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Determinants of Automated Teller Machine Deployment: The Case of Commercial Banks of Ethiopia

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Determinants of Automated Teller Machine Deployment: The case of commercial banks of Ethiopia

A Thesis Submitted to Bahir Dar University in Partial Fulfillment of the Requirement for Degree of Masters of Science in Accounting and Finance

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Statement of declaration

This is to certify that the thesis work by Mahilet Demissie entitled as "Determinants of Automated teller machine Deployment in Commercial Banks of Ethiopia". A Thesis Submitted to Bahir Dar University in Partial Fulfillment of the Requirement for Degree of Masters of Science in Accounting and Finance. Compilies with the regulations of the university and meets the accepted standard with respect to originality and quality.

Approved by the examining committee

Advisor: ------------------------------ Signature----------------Date-------------------

External Examiner:---------------------Signature ---------------Date-----------------

Internal Examiner: -----------------------Signature-------------Date-----------------

Chair person :-------------------------------Signature-------------Date--------------

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List of Acronyms

ATM	Automated teller machine
Bsize	Bank size
CBE	Commercial bank of Ethiopia
Ce	Cost efficiency
Prof	Bank profitability
DD	Demand deposit
DD/TD	The ratio of demand deposit to total deposit
Dsr	Deposit ratio
ECX	Ethiopian commodity exchange
GDD	Growth of demand deposit
GNB	Growth in Number of branch
GOE	Growth of operating expense
ICT	Information and communication technology
ISO	Independt sales organization
LM	Breusch Pagan lag range multiplier
NATM	Number of ATM
Br	Number of branches
OE	Operating expense
OE/TD	Operating expense to total deposit
PDA	Personal digital assistant
POS	Point of sale transfer
PC	Personal computer
PIN	Personal identification number
PROF	Bank profit
PSS	Premiere switch solution
ROA	Return on asset
ROE	Return on equity
SALLEVEL	Salary level

SMS	Short message service
SE	Salary expense
SE/OE	The ratio of salary expense to operating expense
SST	Self service technology
TA	Total asset
TA	Technology associate
TD/TA	The ratio of total deposit to total asset
TD	Total deposit
VATR	Value of ATM transaction

Abstract

The growing trend of information technology investment especially Automated Teller Machine (ATM) in Ethiopia banking industry is below customers demand (Ayana, 2012). The availability and deployment of ATM in Ethiopia is low level compared to the fast growing urban population. Thus, the main objective of this study is to examine the determinants of ATM deployment in commercial banks of Ethiopia. In order to achieve the objective, secondary sources of data were gathered from thirteen commercial banks of Ethiopia in the sample period covering from 2012 to 2016. The collected data is analyzed using descriptive statistics and panel data econometric regression analysis. The random effect model is employed as an appropriate model for this study and interpretations of estimates were made based on this model. The result of the descriptive analysis indicated that the trend of ATM deployment in commercial banks of Ethiopia is up-ward sloping over the sample time period. The results of random effect regression analysis revealed that bank size, bank profitability and deposit ratio were statistically significant and has positive impact on ATM deployment in commercial banks of Ethiopia. Mean while, cost efficiency and number of branches have statistically insignificant relationship with ATM deployment. Based on the finding investigated, it is recommended that the commercial banks of Ethiopia or concerned bodies need to take account the most important determinants of ATM deployment.

Key words: *Automated Teller Machine (ATM), Commercial Banks of Ethiopia, Deployment*

Chapter One

1. Introduction

1.1. Background of the Study

Information and Communication Technology (ICT) has become a very critical aspect of recent banking and financial services delivery in the world at large and Ethiopia in particular. Automated Teller Machine (ATM) is one of a major indicator for this technology by banks (Otukoya, 2014). Now a day, this technology is adopted and is still being adopted by banks with in the globe. They provide benefits for both banks and their depositors or customers. This machine can be able to withdraw, transfer and exchange the currency or cash at convince place and time than through face to face interaction only at banking hour (Olatokun, 2009).

The motive behind to have a bank machine which is automatically dispensed cash and other activities to customer is came in 1930s by George simijan a Turkish born but it is not successful version. For trail purpose he came with the idea of money hole in the wall machine that enables customer to make financial transaction. Until 1960s, the concept of ATM is seen again by John Shepherd UK born and he came with the idea of cash. Many people perceive that John is inventing the ATM but the world's first ATM is installed in Barclays in 1967 (Miller, 2006).

Banks have become the major deplorers of ATMs as the cost of a single transaction performed by ATM is potentially a lesser amount than the cost of a transaction conducted from a teller and as ATMs are able to conduct or handle many transactions with few time than tellers (Laderman, 1990). The most favorable deployment strategies of ATM offer the occasion to provide greater convince and attract more customers by covering the money market with adequate ATM facilities. Moreover, these favorable strategies can provide greater cost efficiency by finding the optimal number of ATMs to be installed. It can also provide greater profitability through increasing the users of ATM to earn more transaction and service fee (Huang, 2012).

Turning to Ethiopia, the growth of ATM banking service is through gradual development and the time where the deployment of ATM started in Ethiopia moved back to the late 2001. The largest state owned bank, Commercial Bank of Ethiopia has introduced ATMs to deliver different services to customer among this cash withdrawal, foreign exchange to domestic users and

payment of bill etc (Gardachewetal, 2015). ATMs have become the most competitive instrument to commercial banks of Ethiopia (WaleAbdual, 2011). Thus, adequate ATM deployment policies are highly required to increase the number of ATM and quality of the services offered. However, in Ethiopia, the deployment of ATMs is still low level compared to other Sub-Saharan Africa. For instance, the deployment of ATM in Nigeria is 150,000 ATMs per 100,000 persons (Amefrele, 2012). But, in Ethiopia the ratio of ATM to urban population is 1922 to 20,202,815.

In Ethiopia, a considerable number of researchers' (Yiheyis, 2015) have been studied on evaluation of customer satisfaction regarding Premiere switch solution automated teller machine (ATM) banking services in Addis Ababa. (Balcha, 2015), studied aggressive branch expansion versus ATM and POS machine in Awash International bank in Addis Ababa. However, empirical evidences on the issue of the determinants of ATM deployment in commercial banks of Ethiopia have been rarely available. To the researcher knowledge, there is no rigorous research conducted so far that attempt to look thoughtfully about the determinants of ATM deployment. Thus, this study aims to fill the knowledge and policy gaps by identifying the determinants of ATM deployment in commercial banks of Ethiopia.

1.2. Statement of the Problem

Automated teller machine is a device that provides access to customer in financial transaction and many other activities or duties without the need of human or teller on banking and financial institution. In the modern time, customers are identified by the machine through inserting plastic ATM card that contains unique card number and some security information such as expiration date and security number or personal identification number (PIN) (Solomon, 2010).

Commercial banks have automated their services by the use of ATM. The aim has been to schedule employees' duties with ease, reduce the building up of queues and increase employees' efficiency. Other reasons for adopting ATMs include; reduction of customer service delivery time, improvement of quality of service, bringing services closer to customers and cutting on cost of operations. Thence, the overall aim is to achieve the highest possible level of profits (Hussein, 2017).

In the year 2016, the number of commercial banks of Ethiopia has reached 18, out of which 16 are private, and the remaining 2 are state owned. The total branches in the country have reached to 3,023. The number of ATMs to urban population becomes 1922 to 20,202,815. Besides, the numbers of population by this year reached 101,853,268 of which 81,650,453 are living in rural areas where financial institutions have not yet reached to majority of those people whereas, the remaining 20,202,815 are live in urban areas which have reached this service to some extent (NBE, 2015/2016). Thus, the deployment of ATM in Ethiopia is low level compared to the fast growing urban population.

Moreover, ATMs should not be installed only inside the location of banks, but also in locations of shopping centers/malls, airports, grocery stores, gas stations and restaurants where large numbers of people reach on (Steve, 2002). However, in Ethiopia ATMs are placed mostly near or inside the premises of commercial banks. As a result, the deployment of ATMs in shopping center, airports, grocery stores, petrol stations, restaurants and any other places are rare or scanty available.

The determinants of ATM deployment were investigated in different countries of the globe. For instance, (Adewoye, 2013) studied that wage rate (salary level), firm size, competitive pressure value of ATM transactions and profitability of the bank could significantly determined ATM investment in commercial banks of Nigeria. In Taiwan, (Liu, 2009) indicated that operating scale, banking deposit service and operating cost were all significant determinants of ATM investment in the Taiwan banking. According to Hannan (1984) wage rate and firm size has positive effects on the decision to adopt ATM. That is in regions of higher wage rates, banks tend to install more ATM to replace expensive labor and also in case of the economic scale theory, larger banks tend to introduce more ATM than small banks do. In Ethiopia, a considerable number of researchers' (Abrehe, 2015), (Gemechu, 2012) and (Takele, 2013) have been conducted so far on ATM adoption of customers in commercial bank of Ethiopia , adoption of electro banking system in Ethiopia banking industry: barriers and drivers , analysis of factors influencing customers intention of E-banking in Bahir dar city respectively. To the best of the researcher knowledge, empirical findings on the determinants of ATMs deployment in Ethiopia are rarely available. They were mainly focused on the issue after deployment of ATMs. Thus, this study is intended to fill the gap by investigating the determinants of ATMs deployment in commercial banks of Ethiopia.

1.3. Objective of the Study

1.3.1. General objective

The main objective of the study is to examine the determinants of ATM deployment in commercial banks of Ethiopia.

1.3.2 Specific Objectives

The specific objectives of this study are

➢ To examine the trends of ATM deployment in commercial banks of Ethiopia.
➢ To examine the relationship between ATM deployment and its determinants.
➢ To identify the most important determinants of ATM deployment in commercial banks of Ethiopia.

1.4 Research questions

Based on the aforementioned problems, the following research questions have been forwarded.

✓ What seems like the trends of ATM deployment in commercial banks of Ethiopia?
✓ What are the relationship between ATM deployment and its determinants   in commercial banks of Ethiopia?
✓ What are the most important determinants of ATM deployment?

1.5 Research Hypothesis

According to Oyerinde (2013), on his paper bank size, bank profitability, deposit ratio, cost efficiency and numbers of branches are significant effect on ATM deployment. The researcher is developed hypothesis to examine the relationship between ATM deployment and its determinants in commercial banks of Ethiopia.

H_1: Bank size has a significant effect on ATM deployment in commercial banks of Ethiopia

H_2: Bank profitability has a significant effect on ATM deployment in commercial banks of Ethiopia.

H_3: Deposit ratio has a significant effect on ATM deployment in commercial banks of   Ethiopia.

