Addis Ababa University

College of Business and Economics

Department of Accounting and Finance

Determinants of non-interest income in selected Ethiopian commercial Banks

By: Getawey Gashawbeza

A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science in Accounting and Finance.

Advisor: Abebaw Kassie (PhD)

Addis Ababa, Ethiopia

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Addis Ababa University

College of Business and Economics

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Declaration

I, Getawey Gashawbeza, hereby declare that this thesis is the result of my own original research and work. I have conducted this research independently and have not used any unauthorized assistance. All sources of information, ideas, and data that have been drawn from other works have been properly cited and acknowledged.

Declared by:

Name: Getawey Gashawbeza

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Date **June 2024**

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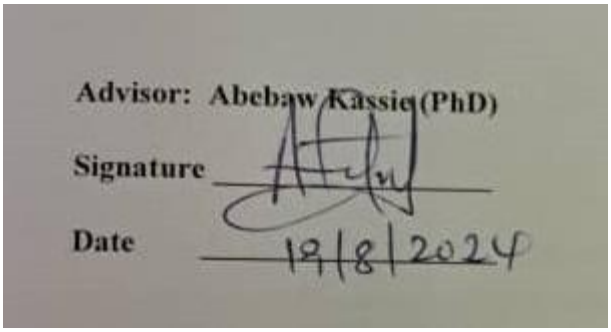

Approval Page

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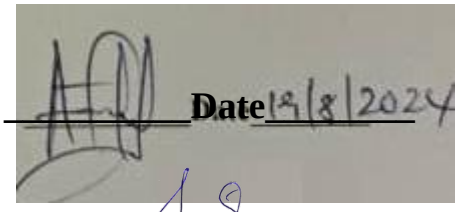
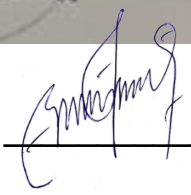
Advisor: Abebaw Kassie (PhD) Signature  **Date** 19/8/2024

External Examiner: Mebrahtu Leake (PhD) Signature  **Date** 26 June 2024

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Abstract

This study aims to identify and analyse the determinants of non-interest income (NII) in Ethiopian commercial banks. Specifically, it examines the impact of bank-specific factors, macroeconomic variables, and technological advancements on non-interest income. An explanatory research design with a quantitative approach was employed, utilizing panel data from ten commercial banks in Ethiopia, spanning from 2010 to 2021. Secondary data was collected from internal and external sources, including the National Bank of Ethiopia, the Ministry of Finance, and annual financial reports of the sampled banks. The results indicate that certain bank-specific factors positively and significantly impact non-interest income. Conversely, macroeconomic variables such as GDP growth and inflation rate negatively impact non-interest income. This study provides a comprehensive analysis of the determinants of non-interest income for Ethiopian commercial banks. It highlights the importance of stable funding sources, foreign currency holdings, and macroeconomic conditions. Banks should focus on increasing core deposits, leveraging foreign currency services, and diversifying income streams to mitigate the impacts of economic cycles and inflation. Inflation-adjusted fee structures can help mitigate the erosion of non-interest income. Investments in digital banking services can further enhance non-interest income. Effective risk management remains crucial for maintaining overall financial stability.

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List of Acronyms

Acronym	Full Name
AB S.C	Awash Bank share company
ATM	Automated teller machine
BIB S.C	Birhan Bank Share Company
BKSZ	Bank size
BOA S.C	Bank of Abyssinia Share company
CAPR	Capital adequacy ratio
CBE	Commercial Bank of Ethiopia
CDTR	Core deposit to total asset ratio
COOP	Cooperative Bank of Oromia
CRE	Credit Risk Exposure
DB S.C	Dashen Bank share company
FXR	Foreign currency holding ratio
GDP	Gross domestic product
HB S.C	Hibret Bank Share company
INFR	Inflation rate
LIQ	Bank liquidity
LOANR	Loan ratio
NIB S.C	Nib international Bank share company

NII	Non interest income
WB S.C	Wegagen Bank Share company
ZB S.C	Zemen Bank Share company

Chapter One

1.1. Background of the study

Banks are critical institutions that assist people, companies, and sovereign countries to carry out socio – economic activities. The banking sector has a pivotal role in the economy also it has a substantial impact on the development of most countries. It allocates resources from the cash holder to the one who is in need of it. Since loans account for a significant portion of a bank's total assets, this core operation generates interest income, which has been a major source of revenue for many years (Reed & Gill 1989).

