The Impact of Information and Communication Technology on Performance of Commercial Banks in Ethiopia

By
Girma Abebe

A Thesis Submitted to
The Department of Accounting and Finance
College of Business and Economics

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science in Accounting and Finance

Addis Ababa University
Addis Ababa, Ethiopia
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Advisor: Sewale Abate (PhD)

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Declaration

I declare that the thesis for the M.Sc. degree in accounting and finance at the University of Addis Ababa, hereby submitted by me, is my original work and have not previously been submitted for a degree at this or any other University, and that all references materials contained therein have been duly acknowledged.

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Certification

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by Girma Abebe, entitled: The Impact of Information and Communication Technology on Performance of Commercial Banks in Ethiopia and submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Accounting and Finance compiles with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

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_____

Chair of Department of Graduate Program Coordinator

Abstract

Information and communication technology has become the heart of banking industry, while the banking industry is the heart of the economy. This research has considered a critical literature review of previous researchers with the objective to examine the impact of Information and Communication Technology on banks performance. Business organizations, especially the banking industry is operating in a complex and competitive environment characterized by the changing conditions and highly unpredictable economic climate with Information and Communication Technology (ICT) is at the center of the change curve. This study assessed the impact of ICT on the performance of Ethiopian banking industry using secondary data over the period 2010 – 2014 published annual reports by the banks. Data analysis is carried out in panel environment. The study employed purposive sampling technique to select the required sample of banks from commercial banks in Ethiopia. The results were affirmed by cointegration regression analysis. Six banks, out of the 18 commercial banks as of June 2014, were selected for the study. The dependent variable used in this study in order to measure the sample commercial banks performance is ROA whereas the explanatory variables are ICT investment, ATM, POS, INF, BRAN and GDP. The study empirically analyzed the impact of information and communication technology in commercial banks performance in Ethiopia by constructing an econometric model to study the effect of various factors such as ICT investment, ATM, POS, INF, BRAN and GDP. Accordingly, the impacts of ICT on return on asset in commercial banks in Ethiopia were analyzed using the OLS technique. The regression result showed that the ICT, ATM and POS have no statistically significant effect on return on asset on commercial banks in Ethiopia. Based on the research findings and conclusions the researcher recommended for commercial banks in Ethiopia to improve return on asset, the banks should improve more on its information and communication technology so as to enhance their performance, enlightenment has to be given to the general public through the various media on how to use some of the information technology, ATM and POS. Finally, banks should put more effort in advertising these products in Ethiopia.

Key words: Bank's Performance, Banking Industry, ICT and Return on Asset.

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Tables of Contents

Declaration i
Certification ii
Abstract iii
Acknowledgements iv
Tables of Contents v
List of Tables viii
List of Figures ix
List of Acronyms and Abbreviations x
Chapter One 1
1. Introduction 1
1.1. Background of the Study 1
1.2. Statement of problem 2
1.2. Objectives of the Study 3
1.3.1. General Objective 3
1.3.2. Specific Objectives 3
1.3. Research Hypothesis 3
1.4. Significance of the Study 4
1.5. Scope of the Study 4
1.6. Limitation of the Study 4
1.7. Operational Definition 5
1.8. Outline of the Thesis (Details of Chapters) 5
Chapter Two 7
2. Review of Related Literature 7
2.1. Theoretical Review 7
2.1.1. ICT Theoretical Background 8
2.1.2. Role of ICT in the Banking Industry 9
2.1.3. ICT in Ethiopian Banking Industry 13
2.1.4. ICT and Banks Performance 13
2.2. Empirical literature 18

2.2.1. Related Empirical Studies in the World 19
2.2.2. Related Empirical Studies in Africa 21
2.2.3. Related Empirical Studies in Ethiopia 23
2.4. Summary and Knowledge Gap 23
2.5. Conceptual Framework 24
Chapter Three 26
3. Research Design and Methodology 26
3.1. Research Design 26
3.2 Target Population 27
3.3. Sample size and sampling Design 27
3.4. Sources of Data 28
3.5. Model Specification 28
3.5. Definition and Measurement of Variables 29
3.5.1. Dependent Variables 30
3.5.2. Independent Variables 30
3.6. Hypothesis 32
3.7. Operationalization of Study Variables 33
3.8. Data Analysis Methods 34
3.9. Diagnostic test procedure 34
3.10. Choice of Random Effects (RE) Model or Fixed Effects (FE) Model 37
Chapter Four 38
4. Results and Discussion 38
4.1. Summary Statistics 38
4.2. Correlation Analysis 40
4.3. Econometric Analysis 41
4.3.1. Diagnosis Tests 41
4.3.2. Choosing Random Effect (RE) Versus Fixed Effect (FE) Models 46
4.3.3. Results of the Regression Analysis 46
4.3.4. Research Hypothesis and Interpretation of the Regression Results 49
4.3.5. Summary of Research Findings 51

Chapter Five 53
5. Conclusion and Recommendation 53
5.1. Conclusion 53
5.2. Recommendation 53
5.3 Further Research 54
References 55
Appendices 60

List of Tables

Table 2.1. Number of Banks and their Branches in Ethiopia ……7
Table2.2. Delivery platform available for electronic banking…….…….12
Table 3.1. Definition of Variables, symbols and Expected Signs……....30
Table 4.1: Summary Statistics – Dependent and Independent Variables…….36
Table 4.2 Correlation Matrix of Dependent and Independent Variables …….…….....37
Table 4.3: Heteroskedasticity Test: Breusch-Pagan-Godfrey…….……...…39
Table 4.3: Correlations matrix of explanatory variables……...42
Table 4.5. Hausman specification test……...43
Table 4.6. The Result of Random Effects Model for Regression Results…….……44
Table 4.7 Summary Hypothesis Testing ……....45

List of Figures

Figure 4.1. Rejection and Non-Rejection Regions for DW Test……...40
Figure4.2. Normality test for residuals……...41

List of Acronyms and Abbreviations

ADCG:	African Development Consulting Group
ATM:	Automated Teller Machine
BRAN:	Number of Branches
CLRM:	Classical Linear Regression Model
DP:	Data Processing
EFT:	Electronic Fund Transfer
GDP:	Gross Domestic Product
ICT:	Information and Communication Technology
INF:	Inflation Rate
IT:	Information Technology
LAN:	Local Area Network
NBE:	National Bank of Ethiopia
NPM:	Net Profit Margin
OLS:	Ordinary Least Squares
PC:	Personal Computer
POS:	Electronic Points of Sale
ROA:	Return on Asset
ROE:	Return on Equity
WAN:	Wide Area Network

Chapter One

1. Introduction

This chapter begins with discussing background of the study that gives some insight on the issues of information and communication technology (ICT). After giving some insights on the issues of ICT, statement of the problem part that shows the direction of the study, justifies the reason to carry out this study. Following this, both general and specific objectives of the study, the research hypothesis those tested against the econometric and descriptive statistics results are presented. Lastly, the subsequent section presents significance of the study, scope and limitation of the study, organization of the paper and ethical issues respectively.

1.1. Background of the Study

Today's business environment is very dynamic and experiences rapid change as a result of creativity, innovation, technological changes, increased awareness and demands from customers. Business organizations, especially the banking industry operates in a complex and competitive environment characterized by dynamic changing conditions and highly unpredictable economic climate with information and communication technology.

The role of ICT in the banking industry became of interest to this study due to the significance role it plays in the economy by stimulating economic growth through the intermediation of funds to economic agents that need them for productive activities. This function is very vital for any economy that intends to experience meaningful growth because it makes arrangement that bring borrowers and lenders of financial resource together and more efficiently too than if they had to relate directly with one another. (Adam, 1998)

Hence, the objective of this study is to examine the role of information and communication technology in ensuring efficient service delivery in the banking industry as a strategy for the actualization of the profit maximization objectives of banks.

The history of modern money in Ethiopia is traced back more than 2000 years (Pankhust 1968 cited in Alemayehu, 2006).

Modern banking in Ethiopia was started in 1905 with the establishment of Abyssinia Bank which was based on a fifty-year agreement with the Anglo-Egyptian National Bank. In 1908 a new development bank (called Socite Nationale d'Ethiope Pour le Development de Agriculture et du Commerce) and two other foreign banks (Banque de 1'Indochine and the Compagnie de 1'Afrique Orientale) were also established. These banks were criticized for being wholly foreign owned. In

1931 the Ethiopian government purchased the Abyssinian Bank, which was the dominant bank, and renamed the Bank of Abyssinia – the first nationally owned bank in Africa. (Pankhust 1968 cited in Alemahehu, 2006).

Banking activity was expanded during Italian occupation from 1936 to1941.After independence; Barclays Bank was established and remained in business in Ethiopia from 1941 to 1943. Following this, in 1943 the Ethiopian government established the State Bank of Ethiopia. The State Bank of Ethiopia was operating as both a commercial and a central bank until 1963when it was remodeled in to National Bank of Ethiopia and the Commercial Bank of Ethiopia (Gedey 1990 cited in Alemahehu, 2006).

At the end of 2013/14 fiscal year, there are eighteen commercial banks operating in Ethiopia, of these sixteen are private commercial banks while the rest two are state owned banks. Despite a rapid increase in the number of financial institutions since financial liberalization, the Ethiopian banking system is still underdeveloped compared to the rest of the world (Birritu, 2015).

1.2. Statement of problem

One of the challenges confronting e-banking could be classified in to three classes as human, operational and technical constraints. The human constraints include physical disability, poor sight, illiteracy and aging. The operational constraints include insecurity of funds transferred, frauds and standardization of channels. The technical constraints are centered on the lack of supporting infrastructure such as erratic electric supply, independence and lack of encryption on short messages system (SMS) messages (Agbada, 2008).

Other identified problems that can have an impact on the banks in the adoption of ICT can be grouped broadly as physiological and behavioral. These include consumer awareness, security, accessibility to computers, reluctance to change, the cost of adoption, and preference for personalized services among others.

Additionally, diffusion of smart card innovation needs high investment for the upgrade of ATMs and EFT/POS terminals to be capable of accepting smart cards and presumably a substantial investment in adding smart card technology for mobile computers and telephony stand to be another challenge.

Coupled with the problems is a situation where a bank issues an individual debit card that is associated with an account with a line of credit and is also an ATM debit card, the individual can perform a number of different types of transactions with the same card. The line of credit could be

accessed fraudulently, where the owner has resource under consumer credit legislation and under regulation if the fraud involves an electronic fund transfer (EFT). When automated teller machines (ATMs) or electronic points of sale (POS) terminals are used, his liability is limited under the electronic fund transfer agreement. If, however, the fraudulent use of the card directly debits his bank account in a paper-based transaction, the consumer has no recourse under current legislation. This is an example where the same card represents three different instruments, each of which, in the case of fraud, would require different actions by the consumer (Agbada, 2008).

In order to investigate the impact of ICT on bank performance in addition to problems identified, this study intends to investigate the following question:

To what extent does ICT improve bank performance with reference to the selected commercial banks in Ethiopia?

1.2. Objectives of the Study

1.3.1. General Objective

The general objective of the study was to analyze the impact of ICT in enhancing the performance of banking operations with reference to selected commercial banks in Ethiopia.

1.3.2. Specific Objectives

Specific objectives of the study were:

i. To evaluate the effects of ICT on bank's profitability
ii. To assess the contribution of macroeconomic factors on banks ICT and bank's profit

1.3. Research Hypothesis

Based on the research objectives stated above, the following research hypothesis will be developed:

H1: POS has no significant relationship on commercial bank's bank performance.

H2: ATM has no significant relationship on commercial bank's bank performance.

H3: ICT has significant effect on commercial bank's bank performance.

H4: Number of branch has significant effect on commercial bank's bank performance.

H5: Inflation has no significant effect on commercial bank's bank performance.

H6: GDP has significant relationship on commercial bank's bank performance.

1.4. Significance of the Study

Introduction of new technologies allowed banks to new channels of services such as ATM facility, internet banking and mobile banking. But not many studies have been conducted to evaluate if banks utilize ICT properly.

The finding of this study, which details with the impact of information and communication technology in commercial banks in Ethiopia, is beneficial for different stakeholders such as banking industry and researchers as follows.

For National Bank of Ethiopia, the finding of this study might be used as directive input in developing regulatory standards regarding the ICT policies of commercial banks of Ethiopia. In addition, this study will initiate the commercial bank's management to give due emphasis on the management of these identified variables and provides them with understanding of activities that will enhance ICT usage performance.

Furthermore, the findings of this study initiate researchers for further studies. Lastly, this study serves as reference for other researchers in related area. Thus, it can minimize the literature gap in the area of study particularly in Ethiopia.

1.5. Scope of the Study

Specifically, the study intends to investigate the use and development of some classes of ICT applications namely; automated teller machine (ATM), point of sales (POS) among others and their impact on selected commercial banks performance. The study covers the period from 2010 to 2014.

The study of this nature is normally faced with lack of accessibility to data because most of the data are classified and considered to be a confidential in nature. However, this limitation would be overcome by relying on officials in the bank that is capable of furnishing the required information by virtue of their ranks and files. The data obtained is expected to serve the purpose of the analysis. Data obtained from published reports and banks' officials are expected to serve as the basis for this analysis.

1.6. Limitation of the Study

Specifically, the study intends to investigate the use and development of some classes of ICT applications namely; automated teller machine (ATM), point of sales (POS) among others

and their impact on selected commercial banks performance. The study covers the period from 2010 to 2014.