H_4: Cost efficiency has a significant effect on ATM deployment in commercial banks of Ethiopia.

H_5: Number of branches has a significant effect on ATM deployment in commercial banks of Ethiopia.

1.6. Significant of the Study

This study investigated the deployment of ATM by identifying its determinants. From this study, the following benefits are expected to be reaped or gained. For policy makers: identifying the determinants of ATM deployment in commercial banks of Ethiopia can give policy makers insights for future courses of action and understanding the role by ascertaining the driving factor for the deployment of ATM can play in expanding the installation of ATM. For the next researcher: it put base line information who would like to conduct further detailed and comprehensive studies related to determinants of ATM deployment by filling the previous researcher knowledge gap.

1.7. Delimitation and Limitation of the study

Drawing boundaries is an important component in undertaking a research. Stating what the researcher are not going to do is often just as important as expressing what the researcher is going to do. The study is confined only the thirteen selected commercial banks of Ethiopia or does not consider the other financial sector in Ethiopia. The issue that the researcher tries to study is delimited to examine the determinants of ATM deployment in commercial banks of Ethiopia. Thus, the study did not considered customers side ATM deployment and any other forms of electronic payment. The limitation of the study is lack of data for the initially selected years or for longer period of time as ATMs are recently installed machine.

1.8. Organization of the Study

The paper is organized as follows. Chapter one elaborates about the introduction, statement of the problem, objective and significance of the study. The second chapter of this study is devoted on various concepts related to ATM; that is a brief review of ATM, determinants of ATM deployment with empirical literature is done. Methodology that includes data and methods is discussed in chapter three of the paper. Fourth chapter is about result and discussion. Finally, conclusion and recommendation are included in chapter five.

1.9. Ethical Considerations

Ethical clearance is obtained from department of accounting and finance, Bahir dar university and a written consent is sought from the banks financial statement other material and concerned government bodies. As much as possible, the data is collected based on banks freely volunteered.

Chapter Two

2. Literature Review

2.1. Introduction

This chapter presents both theoretical and empirical review of studies conducted related to ATM and the purpose of the empirical literature review is to identify what has been done or what has not been done so far by previous researcher, how it has been done (methodological approaches), the results obtained and the way forwarded. This turns paramount significant for identifying the gaps in policy, knowledge and methodology.

2.2. Theoretical Literature Review

2.2.1. Definition of electronic banking

E-banking has been defined in many ways by different scholars; (Daniel, 1999) defines electronic banking as the delivery of banks' information and services by banks to customers via different delivery platforms that can be used with different terminal devices such as personal computers and mobile phone with browser or desktop software, telephone or digital television; (Noreen, 2006) defined it as any use of information and communication technology and electronic means by a bank to conduct transactions and have interaction with stakeholders; (Magemhe, 2002) also defined electronic banking (e-banking) is nothing but e-business in banking industry. E-banking is a generic term for delivery of banking services and products through electronic channels, such as the telephone, internet, cell phone, etc.

E-banking is a form of banking service where funds are transferred through an exchange of electronic signal between financial institutions, rather than exchange of cash, checks, or other negotiable instruments (Kamrul, 2009).

E-banking can be also defined as a variety of platforms such as internet banking or online banking, TV-based banking, mobile phone banking and PC (personal computer) banking (or offline banking) whereby customers access these services using an intelligent electronic device like PC, personal digital assistant (PDA), ATMs, POS, kiosk, or touch tone telephone (Alagheband, 2006) .

2.2.2. Types of E-banking

Among the many e-banking delivery channels to provide banking service to customers ATM, POS, Mobile banking, agent banking and internet banking are the most widely used and discussed below.

Automated Teller Machine (ATM)

It is a machine where cash withdrawal can be made over the machine without going in to the banking hall. It also sells recharge cards and transfer fund, it can be accessed 24 hours/7 days with account balance enquiry. ATM is same as teller point but it run automatically through identity like card and password (Fenuga, 2010).

Internet Banking

Internet banking allows customers of a financial institution to conduct financial transactions on a secure website operated by the institution, which can be a retail or virtual bank, credit union or society. It may include any of transactions related to online usage. Banks increasingly operate websites through which customers are able not only to inquire about account balances, interest and exchange rates but also to conduct a range of transactions. Unfortunately, data on Internet banking are scarce and differences in definitions make cross country comparisons difficult (Alabar, 2012).

Point of Sale Transfer Terminals (POS)

POS also sometimes referred to as point of purchase (POP) or checkout is the location where a transaction occurs. A "checkout" refers to a POS terminal or more generally to the hardware and software used for checkouts, the equivalent of an electronic cash register. A POS terminal manages the selling process by a salesperson accessible interface. The same system allows the creation and printing of the receipt. POS systems record sales for business and tax purposes (Shittu, 2010) .

Mobile Banking

Mobile banking also known as M-Banking is a term used for performing balance checks, account transactions, payments, credit applications and other banking transactions through a mobile

device such as a mobile phone. The earliest mobile banking services were offered over Short Message Service (SMS), a service known as SMS banking. Mobile banking is used in many parts of the world with little or no infrastructure especially remote and rural areas. This aspect of mobile commerce is also popular in countries where most of their population is unbanked. In most of these places, banks can only be found in big cities, and customers have to travel hundreds of miles to the nearest bank. The scope of offered services may include facilities to conduct bank and stock market transactions to administer accounts and to access customized information (Tiwari, 2007).

Agent Banking

A banking agent is a retail or postal outlet contracted by a financial institution or a mobile network operator to process clients' transactions. Rather than a branch teller, it is the owner or an employee of the retail outlet who conducts the transaction and lets clients deposit, withdraw, and transfer funds, pay their bills, inquire about an account balance, or receive government benefits or a direct deposit from their employer. Banking agents can be pharmacies, supermarkets, convenience stores, lottery outlets, post office and many more (Wikimania, 2015).

2.2.3. E-banking in Global Perspective

The advent of internet has initiated an electronic revolution in the global banking sector. The dynamic and flexible nature of this communication channel as well as its everywhere reach has helped in leveraging a variety of banking activities. E-banking technologies have proliferated in recent years and the availability of a wide range of products has led to increasing adoption among customers. These technologies include direct deposit, computer banking stored value card and debit cards (Kaesther, 2008).

Growth of electronic banking in a country depends on many factors such as success of internet access, new online banking features, household growth of internet usage, legal and regulatory framework. E-banking can offer speedier, quicker and dependable services to the customers for which they may be relatively satisfied than that of manual system of banking. E-banking system not only generates latest viable return it can get its better dealings with customers. New banking intermediaries offering entirely new types of banking services have emerged as a result of innovative e-business models.

The internet has emerged as one of the major distribution channels of banking products and services for the banks in US and in the European countries. Initially, banks promoted their core capabilities i.e., products, services and advice through internet. More recently, due to advances in internet security and the advent of relevant protocols banks have discovered that they can play their primary role as financial intermediate's and facilitators of complete commercial transactions via electronic networks especially through the internet. Some banks have chosen a route of establishing a direct web presence while others have opted for either being an owner of financial services centric electronic marketplace or being participants of a non financial services centric electronic marketplace (Foley, 2000).

2.2.4. E-banking Practice in Ethiopian Commercial banks

Certainly the banking industry in Ethiopia is underdeveloped and therefore, there is an all immediate need to embark on capacity building arrangements and modernize the banking system by employing the state of the art technology being used anywhere in the world. With a growing number of import-export businesses, increased international trades and international relations, the current banking system is short of providing efficient and dependable services and therefore all banks operating in Ethiopia should recognize the need for introducing electronic banking system to satisfy their customers and meet the requirements of rapidly expanding domestic and international trades, increasing international banking services. Undeniably the largest state owned bank, Commercial Bank of Ethiopia is the pioneer in introducing ATM service for local users in 2001 with its fleet of eight ATMs located in Addis Ababa. Moreover, CBE has Visa membership since November 14, 2005. However, 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 (Gardachew, 2010).

 Dashen Bank, which worked aggressively to maintain its lead in electronic payment systems. Dashen bank, a forerunner in introducing e-banking in Ethiopia, has installed ATMs at convenient locations for its own cardholders. The Dashen Bank ATM is available 24 hours a day, seven days a week and 365 days a year providing service to Dashen debit cardholders and international visa cardholders coming to the country. At the end of June 2009, Dashen bank has installed more than 40 ATMs in its area branches, university compounds, shopping malls, restaurants and hotels (Dashen bank, 2011).

The first ever electronic banking gateway was signed between Ethiopian Commodity Exchange (ECX), Dashen Bank and CBE. The electronic banking system being developed with both banks is designed to give a secure electronic data sharing gateway between clients, banks and ECX, facilitating a smooth transaction (Demilew, 2008)**.**

As the CBE continues to move at a snail's pace in its turnkey solution for card based payment system, Dashen Bank remains so far the sole player in the field of electronic banking since 2006. The agreements signed by other private banks to introduce e-banking are welcoming and further steps towards realizing those agreements should be taken. Now in Ethiopia electronic banking is highly growing from which mobile banking service provider banks in Ethiopia are Wegagen, Commercial Bank of Ethiopia, United international bank, Dashen, Abay and Cooperative bank of Oromia. Internet banking service provider includes united international, Wegagen, Dashen, Abay, Nib international and Commercial Bank of Ethiopia. Agent bank service provider includes united international, Dashen, Abay, Anbessa and cooperative bank of Ethiopia. In the year 2014/2015 National bank of Ethiopia give ATM (Automatic teller machine) license permission to Abay international bank, Anbesa international bank, Nib international bank and Cooperative banks of Oromia (NBE, 2015).

2.2.5. Definition and Concepts of ATM

Automated teller machine are abbreviated as ATM and it is an electronic device that gives out or receive cash deposit from account holder through using smart card to initiate and complete a transaction with this machine. Simply by putting ATM card as widely called electronic chip that identifies each customer with respect to corresponding account belongs to the customer (Odewale, 2008).

