECAVE	-0.2521	-0.2166
	(0.2359)	(0.3522)
ln AGEAVE	0.3443	0.2234
	(0.2098)	(0.3037)
lnPOPDEN	0.0654	0.1331
	(0.0885)	(0.1034)
lnINETADPT	-2.6904***	-3.8292***
	(0.6870)	(1.2059)
YEAR	0.0981	0.2565**
	(0.0849)	(0.1265)
Constant	-190.46	-505.75*
	(170.26)	(253.72)
Observations	32	32
R-squared	0.86	0.88

Standard errors in parentheses. See Table 7. 1 for variable definitions and sources.
* Significant at 10%;** significant at 5%; *** significant at 1%

Table 7. 9
Mean Values of Selected Variables by Classification 2007

VARIABLE	'BIG' BANKS	'SMALL' BANKS
TRANSAVE	0.686	0.522
TRANODDS	0.487	0.992
WEBAVE	0.894	0.718
WEBODDS	0.121	0.409
GINIASST	0.691	0.677
ASSTAVE*	Ksh 2,536.5	Ksh 568.6
METROAVE	0.958	0.690
LNSPAVE	0.42	0.446
POPDEN	565.8	132.4
IMITATE	7.20	7.00
AGEAVE	31.75	29.13
INETADOPT	60.84	52.11
WAGERATIO	3.21	3.01
DEPINTST	0.274	0.313
ASST98*	Ksh 1,080.0	Ksh 136.5
Obs.	6	15

Notes: See Table 7. 1 for variable definitions and sources. See Table 7. 2 for the average of variables