The study is faced with lack of empirical data in Ethiopia. However, this limitation would be overcome by relying on data in the bank that is capable of furnishing the required information. The data obtained is expected to serve the purpose of the analysis. Data obtained from published reports and banks' officials are expected to serve as the basis for this analysis.

1.7. Operational Definition

Electronic Banking: Electronic banking is the use of computers and telecommunications to enable banking transactions to be done by computer or telephone instead of human interaction. It is the delivery of banking products and services to the customers and general public electronically through the use of electronic banking instruments or products like Automated Teller Machine (ATM) and point of sales (POS) among others.

Information and Communication Technology (ICT): Convergence of telecommunications and computer technology is generally defined as information and communication technology (Laudon, 2001).

Automated Teller Machine (ATM): ATM is a computerized telecommunications device that provides bank customers with self-service access to their financial accounts (Myllynen, 2009).

Point of Sale (POS): are varieties of services rendered through machines located at retail establishments Malak (2007).

1.8. Outline of the Thesis (Details of Chapters)

The thesis consists of five chapters. Chapter one provides important introductory issues, which include background of the study, statement of the problem, basic research questions, objectives of the study, and significance of the study. The chapter also provides definitions for basic terminologies and ends by indicating the overall structure of the thesis.

Chapter two deals with literature review on the areas of information and communication technology and its impact on commercial banks.

Chapter three deals with research methodology.

Chapter four deals with data presentation, analysis and discussion based on information obtained from primary data through questionnaire and secondary data from audited financial statements of the selected banks.

The thesis was then concluded by chapter five, which summarizes the main findings, draws conclusions and suggests recommendations regarding shortcomings and other issues that need remedies.

Chapter Two

2. Review of Related Literature

This chapter starts with presenting the overview of banking system in Ethiopia. Besides, information and communication technology and its impact on commercial bank's performance were presented. Following this, empirical studies are reviewed by focusing on ATM, POS and ICT infrastructure. Then after, the knowledge gaps from the reviewed literatures are outlined.

2.1. Theoretical Review

Ethiopian banking history, in its modern sense, began towards the end of the reign Emperor Menilek. This period witnessed the establishment of the country's first bank, called Bank of Abyssinia, which was an affiliate of the National bank of Egypt, and was founded in 1905 (Pankhurst,2012).

Currently, banking sectors in Ethiopia is showing progressive development in terms of number of branches, total assets and human resource utilization. Thus, currently number of banks in Ethiopia reached nineteen as shown in the following table.

Table 2.1. Number of Banks and their Branches in Ethiopia as of June 30, 2014.

No.	Name of Bank	Number of Branches	% Market Share	Year of Establishment
1	Commercial Bank of Ethiopia	856	38.8	1963
2	Construction and Business Bank	115	5.2	1975
3	Development Bank of Ethiopia	32	1.4	1969
4	Awash International Bank	152	6.9	1994
5	Dashen Bank	142	6.4	1995
6	Abyssinia Bank	109	4.9	1996
7	Wegagen Bank	100	4.5	1997
8	United Bank	99	4.5	1998
9	Nib International Bank	94	4.3	1999

10	Cooperative Bank of Oromia	105	4.8	2004
11	Lion International Bank	62	2.8	2006
12	Oromia International Bank	109	4.9	2008
13	Zemen Bank	9	0.4	2008
14	Bunna International Bank	63	2.9	2009
15	Berhan International Bank	48	2.2	2009
16	Abay Bank	70	3.2	2010
17	Addis International Bank	21	1.0	2011
18	Debub Global Bank	19	0.9	2012
19	Enat Bank	3	0.1	2012

Source: National Bank of Ethiopia Annual Report, 2013/14

2.1.1. ICT Theoretical Background

Information and Communication Technology is a combination of information and technology. It merges computing with high speed communication link carrying data, sound and video. It deals with the collection, storage, manipulation and transfer of information using electronic means. Communication technology refers to the physical devises and software that link various computer hardware components and transfer data from one physical location to another (Laudon, 2001).

ICT refers to a wide range of computerized technologies that enables communication and the electronic capturing, processing and transmission of information. These technologies include products and services such as desk top computers, laptops, hand held devices, wired or wireless intranet, business productivity software, data storage and security, network security etc. With the use of ICT, businesses can interact more efficiently and enables businesses to be digitally networked. With the use of ICT, the time constraint and distance barrier to accessing relevant information is eliminated or drastically reduced hence it improves coordination of activities with in organizational boundaries (Spanos et al., 2001).

2.1.2. Role of ICT in the Banking Industry

Information and Communication Technology has become the heart of banking industry, while banking industry is the heart of the economy. ICT has created a new infrastructure for the world economy to become truly global and also provided the users of new technology a competitive advantage over their rivals. Electronic banking system has become the main technology driven revolution in conducting financial transactions. However, banks have made huge investments in telecommunication and electronic systems, users have also validated to accept electronic banking system as useful and easy to use (Adesina and Ayo, 2010).

Castells (2001) reveals that, now transactions worth billions of dollars can only take place in seconds in the electronic circuit throughout the globe by pressing a single button. Although ICT has revolutionized the way of living as well as conducting businesses and study of banking industry has received increased attention over the last decade, it continues to pose challenges for marketers and academic alike.

Imran et. al., (2012) investigated the role of ICT on the efficiency of the bank and also explored the relationship between the investment in ICT and bank efficiency measures. The result showed that investment in information systems is contributing new products and services. These are the major benefits of investment in ICT which are propelling many banks to invest in ICT.

According to Loonam et. Al., (2008), ICT advancements, globalization, competition and changing social trends such as heightened customer proactivness and increased preferences for convenience have caused intense restructuring of the banking industry.

Evidence from previous empirical studies indicates that ICT has a positive impact on banks' financial performance, owning to multitude of benefits it offers its users and provides alike. The decision to provide on line services is currently perceived as vital for customer retention and maintaining competitive advantage (DeYoung and Duffy, 2002).

The benefits of application of ICT in the enhancement of banking services is not only limited to cost reduction benefits alone, the innovation is found also to have significant contribution to giving access to customers residing outside the branch network and create opportunities for effectiveness (Spanos et al., 2001).

In the conducted to examine technological progress and its effects in the banking industry, Berger et al. (2003) find that ICT investment leads to improvements in costs. The improvement

was hinged on productivity increase in form of improved "back-office" technologies which is in form of organization related benefits such as reduced costs of operation as well as improved "front-office" technologies which is in form of benefits to customers such as improved quality and variety of banking services.

The modernization of ICT has set the stage for extraordinary improvement in banking procedures throughout the world. For instance, the development of worldwide networks has considerably decreased the cost of global funds transfer. Berger (2003) reveals banks that are using ICT related products such as online banking, electronic payments, security investments, information exchanges, financial organizations can provide high quality customer service delivery to customers with less effort.

Considering the dynamism in the drivers of the economies across the globe, it is notable that the world has moved currently to a knowledge based economy of which the ICT has become one of the principal driving forces. The effects of ICT are seen in the improvements in productivity and economic growth at the level of the firm and the economy overall (Stiroh, 2002).

Interestingly, ICT in particular play an important role in the financial industry and this is one reason why the banking sector is among the most intensive industries deploying ICT. With the increase of internet services and cash machines available in various locations, the most recurring problems have been mitigated and in some cases, solved; as an effect, the volume of customers' services increased became easier, and the customer experience turned out to be more comfortable. It is noticeable that the new technologies, particularly in ICT, enabled banks to service customer not only in branches and other dedicated servicing cites, but also in domiciles, work places and stop and shop stores, as well as in a myriad of other channels (Al-Hawari et. al.,2005).

However, to successfully cope with the challenge of the ICT, the banking sector must understand the nature of the changes that revolves around them, changes in terms of ICT, innovation and demography. Without this understanding, attempts to mitigate to ICT may be doomed to failure. Today, banks that are well equipped with a good grasp of the electronic banking phenomenon will be able more to make informed decision on how to transform ICT and to exploit the opportunity in electronic banking. In today's competitive market, establishing core capabilities can help the banking industry reorganize their product and customer service delivery,

so as to sustain competitive advantages and to achieve congruence whilst shifting from the conventional banking to electronic banking (Southard et. al., 2004).

ICT revolution has distorted the conventional banking business model by making it possible for banks to break their comfort zones and value creation chain so as to allow customer service delivery to be separated in to different businesses. Thus, for example, primarily internet banks distribute insurance and securities as well as banking products produced by their group (Delgado and Nieto, 2004).

However, the main economic argument for diffusion of adopting the internet as a delivery channel is based on the expected reduction in overhead expenses made possible by reducing and ultimately eliminating physical branches and their associated costs. The internet delivery channel may generate scale economies in excess of those available to traditional distribution channels (Delgado et al, 2004).

Apparently, ICT creates unprecedented opportunities for the bank sector in the ways they organize financial product development, delivery, and marketing via the internet. While it offers new opportunities to bank sector, it also brings many challenges such as the innovation of ICT applications, the blurring of market boundaries, the breaching of industrial barriers, the entrance of new competitors and appearance of new business models (Cheung et al., 2003).

The revolution in ICT has made the banking sector changed from the traditional mode of operations to presumably better ways with technological innovation that improves efficiency. ICT can enhance efficiency via its use and in recent times banks have been encouraged by the rapid decline in the price of ICT gadgets. This has perhaps increased the bank level of ICT usage (Ovia, 2005).

The convergence of computer and telecommunication after about four decades of applying computers to routine data processing, mainly in information storage and retrieval, has created a new development where information has become the engine of growth around the world. This development has created catch up opportunities for developing countries to attain desired levels of development without necessarily reinventing the wheels of economic growth. This new technology has brought far reaching revolution in societies, which has tremendously transformed most business (banking) scenes (Ovia, 2005).

Electronic banking is a high order construct, which consists of several distribution channels. It should be noted that electronic banking is a bigger platform than just banking via

internet. However, the most general type of electronic banking is banking via internet, in other words internet banking. The term electronic banking can be described in many ways. In very simple form, it can mean the provision of information or services by a bank to its customers, via a computer, television, telephone or mobile phone. It can be described as an electronic connection between bank and customer in order to prepare, manage and control financial transactions. Internet banking allows consumers to access their bank and accounts to undertake banking transactions (Daniel, 1999).

Furthermore, electronic banking is said to have three different means of delivery: telephone, personal computer and the internet. Daniel (1999), for example, introduces four different channels for electronic banking: personal computer banking, internet banking, managed network and TV based banking.

According to Daniel (1999) electronic banking is the newest delivery channel in many countries and there is a wide agreement that the new channel will have a significant impact on the market. It offers the traditional players in the financial services sector the opportunity to add a low cost distribution channel to their numerous different services.

Table2.2. Delivery platform available for electronic banking

Types of Service	**Description**
PC Banking	Proprietary software, distributed by the bank, is installed by the customer on their PC. Access to bank via a modem linked directly to the bank.
Internet Banking	Access their bank via internet.
Managed network	The bank makes use of an online service provided by another party.
TV based	The use of satellite or cable to deliver account information to the TV screens of customers (also internet based).
Telephone banking	Customers access their bank via telephone (own personal ID and password required).
Mobile Phone banking (SMS, WAP,	Access with text message (SMS), internet

3rdgeneration)	connection or high sped 3rd generation mobile connection also internet based.

Source: Daniel, 1999

More and more banks adopted technology to deliver their services and this has resulted in reduced costs, the creation value added services for customers, the facilitation of their employees' jobs and ultimately, the provision self-service options for customers (Thu et al., 2002).

2.1.3. ICT in Ethiopian Banking Industry

According to Gardachew (2010) cited in Ayana (2014), the appearance of e-banking in Ethiopia goes back to the late 2001, when the largest state owned, Commercial Bank of Ethiopia (CBE) introduced ATM to deliver service to the local users. In addition to ATMs located Addis Ababa, CBE has had visa membership since November 14, 2005. But, due to lack of appropriate infrastructure it failed to reap the fruit of its membership. Despite being the pioneer in introducing ATM based payment system and acquired visa membership, CBE lagged behind Dashen bank, which worked aggressively to maintain its lead in e-banking.

2.1.4. ICT and Banks Performance

There is no doubt that commercial banks play an important role in the economic development of any nation. The need for efficiency and effectiveness in the performances of the banks as leading players in the financial services that the commercial banks provide a nation cannot be overemphasized. Recent advances in the technological world giving birth to the emergence of information and communication technology have led to remarkable changes in the ways businesses are running in contemporary times.

There are various literatures that approve positive impacts of information and communication technology on bank's performance. But, according to study conducted by Sullivan (2000) in Kansas USA, there is no systematic evidence that multi-channel banks in the 10th Federal Reserve District were either helped or harmed by having transactional web sites. These findings were among the previous findings of Sathye (2005), for the credit unions in Australian banks for the period of 1997 to 2001, that shows electronic banking has not proved to be yard stick for performance enhancing tool.

According to Haq (2005) banks' existence depend on their ability to achieve economies of scale in minimizing asymmetry of information between savers and borrowers. Today, one of the major challenges facing the banking industry is how ICT has helped banks to sustain the economies of scale whilst shifting from bricks and mortar banking to online banking.

As stated by DeYung et al. (2005), the internet delivery channel may generate scale economies in excess of those available to traditional distribution channels. In this context, DeYoung et al. (2005) refer to the internet banking as a "process of innovation that functions mainly as a substitute for physical branches for delivering banking services".

According to Hernando et al., (2007), the adoption of internet as a delivery channel involves a gradual reduction in overhead expenses. This effect is statistically significant after one and half year of adoption. The cost reduction translates in to an improvement in banks profitability, which becomes significant in terms of return on assets (ROA) and after three years in terms of return on equity (ROE).