Just like other data terminal ATM is terminal with two inputs and four output devices, it is used to connect and communicate through a host processor. This processor is analogous to an internal service provider in that it is the gate way through which all the various ATM networks are a veiled to the card holder (Fawcett, 2001). It is connected to a computer terminal, record keeping system and cash vault in one unit that permits a customer to enter personal identification number (PIN) or by punching a special code number into the computer terminal that is linked to the bank's computerized records. The initiative behind ATM was to automate or to make easy the task of a bank teller which subsequently removed the face to face interaction between customer

and bank teller, in the service sector such as banks the ATM technology is used to regulate service by way of reducing the employee/customer interaction and are expected to provide the same service where ever the customer goes and also expected that service provided by ATM from one customer to the other should be consistent. Depending on their location ATM may be either on premises or off premises. On premises if ATM are located only inside the bank premises and are typically more advanced they are also multi-function to complement the capabilities of an ideal bank branch are usually expensive. Off premises if ATM is located other than the location of the bank at places like shopping malls, super market and filling station are usually less expensive mono function devises (Humphery, 1993). ATM (Automatic Teller Machine) 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). Automated teller machines have reduced costs per transactions to almost one fourth as compared to the branches. ATMs support a variety of transactions such as cash withdrawal, cash deposits, cherub deposits and placement of service requests including the request for a new cheque book. New technology has facilitated the installation of in wall ATMs which are weather proof and can be established in shopping malls or busy commercial localities and have further reduced the transactions and operations costs for banks (Sambamurthy, 2010).

An automated teller machine or automatic teller machine (ATM) also known as an automated banking machine is a computerized telecommunications device that provides the clients of a financial institution with access to financial transactions in a public space without the need for a cashier, human clerk or bank teller. On most modern ATMs the customer is identified by inserting a plastic ATM card with a magnetic stripe or a plastic smart card with a chip that contains a unique card number and some security information (Humphery, 2004).

2.2.6. What ATMs Do?

ATMs provide many of the most demanded deposit services. ATM services include cash withdrawals, cash or check deposits, transfers among deposit accounts and bill payments.
The ATMs can and could more often in the future dispense physical goods to consumers. Already, some ATMs dispense stamps, lottery tickets and gift cards etc (Wikimania, 2015).
Many banks employ tellers who handle basic transactions and senior level associates who help customers open accounts and handle more complex transactions. Tellers can cash checks, make

deposits and withdrawals, provide account balance information and issue money orders. ATMs serve many of the same functions, accepting checks and cash for deposit, displaying account information and most popularly issuing cash (Dennis, 2014).

2.2.7. Reasons for Introduction of Automated Teller Machines (ATM) by the bank

ATMs have introduced by the bank for many reasons. First, ATMs are deployed to increase their share on banking market and to attract new or existing customer by offering more flexible, convenient and timely service for those customer and hoped that lead to high level of individual account balance and make small credit loan more easily available. Second, to perform many deposit withdrawal and transfer operation at a lower cost than human teller further they substitute branches and decrease the number of hours that a regular branch needed to be open. Finally, it is used for marketing purpose to test the demand for service in a particular area before a regular branch was established. On the cost side, besides the expense of setting up and maintain an ATM system or obtaining access to tone (Brand, 1988).

2.2.8. The Benefits of ATM

The benefits that can derived from ATM are so numerous, some are outlined below (Brain, 2000), allows clients to access their accounts at their convenience without the presence of human teller we can access transaction and have more time to serve clients, increased hours of operation fit client schedules more clients can be reached beyond the branch network, such as in smaller population centers, low cost funds are available because ATMs make it easier for clients to deposit savings.

Most modern ATM has the following benefits (Http://kalyan-city.blogspot.com, 2011), it provide24 hour's service: ATM provides service round the clock enabling bank customers to make cash withdraw up to a certain limit. Gives convenience to bank's customers: ATMs provide convenience to the customers. Even though, ATMs are located in Ethiopia mostly in places such as within the bank premises (on site ATMs). Reduce the workload of bank staff: ATMs reduce the work pressure on bank staff. Provide service without any error: ATMs provide service without error, the customer can obtain exact amount of cash they request, very useful for travelers: it help travelers because they need not carry large amount of cash with them. They can

withdraw cash from any city or state, across the country and even from outside their country. ATMs may give customers new currency notes: Customers may get brand new currency notes from ATMs the monies loaded into ATMs are often new and intact, this is because torn and soiled monies normally jam the machine, provide privacy in banking transactions to the customer He/she was not shy to withdraw a very small amount of money from the machine as compared to withdrawing that same amount of money from the teller and ATM technology has reduced paper work because it does not require a customer to fill cash withdrawal slips or cheques in order to withdraw money.

2.2.9. Deployment of ATMs

The motivation behind deploying ATM by the bank and share with the customer are areas that economists have investigated (Humphrey, 1993) examine that the motives for deploying ATM are based on cost saving. He investigates that the cost of banking in U.S and how the cost are influenced by the deployment of ATM. He finds that substantial scale economics in the production of ATM service and that ATM transaction cost about half an amount that the same transaction would cost if it were conducted in a branch of bank. However, no saving was realized from significant expansion of ATM service. So the deployment of ATM at convenience place can increased the number of transactions, leaving total bank cost roughly and also satisfying consumer demand.

The deployment of ATMs by individual banks prior to the advent of sharing ATMs in the U.S by considering the size of the bank and the geographic dispersion of the bank's depositors, they are able to detect a significant network effect in the demand for ATM services by bank customers. They examine a dynamic model of investment banks whose customers have a higher willingness to pay for a service will invest in providing that service sooner than another bank that is similar in other respects. Saloner and Shepard find that banks that have a more extensive branch network adopted ATMs sooner than other large banks, as their customers could take better advantage of the geographic diversity of ATM sites (usually provided at a bank's branches) in meeting their demands for cash (Shepard, 1995).

2.2.10. Determinants of ATM deployment

(Ou et al. 2009) constructs a framework on determinants of ATM investment. Their framework suggests that the ATM investments are influenced by bank scale, cost efficiency, and deposit

structure. Following (Ou et al. 2009), three proxy variables of bank scale are the log value of total assets (TA), the number of branches (NB) and the growth in the number of branches (GNB). The proxies of deposit structure are the ratio of total deposits to total assets (TD/TA), the ratio of demand deposits to total deposits (DD/TD) and the growth of demand deposits (GDD). Finally, operating expenses are measured by the ratio of operating expenses to total deposits (OE/TD), the ratio of salary costs over operating expense (SE/OE) and the growth of operating expenses (GOE).

Other determinants of ATM investments are first, firm size has traditionally been found to have a positive effect on determining new IT adoption. (David, 2008), suggest that larger banks have higher condition probability of adopting ATM technology all else equal. (Humphrey, 2004) confirmed the existence of significant scale and scope economies for ATM technology. This suggests that adopting ATM is likely to be more profitable for relatively larger institutions. Generally speaking, it is assumed that the firm size variable can capture the effect of scale. (Peffers, 1995), state that ATMs may provide two kinds of economies of scale. One is saving in operating cost and the other is to change customer value. Investments in ATM had a lot of sunk costs however; the variable costs per transaction were very low contrary to costs of human tellers. Therefore, the substitution of expensive personnel expenditures for larger banks has a substantial effect on cost reductions. As for change in customer value, larger banks usually have more ATM than smaller banks.

Second, several studies suggest that cost efficiency and wage rate of labor as the explanatory variables because of ATM have labor saving qualities. (Hunter, 2001), suggest that banks with higher wage rates could install more ATMs to release the pressure of personnel affordability. On the other hand, from the labor productivity perspective, firms are usually willing to pay higher salary to more skilled employees. The reason is obvious that skillful workers can handle more work and their labor productivity on average, is usually higher than less skilled workers.

Third competitive pressure on time, which might influence an adopter's decision to use an ATM; besides this, the stiff competition among banks trying to carve niches in the stock market alongside the large size of potential customer patronage (as a result of the large population of the country) makes ATM adoption for banks crucial. (Kwan, 2003), hypothesize that banks cannot ignore information system because it plays a critical role in their competitive edge both locally

and internationally, they pointed out that most fortune banks' cash flow is linked to their adoption of information system. Competitive pressure in the banking industry can be explained based on the number of banks competing in the market.

(Hwang et al.2009) suggest that competitiveness of environment as an organizational characteristic among other factors is crucial in determining adoption of IT. Also found that among other factors competitive pressure affect the adoption of data warehouse technology. Fourth, value of ATM transactions the increased usage of ATMs is attributed to the increase in number of ATMs in the country, awareness and ease as well as convenience of operating system. This suggests that the value and volume of ATM transactions were influenced by the number of ATM in the country. One would have expected the reverse suggesting that the deployment of ATMs should have been in response of the increase value and volume of ATM transactions.

Finally, bank profitability past studies found inconclusive relationship between IT investments and the profitability of banks. The relationship can be seen to be insignificant especially in the short run due to high costs of investments in ICT (Saythe, 2000) , (Siam, 2006). However latest studies seems to find a positive relationship between ICT and profitability. (Milne, 2006) , support this view when he stated that modernization of IT has set the stage for extraordinary improvement in banking procedure throughout the world. The study reveals that IT brings down the operational costs of the banks. Internet technology facilitates and speed up banks procedures to accomplished standardized and low value added transactions. Past studies in developing countries did not reflect any significant empirical relationship between ICT investment and banks profitability. Previous studies in Nigeria don't show any significant empirical relationship between ICT investments and the profitability of banks in Nigeria (Adewoye, 2007).

2.3.   Empirical Literature Review

This section of the study is devoted to review papers investigated by different authors. (Adriaine, 2000), examine a study on technology diffusion specifically ATM. The main objective of the paper is to investigate the role of firm and industry specific factors in the diffusion of ATM in UK financial sector. To achieve this goal the author has used panel data set over the period of 1972-1997. The variables used under investigation were endogenous learning, cumulative learning by doing effect, firm size, growth profitability and price expectation. Of the included variables, growth profitability and price expectation were the main factors affecting the

diffusion of new technology. However, the role of stock has little evidence on the diffusion process and recommended that to be robust across a number of specifications of baseline hazard function.

(Jonathan, 2013), conduct a research on the impact of ATM on cost efficiency of banks in Nigeria. The main objective is to analyze the impact of the intensity of ATM deployment on cost efficiency and the specific objectives are to ascertain the determinants of ATM and to evaluate the effect of ATM deployment on cost efficiency of Nigerian banks. Panel data is collected on twenty two commercial banks for five years financial report and internal operational record. The variables considered by the author as determinants of ATM deployment were bank size, bank profitability, salary level, number of banks and value of ATM transaction. Finally, the finding revealed that only bank size, salary level and value of ATM transaction were the key determinants of ATM deployment.

(Chia, 2012), has investigated on the relationship between self service technology investment and firm's financial performance. The prime objective of the study is to estimate the determinants of ATM investment and then to estimate the impact of ATM on bank financial performance. A time series data on eight categories of banking industry in Taiwan for one and two period lag were gathered. The variables used under investigation are bank scale (log value total asset, number of branches and change in number of branches), deposit structure (the ratio of total deposit to total asset, ratio of demand deposit to total deposit and change in demand deposit) and cost efficiency (ratio of operating expense to total deposit, ratio of salary expense to operating expense and change in operating expense). The author found that there were significant positive relationship between the independent variables and ATM investment thus, recommended that not only use self service technology to enhance financial performance but also use some other means.