Banks' sources of revenue may differ greatly. Some focus on commercial lending, while others focus on consumer lending and fee-based businesses. Throughout the last decades, the financial sector has transformed dramatically over the world. Banks have extended their operations and introduced innovative lines of business because of deregulation and stiff competition, in addition to their traditional interest activities (Brei & Schclarek, 2015). By exploring additional business operations including treasury insurance and trading, consultancy and investment banking, as well as other non-interest-earning activities, banks have recently expanded their earnings. (Celine et al., 2013). Non-interest income comes from things like, Consulting fee, collateral release fee, margin utilization fee, guarantee conversion fee, merchandise release fee, audit confirmation fee, swift charge, purchase order approval fee, share related charges, supplier credit handling fee, import, outgoing transfer, supplier credit and freight payment fee.

Financial institutions in Ethiopia were restructured to operate within a market-oriented policy framework following a transition of power in 1991 and a transformation in economic policy approaches (Admassu & Asayehegn, 2014). Proclamation No. 83/1994 paved the way for the formation of private banks, which marked the start of a new era in Ethiopian banking growth. Commercial Banks both public and private are currently operational in line with Banking Proclamation No. 592/2008. A number of private banks were founded after the country's banking regulations was enacted in the 1990s.

Most commercial banks in Ethiopia traditionally rely on interest income as their primary revenue source (Tamirat, 2014). However, the landscape has changed due to increasing competition from non-bank financial institutions (NBFIs), which has significantly reduced banks' interest income, previously safeguarded by major regulatory protections (Gololo, 2018; Dimitrios & Mike, 2016; Psillaki & Mamatzakis, 2017). This has prompted banks to explore non-interest income sources more extensively. The rapid growth of information technology and intensified competition among financial firms have forced banks to diversify their revenue streams through fee income and non-banking services such as insurance and auxiliary banking services (Estifanos, 2015). Non-interest income in Ethiopian commercial banks has varied over time and across different banks (Estifanos, 2015). Non-interest income has become an increasingly significant component of banks' revenue structures globally, serving as a crucial diversification strategy away from traditional interest-based earnings. This income category encompasses a wide range of sources, including fees from various banking services, commissions, and income from trading, investment banking, and asset management activities. The importance of non-interest income has grown as banks seek to manage profitability in the face of narrowing interest margins and evolving regulatory landscapes (Hirtle & Stiroh, 2007).

Understanding the critical factors that influence non-interest income was crucial for managing banking income and ensuring the financial stability of the industry. This study aimed to investigate these factors to provide bank executives with insights into effectively managing and enhancing non-interest income. The research focused on determining the crucial elements affecting non-interest revenue in Ethiopian commercial banks, enabling bank executives to concentrate on managing these variables and improving non-interest income. By identifying these factors, financial institutions could better direct their efforts toward increasing non-interest income and sustaining financial stability.

1.2. Statement of the Problem

The ultimate goal of commercial banks is to maximize shareholder value by generating income from various sources, including interest and non-interest income. Historically, many banks have relied heavily on interest-based conventional banking (Tamirat, 2014). However, recently, commercial banks have introduced diverse banking products to enhance their earnings (Kevin, 2004). Widespread deregulation and technological advancements have significantly influenced bank profit patterns, presenting both challenges and opportunities for income diversification beyond traditional interest-based activities.