The study was conducted by Eyadat et al., (2005), and evaluated the effects of ICT on gains efficiency and banks cost in American banks between 1992 and 2000. The study showed a positive relationship between level of ICT implementation and profitability of the bank's assets and costs reduction. However, efficiency has increased for all American banks but the cost efficiency was less than the benefit. This point reflects the fact that introduction of new banking services lead to increase revenues on the other hand offers new and higher expenses.

ICT Investment

According to McKenney (1995) the information and communication technology infrastructure of an organization comprises of its physical ICT asset stock. The business functionality of an organization depends on the reach and range of the stock of this resource. It is a major business resource and a key source for attaining long term competitive position.

Many researchers have studied the relationship between ICT investment and firm performance. Bitler (2001) investigated the relationship between information and communication technology and firms' performance. His study revealed that there is a significant performance difference between firms that adopt ICT and those that do not adopt the technology.

Automated Teller Machine (ATM)

Automated Teller Machine (ATM) is a device, which offers a range of services to users that are authorized by using a PIN-code. From a cash ATM, user is able to make payments, withdraw money or view account information (Myllynen, 2009).

ATMs have reduced costs per transaction to almost one-fourth as compared to almost the branches. ATMs support a variety of transactions such as cash withdrawal, cash deposits and placement of service requests, including the request for a new cheque book. New technology has facilitated the installation of ATMs in shopping malls or busy commercial localities and has further reduced the transaction and operation costs for banks (Sambamuthy et al., 2010).

The ATMs were one of the first ICT technologies to be used by banks and it has remained one of the most successful. The ATM is a computerized telecommunication device that provides bank customers with self-service access to their financial accounts. A prototype was first created in 1939, a modern ATM was patented in 1966, an ATM was installed in Barclays Bank in London in 1967 and the United States started productizing ATMs in 1968 (Bellis, 2010).

According to Koltveit et al. 2000, alternate delivery channels such as ATMs, Telephone Interactive Voice Response systems, and online banking are mature channels, but advance in ICT permit opportunities for enhancements even in these established technologies. Current popular alternate delivery channel technologies include service such as short message service (SMS) banking, text alerts, bill pay, automated clearinghouse, electronic payments, mobile banking, e-mail alerts and notifications, and online banking. These technologies are all relatively recent ICT enabled strategies that enhance performance.

As stated by Morsi (1996) banks are adding ATM functions such as on line loan applications, distribution of statements, dispensing of foreign currency, purchase of traveler's checks, and check cashing to attract customers.

Point of Sale (POS)

According to Malak (2007) cited in Ayana (2014) POS system allows consumers to pay for retail purchase with a check card, a new name for debit card. This card looks like a credit card but with a significant difference. The money for the purchase is transferred immediately from account to debit card holder to the store's account.

Inflation

As to (Herald & Heiko, 2008), inflation is one of the factors that determine commercial banks deposits. Fischer showed that in Latin America the effect of inflation on savings and time deposit to GDP was significantly negative (Mohammad & Mahdi, 2010).

The classical belief is that, because bank assets and liabilities are expressed in monetary terms and because these assets will normally grow in line with growth in money supply, banks are relatively immune from the effects of inflation (Devinaga, 2010). In brief, monetary policy works by controlling the cost and availability of credit. During inflation, the Central bank can raise the cost of borrowing and reduce the credit creating capacity of commercial banks. According to (Devinaga, 2010), this will make borrowing costlier than before and thereby the demand for funds will be reduced. Similarly, with a reduction in their credit creating capacity, the banks will be more cautious in their lending policies. Since the banks demand for fund decreases obviously the deposits will decrease. Banking system was affected by inflation in terms of deposit absorption and facilities grant (Mohammad & Mahdi, 2010). As to (Mohammad & Mahdi, 2010), in developed countries negative correlation between inflation and absorbed deposits and granted facilities has been documented. However, in developing countries the opposite is true.

Banking system as an important effective factor in economic performance has also been under the influence of inflation. As far as the effect of inflation on financial sector conceived the literature demonstrates that inflation affects the capacity of financial sector for optimal allocating of resources. That is as inflation rate increases, true yield rate of money and assets decreases; therefore, deposits are no longer attractive. Also the increase of inflation rate has a negative effect on the performance of financial sector through the market credits and in turn, on the performances of banks and capital markets and finally on the long term economic growth (Mohammad & Mahdi, 2010).

With respect to the effect of inflation on savings, it can be mentioned that in general, all individuals who save a part of their incomes in banks are directly damaged by the inflation and their assets decrease in proportion with money value decrease (Mohammad & Mahdi, 2010). In that case as (Mohammad & Mahdi, 2010) describes people try to change their cashes and savings to more reliable and stable forms such as land, jewelry, antiques, art collections, foreign currencies that causes to definite decrease in commercial bank's total deposit. High inflation

rates reduce the real value of deposits (M. A. Baqui & Richard L. Meyer, 1987). According to (M. A. Baqui & Richard L. Meyer, 1987), inflation technically did not decrease deposit; however, it decreases the value of deposits.

Number of Bank Branches

Studies conducted on determinants of bank profitability took bank size variable, as considered to an important determinants of bank performance Kosmidou (2008). If the relative size of a firm expands its market power and profits increases, this is the Market-Power (MP) hypothesis.

The availability of banking services in a country can be measured by the total number of bank branches. The good bank site occupies in the ability of the positive impact in attracting deposits. This is due to the difficulty of movement of people from one place to another, and the difficulties they face in traffic, distinct positions available and free for customer service to the line-up by car, where the applicant is interested in the bank's website and was approaching his location unlike the consumer, who is ready to move long distances in order to get the loan (Ali, 2002). Conveniently located bank branches can reduce transaction costs significantly and thereby increases the net return earned on deposits.

One of the most important questions underlying bank policy is which size optimizes bank profitability? Because there is no clear cut point which indicates the relation of appropriate bank size and its profitability. The effect of a growing size on profitability has proved positive to a certain extent. However, for banks that become extremely large, the effect of size could be negative due to bureaucratic and other reasons Athanasoglou et al. (2005).

The different studies regarding bank size concluded mixed emperical results. Some studies found economies of scale for large banks (e.g. Athanasoglou, 2006 South Eastern European banks and Kosmidou, 2008 on Greece banks,) and others concluded that disecomies scale for large banks due to possible bureaucratic bottlenecks and managerial inefficiencies or economics of scale for small banks (e.g. Athanasoglou et al., 2005 on Greece banks, Aburime, 2008 on Nigeria banks and Ngo, 2006 Australian bank). As extensive researchers pointed out the expected sign of bank size is ambiguous. Hence, the size-profitability relationship may expect to be non-linear. The researcher uses the natural logarithm of total assets as a proxy for bank size, while the square of the natural logarithm of total assets is included to capture any non-linearity's in the size-profit relationship.

Accourding to Belayneh (2011) research conducted on the determinants of commercial banks profitability during the period 2001 – 2010 concluded that the size of all Ethiopian commercial banks which is measured by log of total asset is increased for the last 10 years. In case of Ethiopian commercial banks, as the result implies that larger banks enjoy the higher profit than smaller banks in Ethiopia banking sector because they are exploiting the benefit of economies of scale. In the literature, asset and/or deposit base of banks have adopted as proxy for their size. At times, their market shares of assets and/or deposit have also used. The second set of measures, however, follows from the first. According Aburime (2008) investigation on Nigeria banking industry on the area of bank performance and supervision by adopted the data envelopment analysis approach founded that, the profitability of the bigger banks is significantly higher than that of the smaller banks.

2.2. Empirical literature

Under this section, previous empirical studies on the impact of ICT on the performance of commercial banks and related studies in developed and developing countries and Ethiopia will be reviewed.

Managers cannot ignore Information Systems because they play a critical role in contemporary organization. The application of information and communication technology concepts, techniques, policies and implementation strategies to banking services has become a subject of fundamental importance and concerns to all banks and indeed a prerequisite for local and global competitiveness. ICT directly affects how managers decide, how they plan and what products and services are offered in the banking industry. It has continued to change the way banks and their corporate relationships are organized worldwide and the variety of innovative devices available to enhance the speed and quality of service delivery.

Information and Communication Technology (ICT) is the automation of processes, controls, and information production using computers, telecommunications, software's and other gadget that ensure smooth and efficient running of activities. It is a term that largely covers the coupling of electronic technology for the information needs of a business at all levels. ICT has surpassed the role of support services or only electronic data processing; its fields of applications are slightly global and unlimited. Its devices especially the Internet and modern computer email facilities have further strengthened early modernizations like the telephone and fax. Other ICT devices include

data recognition equipment, factory automation hardware and services, telecommuting and teleconferences using real time and online system (Adeoti, 2005).

It is a concept that is having a remarkable effect on almost entire aspects of the human endeavors. This implies that it involves the application of principles to engage physical component in achieving an intended goal. The merging of computer and telecommunication after about four decades of applying computers to routine data processing, mainly in information storage and retrieval, has created a new development where information has become the engine of growth around the world. This development has created catch-up opportunities for developing countries to attain desired levels of development without necessarily reinventing the wheels‟ of economic growth. This new technology has brought far-reaching revolution in societies, which has tremendously transformed most business (banking) scenes (Ovia, 2005).

Information and Communication Technology (ICT) is the automation of processes, controls, and information production using computers, telecommunications, software and ancillary equipment such as automated teller machine and debit cards (Johnson 2005). Irechukwu (2000) lists some banking services that have been revolutionized through the use of ICT as including account opening, customer account mandate and transaction processing and recording. Communication technology deals with the physical devices and software that link various computer hardware components and transfer data from one physical location to another (Laudon and Laudon; 2001). ICT products in use in the banking industry include automated teller machine, smart cards, telephone banking, MICR, electronic funds transfer, electronic data interchange, electronic home and office banking (Akpan, 2008 and Johnson, 2005).

2.2.1. Related Empirical Studies in the World

Berger et al., (2003) examined technological progress and its effects in the banking industry using data collected from the banking industry in the United States over the period 1967 to 2001. The author employed multiple regression model, and the findings revealed that improvements in costs of lending capacity due to improvements in “back – office” technologies, as well as consumer benefits from improved “front office” technologies suggests significant overall productivity increases in terms of improved quality and variety of banking services.

Malhotra and Singh (2009) examined the implications of internet banking on the Indian banking industry using information drawn from a survey of 85 scheduled commercial banks’ websites, during the period June 2007, by applying multiple linear regression models. Results

revealed however, that profitability in the banking industry while offering internet banking does not have any significant association with their overall performance.

Dos Santos et. al., (1993) empirically studied the effects of early adoption of Automated Teller Machine (ATM) technology by banks on employee efficiency using a sample of 3,838 banks covering the period 1970 to 1979 by applying multiple regression models. The finding revealed that the introduction of ATM technology improves the bank's performance. Akram et. al., (2010) examined the effects of information and communication technology (ICT) on Jordanian banking industry for the period of 2003 – 2007. The authors used a sample of 15 banks to analyze the data obtained by applying multiple regression model and diagnostics test to check the normality and multicollinearity problems. The results of the study indicated that there is a significant impact on the use of ICT in Jordanian banks on the market value added (MVA) earnings per share (EPS), Return on Assets (ROA) and Net Profit Margin (NPM).

Kagan, et al., (2005) examined the impact of online banking applications on community bank performance in the United States using data collected from 1183 banks operating in Iowa, Minnesota, Montana, North Dakota, and South Dakota. The authors employed an econometric model (Structural Equation Model) for the data analysis. The findings of the study revealed that online banking helps community banks improve their earning ability.

Studies on the effects of ATMs on profitability provide evidence of cost savings and better services for customers. Survey of banks conducted by Katagiri (1989) in Japan and Shawkey (1995) in the USA revealed that investing in ATMs reduces banking transaction costs, the number of staff and the number of branches. Therefore, investing in ATMs increases the value of deposit accounts, which are cheaper in terms of costs of funds than other sources, such as borrowing money from other institutions, hence reducing the overall cost of funds. This suggests that there is a role for IT investment in the explanation of bank profitability.

Kozak (2005) analyzing the values of return on asset (ROA) and over the period of 1992 - 2003 found out that the value of the return on assets for the U.S, the banking sector has increased by 51 percent. This result suggests that IT improvements, associated with extensive office networks and range of offered services have helped to generate additional revenues for banks. For the same period much smaller reduction of the non-interest costs has been achieved. It means the value of cost efficiency fell by 13 percent. This means that a huge number of diverse operations require higher IT investments and additional non-interest charges. In order to assess relationships

between the degree of the IT progress, and the profitability (ROA) and cost efficiency, the regression analysis was used to achieve more precise statistical results.

Banking sector in Saudi Arabia has been examined by Ahmed and Khababa (1999). They used three measures of profitability as dependent variables; ROE, ROA and percentage change in earnings per share. On the other hand, they used four independent variables. These were: business risk measured by dividing the total loans of the bank by its total deposits, market concentration, the market size measured by dividing the deposits of the bank by the total deposits of the commercial banks under study and the size of the bank. The results of their findings indicated that the business risk and the bank size were the major determinants of the banks' performance.

2.2.2. Related Empirical Studies in Africa

Harold and Jeff (1995) contend that financial service providers should modify their traditional operating practices to remain viable in the 1990s and beyond, they claim that the most significant shortcoming in the banking industry today is a wide spread failure on the part of senior management in banks to grasp the importance of technology and incorporate it into their strategic plans accordingly. Woherem (2000) claimed that only banks that overhaul the whole of their payment and delivery systems and apply ICT to their operations are likely to survive and prosper in the new millennium. He advices banks to re-examine their service and delivery systems in order to properly position them within the framework of the dictates of the dynamism of information and communication technology. The banking industry in Nigeria has witnessed tremendous changes linked with the developments in ICT over the years.