A study is also conducted by Adewoye (2013), on the determinants of ATM deployment in Nigerian banks. The main objective of the study is to examine the determinants of ATM deployment in Nigerian banks using panel data set on twenty two commercial banks quoted by Nigerian stock exchange market for the year 2007-2011. The variables under consideration were employee's salary level, asset base, profitability, number of banks ,degree of competition and value of ATM transaction. Among these variables only bank size, salary level and value of ATM

transaction were the key determinants of ATM deployment and recommended that banks in Nigeria should continue to deploy ATM as a strategic tool to improve banks' efficiency.

(Hussein, 2017), undertook study on the effect of ATMs usage on operational performance of commercial banks in Nakuru country, Kenya. The main objective of the study is to evaluate the effect of ATMs usage on operational performance of commercial banks in Kenya. The study has employed theories namely diffusion of innovation and theories of reasoned action. The authors have used a correlation crossectional research design for 56 employees of the 28 commercial banks were selected through simple random sampling technique. The variables used in the study were ATMs usage and operational performance. The finding indicated that ATMs usage has significant and positive relationship with operational performance and the authors recommended that managements of commercial banks should highly invest on ATMs as it positively influences operational performance.

(Aijaz, 2012), conduct a research on ATM fraud, the case of commercial banks in Pakistan. The aim of the study is to investigate a mapping flaw bug in ATM controller commonly known as financial middle ware. The methodology used is exploratory research design based on secondary data since financial year 2006 for the state bank of Pakistan technology partners and ATM switch operator. Banks internal control, lack of understanding of higher management on the system and procedures of ATM infrastructure were the variables considered in the study. The result reveals that banks internal control system has failed to detect the implementation of mapping bug. Finally, the authors recommended that strong internal control implementation over the payment system applications and detailed review of fraud screening strategy to ensure that the security tool for the bank.

(Sultan, 2009), has investigated on impact of ATM on customer satisfaction: The case of three major banks of India. The objective of the study is to examine the scenario of ATM in three major banks, state bank of India, Housing Development Finance Corporation and industrial credit and Investment Corporation of India. The methodology used by the author is analytical and exploratory nature of design through primary and secondary data collection method for 360 respondents equally representing each bank by questionnaire. The variables were fee charged, problem faced, post purchase behavior generally included by the martial customer satisfaction level and abstract customer satisfaction level. The result shows that martial customer satisfaction

level is highest in state bank of India followed by industrial credit and Investment Corporation of India, and Housing Development Finance Corporation. This is due to the size of the respective bank and years of establishment.

Turning back to our country Ethiopia, a host of researches have been envisaged by previous scholars with regard to electronic payments and issues related to customer's adoption of ATM. Here are the studies that tried to assess adoption of ATM machines and others.

A research conducted by Balcha (2015), on aggressive branch expansion versus ATM and POS machine use in awash international bank, Addis Ababa city. The main objective of the study is to examine whether aggressive branch expansion of AIB is advisable or not. To achieve the objective, the author employed descriptive research design and to gather qualitative and quantitative data, both primary and secondary collection method for five branches were deemed. The variables considered were gender, age, marital status and monthly income; the result shows that aggressive branch expansion is not advantageous for AIB while, moderate branch expansion along ATM /POS expansions is better for AIB from profit perspective.

(Addis, 2015), investigate the evaluation of customers' satisfaction regarding PSS primary switch solution) ATM banking services in Addis Ababa. The main objective of the study is to evaluate the extent of customers' satisfaction in using PSS ATM banking services. The methodology used to achieve this objective is explanatory research design and cross sectional data set covering five years period for 384 respondents of survey data. The result indicated that most of PSS member bank customers' were satisfied with PSS ATM service. Finally, the author recommended that PSS ATM service delivery system should be more flexible and more tailored to enhance customers' satisfaction.

(Fyery, 2015), studied about ATM adoption of users in Commercial Bank of Ethiopia in Mekelle branch. The general objective of the study is 'ATM usage practice of ATM Customers in Commercial Bank of Ethiopia; The Case of Mekelle Branch'. A sample of 123 ATM adopters is taken through convenience sampling for the study. Data is also collected using structured questionnaire and analyzed through SPSS version 20 using descriptive statistical tools. The result has shown that ATM adopters in the bank used only limited types of services predominantly cash withdrawals. Lastly, the study recommended that the bank has to increase its promotion by

focusing on improving customers' awareness towards the technology and the different types of services it provides.

Coming to conclusion, all the researches undertaken in Ethiopia were mainly focused on assessing or evaluating customer side of ATMs and any other form of electronic payments employed by commercial banks. There is no studies conducted so far that attempt to look thoughtfully about the determinants of ATM deployments. Thus, this study aims to fill the knowledge and policy gaps by identifying the determinants of ATM deployment: the case of commercial banks of Ethiopia.

The above discussion indicated the impact of each explanatory variable on IT investment in general and ATM investment decision in particular and most of the variables deemed as determinants were significant to affect the deployment of ATMs. The following are some of the variables given strong emphasis by previous scholars.

I. Cost efficiency on ATM deployment

Cost efficiency is three proxy variables, the ratio of operating expenses to total deposits (OE/TD), the ratio of salary costs over operating expense (SE/OE) and the growth of operating expenses (DOE). The bank with higher operating expense burdens to invest more ATMs in an attempt to reduce their cost burdens because of reducing operating cost is one of the important drivers for banks to invest in innovation of IT such as ATM. In general, the results suggested that banks invest in ATMs to satisfy customers' needs for deposit related services and to improve cost performance and have significant positive impact on ATM investment (Stump, 2004).

II. Bank Size on ATM deployment

The actual bank size has been found to have a positive effect in determining new IT such as ATM deployment (Mcdowell, 1984) in examining the relationship between the decision of new IT adoption and size of the bank found out that consistent with the economic scale theory; it conclude that larger banks tend to introduce more ATM than small banks do. (Hwang et al, 2004) also examine the critical factors influencing the adoption of data warehouse technology in the Taiwan banking industry and also found out that bank size affect the adoption of data warehouse technology. (Chinet al, 2009) hypothesize also that larger banks invest more on ATM.

III.   Deposit Ratio on ATM deployment

The coefficients of (TD/TA) and (DD/TD) or the proxies of deposit ratio are significantly positive, indicating that banks with higher customer demand for deposit services and demand deposit services tend to invest more on ATMs (Ou, 2009).

IV.   Bank Profitability on ATM deployment

In line with the work of (Humphrey, 1994) and (Hung, 2009), the coefficients of bank profitability are negative and are not statistically significant. The implication is that the extent of ATM deployment is not really dependent on the bank profitability. But in recent studies (Oyerinde, 2013) investigated that there is positive relationship between ATM deployment and bank profitability and the coefficient of bank profitability is statistically significant.

Conclusions

This chapter discussed both the theortical and empirical literature review. The first section is devoted to the theortical part: the concept, types of electronic banking and its practice in the world at large and Ethiopia in particular. Besides, the concept, benefit, deployment and determinants of ATMs have been explained. Meanwhile, empirical literature is dealt on the second section: Different scholars have done a study in different aspect of ATM by using different methodologies. Finally, the researcher is identified what has not been done earlier.

Chapter Three

3.   Methodology of the Research

3.1.   Introduction

Research methodology is the technique and procedures used to obtain or analyze research data and finally help to achieve the desired objectives (Saunders, 2007). This chapter consists of the study area profile, research approach that are used in the study, research design, target population and sampling, variables and its measurement, sources and instruments of data collection, model specification and method of data analysis.

3.2.   Study Area Profile

The expansion of ATM banking service in Ethiopia is through progress and its emergence in Ethiopia moved back to the late 2001, when the largest state owned or Commercial Bank of Ethiopia (CBE) introduced ATM to deliver service to the local users (Gardachew et.al, 2010). Though, due to lack of modern technology consciousness and appropriate infrastructure is unsuccessful to provide capable service. Dashen Bank was the subsequent bank that has been installed ATMs at suitable locations for its own customers since 2006 (Ibid). Both banks tried to develop the ATM system by designing in the way to provide a secure electronic data-sharing gateway between clients and banks by facilitating a smooth transaction (Abiy, 2012). Wegagen Bank has signed an agreement with Technology Associates (TA), a Kenyan based information technology (IT) firm for the development of the solutions for the card payment system and installation of a network of ATMs on December 30, 2008 (Asrat, 2010). In February 2009, the three private commercial banks; Nib International Bank, Awash International Bank and United Bank have established separate entity under the name of Premiere Switch Solutions (PSS) with 165 million birr capitals (Amanayehu, 2008). The main objective of PSS formation is for the common ATM operational function and control. This policy agreement signed to avoid possible underutilization of the ATM system and to improve electronic card payment system in Ethiopia. This agreement is the first significant cooperation between competing banks in Ethiopia, which others should be encouraged to follow as there is no single bank in Ethiopia that can pay for providing wide geographical coverage and access (Binyam, 2009).

3.3. Research Approaches

3.3.1. Quantitative research approach

Quantitative research is grounded in the post-positivism knowledge claim that primarily reflects the scientific method of the natural sciences. This paradigm adopts a deductive approach to the research process. The researcher gathers data from the real world setting and then analyses the data statistically to support or reject the hypotheses (Babbie, 1995). Researchers who adopt a more deductive approach use theory to guide the design of the study and the interpretation of the results. In line with this, the overall objective of quantitative research is to test or verify a theory rather than to develop one. Therefore, the theory offers a conceptual framework for the entire study and it also serves as an organizing model for the entire data collection procedure. (Churchill, 2005), has seen quantitative techniques as an attempt to test a hypothesis by incorporating it into the research design and responding to it by measuring its strength and weaknesses that give numerical measurements to the data collected. Quantitative researchers put their emphasis on procedures, methodologies and statistics. As a result, it relies on statistical techniques aided by computational algorithms and software packages for analysis the problem under study. Quantitative research is one in which the investigator primarily uses positivist claims for developing knowledge and its strategies of inquiries are associated with experimental and survey research methods.

(Creswell, 2009), mentioned that experimental research seeks to determine if a specific treatment influence an outcome. This impact is assessed by providing a specific treatment to one group and withholding it from another and then determining how both groups scored on an outcome. Therefore, pure experiment enables the researcher to manipulate an independent variable in order to see the effect on the dependent variable with the random assignment of subjects to treatment conditions while quasi experiments uses non randomized designs and it is a single subjects design whereas, survey research provides quantitative or numeric description of research trends attitudes or opinions of a population by studying a sample of population. It includes cross-sectional (data will be collected in one point in time) and longitudinal studies (data will be collected through time with different interval) using questionnaires, structured interviews and documentary reviews for data collection with the intent of generalizing from the sample to the population.