Despite these global trends, the Ethiopian banking industry remains underdeveloped due to a stagnant reform process. It is small, closed, and significantly state-dominated. The state's extensive involvement in the banking sector, complete control over land and telecommunications, and majority ownership in many economic sectors impede the development of the private sector (Admassu & Asayehegn, 2014). Additionally, strict regulations from the National Bank of Ethiopia (NBE) have hindered the expected diversification of income sources among Ethiopian banks. The recent credit limit imposed by the NBE to control inflation further restricts banks' interest income potential, necessitating alternative income strategies.

To foster economic progress, significant market-oriented policies are required. Diversifying income sources allows banks to manage risks, create employment opportunities, and better serve clients. Increased profits from non-interest income also contribute to the nation's GDP and government tax revenues.

Studies by Kiweu (2012) and Teimet et al. (2010) highlight the positive impact of income diversification on the financial performance of banks. However, the applicability of these findings to Ethiopian banks is limited. Previous studies in Ethiopia, such as those by Tesfaye (2018) and Estifanos (2014), have not fully addressed the critical variables affecting non-interest income.

This research gap has drawn attention to exploring how Ethiopian banks can generate income in alternative ways, apart from relying on interest, to remain profitable despite lending restrictions. The study aims to address this gap by examining the impact of bank-specific characteristics,

market conditions, technological changes, and macroeconomic factors on non-interest income in Ethiopian commercial banks. By identifying these key determinants, the research seeks to provide actionable insights to enhance the financial performance and competitive position of Ethiopian banks.

1.3. Research Questions

The main question that this study attempted to answer was what factors determined non-interest income and its growth in Ethiopia over the last decade. Specific questions included:

1. What are the key financial and operational determinants impacting the non-interest income of commercial banks in Ethiopia?
2. How do changes in the economic environment affect the non-interest income of these banks?
3. What role do technological advancements and innovations play in shaping the non-interest income of Ethiopian commercial banks?

1.4. Objectives of the study

To identify the key determinants of non-interest income in selected Ethiopian commercial banks.

1.4.1. Specific Objective

- Analyze how the volume of the bank's overall income is impacted by non-interest income.
- To examine the effect of core deposit to total asset ratio on non-interest income of commercial banks in Ethiopia.
- To evaluate the effect of bank size on non-interest income of commercial banks in Ethiopia.
- To assess the impact of loan ratio on non-interest income of commercial banks in Ethiopia.
- To analyse the effect of liquidity ratio on non-interest income in Ethiopian commercial banks.
- To examine capital adequacy's ration effect on non-interest income in Ethiopian commercial bank

- To determine the impact of foreign currency holding ratio on non-interest income of commercial banks in Ethiopia.
- To evaluate the effect of credit risk exposure on non-interest income of commercial banks of Ethiopia.
- To investigate the effect of GDP on non-interest income in Ethiopian commercial banks
- To determine the effect of inflation rate on non-interest income in Ethiopian commercial banks

1.5. Significance of the study

Commercial banks face significant pressure to sustain long-term profitability by diversifying their revenue streams beyond traditional interest income to include fee-based activities such as investment banking and insurance services. This strategic shift aims to reduce dependency on lending and mitigate default risks. This study aims to comprehensively analyze the factors influencing non-interest income in Ethiopia's commercial banking sector. By identifying both bank-specific and economy-wide determinants, the research will highlight key drivers of non-interest revenue. Moreover, the study intends to provide valuable policy insights and strategic recommendations to enhance non-interest income generation strategies for commercial banks. This research builds upon prior studies and aims to contribute new perspectives to policy formulation and strategic planning within the banking industry. Furthermore, it seeks to serve as a foundational resource for future research endeavors in this critical area of financial sector development.