Brucher, Scherngell et al., (2003) opined that ICT adoption will improves three critical domains which are efficiency, quality, and transparency in any organization**.** Agboola et al., (2002) discussed the dimensions in which automation in the banking industry manifest in Nigeria. They include: Bankers Automated Clearing Services: Automated Payment Systems, Automated Delivery Channels.

Ovia (2001) concluded that banking in Nigeria has increasingly depended on the deployment of Information Technology and that the IT budget for banking is by far larger than that of any other industry in Nigeria. He contended that On-line system has facilitated Internet banking in Nigeria as evidenced in some of them launching websites. He found also that banks now offer customers the flexibility of operating an account in any branch irrespective of which branch the account is domiciled.

Woherem (2000) revealed that Nigeria banks since 1980s have performed better in their investment profile and use of ICT systems than the rest of industrial sector of the economy. An analysis of the study carried out by African Development Consulting Group Ltd. (ADCG) on IT diffusion in Nigeria shows that banks have invested more on IT, have more IT personnel, more installed base for PCs, LANs, and WANs and a better linkage to the Internet than other sectors of the Nigerian economy. The study, however pointed out that whilst most of the banks in the west and other parts of the world have at least one PC per staff, Nigerian banks are lagging seriously behind, with only a PC per capital ratio of 0.18.

Ovia (2005) opined that the revolution in ICT has made the banking sector changed from the traditional mode of operations to presumably better ways with technological innovation that improves efficiency. ICT can enhance efficiency via its use and in recent times banks have been encouraged by the rapid decline in the price of ICT gadgets. This has perhaps increased the bank level of ICT usage. The increase might have also been attributable to business environment that became relatively flexible to accommodate new forms of technological change as a result of reforms in the country.

According to Wali (2010) the relationship between ICT and the various organizational activities is similar to government & civil servants while Governments outlines policies and civil servants execute those policies. ICT acts as a tool for the actualization of various organizational activities in order to implement and enforce policies.

Osabuohien, (2008) established that while the gender of the bank officials does not affect efficiency in ICT use, factors such as age, educational qualification, computer literacy and type of ICT gadgets, were significant in influencing banks‟ intensity of ICT usage. Also ICT was found to impact positively the speed of banking service delivery, as well as productivity and profitability. Banks should incorporate ICT into their strategic plans for effective performance in payment and delivery systems. This calls for proper analysis to determine the type, nature and extent of ICT products required for effectiveness and efficiency. It is imperative for bank management to intensify investment in ICT product to facilitate speed convenience and accurate service. Orhan (1997) observed the relevance of a modern information infrastructure to the economic and social well-being of a society as the quality of the information determines the effectiveness of any given choice. Wisdom, knowledge and information infrastructures promote dialogue between those holding various ideas.

2.2.3. Related Empirical Studies in Ethiopia

Some related studies are conducted by different researchers in different parts of the world. However, there are limited numbers of studies conducted in Ethiopia on the adoption of technological innovation.

Gardachew (2010) conducted research on the opportunities and challenges of E-banking in Ethiopia. The aim of his study was focused on analyzing the status of electronic banking in Ethiopia and investigates the main challenges and opportunities of implementing E-banking system. The author conducted a survey on the existing operating style of banks and identifies some challenges of using E-banking system, such as, lack of suitable legal and regulatory frame works for E-commerce and E- payments, political instability in neighboring countries, high rates of illiteracy and absence of financial networks that links different banks.

Wondwossen and Tsegai (2005) also studied on the challenges and opportunities of E-payments in Ethiopia; their objective was studying of E-payment practices in developing countries, Africa and Ethiopia. The authors employ interview and on site observation to investigate challenges to E-payment in Ethiopia and found that, the main obstacles to the development of E-payments are, lack of customers' trust in the initiatives, Unavailability of payment laws and regulations particularly for E-payment, Lack of skilled manpower and Frequent power disruption. According to Wondwossen and Tsegai (2005), an adequate legal structure and security framework could foster the use of E-payments, which is contradicting with the finding of the previous study.

2.4. Summary and Knowledge Gap

In summary, all the literature review regarding the impact of ICT on commercial banks performance is pointing to the fact that ICT has impact on performance of commercial banks.

To the knowledge of the researcher there is no empirical studies done regarding the impact ICT has on commercial banks in Ethiopia. Since ICT in banking industry in Ethiopia is at its infant stage there is no ample empirical data on the relationship between ICT and commercial banks performance in Ethiopia.

In general, this study is different from previous works done by others; specifically, it examines three determinants of commercial bank performance using a panel data in commercial

banks in Ethiopia and then assesses the quantitative data for these determinants based on the context of Ethiopia.

2.5. Conceptual Framework

Theoretical Framework

Some analysis applied modified forms of Solow's (1957) neoclassical growth model (e.g., Jorgenson and Stiroh (2000); Oliner and Sichel (2000). Essentially, they employed aggregate output (Y) modeled as a simple function of IT capital services (KIT), other capital services (KOTH), include labor (L), and a multifactor productivity term (MFP). Technological change is embodied in the MFP variable. A number of neoclassical assumptions are imposed, including perfect competition, constant returns to scale, no adjustment costs, equal returns to all types of capital, Hicks-neutral technological change, etc. The growth in labor productivity is given by:

$$\Delta(Y/L) = \alpha 1\ \Delta\ (KIT/L) + \alpha 2\ \Delta(KOTH/L) + \Delta MFP$$

Where Δ denotes a growth rate, and the α are income shares. Technological progress is measured by the Solow residual or ΔMFP.

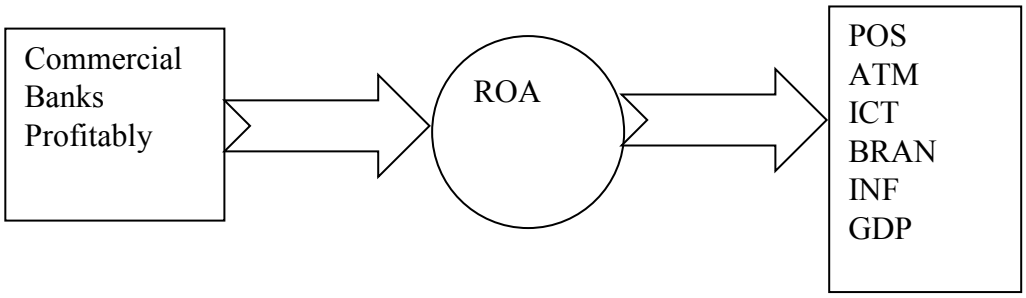
These studies generally found that IT contributed significantly to the recent upswing in aggregate productivity in two ways. First, the very large investment in IT equipment over time resulted in "capital deepening" or increases in Δ (KIT/L), growth in IT capital per unit of labor. Second, IT contributed to ΔMFP primarily as a result of productivity gains in the production of this equipment.

Porter (1985) explains that competitive advantage grows fundamentally out of the value a firm is able to create for its buyers that exceeds the firm's cost of creating it. In this sense, value is what buyers are willing to pay, and superior value stems from offering lower prices than competitive price for equivalent benefits or providing unique benefits that more than offset a higher price. To achieve sustainable profit, therefore, a firm needs sustainable advantage, in either cost or differentiation (Porter, 1980, 1985). Thus, there are two basic types of competitive advantage: cost leadership and differentiation. These two basic types of source of competitive advantage combined with the scope of the firm's activity lead to three known generic strategies – cost leadership, differentiation strategy and focus strategy – for achieving above – average performance in an industry.

This research work adopted Porter (1985) "competitive advantage grows" as it is more significant in developing countries. It is the theory among all other competing theories that regards

competition as an "engine of growth". Most of the empirical studies reviewed in this research work that use data from developing countries adopt a competitive theory, and most of them confirm the positive and significant influence of competition, with very few that confirms negative influence.

Figure 2.1: Relation between ROA and its determinants



Chapter Three

3. Research Design and Methodology

According to Leedy et al., 2005 research methodology is a means to extract the meaning of data. Data and methodology are highly interdependent. Therefore, the methodology to be used for a particular research problem must always take into consideration about the nature of data that will be collected to resolve the research problem. This section explains the research methodology that was applied to obtain representative data from commercial banks in Ethiopia. This study also aims to examine the impact of ICT in the commercial banks found in Ethiopia. Accordingly, this chapter discusses the research procedure that is used to carry out this study. In case, it starts by discussing research design followed by the nature and instruments of data collection and sampling design. The subsequent section presents and discusses method of data process and analysis. Finally, definition of study variables with their measurement and model specifications are presented.

3.1. Research Design

Research design is a master plan specifying the methods and procedures for collecting and analyzing the required data. The choice of research design depends on objectives that the researchers want to achieve (John, 2007). Since this study was designed to examine the relationships between ICT and banks performance, a logical reasoning either deductive or inductive is required. Deductive reasoning starts from laws or principles and generalizes to particular instance where as inductive reasoning starts from observed data and develops generalization from facts to theory. Besides, deductive reasoning is applicable for quantitative research whereas inductive reasoning is for qualitative research. Thus, due to quantitative nature of data, the researcher used deductive reasoning to examine the relationship between ICT and commercial banks performance in this study.

As noted by Kothari (2004), explanatory research design examines the cause and effect relationships between dependent variables and independent variables. Therefore, since this study examined the cause and effect relationships between information and communication technology and performance of commercial banks, it is explanatory research.

According to Creswell (2003), the objective to be achieved in the study is a base for determining the research approach for the study. In case, if the problem identified is factors

affecting the outcome having numeric values, it is quantitative research. Therefore, the researcher employed quantitative research approach to see the regression result analysis with respective empirical literatures on the impact of ICT on commercial banks performance. Thus, the researcher used data from 2010 to 2014 period for seven commercial banks in Ethiopia.

A panel data is analyzed using E-Views, econometric software version 8.

3.2 Target Population

Target population was all banks that engage in commercial activities and registered by National Bank of Ethiopia. Consequently, six banks, out of the 18 commercial banks as of 2014, were selected for the study. The banks have purposively been selected based on data availability from 2010 to 2014, and the consistency of their identities between the periods. The study covers a period of five years from 2000-2014. The selected banks were: Awash International Bank, Commercial Bank of Ethiopia, Dashen Bank, Nib International Bank, Wegagen Bank and Zemen Bank.

3.3. Sample size and sampling Design

Sample design deals with sample frame, sample size and sampling technique. Sampling is a technique of selecting a suitable sample for the purpose of determining parameters of the whole population. Population is the list of elements from which the sample may be drawn (John, 2007). A sample is drawn to overcome the constraints of covering the entire population with the intent of generalizing the findings to the entire population.

As noted by Kothari (2004), good sample design must be viable in the context of time and funds available for the research study. Besides, judgmental sampling offers the researcher deliberately select items for the sample concerning the choice of items as supreme based on the selection criteria set by the researcher.

According to Asika (2006), it is practically impossible to take a complete and comprehensive study of the entire population going by nature and pattern of distribution. Hence, a representative sample is used from the population of the study.

For the purpose of this research work, the sample used comprises six selected commercial banks out of eighteen commercial banks in Ethiopia. Thus, compared to the population, the sample is 61.3%, which makes it adequate for the purpose of drawing inferences with respect to the entire population of the eighteen banks in Ethiopia.

A non-probability sampling method is applied in some circumstances where it is not feasible or practical to conduct random sampling. Therefore, in this research, a non-probability sampling method or purposive sampling technique has been used. The use of purposive sampling technique is relied up on in order to solicit information that is available on the variables of interest in this study, which is purposefully designed in the model.

Accordingly, this study employed purposive sampling technique to select the required sample of banks from commercial banks in Ethiopia. The selection criteria set by the researcher was first the banks are only commercial bank in Ethiopia, second the bank would constitute major market share and third being pioneer in implementing information and communication technology infrastructure and IT solutions. Therefore, all the selected banks are commercial and their market share is as follows: Commercial Bank of Ethiopia 38.8 %, Awash International Bank 6.9 %, Dashen Bank 6.4%, Nib International Bank 4.3%, Wegagen Bank 4.5%, and Zemen Bank 0.4%. Totally, the sample comprises of 61.3 % of the total market share.

To this end, the sample size of this study is not less than specified sample size required for ones' study since the accuracy and validity of the works never guaranteed by increasing the sample size beyond specified limit.

3.4. Sources of Data

The research has relied on secondary sources of data that has used panel data to analyze the impact of information and communication technology on commercial banks performance. Panel data contain measurements on the same firms over several periods. The required secondary data was collected from various published documents maintained by the commercial banks that will be used in this paper obtained from annual reports of the commercial banks in Ethiopia accounts from 2010 to 2014 of six purposively selected banks out of the 18 existing commercial banks and publications of the National Bank of Ethiopia Bulletin and Annual Reports. Accordingly, the study has 30 observations i.e. five observations for each individual bank.

3.5. Model Specification

The aim of this study is to examine the impact of information and telecommunication technology in commercial banks in Ethiopia. Similar to the most noticeable previous research works conducted on the impact of ICT on commercial banks, this study used return on asset as dependent variable whereas ICT infrastructure, ATM investment and POS investment as

explanatory variables. These variables were chosen since they are widely existent for commercial banks in Ethiopia. Accordingly, this study examined the impact of ICT on commercial banks in Ethiopia by adopting a model that is existed in most literatures. The regression model, which existed in most literatures, has the following general form:

$Yit = \beta o + \beta Xit + \mu$

Where: Yit is the dependent variable for firm 'i' in year 't', βo is the constant term, β is the coefficient of the independent variables of the study, Xit is the independent variable for firm 'i' in year 't' and μ the normal error term.