The well planned and implemented quantitative research has the merit of being able to make generalizations, for a broader population, based on findings from the sample. To enhance the generalization of findings quantitative research methods follow at least theoretically, standardized procedures in sample selection, instrument design, implementation and analysis. This standardization in turn increases the duplicability of procedures and the reliability of findings and also can mitigate the impact of interviewer (if administered through direct interviews) and interviewee biases (Ibid).

Notwithstanding the above advantage, quantitative research design has a number of limitations. First, it belittles human individuality and the ability to think. Second, it fails to provide the researcher with information on the context of the situation where the studied phenomenon occurs. Third, it will have limited outcomes to only those outlined in the original research proposal due to closed type questions and the structured format and finally, quantitative research appears to lack flexibility in design which may be crucial when additional information revealed through data collection needs further exploration for knowledge (Ibid).

In general, according to Mckerchar (2008), the choice among the three research approaches is guided by mainly the research problem apart from the underlying philosophy of each research method. That is, whether the research problem is based on a framework developed deductively through a review of the literature and prefigured information to be collected in advance of the study or to allow it to emerge from participants in the project or both. In light of the research objective and hypotheses presented at the beginning of the chapter along with the underlying philosophy of each research approach. In this study, the researcher adopted quantitative approach as the objectives of the study is to quantify data by generalizing results from sample to population and the data were presented in the form of numbers and statistics. In addition, both the dependent and independent variables are continuous (Bhattacherjee, 2012).

3.4. Research Design

The choice of research design depends on objectives that researcher want to achieve (Alemayhu, 2009).

3.4.1. Explanatory Research

Seeks explanations of observed phenomena, problems or behaviors and seeks answers to why and how types of questions. Attempt to connect the dots in research, by identifying causal factors and outcomes of the target phenomenon. It involves: Explaining things not just reporting why? Elaborating and enriching a theory's explanation, determining which of several explanations is best, determining the accuracy of the theory, test a theory's predictions and also examines the cause and effect relationships between dependent and independent variable (Kothari, 2004). As a result, the study is employed explanatory research design and panel data set to address a broader range of issues and tackle more complex problems, to examine the relationship between the dependant and in dependant variables changes dynamically (over time). Panel data structured the model in an appropriate way it can improve the impact of certain forms of omitted variables bias in regression results (Brook, 2014). It is a data set in which the behavior of entities is observed across time because of panel data allows the researcher to control variables that cannot observe than pure time series or pure cross sectional data alone (Baltagi, 2008) .

3.5. Target Population and Sampling

The target populations for this study were both private and state owned commercial banks of Ethiopia. According to the national bank of Ethiopia (2015/16) report, there are 18 banks in Ethiopia. Using non-probability sampling technique that is purposive judgmental sampling, the researcher has selected thirteen banks out of eighteen banks. The purposively chosen banks were Bank of Abyssinia, Commercial Bank of Ethiopia, Wegagen Bank, Awash International Bank, Dashen Bank, United Bank, Nib International Bank, Lion International Bank, Zemen Bank, Berhan International bank, Abay Bank, Oromia International Bank and Cooperative Bank of Oromia for the period 2012-2016 G.C. This period is selected to get well organized data as ATM is a recent phenomenon. The remaining banks were not considered as part of this study since they did not fulfill the judgment or criteria outlined by the researcher. Hence, for these banks, it is hardly possible to find data on the outcome variable (ATM deployment) even for the chosen time period.

3.6. Variables and its Measurement

The interest variable employed in the study is ATM deployment. It is measured in terms of number of ATM deployed by banks. Bank size, bank profitability, deposit ratio, cost efficiency and branch expansion are the explanatory variables for this study. Including more than one explanatory variable in the model never indicates the absence of missed variables from the model (Brooks, 2014). Thus, to minimize the effect of missed variables from the model, the researcher is included disturbance term in this study.

3.6.1. Dependent Variable and Measurement

ATM deployment means the number of ATM that is deployed by banks. The motive for deploying ATMs are based on cost saving and it is measured by natural logarithm of the number of ATM. Natural logarithm is used to scale down the value of the variable if there is higher digit and to easily interpret the coefficient with elasticity.

3.6.2. Independent Variables and Measurements

Independent variables are explanatory variables that explain the dependent variable. The independent variables for this study were bank size (Bsize), bank Profitability (Prof), deposit ratio (Dsr), cost efficiency (Ce) and number of branch (Br). All of the above variables are adopted from previous studies, for instance from Chin etal, (2009), Hannan and Mcdowell (1984) and others based on the degree of their effect on ATM deployment.

Bank Size

The actual bank size has been found to have encouraging effect in determining new IT such as ATM deployment. By examining the relationship between the decision of new IT adoption and its determinants, (Hwang etal, 2004), found consistent results with economic scale theory; larger banks tend to introduce more ATM than small banks do. They also examined the critical factors influencing the adoption of data warehouse technology in the Taiwan banking industry and also found that bank size affect the adoption of data warehouse technology opined that operating scale which is represented by total assets, number of branches as well as growth in branches were positive and significant. They posited also that larger banks invest more on ATMs. Bank size is measured by natural logarithm of total asset.

Bank Profitability

Profitability could be measured in terms of return on equity (ROE) or return on Assets. ROE measures the return to share holder capital while ROA indicates or measures income earned on each asset unit and ROE is not most favorable measure of profitability even if the degree of capitalization often established by regulatory authority. In the study of Adewoye (2013), ROA is the key measure of profitability for banks. Hence, in this paper, ROA (the ratio of net income after tax to its total asset) is used as the measure of profitability. Profitable bank would invest more in asset acquisition including ICT investment. Past studies found inconclusive relationship between IT investments and the profitability of banks. The relationship can be seen to be insignificant especially in the short run due to high costs of investments in ICT (Huang, 2012). However, most recent studies found that there is a positive relationship between ICT and profitability. (Milne, 2006) state that modernization of IT has set the stage for extraordinary improvement in banking procedure throughout the world.

Deposit ratio

According to Yen (2011), the bank with higher customer demand for deposit service tend to invest more on ATM because the banks invest on modern technology particularly ATM to increase customer satisfaction and thereby to attract deposits. It is measured by the ratio of total deposit to total asset.

Cost efficiency

The bank with higher operating expense burdens to invest more on ATM in an attempt to reduce their cost burdens because the bank invest on ATM to improve cost performance. Thus, the relationship between operating expense and ATMs investment are positive. Cost efficiency is measured by the ratio of operating expense to total deposit (Ou, 2009) .

Branch expansion

When the bank expands the number of branches it may also expand the technology like ATM to convince and attract customers in line with the branch. The main reason to expand the branch is deposit mobilization and this variable is measured by the number of branches (Ou, 2009).

3.7.   Nature of Data and Instruments of Data Collection

The study has collected panel or longitudinal data for banks over some time period. To achieve the aforementioned research objectives, secondary source of data is gathered. It is data and information which already exists in some forms but which is not primarily collected at initially, for the purpose of the study at hand and it is data that is being reused (Bougie, 2010). The instrument of data collection for this study consisted of published or unpublished form by official records or document analysis from the audited annual financial statements of the commercial banks of Ethiopia.

3.8.   Model Specification

The data obtained is specified using the panel data regression model in order to investigate the determinants of ATM. The econometric model is specified with number of ATM deployed by banks as the outcome or dependent variable and the independent variables were banks size, banks profitability, deposit ratio, cost efficiency and number of branch. This model is empirically in line with (Chin S et al., 2009), (Hannan and Mcdowell, 1984), (Huang, 2009), (Adewoye, Jonathan oyerinde, 2013) and (Yen, 2011).The panel data regression model which is existed in most literature has the following general form.

$$Y_{it} = \beta_0 + \beta \times_{it} + \varepsilon_{it}$$

Where: - Y_{it} is the dependent variable for entity i 'in time period t', β_0 is the constant term, β is the coefficient of the independent variables of the study, $\times_{it}$ is the independent variable for entity i in time period 't' and ε_{it} the disturbance or error term. Thus, the econometrics model for this study is specified as follows.

$$lnNATM_{it} = \beta_0 + \beta_1 ln(Bsize)_{it} + \beta_2 (Prof)_{it} + \beta_3 (Dsr)_{it} + \beta_4 (Ce)_{it} + \beta_5 (Br)_{it} + \varepsilon_{it}$$

Where

- β_o is an intercept.
- $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 represents estimated coefficient of the independent variables for bank i at time t.
- Ln Bsize, Prof, Dsr, Ce and Br represents ln of bank size, bank profitability, deposit ratio, cost efficiency and number of branches respectively.

- ε_{it} represents error terms for intentionally/ un intentionally omitted variables. It has zero mean, constant variance and non auto correlated.

The estimators in econometrics model are pooled OLS, Random effect and fixed effect.

Comparisons of Pooled OLS vs Panel model estimators

The researcher is employed LM (Breusch-Pagan Lagrange multiplier) to know whether the pooled OLS or random effect model is preferred. The same observations are used over time and unobserved heterogeneity can be controlled in panel data where as in pooled OLS data it cannot control unobserved heterogeneity and has the problem of omitted variables. The panel frame work explains that there are K regressor in Xit with no constant term whereas, pooled OLS is very basic process that use when it have a panel data, pool the data and estimate OLS regression. So relating to the basic framework above if zi has a constant term, OLS is consistent and efficient estimate of α and the slope vector β (Green, 2012)

The null hypothesis in the LM test is variance across entities is zero or there is no significant difference across units (no panel effect) that mean pooled OLS are appropriate using command xttest0 (William, 2008).

The researcher also used F-test to identify whether pooled OLS or fixed effect is appropriate model for the study. The null hypothesis under this test is that pooled OLS is appropriate for the study while rejecting the null hypothesis is that fixed effect model is appropriate (Green, 2012).

Comparisons of Fixed vs Random effect model

Fixed effect (within estimator) design is that it allows for the unit specific effect (unobserved heterogeneity or omitted) to be correlated with the regressor where as the random effect (covariance model) assumes that the unit-specific effect is uncorrelated with the regressor. The researcher is used Hausman test to decide whether random effect or fixed effect model is fit the data well using command husman fixed random. The null hypothesis is that the preferred model is random effects that means there is no correlation between regressor and un observed effects whereas, the alternative hypothesis says fixed effects model is preferred meaning there is correlation between them (James, 2007).