Thus, this study is based on the conceptual model adopted from Muhammad A. et al (2013). Accordingly, the estimated models used in this study were modified and presented as follow:

$BP=\beta 0 + \beta 1 Profit + \beta 2 ICT + \beta 3 ATM + \beta 4 POS + \beta 4 BRAN + \beta INF + \beta 4 GDP + \mu$

Where;

- BP is Bank Performance
- $\beta 0$ is intercept
- $\beta 1, \beta 2, \beta 3, \beta 4, \beta 5$ and $\beta 6$ represent estimated coefficient for specific bank i at time t,
- Profit, ICT, ATM, POS, BRAN, INF and GDP represent profit after tax, information and communication infrastructure, automated teller machine, point of sale, number of branches, inflation rate and gross domestic product respectively.
- μ represents error term for intentionally or unintentionally omitted or added variables. It has zero mean, constant variance and non-autocorrelated. The coefficients of explanatory variable were estimated by the use of ordinary least squares (OLS) technique.

3.5. Definition and Measurement of Variables

According to Creswell (2009), the variables need to be specified in quantitative researches so that it is clear to readers what groups are receiving the experimental treatment and what outcomes are being measured. Return on asset (ROA) is dependent variable used in this study. It is measured in terms of net profit to total assets. As noted by Brooks (2008), including more than one explanatory variable in the model never indicates the absence of missed variables from the model. Thus, to minimize the effect of missed variables from the model, the researcher was included disturbance term in the study.

3.5.1. Dependent Variables

Bank performance has often been measured using return on asset (ROA). Return on asset is defined as net income after tax divided by total assets. This ratio is an indicator of managerial efficiency; it indicates how capable the management of the bank's assets in to net earnings (Adegbaju, 2008). Thus, in this research use return on asset will be used as a proxy on bank performance.

Return on Asset (ROA) represents efficiency in asset utilization and shows how much net income is generated out of assets. It indicates the ability of bank management to generate profits by utilizing the available assets of the bank. Thus, if the ratio of ROA is high, it indicates that it is better performance in order to generate profit. It is measured by the ratio of net profit to total asset as follows:

ROA = Net Profit / Total Asset

Measurement of bank performance is complicated activity. Researchers have used different approaches to assess the performance of banks in various times. However, some of the most reliable yardsticks that have been used in the past to measure bank performance are on assets (ROA).

According to Ross et al., (2006) return on asset (ROA) is a comprehensive measure of overall bank performance from an accounting perspective. It is a primary indicator of managerial efficiency. It indicates how capable the management of the bank has been converting the bank's assets in to net earnings.

3.5.2. Independent Variables

Independent variables are explanatory variables that explain the dependent variables. In case the independent variables included in this study are ICT investment, ATM, and POS. These factors were determined by detailed review of the literatures. These independent variables are proposed to increase the understanding of the determinant factors of performance in commercial banks.

Information and Telecommunication Technology (ICT)

According to Spanos et al., (2002), the benefits of application of ICT in the enhancement of banking services is not only limited to cost reduction benefits alone, the innovation is found also to have significant contribution to giving access to customers residing outside the branch network and create opportunities for effective cross selling, among others.

Kozak (2005), in his study on analysis of the values of return on asset (ROA) arising from ICT investment in USA finds that the value of the return on asset for the US banking sector has increased by 51% thereby suggesting the improvement in ICT investment, associated with extensive office networks and range of offered services have helped to generate additional revenues for banks thus pointing to the fact that a huge number of diverse operations require higher ICT investment.

Automated Teller Machine (ATM)

Delgado et al., (2004), argues that the development of electronic communication channels has had a profound impact on the banking industry. The electronic distribution of retail banking services for example, emerged with the introduction of automated teller machines (ATM), a technology pioneered by Barclays Bank in 1967.

Evidence from other empirical studies conducted on the contribution of automated teller machines (ATM) to bank's profitability reveal that investment in ATMs increases both the volume and value of deposit accounts, reduces banking transaction costs, reduces number of staff and the number of branches and consequently improves bank's profitability (Abdullah, 1985).

Point of Sales (POS)

According to Dieterich (2014), POS covers a variety of services rendered through machines located at retail establishments. POS terminals are generally clerk generated devices located at the checkout or convenience counter or retail establishment. Electronic cash register versions of these terminals have been in operation for several years, maintaining store records on sales, inventories, accounts receivable and the like. Now, POS devices have been linked to financial institution computers, allowing retail customers to receive approval for check cashing and electronically initiate transfers from their accounts to the retailer's. In some installations, customers can make deposits to their accounts. POS devices accept either a plastic credit card or a plastic debit card, depending on whether the customer wants to delay payment by charging the purchase deducted directly from customer's account. As electronic POS systems proliferate, their use will probably replace many of the paper transactions accomplished through cash payments and check and credit transactions.

Inflation Rate

Inflation is a major economic indicator that is considered by economic partners in dealing with a particular country. It is defined as the persistent increase in the general prices of goods and

services within an economy over a given period. Inflation may influence savings (bank deposit) through several channels. First, theory postulates that greater uncertainty should raise savings since risk averse consumers set resources aside as a precaution against possible adverse changes in income and other factors. Hence, inflation may increase precautionary savings by individuals. Second, inflation can influence saving through its impact on real wealth. If consumers attempt to maintain target level of wealth or liquid assets relative to income, saving will rise with inflation. Finally, savings may rise in inflationary period if consumers mistake an increase in the general price level for an increase in some relative prices and refrain from buying (Deaton, 1991).

The rate of inflation and the inflationary expectations might have some influence on the growth of overall deposits with the banking system. It is generally assumed that the growth of total deposits is to be negatively related with inflationary expectation. As inflation accelerates, deposits become less attractive, depending on the interest rate. In this case, the assumption would be that as deposit interest rates rise, deposits would increase in principle as well. The narrower the spread between deposit rates and inflation, the less attractive it should be to hold deposits above the required level. As the rate of inflation increases, people will be tempted to divert their savings from bank deposits to any other kind of tangible assets because these assets act as hedge against. This is the persistent increase or decrease in the average price of goods and services. It will be proxied by the changes in consumer price index with 2000 as the base year.

Number of Branches

The availability of banking services in a country can be measured by the total number of bank branches. The good Bank site occupies in the ability of the positive impact in attracting deposits. This is due to the difficulty of movement of people from one place to another, and the difficulties they face in traffic, distinct positions available and free for customer service to the line-up by car, where the applicant is interested in the Bank's website and was approaching his location. Unlike the consumer, who is ready to move long distances in order to get the loan (Ali, 2002). Conveniently located bank branches can reduce transaction costs significantly and thereby increases the net return earned on deposits.

3.6. Hypothesis

This study has tested the following hypotheses, which was based on the connections between the explanatory variables and the dependent variable:

H1: POS has no significant relationship on commercial bank's bank performance.

H2: ATM has no significant relationship on commercial bank's bank performance.

H3: ICT has significant effect on commercial bank's bank performance.

H4: Number of branch has significant effect on commercial bank's bank performance.

H5: Inflation has no significant effect on commercial bank's bank performance.

H6: GDP has significant relationship on commercial bank's bank performance.

Based on these hypotheses, the study builds the multiple regression of the econometric model through which the impact of ICT on performance of commercial banks in Ethiopia is analyzed.

3.7. Operationalization of Study Variables

This section presented the measurements that have employed to operationalize the study variables. For this study, return on asset was used as a dependent variable which is determined by many factors. And those factors have chosen by taking in to account the availability of data and its influence on bank performance as mentioned in literature.

Table 3.1. Definition of Variables (proxies), symbols and Expected Signs.

Variables	Measurement	Notation	unit	expected impact
Point of Sale	Number points of sale	POS	Numeral	+
Automated Teller Machine	Number of ATM's	ATM	Numeral	+/-
Information and Communication Technology	Amount of Birr Invested	ICT	Birr	+
Bank Branches	Number of branches	BRAN	Numeral	+
Inflation rate	Annual Inflation rate	INF	Percentage	-/+
Economic Growth	Growth of per capita income	GDP	Percentage	+ /-

Table 3.1 Definition of Variables (proxies), symbols and Expected Signs.

3.8. Data Analysis Methods

Creswell (2005) defined data analysis as a process which involves drawing conclusions and explaining findings in words about a study.

Panel regression analysis has conducted using E-View 8 data analysis econometric packages to determine the exact nature of the relationship that exist between ICT investment, ATM and POS. Prior to the estimation of the regression line, descriptive analysis was used to describe the behavior of the individual variables over the period under review. The descriptive analysis was also inculcated a brief assessment of the general external and internal variables in the country over the period. Correlation analysis was also conducted to see the relationship among the dependent and independent variables. This would help to get an initial picture as to the nature of the relationship among the variables before proceeding to regression analysis.

3.9. Diagnostic test procedure

In this section, the study has considered the statistical tools which will apply in analysis part in analyzing data collected in the course of this study.

The statistical tools were employed using quantitative techniques in analyzing data so as to fulfill the objectives of the study. This study has used panel model to show the relationship between the response and explanatory variables. Correlation matrix was employed to demonstrate the strength of the relationship. Before running the regression equation, the data has first been tested for multicollinearity using correlation matrix, heteroscedasticity and autocorrelation using the Durbin-Watson statistic, normality uses Bera-Jarque (BJ) test to know the property of a normally distributed random variable that the entire distribution is characterized by the first two moments the mean and the variance. Sometimes due to large observations and smaller time period, fixed and random effects model may give conflicting results. In this scenario the study has conduct Housman test.

Every estimator of the model should have to meet the Ordinary Least Squares (OLS) assumptions before the estimation is carried out. If the estimators of the model satisfy the OLS assumptions it is possible to say the estimators are blue (best linear unbiased estimates) (Brooks, 2008). The regression starts with the Ordinary Least Squares (OLS) analysis which shows the

coefficients of the variables and the fit of the model. Although OLS is mostly used for analyzing cross-sectional data, it can be used for analyzing panel data, provided that the following assumptions, known as the Gauss-Markov assumptions, are not violated.

The OLS method assumes the following:

- Linearity in parameters;
- The mean of the errors terms is zero;
- No perfect collinearity, which is already described above;
- Homoscedasticity - the variance of the error is constant across all observations;
- No serial correlation, which means that the covariance between error terms is zero;
- Exogeneity - the error term and explanatory variables are not correlated with each other (Wooldridge, 2000).

Although some of the assumptions mentioned above will be violated because this study contains panel data, the OLS analysis will give insights in the relationship between ROA and the independent variables. In the following analyses, all the assumptions described above have presumed, unless it is stated otherwise.

Heteroskedasticity

The OLS method assumes no heteroskedasticity, hence this issue is not taken into account in the OLS method. This means that in the OLS method, the variances in the unobservable error are constant across all observations (Wooldridge, 2000). Since the data used in this study are panel data, heteroskedasticity could become an issue.

The presence of heteroskedasticity, while not causing bias or inconsistency in the coefficients, does invalidate the usual standard errors, t statistics and F statistics. Hence it could bias the statistical significance concluded from the OLS analysis (Wooldridge, 2000). To test for heteroskedasticity, the Breusch-Pagan / Cook-Weisberg test and the White's general test are conducted. The White's general test is a general test which does not presume a particular form of heteroskedasticity. Panel data is likely to the presence of out layers. In order to detect hetroskadascity in the data test was conducted by using Breuch Pagan-Cook Wesiberg test for hetroskadascity.

Serial Correlation (Autocorrelation)

The OLS method assumes no serial correlation (also called autocorrelation) which means that the errors in subsequent periods are not correlated. However, the problem of serial

correlation could be present in this research because time series panel data are used, incorporating data from the same firms for several periods of time. To control for serial correlation, the RE or FE models (dependent on which model suits best) are adjusted for this issue with a first order autocorrelation – AR (1) - disturbance. AR (1) means that the variable is a function of just one lag of itself (Gujarati, 2004).

Normality

Descriptive statistics was undertaken to examine the distribution of data. Upon examination the Bera-Jarque (BJ) test uses to know the property of a normally distributed random variable that the entire distribution is characterized by the first two moments the mean and the variance.

Correlation Matrix and Multicollinearity

First, there is a correlation matrix created in which all variables are included. This matrix shows the correlations and their corresponding significance between the variables. The correlation matrix gives a first insight in the direction and the strength of the relationships between the variables. When the correlation between two or more independent variables is (too) high, the problem of multicollinearity occurs (Wooldridge, 2000). The problem of multicollinearity may lead to less accurate results in the analyses; the coefficients may have very high standard errors and perhaps even incorrect signs or implausibly large magnitudes. Multicollinearity can be detected by calculating the variance inflation factors (VIF) for each independent variable. Multicollinearity is present when VIF values are larger than 10. Furthermore, the critical value can be calculated by 1/VIF. If this value is below 0.1, this would mean that more than 90% of the variation in the variable is explained by the other variables. The variable(s) with VIF values larger than 10 or 1/VIF values below 0.1 should be excluded from the analyses Brooks (2008). Different empirical studies show different argument towards the mulitcollinarity problem. Multilicollianrity problems exist when the correlation coefficient among variables greater than 0.75. Brooks, 2008 suggested that a correlation above 0.8 between explanatory variables should be corrected for. Lastly, (Wooldridge, 2000) argued that also correlation coefficient below 0.9 may not cause serious multicolinary problem. A correlation matrix was used in this study to ensure the correlation between explanatory variables. Then balanced panel data models are applied to control for multicollinearity.

3.10. Choice of Random Effects (RE) Model or Fixed Effects (FE) Model

Panel data may have unobserved group effects, time effects or both included in the error term. These effects are either fixed effects, random effects or both. These effects may lead to heterogeneity or even endogeneity and the OLS estimators will be biased and inconsistent. The panel data models, fixed effects (FE) model and random effects (RE) model, allow for heterogeneity across panel units (and possibly across time) but confines that heterogeneity to the intercept terms of the relationship (Brooks, 2008).

There must be determined model, the random effects (RE) model or the fixed effects (FE) model is most suitable for this dataset. The RE model assumes that the unobserved effect is uncorrelated with the independent variables; the individual-specific effects are parameterized as additional random disturbances. In the FE model the unobserved effects are permitted to correlate with the explanatory variables, hence this model allows a limited form of endogeneity (Gujarati, 2004). The fixed effects model can be used to control for omitted variables that differ between the banks but are constant over time, hence it is bank fixed effects. The random effects model can be used to control for some omitted variables that are constant over time and vary between banks and other omitted variables that vary over time and are constant between banks. The Housman test has conducted to test which model, RE or FE, fits the data best.

Chapter Four

4. Results and Discussion

This study aimed to identify the effect of ICT on commercial banks performance in Ethiopia for the period of 2010-2014. In this chapter the data set is presented and analyzed. Besides, in each sub-section, brief interpretations are made to the results obtained. This chapter, therefore, deals with; firstly, the interpretation of the summary statistics results of key variables; secondly, illustration and interpretations of the correlation analysis among basic variables; thirdly, interpretations of heteroscedasticity, autocorrelation and multicollinearity and finally, a detail interpretation was made based on the regression results of the impact of ICT on commercial banks performance in Ethiopia.

4.1. Summary Statistics

In this section the summary statistics of each variables of the study have been discussed. The variables included the dependent and independent variables. The dependent variable used in this study in order to measure the sample commercial banks performance is ROA whereas the explanatory variables are ICT investment, ATM and POS. Accordingly, the summary statistics for all variables are presented below in table 4.1. The descriptive table included mean, maximum, minimum, standard deviation and observations of both of dependent and independent variables of the study. Basically, a small standard deviation means that the values in a statistical data set are close to the mean of the data set, on average, and a large standard deviation means that the values in the data set are farther away from the mean, on average. The standard deviation measures how concentrated the data are around the mean; the more concentrated, the smaller the standard deviation. The general rule stated that the higher value of standard deviation implies greater spread of data, smaller the standard deviation shows the data is concentrated around mean.

Table 4.1: Summary Statistics – Dependent and Independent Variables

	ROA	POS	ATM	ICT	BRAN	INF	GDP
Mean	0.030771	256.3333	74.76667	28179927	144.1	0.1532	0.1016
Median	0.030781	147	50	15745921	70.5	0.135	0.103
Maximum	0.040209	827	433	1.01E+08	856	0.341	0.114
Minimum	0.024663	0	0	4745044	1	0.028	0.087
Std. Dev.	0.003935	269.2512	91.59268	27450856	210.007	0.108844	0.009111
Skewness	0.338371	1.035428	2.565413	1.232216	2.349241	0.701736	-0.32396
Kurtosis	2.453571	2.661639	9.811134	3.414388	7.491606	2.314077	2.162814
Jarque-Bera	0.945705	5.503666	90.89616	7.806422	52.81282	3.050279	1.400838
Probability	0.623222	0.063811	0	0.020177	0	0.217591	0.496377
Sum	0.923127	7690	2243	8.45E+08	4323	4.596	3.048
Sum Sq. Dev.	0.000449	2102391	243287.4	2.19E+16	1278985	0.343565	0.002407
Observations	30	30	30	30	30	30	30

Source: E-Views 8 output from financial statements of sample banks

The above table indicates the mean, maximum, minimum and standard deviation values of variables. A dataset of 30 observations provides the basis for descriptive analysis. This study has used six variables for the analysis and interpretation, including one dependent variable, ROA.

As shown in the table 4.1 above, the mean value of bank ROA was around 3.1 percent for sampled commercial banks in Ethiopia. It can be noticed that the bank ROA growth fluctuates between 2.5 and 4.02 percent. This means, commercial banks were achieved 3.1 percent average return on asset from ICT for the period of 2010-2014. The standard deviation among banks in terms of bank profit growth was 0.39 percent; this confirms that there were lower variations of performance growth among commercial banks during the study period.

The mean value of POS 256 unit; the standard deviation was 269, while 827 and 0 observed as maximum and minimum values, respectively, exhibits higher dispersion larger than its mean value. As shown in the result, there were higher differences among banks regarding POS. This implies that the effort of some banks to invest in POS.

The mean value of the bank ATM investment over the period under study was 7476 percent with the maximum and minimum values of Birr 4745044 and 1.1 billion in the years 2010 and 2014 respectively. There was a variation in ATM towards its mean value over the periods under study

with the value of standard deviation 9159 percent. This implies that there was competition between commercial banks to attract the customers with a motive of ATM under the study period.

4.2. Correlation Analysis

Correlation is a way to index the degree to which two or more variables are associated with or related to each other. The sample size is the key element to determine whether or not the correlation coefficient is different from zero or statistically significant. The values of the correlation coefficient are always between -1 and +1. A correlation coefficient of +1 indicates that the two variables are perfectly related in a positive linear sense; while a correlation coefficient of -1 indicates that two variables are perfectly related in a negative linear sense. A correlation coefficient of 0, on the other hand indicates that there is no linear relationship between two variables (Brooks, 2008). The correlation matrix in table 4.2 predicts the likely relationship among variables in the study. The P-value is listed in parenthesis that shows the correlation coefficient between the dependent variables and independent variables.

Table 4.2 Correlation Matrix of Dependent and Independent Variables

	ROA	POS	ATM	ICT	BRAN	INF	GDP
ROA	1						
POS	-0.08606	1					
ATM	-0.27525	0.366292	1				
ICT	-0.35871	0.445392	0.781308	1			
BRAN	-0.42626	0.085896	0.822418	0.731089	1		
INF	0.668325	-0.0204	-0.10209	-0.01047	0.001529	1	
GDP	-0.32893	-0.09012	-0.1309	-0.13881	-0.08263	-0.62249	1

Source: E-Views 8 output from financial statements of sample banks

The correlation result in Table 4.2 shows that ICT investment, ATM and POS are positively correlated to bank ROA.

The correlation matrix in Table 4.2 produced statistical evidence that POS has significant and positive linear relationship with ATM ratio at 0.366292 per cent. ATM is insignificantly and positively correlated with ICT investment at 0.781308 per cent.

In general, even though the correlation analysis shows the direction and degree of associations between variables, it does not allow the researcher to make cause and effect inferences regarding the relationship between the identified variables. According to Brooks (2008), if it is stated that *y* and *x* are correlated, it means that *y* and *x* are being treated in a completely symmetrical way. Thus, it is not implied that changes in *x* cause changes in *y*, or indeed that changes in *y* cause changes in *x* rather, it is simply stated that there is evidence for a linear relationship between the two variables, and that movements in variables are on average related to an extent given by the correlation coefficient. Thus, in examining the effects of selected independent variables on bank deposit growth the econometric regression analysis which is discussed in the forthcoming section of the paper gives assurance to overcome the shortcomings of correlation analysis.

4.3. Econometric Analysis

This section of the study presents the results and discussions of the regression (econometrics) analysis. So far the study has established a framework of literature and data analysis including summary statistics and correlation analysis in order to investigate the impact of ICT on commercial banks performance on sampled commercial banks in Ethiopia. To shed more light on the effect if ICT on commercial banks performance panel data regression models have been run. Before running the regressions, the data sets were checked for certain tests; heteroskedasticity, autocorrelation, normality, multicollinearity, and model specification tests have been made to fit the Classical Liner Regression Model (CLRM) assumptions and to undertake reliable estimations.

4.3.1. Diagnosis Tests

The diagnostic checks are very important to the model because they validate the parameter evaluation outcomes achieved by the estimated model. This arises because, if there is a problem in the residuals from the estimated model; it is an indication that the model is not efficient such that parameter estimates from the model may be biased. Accordingly, the study was tested the Classical Linear Regression Models (CLRM) assumptions. As per Brooks (2008), the first assumption required that the average value of the errors is zero (E (ut) = 0). In fact, if a constant term is included in the regression equation, this assumption will never be violated. Since, no intercept parameter without constant term the first assumption will never be go against that

means there is no potentially severe biases in the slope coefficient estimates in the regression model. So, the diagnosis taste included normality, multicollinearity, autocorrelation and heteroskedasticity.

Test for Heteroscedasticity Assumption

It has been assumed far that the variance of the errors is constant. This is known as the assumption of homoscedasticity. If the errors do not have a constant variance, they are said to be heteroscedastic. To test this assumption, the Breusch-Pagan-Godfrey was used having the null hypothesis of heteroskedasticity. Both F-statistic and chi-square (χ) 2 tests statistic were used.

Table 4.3: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.374380	Prob. F (6,23)	0.2666
Obs*R-squared	7.917369	Prob. Chi-Square (6)	0.2442
Scaled explained SS	3.118013	Prob. Chi-Square (6)	0.7939

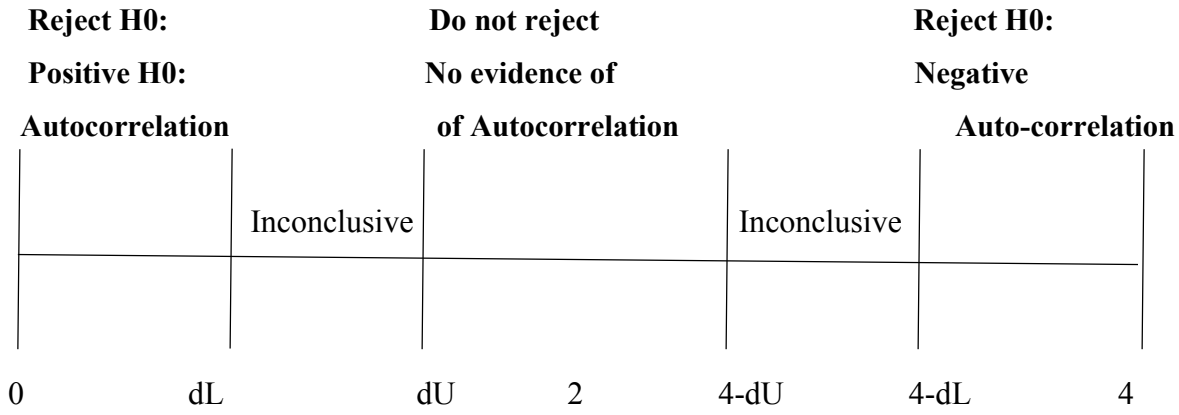
Source: E-views output from banks financial statements

In the case of the effect of ICT on commercial banks performance both the *F*- and χ2 -test statistic give the same conclusion that there is evidence for the absence of heteroscedasticity. Since the *p*-values in all of the cases were above 0.05, the null hypothesis of heteroscedasticity should be accepted as seen in table 4.3. The null hypothesis of heteroscedasticity should be accepted at 5% level for the F-statistics. Generally, in all of the regression models used in this study it was proved that the variance of the error term is constant or homoscedastic.

Test for Absence of Autocorrelation Assumption

The test for autocorrelation was made by using Durbin and Watson (1951). Durbin-Watson (DW) is a test for first order autocorrelation i.e. it tests only for a relationship between an error and its immediately previous value. The null hypothesis for the DW test is no autocorrelation between the error term and its lag. According to Brooks (2008), DW has 2 critical values: an upper critical value (dU) and a lower critical value (dL), and there is also an intermediate region where the null hypothesis of no autocorrelation can neither be rejected nor not rejected. The rejection, non-rejection, and inconclusive regions are shown on the number line in figure 4.1 bellow.

Figure 4.1. Rejection and Non-Rejection Regions for DW Test



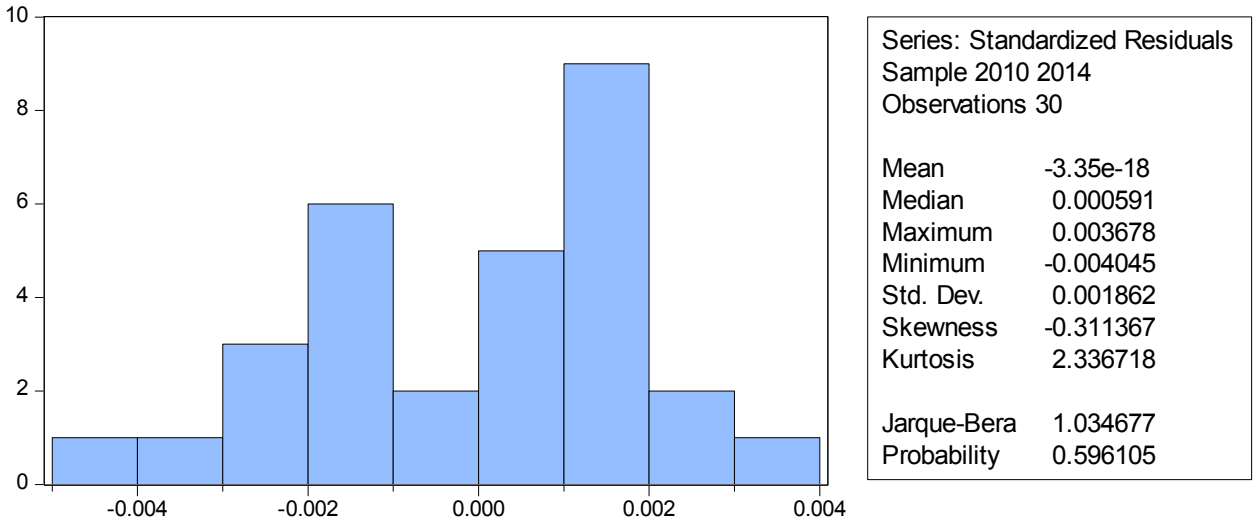
The study used the dL and dU values for 30 observations. As per the DW table in the figure above for 30 observations with three explanatory variables at 1% level of significance, the dL and dU values are 1.400 and 1.693 respectively. The values of 4 – dU = 4-1.1.693 =2.307; 4 - dL = 4-1.400 =2.22. The Durbin-Watson test statistic of 2.22 is clearly between the upper limit (dU) which is 1.693 and the critical value of 4-dU i.e.2.22 and thus the null hypothesis of no autocorrelation is within the non- rejection region of the number line and thus there is no evidence for the presence of autocorrelation.