Specification test

Various diagnostic tests such as linearity, heteroscedasticity, serial autocorrelation, normality and multicolinearity test are conducted to decide whether the model used in the study is appropriate and to fulfill the assumption of classical linear regression model. Thus, in order to examine the possible degree of multicolinearity among variables variance inflation factor is used. Heteroscedasticity is tested by using group wise heteroscedasticity using command xttest3, the null is homoscedasticity (or constant variance) and reject the null or alternative hypothesis is heteroscedasticity. Serial correlation tested by Wooldridge autocorrelation using command xtserial, The null is no serial correlation, fail to reject the null means the researcher concluded that data does not have first-order autocorrelation .Whereas, the remaining test that are linearity and normality can be tested by Ramsey reset test and Shapiro W / Normality P-P plot respectively (Wooldridge, 2002).

3.9. Method of data Analysis

As noted by (Kothari, 2004), data has to be analyzed in line with the purpose of the research plan after data collection. Thus, the study employed descriptive and panel model econometric analysis based on panel data collected from thirteen banks for the period 2012-2016. The data collected from secondary sources are coded, checked and entered to simple excel program to make the data ready for analysis. Then the collected data is entered and analyzed through STATA version 12 software packages. For descriptive analysis; table and graph are used to analyze the data. Besides, results of the descriptive statistics such as mean, standard deviation, minimum and maximum values were reported to describe the characteristics of variables under investigation.

Chapter Four

4. Results and Discussion

In this section of the study, the following main issues are addressed. The first section encompasses descriptive statistics of the dependant and independent variables with table and graph. The second section presents the model specification test, which model is appropriate for the data collected. The third section elaborates diagnostic tests for classical linear regression model assumptions through stata version 12. Finally, the last section discusses the findings or results of the selected model.

4.1. Descriptive Statistics

This section presents the descriptive statistics of the dependent and explanatory variables used in this study. The dependent variable used in this study is ln of number of ATM deployment while explanatory variables are ln of bank size, bank profitability, deposit ratio, cost efficiency and number of branches. Accordingly, the following table reports mean, maximum, minimum, standard deviation and number of observation for each variables used in this study.

Table 4.1: Results of Descriptive Statistics for the Entire Sampled Period of Selected Banks

Variables	Obs	Mean	Std. Dev.	Min	Max
lnNATM	65	3.809936	1.246208	0.6931472	7.313887
lnBsize	65	9.232838	1.215249	7.121253	13.27165
Prof	65	4.809692	1.371419	2.1	8.5
Dsr	65	0.7651385	0.0491693	0.629	0.9
Ce	65	0.0462462	0.0146309	0.016	0.096
Br	65	151.4308	214.3368	1	1137

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

The mean of ATM deployment which is measured by ln of number of automated teller machine for the selected banks throughout the study period reflects 3.809936 with standard deviation of 1.246208. The minimum and maximum number of ln of automated teller machine is 0.6931472 and 7.313887 respectively. The mean of bank size which is measured by ln of total asset is 9.232838 and the minimum of ln of asset is 7.121253 and the maximum of ln of asset is

13.27165 with standard deviation of 1.215249. The average return on asset as measurement of profitability of the selected banks in the study is 4.809692. The lowest return on asset is 2.1 and the highest return on asset is 8.5 with standard deviation of 1.371419. For the variable deposit ratio a deviation from the mean of 0.7651385 is about 0.0491693 with range between 0.629 and 0.9. The efficiency of costs of banks reflected by total operating expense to total deposit showed that the average of 0.0462462 with standard deviation of 0.0146309 minimum and maximum of deposit ratio is 0.016 and 0.096 respectively. The mean with regard to branches measured by the number of branches of each selected banks is 151.4308 with deviation of 214.3368 ranging between 1 branch to 1137 branches.

4.1.1. Analysis for Automated Teller Machine Trend from   2012-2016

This analysis establishes a pattern for ln of number of ATM in commercial banks of Ethiopia during the period in consideration, which is from 2012-2016. Accordingly, figure 4.1 below provides a respective pictorial presentation for ln number of ATM figure from 2012-2016. In the figure below, the x-axis represents the years and y-axis represents the level of ln of number of ATM in commercial banks of Ethiopia.
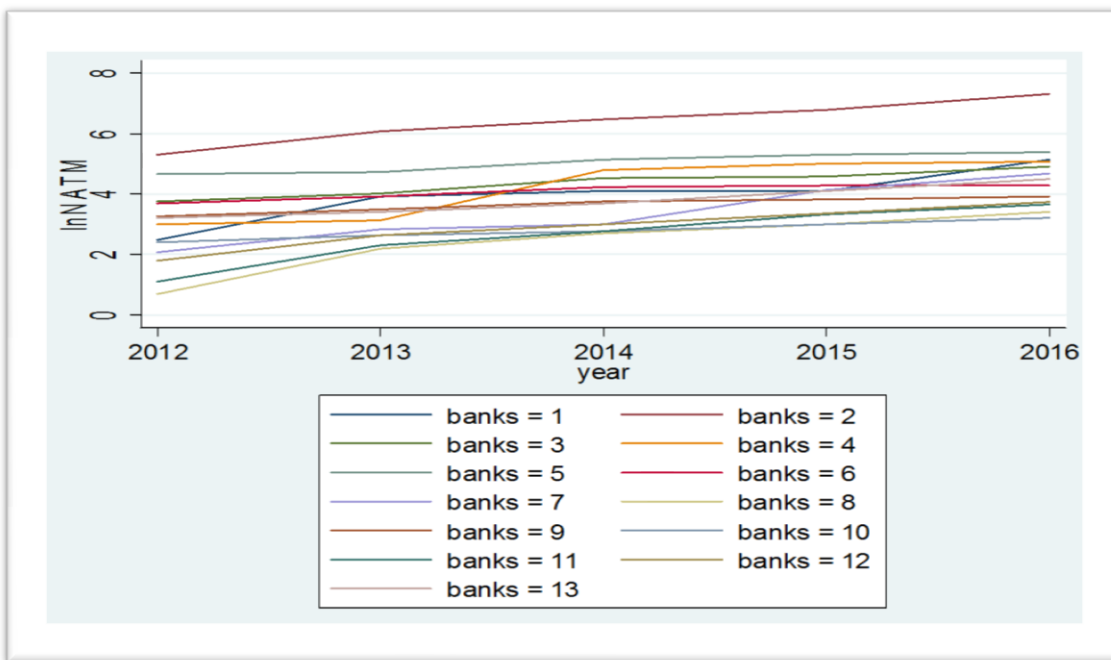

Figure 4.1: Trend Analysis of Automated Teller Machine

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

As shown from figure 4.1 above, the trends of ATM deployment in commercial banks of Ethiopia from the period 2012 to 2016 are slightly or inconsiderably increasing. The increase in ln of number ATM might be due to higher bank size, profitability and deposit ratio and other factors which included in the error term. Even if there is increasing trend in the level of ln of number of ATM, the rate and magnitude of increase is small. Thus, this result suggested a slightly upward sloping trend of ln of number of ATM.

4.2. Model Specification Test

Panel model starts by making comparison between three models viz, pooled regression model, fixed effect model and random effect model before estimating econometrics model. Therefore, the choice among pooled regression, fixed effect and random effect model is very important as it largely influences conclusions on the individual coefficients (Gujarati, 2004). Specification test and determination of appropriate model is carried out by using F- test, Breusch pagan lag range multiplier and Hausman specification test. Accordingly, the F-test is validated for comparing fixed effect over pooled regression. The null under F-test is pooled regression is appropriate meaning there is no significant difference across banks while the alternative hypothesis is fixed effect appropriate. Since the test statistics in the F test is statistically significant, the researcher have rejected the null hypothesis of pooled regression is appropriate, thus fixed effect is appropriate.

Table 4.2: F-test of Simple Pooled OLS versus Fixed-Effects Model

LnNATM	Coef.	Std. Err.	T	P>|t|	[95% Conf. interval]	
lnBsize	1.050537	.2570835	4.09	0.000	.5333521	1.567723
Prof	.0359096	.0967665	0.37	0.712	-.1587595	.2305787
Dsr	2.135002	1.813494	1.18	0.245	-1.513278	5.783281
Ce	5.885059	6.711375	0.88	0.385	-7.616486	19.3866
Br	.0009071	.0011558	0.78	0.436	-.0014181	.0032323

Cons	-8.105319	2.152354	-3.77	0.000	-12.4353	-3.775342

sigma_u   .59308976

sigma_e   .4230511

rho   .66277955   (fraction of variance due to u_i)

F test that all u_i=0:   F(12, 47) =   3.98   Prob > F = 0.0003

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

The Breusch and Pagan Lagrange Multiplier test is carried out to make a choice between the pooled regression model and the random effect model. This test is based on the null hypothesis that the variance of the random disturbance term is zero or no panel effect. The test is performed using command xttest0. The result of this test shows statistically significant p-value. So, the null hypothesis are rejected and suggested that random effect is appropriate*.*

Table 4.3*:* Breusch and Pagan Lagrangian Multiplier Test for Random Effect

lnNATM [banks,t] = Xb + u[banks] + e[banks,t]

Estimated results:

	Var	sd = sqrt(Var)
LnNATM	1.553036	1.246208
E	.1789722	.4230511
U	.1893683	.4351646

Test: Var (u) = 0

chibar2 (01) =   15.14

Prob > chibar2 =   0.0000

Further, Hausman test is applied to make a choice between the fixed effect and random effect model for the reason that both the fixed and random effects were selected over the pooled

regression model following the F-test and the Breusch and Pagan Lagrange Multiplier test respectively. The result of Hausman test revealed fail to reject the null hypothesis, suggesting that random effect model is better suited compared to the fixed effect.

Table 4.4: Hausman Specification Test for Fixed Vs. Random Effect Model

	-----Coefficients----			
	(b)	**(B)**	**(b-B)**	**sqrt(diag(V_b-V_B))**
	Fixed	**Random**	**Difference**	**S.E.**
lnBsize	1.050537	.8941065	.156431	.1956175
Prof	. 0359096	.1167022	-.0807926	.0676335
Dsr	2.135002	2.932545	-.7975433	.9517461
Ce	5.885059	8.024531	-2.139472	3.72462
Br	.0009071	-.0000934	.0010005	.0007773

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$chi2(4) = (b-B)'[(V\_b-V\_B)^{(-1)}](b-B)$$

$$= \quad 1.96$$

$$Prob>chi2 = \quad 0.7438$$

Therefore, from the results of the F test, Breusch and Pagan Lagrange Multiplier test and Hausman test, the best and reasonable fit model used in this study is random effect regression model. Hence, the regression results of the random effect model were used for statistical inference and further analysis of the individual coefficients.

4.3.   Diagnostic Tests for Classical Linear Regression Model Assumptions

4.3.1. Multicolinearity

This assumption states that explanatory variables are not correlated with one another. A problem occurs when the explanatory variables are very highly correlated with each other, and this problem is known as multicolinearity. If problems of near multicolinearity is present but ignored, R^2 will be high but the individual coefficients will have high standard errors, so that the regression looks good as a whole, but the individual variables are not significant (Brooks, 2014). The severity of the problem of multicolinearity across the independent variables is detected through variance inflation factors (VIF). According to (Gujarati, 2004), as a rule of thumb variables are considered as highly collinear if the VIF exceeds 10. In this study, the result shows that mean VIF of 3.08 which is lower than 10 and suggested that there is no severe multicolinearity problem in the estimated model.

Table 4.5: Test of Multicolinearity using Variance Inflation Factor (VIF)

Variables	VIF	1/VIF
LnBsize	6.32	0.158110
Br	4.75	0.210344
Ce	1.54	0.649743
Prof	1.46	0.682779
Dsr	1.32	0.757257
Mean VIF	**3.08**	

4.3.2. Linearity test

One of the classical linear regression models assumptions is that the appropriate functional form is linear. This means that the appropriate model is assumed to be linear in the parameters and that in the bivariate case, the relationship between y and x can be represented by a straight line (Brook, 2014). For this study, the Ramsey reset test is performed for linearity with the null hypothesis of model has no omitted variables. As the result shows, p-value is statistically insignificant supporting the null hypothesis of the functional form is linear**.**

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Table 4.6: Test of Linearity Using Ramsey Reset

Ramsey RESET test using powers of the fitted values of lnNATM

Ho: model has no omitted variables

    F(3, 56) =   0.32
    Prob > F =   0.8137

4.3.3. Heteroscedasticity

In the classical linear regression model, one of the basic assumptions is homoscedasticity assumption that states as the probability distribution of the disturbance term remains same for all observations. That is the variance of each u_i is the same for all values of the explanatory variable. However, if the disturbance terms do not have the same variance, this condition of non constant variance or non homogeneity of variance is known as heteroscedasticity (Wooldridge, 2002). Modified Wald test is used to test heteroscedasticity with null hypothesis that variance of errors is homoscedasticity or constant. The result of this test is statistically significant indicating existence of heteroscedasticity and this would results spurious estimates. However, for the purpose of coefficient estimates interpretation, problem of heteroscedasticity are controlled using clustered robust standard error.

Table 4.7: Heteroscedasticity Test

Modified Wald Test for Group Wise Heteroscedasticity in Fixed Effect Regression Model

H0: sigma(i)^2 = sigma^2 for all I

chi2 (13) =   2169.81

Prob>chi2 =   0.0000

4.3.4. Autocorrelation

Furthermore, the researcher tested the autocorrelation assumptions that imply zero covariance of error terms over time. That means errors associated with one observation are uncorrelated with

the errors of any other observation. There exists the possibility that the wrong inferences could be made about whether a variable is or is not an important determinant of variations in the dependent variable (Gujarati, 2004). Wooldridge test is used to test autocorrelation with null hypothesis that there is no first order auto correlation. Wooldridge test indicated statistically insignificant result supporting the null hypothesis of there is no first order autocorrelation.

Table 4.8: Autocorrelation test

Wooldridge test for autocorrelation in panel data

H0: no first order autocorrelation
F(1,   12) =   1.376
Prob > F =   0.2635

4.3.5. Normality

Normality assumption is required in order to conduct single or joint hypothesis tests about the model parameters, which stated that normality of the residual shows that the estimator is unbiased, minimum variance and consistent (Brooks, 2014). In this study, Shapiro Wilk test is used to test normality distribution of error term with null hypothesis that residuals are normally distributed. Result of this test indicated that Prob>z = 0.00390 which is statistically significant revealing as the null hypothesis of normally distributed is rejected and the residuals are not normally distributed.

Table 4.9: Normality Test Using Shapiro W Wilk

Variable	Obs	W	V	Z	Prob>z
U	65	0.94105	3.417	2.661	0.00390

4.4. Empirical Results of Regression Analysis and Discussion

This section presents the regression result of pooled, fixed and random effect model that were made to examine the determinants of ATM deployment in commercial banks of Ethiopia. Accordingly, the regression result is made and coefficients of the variables were estimated via STATA version 12 software.

In the first step, the pooled OLS were estimated, from which the results were used as starting values for fixed and random effect models. The three models were estimated to identify the determinants of ATM deployment using the following econometric model.

$$\ln\text{NATM}_{it} = \beta_0 + \beta_1 \ln(\text{Bsize})_{it} + \beta_2 \ (\text{Prof})_{it} + \beta_3 (\text{Dsr})_{it} + \beta_4 \ (\text{Ce})_{it} + \beta_5 \ (\text{Br})_{it} + \varepsilon_{it}$$

Table 4.10: Regression Results of the Three Models

	Models		
	Pooled OLS	**Fixed effect**	**Random effect**
Variables	**Coef.** (Robust S.e, P-Value)	**Coef.** (Robust S.e, P-Value)	**Coef.** (Robust S.e, P-Value)
lnBsize	.9473713 (.1387158, 0.000***)	1.050537 (.2570835, 0.000***)	.8941065 (.1668105, 0.000***)
Prof	.138718 (.0591509, 0.022**)	.0359096 (.0967665, 0.712)	.1167022 (.069206, 0.092*)
Dsr	2.668442 (1.566592, 0.094*)	2.135002 (1.813494, 0.245)	2.932545 (1.543678,0.057*)
Ce	7.235199 (5.683676, 0.208)	5.885059 (6.711375, 0.385)	8.024531 (5.582989, 0.151)
Br	-.0006889 (.0006819, 0.316)	.0009071 (.0011558, 0.436)	-.0000934 (.0008554, 0.913)
Constant	-7.876183 (1.535152, 0.000)	-8.105319 (2.152354, 0.000)	-7.607274 (1.701664, 0.000)
Obs.	65	65	65
R^2	.8293	.7935	.8256
	F(5,59) =57 Prob > F (0.0000)	F(5,47)=22.61 Prob > F (0.0000)	Wald chi2(5) = 174.48 Prob > chi2 (.0000)

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

 Note: ***significant at 1%, **significant at 5%, and *significant at 10%

As shown from the table above, among the five explanatory variables, only the coefficient for ln of bank size (ln Bsize) is significant at 1% for the three models. The variable profit (Prof) is statistically significant at 5 % and 10% for the pooled and random effect model respectively, and deposit ratio (Dsr) is statistically significant at 10% for both pooled and random effect models. Meanwhile, cost efficiency (Ce) and number of branches (Br) were found to be statistically insignificant impact on the deployment of ATM (NATM) in commercial banks of Ethiopia for the three models employed. The constant term is also included to capture the effect of the stochastic term on the interest variable for all models.

Coming to the goodness of fit or the explanatory power of the model, 82.93 % of the variation in ln of number of ATM is explained by the included variables in the pooled model. Whereas, 79.35 and 82.56 % of the change in the dependent variable is explained when fixed and random effect model is employed respectively.

To select which model is appropriate for this study, conventional model specification test: the F-test, LM tests and Hausman specification tests were used. Based on comparison result among the three models deemed, an appropriate model for this study is random effect model. Thus, the determinants of ATM deployment and their effect were investigated by this model. Hence, interpretation of coefficients for this study is made based on estimated results of random effect model.

Table 4.11: Regression Results of Random Effect Model

LnNATM	Coef.	Robust Std. Err.	z	P>z	[95% Conf. Interval]	
lnBsize	.8941065	.1668105	5.36	0.000	.5671639	1.221049
Prof	.1167022	.069206	1.69	0.092	-.018939	.2523434
Dsr	2.932545	1.543678	1.90	0.057	-.09300725	.958097
Ce	8.024531	5.582989	1.44	0.151	-2.91792618	.96699
Br	-.0000934	.0008554	-0.11	0.913	-.0017699	.001583
cons	-7.607274	1.701664	-4.47	0.000	-10.94248 4	.272073

sigma_u	.43516463
sigma_e	.4230511
rho	.51411198 (fraction of variance due to u_i)
Number of obs	= 65
Wald chi2(5)	= 174.48
Prob > chi2	= 0.0000
R squared	= 0.8256

Source: Own Computations via Stata 12 Using Data Collected from Head Office of each Bank and NBE

Thus, the regression output of the random effect became

$LnNATMit = -7.607274 + 0.8941065* lnBsize + 0.1167022*Prof + 2.932545*Dsr + \varepsilon_{it}$

The regression output revealed that the dependent variable is well explained by the included explanatory variables in the model with R square 82.56% and the rest of the variation in ATM deployment were not explained by the explanatory variables included in the model of this study. The P- value is also significant, suggesting that variations in the dependent variable are well enough explained by the regressor in the model.

Among the five variables considered in the random effect model, ln of bank size, banks profitability and deposit ratio were found to be significant determinants of ATM deployment.

Bank Size

The ln of bank size is statistically significant at 1 % with z value of 5.36 and had positive impact on the deployment of ATM. The implication is that when bank size increases by 1%, then ATM deployment would rises by 0.894%, ceteris paribus. This result confirms researchers' priori expectation about the significant relationship between bank size and the ATM deployment. Hence, the researcher has been accepted the alternative hypothesis of Bank size has a significant effect on ATM deployment in commercial banks of Ethiopia. This result is also consistent with the economic scale theory; larger banks tend to introduce more ATM than small banks do (Hannan and Mcdowell, 1984).

Bank Profitability

The second significant variable in this model was bank profitability. This variable is statistically significant at 10% with z value of 1.69 and has positive effect on ATM deployment in commercial banks of Ethiopia and this supported the alternative hypothesis of bank profitability has a significant impact on ATM deployment. The implication is that when bank profitability

increases by one birr per year, ATM deployment rises by 0.116%. Suggesting profitable bank would invest more in asset acquisition including ICT investment. Past studies found inconclusive relationship between IT investments and the profitability of banks but recent studies including this study found significant relationship between bank profitability and ATM deployment (Milne, 2006).

Deposit Ratio

The results of this study also revealed that the ratio of total deposit to total asset is statistically significant at 10% with z value of 1.90 and positively related to ATM deployment. The implication is that when banks deposit ratio increase by one birr per year, ATM deployment raises by 2.93% indicating that the greater the ratio of deposit, the better the deployment of ATM in commercial banks of Ethiopia. This suggested that banks with higher customer demand for deposit service tend to invest more on ATM because banks investment on modern technology particularly ATM can increase customer satisfaction and thereby to attract deposits (Yen, 2011). This result is also consistent with researcher expectation of significant effect on ATM deployment.