Test of Normality

Normality test was applied to determine whether a data is well-modeled by a normal distribution or not, and to compute how likely an underlying random variable is to be normally distributed. According to Brooks (2008), if the residuals are normally distributed, the histogram should be bell shaped and the Bera Jarque statistic would not be significant. This means that the p-value given at the bottom of the normality test screen should be greater than 0.05 to support the null hypothesis of presence of normal distribution at the 5 percent level. Theoretically, if the test is not significant, then the data are normal, so any value above 0.05 indicates normality. On the other hand, if the test is less than 0.05 which proves significance, then the data are non-normal. Bera-Jarque formalizes this by testing the residuals for normality and testing whether the coefficient of skewness and kurtosis are close to zero and three respectively. Skewness measures

the extent to which a distribution is not symmetric about its mean value and kurtosis measures how far the tails of the distribution are. The Bera-Jarque probability statistics, P-value is also expected not to be significant even at 10% significant level (Brooks, 2008).

Figure4.2. Normality test for residuals



Source: E-views output from banks financial statements

As shown in the histogram above in the figure 4.2 kurtosis approaches to 2 (i.e. 2.336718) skewness approaches to 0 (i.e. -0.311367) then the probability density function has a long tail to the right) and the Jarque-Bera statistics was not significant even at 10% level of significance as per the P-values shown in the histogram in the appendix (i.e. 1.034677). Hence, the null hypothesis that is the error term is normally distributed should not be rejected and it seems that the error term in all of the cases follows the normal distribution. Also, it indicates that the inferences made about the population parameters from the sample parameters tend to be valid.

Test for Multicollinearity

Multicollinearity indicates a linear relationship between explanatory variables which may cause the regression model biased Gujarati (2004). If an independent variable is an exact linear combination of the other independent variables, then we say the model suffers from perfect

collinearity and it cannot be estimated by OLS (Brooks, 2008). Gujarati (2004), Multicollinearity condition exists where there is high, but not perfect, correlation between two or more explanatory variables. When there is multicollinearity, the amount of information about the effect of explanatory variables on dependent variables decreases. The standard statistical method for testing data for multicollinearity is analyzing the explanatory variables correlation coefficients (CC); condition index (CI) and variance inflation factor (VIF). Therefore, in this study correlation matrix for three of the independent variables shown below in the table had been estimated. The correlation matrix is useful to measure the propensity of how much the independent influences the dependent variable Wooldridge (2005).

Table 4.4: Correlations matrix of explanatory variables

	POS	ATM	ICT	BRAN	INF	GDP
POS	1					
ATM	0.366292	1				
ICT	0.445392	0.781308	1			
BRAN	0.085896	0.822418	0.731089	1		
INF	-0.0204	-0.10209	-0.01047	0.001529	1	
GDP	-0.09012	-0.1309	-0.13881	-0.08263	-0.62249	1

Source: E-views output from banks financial statements

According to Brooks (2008) suggestion in order to find out the multicollinearity problem, the bivariate correlations among the independent variables should be examined and the existence of correlation of about 0.8 or larger indicates a problem of multicollinearity. Gujarati (2004) argued that correlation coefficient below 0.9 may not cause serious multicollinearity problem. Also, Cooper and Schendlar (2009) suggested that a correlation above 0.8 should be corrected for. The results in the above correlation matrix table shows that the highest correlation of 0.78 which is between ICT investment and ATM. Since there is no correlation above 0.8, and 0.9 in this study according to Brooks (2008), Gujarati (2004) respectively, it can be concluded in this study that there is no problem of multicollinearity, thus enhanced the reliability for regression analysis.

4.3.2. Choosing Random Effect (RE) Versus Fixed Effect (FE) Models

According to Brooks (2008), it is often said that the Random Effect Model is more appropriate when the entities in the sample can be thought of as having been randomly selected from the population, but a Fixed Effect Model is more plausible when the entities in the sample effectively constitute the entire population or sample frame. According to Gujarati (2004), if T (the number of time series data) is large and N (the number of cross-sectional units) is small, there is likely to be little difference in the values of the parameters estimated by fixed effect model and random effect model. Hence the choice here is based on computational convenience. Therefore, the Hausman Test is used to determine the suitability of random effects model over fixed effects model.

Table 4.5. Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.388024	6	0.9989

Source: E-Views output from banks financial statements

Even with the fact that the results of random effects model are better than those of the fixed effects model, since both models are valid, the Hausman test has been performed. According to Table 4.5, the results of the random effects model are better than those of the fixed effects model, as the Chi-Sq. value of 0.57 is significant at a significance level of greater than 5%. With respect to the Hausman test, the null hypothesis that the random effects model is the correct specification was accepted since cross-section random greater than 5% significance level, which gives more comfort that random effects model results are valid.

4.3.3. Results of the Regression Analysis

After correcting for all CLRM assumptions, a regression models with the inclusion of the lagged dependent variables were used to find the effect of ICT on commercial banks performance

in Ethiopia. A regression model is created by adding one lag of the dependent variable on the right hand side of the equation; The regression coefficients are analyzed the independent and dependent variables identify both magnitude and the direction of impact. Under the following regression out puts the beta coefficient may be negative or positive; beta indicates that each variable's level of influence on the dependent variable. P-value indicates at what percentage or precession level of each variable is significant. R2 values indicate the explanatory power of the model and in this study adjusted R2 value which takes into account the loss of degree of freedom associated with adding extra variables were inferred to see the explanatory powers of the models.

Obviously, the results of the random effects model are superior to those of the fixed effects model, also confirmed by the Hausman test (Table 4.5), as the Chi-Sq. value of 0.74 is not significant even at a level of more than 5%. Therefore, the random effects model is relevant to the regression analysis. In this case, the ROA of the commercial banks, measured through the banks ICT investment, ATM and POS can be illustrated as follows:

Table 4.6. The Result of Random Effects Model for Regression Results

REGRESSION RESULT
Dependent Variable: ROA
Method: Panel EGLS (Cross-section random effects)
Date: 05/28/16 Time: 04:05
Sample: 2010 2014
Periods included: 5
Cross-sections included: 6
Total panel (balanced) observations: 30
Wallace and Hussain estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.018389	0.006172	2.979566	0.0067
POS	-2.81E-06	2.16E-06	-1.300651	0.2063
ATM	3.69E-05	9.59E-06	3.846618	0.0008
ICT	-3.21E-11	2.50E-11	-1.283726	0.2120
BRAN	-1.77E-05	4.49E-06	-3.932024	0.0007
INF	0.031733	0.004624	6.863090	0.0000
GDP	0.087923	0.054661	1.608505	0.1214

Effects Specification	S.D.	Rho
Cross-section random	0.000787	0.1356
Idiosyncratic random	0.001986	0.8644

Weighted Statistics

R-squared	0.768080	Mean dependent var	0.023038
Adjusted R-squared	0.707579	S.D. dependent var	0.003680
S.E. of regression	0.001990	Sum squared resid	9.11E-05
F-statistic	12.69537	Durbin-Watson stat	1.908408
Prob(F-statistic)	0.000003		

Source: E-Views output from banks financial statements

According to the final results achieved by applying panel data techniques, the impact of the commercial banks performance in Ethiopia are ICT investment, ATM and POS. The estimation results reported in Table 4.6 have The Adjusted R-squared values of 0.092443 is an indication that the model is a good fit. This means 9.24 percent of variations in commercial banks performance were explained by independent variables included in the model. However, the remaining 90.76 percent changes in bank performance are caused by other factors that are not included in the model. Furthermore the

F-statistic was 1.369239 and the probability of not rejecting the null hypothesis that there is no statistically significant relationship existing between the dependent variable ROA and the independent variables, is 0.265963 indicates that the overall model is highly significant at and that all the independent variables are jointly insignificant in causing variation in commercial banks performance means there is no significant relationship between the dependent variable and the independent variables.

Evidence from the table indicates that ICT investment, ATM and POS are not a major factor in explaining the Commercial Banks' performance in Ethiopia.

4.3.4. Research Hypothesis and Interpretation of the Regression Results

As the above section presents the brief discussion of the regression results, this section of the study gives a detail hypothesis testing and discussion of results with the sign of relationship between bank performance growth and its determinants. Hypothesis testing conducted on the basis of the relationship of dependent variable ROA and independent variables with reference to previous empirical studies and different theories.

The hypothesis made by this study states that there is no significant relationship between the level of ICT and bank performance in commercial banks performance in Ethiopia.

Table 4.7 Summary Hypothesis Testing

Variables	t-statistic	P-value	Observation	Decision
POS	-2.979566	0.2063	p-value>0.05	Accept null
ATM	3.846618	0.0008	p-value<0.05	Reject null
ICT	-1.283726	0.2120	p-value>0.05	Accept null
BRAN	-3.932024	0.0007	p-value<0.05	Reject null
INF	6.863090	0.0000	p-value<0.05	Reject null
GDP	1.608505	0.1214	p-value>0.05	Accept null

Source: E-views output from banks financial statements

Null hypothesis to be tested is that the explanatory variables (POS, ICT Investment and GDP) used in the model has no significant impact on bank performance. If the p-value of any explanatory variable is less than at 5% significance, such variable is said to have significant influence on bank performance, and if otherwise it has no significant influence. As earlier

observed, the F-statistic proved that variables entered have no capacity to determine the level of performance in commercial banks in Ethiopia. However, the researcher will go on and test for individual contributions of each of this variables. From the table 4.7 above, it can be observed that POS, ICT investment and GDP do not significantly contribute to return on asset in commercial banks in Ethiopia. Comparing the t-statistic value to p-value of each independent variable, it can be seen that the independent variables are not significant at 5% critical level.

ICT Investment (ICT)

The result in table 4.7 shows that ICT investment has no statistically significant positive impact in commercial banks performance in Ethiopia.

Akram et al., (2010) examined the effects of information and communication technology (ICT) on Jordanian banking industry and the results of the study indicated that there is a significant impact on the use of ICT in Jordanian banks on the market value added (MVA) earnings per share (EPS), Return on Assets (ROA) and Net Profit Margin (NPM).

Kagan, et al. (2005), Kozak (2005), Woherem (2000 and Osabuohien (2008) found a positive and significant relationship between ICT and commercial banks performance. This finding does not agree with the findings. This implies that the ICT investment does not have significant impact on profitability of commercial banks in Ethiopia. Thus, in general, null hypothesis has been accepted and conclude that ICT investment has no causality relationship with performance in commercial banks in Ethiopia.

Automated Teller Machine (ATM)

Dos Santos et al., (1993) empirically studied the effects of early adoption of Automated Teller Machine (ATM) technology by banks on employee efficiency and the findings revealed that the introduction of ATM technology improves the bank's performance. Studies on the effects of ATMs on profitability provide evidence of cost savings and better services for customers. Survey of banks conducted by Katagiri (1989) in Japan and Shawkey (1995) in the USA revealed that investing in ATMs reduces banking transaction costs, the number of staff and the number of branches. Therefore, investing in ATMs increases the value of deposit accounts, which are cheaper in terms of costs of funds than other sources, such as borrowing money from other institutions, hence reducing the overall cost of funds. This suggests that there is a role for ATM investment in the explanation of bank profitability.

This finding does agree with the findings. This implies that the ATM does have significant impact on commercial banks in Ethiopia. Thus, in general, null hypothesis has been rejceted and conclude that ATM has causality relationship with performance in commercial banks in Ethiopia.

Point of Sale (POS)

The result in table 4.7 shows that POS has not insignificant positive impact in commercial banks performance. Woherem (2000) claimed that only banks that overhaul the whole of their payment and delivery systems to their operations are likely to survive and prosper in the new millennium. He advices banks to re-examine their service and delivery systems in order to properly position them within the framework of the dictates of the dynamism of information and communication technology. This finding does not agree with the findings. This implies that the POS does not have impact on commercial banks in Ethiopia. Thus, in general, null hypothesis has been accepted and conclude that POS has no causality relationship with performance in commercial banks in Ethiopia.

Inflation Rate

The result in table 4.7 shows that inflation rate has insignificant positive impact in bank's performance. The coefficient of this relationship of 6.863090 indicates that holding other things constant, a percentage increase in inflation rate will lead to a 68.63 percent increase in bank profitability at an insignificant level of more than 10 percent. This implies that persistent inflation has a positive insignificant effect on growth of bank profitability. According to the findings this study in Ethiopia consumers are motivated to save in inflationary period.

This finding supports the idea of Wubetu (2012); Shemsu (2015); Davis (2013); Ukinamemen (2010); Patrick (1966); Ozcanelal, (2010) and Athukorala et al (2004). Loayza, Schmidt-Hebbel and Serven (2000) found a positive and statistically significant relationship between saving and inflation in their study while SchmidtHebbel, Webb and Corsetti (1992) found a negative (-0.14) and non-statistically significant relationship.

4.3.5. Summary of Research Findings

The research on the title of The Impact of Information and Communication Technology on Commercial Banks in Ethiopia: An empirical study on commercial banks in Ethiopia had gone

through empirical analysis. As a result of the analysis and interpretation, the following are the summary of the findings:

- Information and Communication Technology, Point of Sale and Number of Branches have positive relationship with profitability in commercial banks in Ethiopia.
- ATM, Inflation Rate and Gross Domestic Product have negative relationship with performance in commercial banks in Ethiopia

Chapter Five

5. Conclusion and Recommendation

The basic intent of this chapter is to present the overall overviews of the research by summing up the main findings of the analysis part and give future research directions. Accordingly, the chapter starts with its discussion by briefly sum up the overviews of the study and its main findings. In section two based on the study finding the researcher highlight some recommendations for the target populations the study pivoting on.

5.1. Conclusion

The study empirically analyzed the impact of information and communication technology in commercial banks performance in Ethiopia by constructing an econometric model to study the effect of various factors such as ICT investment, automated teller machine and point of sale. Accordingly, the impacts of ICT on return on asset in commercial banks in Ethiopia were carefully analyzed using the OLS technique. The regression result showed that the POS, ICT and number of branches have negative effect on return on asset on commercial banks in Ethiopia. The result from the F-statistic and R-square show that the model is stable over the study period thus become a formidable policy reference point in banking reform planning. Inflation, gross domestic product and ATM have positive impact on return on asset on commercial banks in Ethiopia.

This study will benefit to the consistent improvement of commercial banks performance Ethiopia. This research study will be of immense help to policy formulator particularly National Bank of Ethiopia in the development of ICT policies for commercial banks. This analysis improves the understanding of the performance of commercial banks and can provide useful information to commercial banks, investors, experts and supervisory authorities. And also the study will add a knowhow to existing stock of knowledge on the impact of ICT on commercial banks performance.

5.2. Recommendation

Based on the research findings and conclusions above, the following are recommended for commercial banks in Ethiopia to improve return on asset:

- Knowing full well that the information and communication technology cannot be separated from the industry due to its immense contributions to the banking industry and based on the data analysis the researcher therefore recommends with the intent that if adopted would have positive effects on the banking industry the banks should improve more on its information and communication technology so as to enhance its performance.
- From time to time there should be enlightenment given to the general public through the various media on how to use some of the ICT equipment like the smart cards, ATM, mobile banking and their importance should also be made known to the public.
- Therefore, this study recommends that the banks should put more effort in advertising these products in Ethiopia. Improved internet and information technology awareness for the public in form of seminars and conferences will cause an uprising in ATM and POS usage.

5.3 Further Research

This research is an important contribution to the literature due to the findings of the study which will help policy makers to formulate policy. However, this study is not beyond limitations.

This research also examined bank specific performance determinants such as ICT infrastructure, ATM and POS for commercial banks in Ethiopia that constitutes major market share. However, there are so many variables that were not included in this study. Thus, future researchers may be interested in validating the consistency of the result and provide supplementary results for this study by including other variables.

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Appendices

Appendix: 1

REGRESSION RESULT

Dependent Variable: ROA
Method: Panel EGLS (Cross-section random effects)
Date: 05/28/16 Time: 04:05
Sample: 2010 2014
Periods included: 5
Cross-sections included: 6
Total panel (balanced) observations: 30
Wallace and Hussain estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.018389	0.006172	2.979566	0.0067
POS	-2.81E-06	2.16E-06	-1.300651	0.2063
ATM	3.69E-05	9.59E-06	3.846618	0.0008
ICT	-3.21E-11	2.50E-11	-1.283726	0.2120
BRAN	-1.77E-05	4.49E-06	-3.932024	0.0007
INF	0.031733	0.004624	6.863090	0.0000
GDP	0.087923	0.054661	1.608505	0.1214

Effects Specification	S.D.	Rho
Cross-section random	0.000787	0.1356
Idiosyncratic random	0.001986	0.8644

Weighted Statistics

R-squared	0.768080	Mean dependent var	0.023038
Adjusted R-squared	0.707579	S.D. dependent var	0.003680
S.E. of regression	0.001990	Sum squared resid	9.11E-05
F-statistic	12.69537	Durbin-Watson stat	1.908408
Prob(F-statistic)	0.000003		

Unweighted Statistics

R-squared	0.775951	Mean dependent var	0.030771
Sum squared resid	0.000101	Durbin-Watson stat	1.728427

Appendix: 2

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.388024	6	0.9989

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
POS	-0.000005	-0.000003	0.000000	0.6036
ATM	0.000044	0.000037	0.000000	0.5829
ICT	-0.000000	-0.000000	0.000000	0.7606
BRAN	-0.000023	-0.000018	0.000000	0.5988
INF	0.032167	0.031733	0.000004	0.8186
GDP	0.086163	0.087923	0.000395	0.9295

Appendix: 3

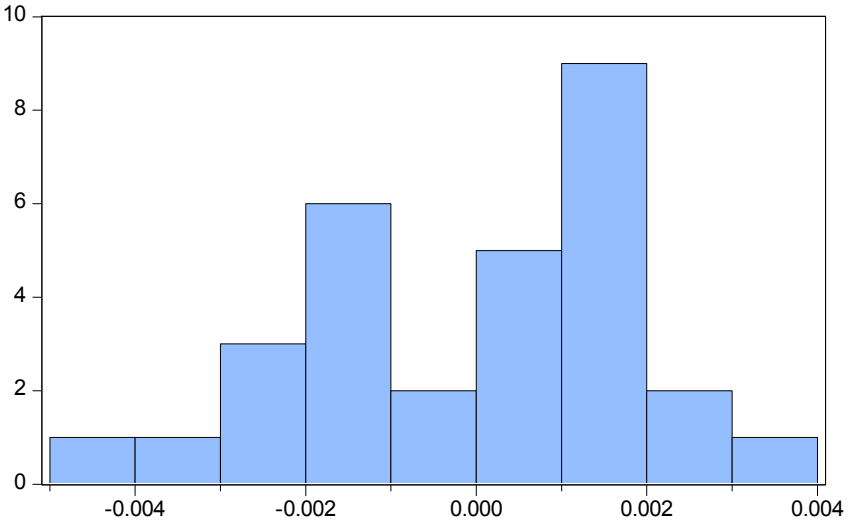
Cross-section random effects test equation:
Dependent Variable: ROA
Method: Panel Least Squares
Date: 05/28/16 Time: 04:08
Sample: 2010 2014
Periods included: 5
Cross-sections included: 6
Total panel (balanced) observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019178	0.006739	2.845903	0.0107
POS	-4.85E-06	4.48E-06	-1.082091	0.2935
ATM	4.39E-05	1.59E-05	2.751439	0.0131
ICT	-2.81E-11	2.83E-11	-0.990737	0.3349
BRAN	-2.31E-05	1.14E-05	-2.037803	0.0565
INF	0.032167	0.004995	6.439612	0.0000
GDP	0.086163	0.058166	1.481318	0.1558

Effects Specification
Cross-section fixed (dummy variables)

R-squared	0.826942	Mean dependent var	0.030771
Adjusted R-squared	0.721185	S.D. dependent var	0.003935
S.E. of regression	0.002078	Akaike info criterion	-9.226090
Sum squared resid	7.77E-05	Schwarz criterion	-8.665611
Log likelihood	150.3913	Hannan-Quinn criter.	-9.046788
F-statistic	7.819227	Durbin-Watson stat	2.220432
Prob(F-statistic)	0.000079		

Appendix: 4



Series: Standardized Residuals
Sample 2010 2014
Observations 30

Mean	-3.35e-18
Median	0.000591
Maximum	0.003678
Minimum	-0.004045
Std. Dev.	0.001862
Skewness	-0.311367
Kurtosis	2.336718
Jarque-Bera	1.034677
Probability	0.596105

Appendix: 5

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.339121	Prob. F (2,21)	0.7162
Obs*R-squared	0.938604	Prob. Chi-Square (2)	0.6254

Appendix: 6

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/28/16 Time: 04:13
Sample: 1 30
Included observations: 30
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.39E-05	0.006639	0.002091	0.9984
POS	5.97E-08	1.95E-06	0.030609	0.9759
ATM	4.61E-07	9.95E-06	0.046259	0.9635
ICT	1.00E-12	2.71E-11	0.037052	0.9708
BRAN	-2.02E-07	4.15E-06	-0.048594	0.9617
INF	-4.79E-05	0.005004	-0.009574	0.9925
GDP	-0.000480	0.059071	-0.008124	0.9936
RESID (-1)	0.182250	0.222468	0.819219	0.4219
RESID (-2)	-0.013578	0.231165	-0.058739	0.9537

R-squared	0.031287	Mean dependent var	3.85E-18
Adjusted R-squared	-0.337747	S.D. dependent var	0.001862
S.E. of regression	0.002153	Akaike info criterion	-9.200467
Sum squared resid	9.74E-05	Schwarz criterion	-8.780108
Log likelihood	147.0070	Hannan-Quinn criter.	-9.065991
F-statistic	0.084780	Durbin-Watson stat	1.986565
Prob(F-statistic)	0.999360		

Appendix:7

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.374380	Prob. F (6,23)	0.2666
Obs*R-squared	7.917369	Prob. Chi-Square (6)	0.2442
Scaled explained SS	3.118013	Prob. Chi-Square (6)	0.7939

Appendix: 8

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/28/16 Time: 04:14
Sample: 1 30
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.65E-06	1.17E-05	0.738528	0.4677
POS	-1.87E-09	3.42E-09	-0.547609	0.5892
ATM	-5.08E-10	1.73E-08	-0.029415	0.9768
ICT	8.41E-14	4.71E-14	1.786659	0.0872
BRAN	-1.11E-08	7.30E-09	-1.526841	0.1404
INF	7.64E-06	8.81E-06	0.867636	0.3946
GDP	-6.61E-05	0.000104	-0.634564	0.5320

R-squared	0.263912	Mean dependent var	3.35E-06
Adjusted R-squared	0.071889	S.D. dependent var	3.94E-06
S.E. of regression	3.80E-06	Akaike info criterion	-21.92229
Sum squared resid	3.32E-10	Schwarz criterion	-21.59534
Log likelihood	335.8343	Hannan-Quinn criter.	-21.81769
F-statistic	1.374380	Durbin-Watson stat	2.320932
Prob(F-statistic)	0.266630		

Appendix 9

Correlation matrix of Explanatory Variables

	POS	ATM	ICT	BRAN	INF	GDP
POS	1	0.366292	0.445392	0.085896	-0.0204	-0.09012
ATM	0.366292	1	0.781308	0.822418	-0.10209	-0.1309
ICT	0.445392	0.781308	1	0.731089	-0.01047	-0.13881
BRAN	0.085896	0.822418	0.731089	1	0.001529	-0.08263
INF	-0.0204	-0.10209	-0.01047	0.001529	1	-0.62249
GDP	-0.09012	-0.1309	-0.13881	-0.08263	-0.62249	1

Appendix 10

Correlation matrix of dependent and independent variables

	ROA	POS	ATM	ICT	BRAN	INF	GDP
ROA	1	-0.08606	-0.27525	-0.35871	-0.42626	0.668325	-0.32893
POS	-0.08606	1	0.366292	0.445392	0.085896	-0.0204	-0.09012
ATM	-0.27525	0.366292	1	0.781308	0.822418	-0.10209	-0.1309
ICT	-0.35871	0.445392	0.781308	1	0.731089	-0.01047	-0.13881
BRAN	-0.42626	0.085896	0.822418	0.731089	1	0.001529	-0.08263
INF	0.668325	-0.0204	-0.10209	-0.01047	0.001529	1	-0.62249
GDP	-0.32893	-0.09012	-0.1309	-0.13881	-0.08263	-0.62249	1

Appendix 11:

	ROA	POS	ATM	ICT	BRAN	INF	GDP
Mean	0.030771	256.3333	74.76667	28179927	144.1	0.1532	0.1016
Median	0.030781	147	50	15745921	70.5	0.135	0.103
Maximum	0.040209	827	433	1.01E+08	856	0.341	0.114
Minimum	0.024663	0	0	4745044	1	0.028	0.087
Std. Dev.	0.003935	269.2512	91.59268	27450856	210.007	0.108844	0.009111
Skewness	0.338371	1.035428	2.565413	1.232216	2.349241	0.701736	-0.32396
Kurtosis	2.453571	2.661639	9.811134	3.414388	7.491606	2.314077	2.162814
Jarque-Bera	0.945705	5.503666	90.89616	7.806422	52.81282	3.050279	1.400838
Probability	0.623222	0.063811	0	0.020177	0	0.217591	0.496377
Sum	0.923127	7690	2243	8.45E+08	4323	4.596	3.048
Sum Sq. Dev.	0.000449	2102391	243287.4	2.19E+16	1278985	0.343565	0.002407
Observations	30	30	30	30	30	30	30