Generally, among the three significant variables bank size has most important determinants of ATM deployment in commercial banks of Ethiopia. Because, it is significant at 1%.

From the result of random effect regression model, taking variability in ATM deployment as the dependent variable, it is observed that the p-value of cost efficiency and number of branches were statistically insignificant. This indicated that ATM deployment varies across individual bank depending on their ln of bank size, bank profitability and deposit ratio. Whereas, the variation in ATM deployment do not basically different across banks based on their cost efficiency and number of branches. Thus, the variables cost efficiency and numbers of branches have no effect on ATM deployment. This result is not supported the alternative hypothesis of both have significant effect on ATM deployment in commercial banks of Ethiopia, hence failed to reject the null hypothesis of no significant effect on ATM deployment. This result is inconsistent with the finding investigated by (Ou et al., 2009), found both cost efficiency and number of branches have significant impact on ATM deployment.

Chapter Five

5. Conclusion and Recommendation

This chapter comprises of conclusions made based on the findings and the way forwarded to concerned bodies. Accordingly, the first section is devoted for the conclusion part of the study. Meanwhile, the second section presents the policy implication or recommendation of the result of this paper.

5.1. Conclusion

The growing trend of information technology investment especially ATM in Ethiopia banking industry is below customers demand (Ayana, 2012). The availability and deployment of ATM in Ethiopia is low level compared to the fast growing urban population.

Thus, the main objective of this study is to examine the determinants of ATM deployment in commercial banks of Ethiopia based on a balanced panel data analysis for the time period beginning from 2012 to 2016 G.C. This study has passed various model specification tests and random effect model is selected among fixed effect and pooled OLS regression analysis. The collected data is analyzed using random effect model and interpretations of estimates were made based on this model. Descriptive statistics and econometric method is employed as methods of analysis. The result of the descriptive analysis indicated a slight increase in ATM deployment in commercial banks of Ethiopia over the time period of the study.

The results of empirical evidence from the econometric regression analysis of random effect model revealed that independent variables: bank size, bank profitability and deposit ratio were statistically significant to explain the number of automated teller machine in commercial banks of Ethiopian. The directions of influence for the aforementioned significant variables were positive with researcher priori intuition. Specifically, the finding indicated that bank size measured by total asset has positive and statistically significant impact on ATM deployment. This result is consistent with the economic scale theory. The implication is that larger banks tend to introduce more ATM than small banks do (Hannan, 1984).

Similarly, the study also found out that bank profitability measured by ROA has positive and statistically significant impact on deployment of ATM in commercial banks of Ethiopia. The implication is that banks with higher ROA have better ATM deployment. This result is

consistent with recent studies and researcher prior expectation of significant relationship between bank profitability and ATM deployment. However, this is inconsistent with result obtained by previous studies. For instance, according to (Adewoye, 2013) the relationship between profitability and ATM deployment were statistically insignificant.

Moreover, the study investigated that deposit ratio measured by total deposit to total asset has positive and statistically significant impact on the deployment of ATM. This result is consistent with results investigated by (Yen, 2011). The implication is that banks with higher customer demand for deposit service tend to invest more on ATM because banks invest on modern technology particularly ATM to increase customer satisfaction and thereby to attract deposits.

In a nut shell, the implication of significant and positive coefficient of bank size, bank profitability and deposit ratio is that those banks with higher total asset, higher profit and larger ratio of deposit have better automated teller machine deployment. On the other hand, those banks with lower total asset, lower profit and lower ratio of deposit have small number of ATM deployment.

However, cost efficiency and number of branches has statistically insignificant relationship with number of ATM deployment. Therefore, for this study, cost efficiency and number of branches were not considered as important or determining factors of ATM deployment by Ethiopian commercial banks. The coefficient sign for cost efficiency measured by the ratio of total operating expense to total deposit revealed positive but insignificant impact on ATM deployment. The study also found that branches which are measured by the number of branches have statistically insignificant relationship with ATM deployment in commercial banks of Ethiopia. Therefore, in the case of Ethiopian banks, number of branches is not a key factor that determines ATM deployment.

5.2. Recommendation

Based on the findings of the study and conclusion made, the following recommendations were forwarded.

To date, IT investment especially ATM is an important strategic tool for both banks and customers for speedy their work than that of teller (Brand, 1988). As a result, this study is oriented toward ATM deployment and its determinants in the case of commercial banks of Ethiopia. Practically, the result of this study can provide benchmark information about the status of ATM deployment among commercial banks of Ethiopia and the determinant factors influencing this deployment.

Hence, the findings of this study suggested that commercial banks of Ethiopia with lower ATM deployment should take action for better deployment of ATM by increasing bank size, bank profitability and ratio of deposit

- ✓ Bank size has a positive effect on ATM deployment; commercial banks of Ethiopia should have taken some measures to increase their asset. This may achieve through investing in government securities, investing in term bonds and also growth in placement with other banks.
- ✓ Profitability has also positive and significant impact on ATM deployment in commercial banks of Ethiopia. Hence, there is positive relationship between them commercial banks increase profitability by strengthen business linkages with potential exporters and importers, by improving customer service delivery and by enhancing staffs efficiency and productivity.
- ✓ Deposit ratio is one of the variables that have positive and significant impact on ATM deployment. Therefore, commercial banks increase their deposit through increasing the number of deposit account holders, increasing branch network and the public confidence and customer attraction policy.

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Appendix

Table 4.12: Raw Data Collected for the Pursue of MSc. In accounting and Finance

Banks	Year	Ln of No. of ATM	Ln of Bank Size	Profit	Deposit Ratio	Cost Efficiency	No. of Branches
BOA	2012	2.484907	9.016756	2.8	0.821	0.033	63
BOA	2013	3.912023	9.223158	2.9	0.838	0.026	78
BOA	2014	4.094345	9.330432	4.2	0.806	0.037	100
BOA	2015	4.094345	9.522776	5	0.813	0.041	132
BOA	2016	5.135798	9.730803	2.4	0.81	0.052	185
CBE	2012	5.298317	11.97549	3.98	0.734	0.016	547
CBE	2013	6.070738	12.19149	4.43	0.773	0.018	695
CBE	2014	6.467699	12.39009	5.06	0.799	0.021	838
CBE	2015	6.790097	12.67733	5.5	0.88	0.026	965
CBE	2016	7.313887	13.27165	6.6	0.9	0.029	1137
WB	2012	3.7612	9.029657	4.1	0.689	0.043	76
WB	2013	4.025352	9.248984	5	0.726	0.043	95
WB	2014	4.521789	9.327464	5.4	0.745	0.052	116
WB	2015	4.574711	9.52598	5.8	0.719	0.058	161
WB	2016	4.905275	9.692097	6.01	0.684	0.064	170
AIB	2012	2.995732	9.387398	3.6	0.771	0.032	86
AIB	2013	3.135494	9.606361	3.8	0.844	0.037	115
AIB	2014	4.787492	9.904926	4.5	0.75	0.041	150
AIB	2015	5.010635	10.08036	5.5	0.775	0.043	202
AIB	2016	5.075174	10.29585	6.8	0.771	0.046	240
DB	2012	4.65396	9.771098	4.05	0.802	0.029	72
DB	2013	4.718499	9.890765	5.66	0.802	0.032	103
DB	2014	5.135798	9.997078	5.78	0.805	0.034	133
DB	2015	5.298317	10.11714	6.01	0.8	0.044	156
DB	2016	5.393628	10.26034	6.5	0.796	0.045	220
UB	2012	3.688879	9.081029	4	0.769	0.033	63
UB	2013	3.912023	9.208138	6	0.808	0.043	73
UB	2014	4.234107	9.382306	7	0.749	0.045	94
UB	2015	4.276666	9.572263	8	0.821	0.049	124
UB	2016	4.29046	9.756719	8.5	0.754	0.055	161
NIB	2012	2.079442	9.021115	3.7	0.705	0.037	55

NIB	2013	2.833213	9.120962	3.84	0.727	0.041	71
NIB	2014	2.995732	9.282408	4.09	0.737	0.034	88
NIB	2015	4.127134	9.492214	5	0.737	0.047	105
NIB	2016	4.672829	9.669686	5.4	0.784	0.046	130
LIB	2012	0.6931472	7.809135	4	0.705	0.043	36
LIB	2013	2.197225	7.986845	5.6	0.715	0.043	43
LIB	2014	2.70805	8.192294	5.7	0.743	0.052	60
LIB	2015	2.995732	8.675735	6	0.76	0.068	63
LIB	2016	3.401197	9.00199	6.9	0.78	0.069	90
ZB	2012	3.258096	7.780721	4.3	0.748	0.042	1
ZB	2013	3.496508	8.085794	4.7	0.771	0.072	1
ZB	2014	3.7612	8.275122	5.1	0.772	0.039	8
ZB	2015	3.828641	8.491671	6.5	0.784	0.043	11
ZB	2016	3.912023	8.905716	6.7	0.774	0.041	16
BrIB	2012	2.397895	7.158514	3.1	0.725	0.037	15
BrIB	2013	2.639057	7.694848	3.55	0.725	0.031	22
BrIB	2014	2.772589	7.942007	4.8	0.715	0.057	37
BrIB	2015	2.995732	8.336137	5	0.735	0.052	72
BrIB	2016	3.218876	8.881322	5.6	0.736	0.056	105
AB	2012	1.098612	7.121253	2.9	0.629	0.064	26
AB	2013	2.302585	7.576097	3.02	0.756	0.06	48
AB	2014	2.772589	8.0699	3.65	0.787	0.061	71
AB	2015	3.332205	8.429933	4	0.79	0.061	88
AB	2016	3.663562	8.730469	4.9	0.78	0.06	110
OIB	2012	1.791759	7.932721	2.1	0.759	0.051	45
OIB	2013	2.639057	8.271548	2.8	0.779	0.058	65
OIB	2014	2.995732	8.724532	3.1	0.813	0.047	106
OIB	2015	3.367296	9.162724	3.7	0.764	0.053	151
OIB	2016	3.73767	9.330964	4.1	0.828	0.061	200
CBO	2012	3.218876	8.20822	3	0.762	0.037	53
CBO	2013	3.401197	8.78554	4	0.682	0.042	78
CBO	2014	3.688879	8.902592	5	0.741	0.056	106
CBO	2015	4.094345	9.346792	5.9	0.642	0.082	143
CBO	2016	4.49981	9.271059	6	0.79	0.096	174

Source: *National Bank of Ethiopia and Head Office of Each Bank*