1.6. Scope of the study

To determine the determinants of non-interest income of Ethiopian commercial banks, financial statements for ten commercial banks over twelve years (2010-2021) were analyzed. This period was selected for several compelling reasons: first, Ethiopia experienced significant economic and regulatory changes during these years, which likely influenced the operational strategies and financial performance of commercial banks. Second, the banking sector in Ethiopia underwent reforms and expansions, introducing new financial products and services that impacted revenue streams. Additionally, the competitive dynamics within the Ethiopian banking market evolved, with new entrants and changing market conditions affecting revenue generation strategies.

Moreover, global economic events and local policy reforms during this period had notable implications for the financial sector's performance. Therefore, analyzing financial statements from 2010 to 2021 provides a comprehensive longitudinal perspective on the factors influencing non-interest income in Ethiopian commercial banks. These banks included Commercial Bank of Ethiopia (CBE), Awash Bank (AB), Bank of Abyssinia (BOA), Berhan Bank (BB), Nib Bank (NIB), Zemen Bank (ZB), Hibret Bank (HB), Cooperative Bank of Oromia (COOP), Dashen Bank (DB), and Wegagen Bank (WB). The selection of these ten banks for the study on the determinants of non-interest income in Ethiopian commercial banks from 2010 to 2021 was carefully guided by several key criteria. First, these banks were chosen based on their substantial market share and influence within Ethiopia's banking sector. Including banks such as Commercial Bank of Ethiopia (CBE), Awash Bank (AB), Bank of Abyssinia (BOA), and others ensures representation across various sizes and operational strategies, providing a comprehensive view of the industry dynamics. Moreover, the availability and consistency of their financial data over the twelve-year period were crucial factors, ensuring reliable and robust data for rigorous analysis. This selection also considers the relevance of these banks in capturing significant economic and regulatory changes that have shaped the banking landscape in Ethiopia. By focusing on these ten banks, the study aims to offer deep insights into how different institutions manage and strategize their non-interest income amidst evolving market conditions and regulatory environments.

1.7. Limitation of the study

The studies may inadvertently overlook the significant impact of the dynamic regulatory landscape within the banking sector on non-interest income in Ethiopian commercial banks. Regulatory reforms, including changes in lending policies and capital requirements, introduce uncertainties and constraints that influence banks' strategic decisions and operational effectiveness in diversifying income sources. Moreover, non-financial factors such as customer service quality, inflation rates, and broader economic conditions also play crucial roles. Therefore, while the study aims to comprehensively analyze the financial determinants of non-interest income, it is essential to acknowledge and incorporate both regulatory dynamics and non-financial influences to provide a nuanced understanding of the profitability dynamics of Ethiopian commercial banks.

1.8. Organization of the study

The study is structured into five distinct chapters. The first chapter offers an introductory overview of the research, setting the stage for the subsequent chapters. Chapter two critically reviews existing literature, identifying gaps in previous studies. In chapter three, the research methodology is detailed, outlining the chosen approach and techniques employed. Chapter four presents and analyzes the study data, discussing key findings and insights derived from the empirical evidence. The final chapter consolidates the study's conclusions and explores their implications. Lastly, the report concludes by proposing avenues for future research to further advance understanding in the field.

Chapter Two

2. Literature review

2.1. Introduction

Several financial and banking sectors have concentrated on examining for the factors that influence non-interest income. This concern results from the viewpoint that non-interest revenue is a key factor in the profitability of banks and financial intermediaries. Throughout this part, the study provided a brief overview of the relevant research that looked at the factors influencing non-interest income in commercial banks. For the analysis of non-interest income drivers, the majority of the literature has used a variety of models that are based on Ho and Saunders' (1981) dealership model, in which banks are viewed as risk-averse intermediaries between depositors and fund borrowers (Fungáová&Poghosyan, 2011).

2.2. Theoretical Literature

The major aim of this theoretical literature review is to specifically investigate the body of theory that has accumulated in relation to a problem, idea, theory, or phenomenon that exist in the area of non-interest income determinant. The theoretical literature review aids in identifying the theories that are currently in existence, their connections, the depth to which the theories have been explored, and the creation of new testable hypotheses.

Over the last two decades, the commercial banking industry has undergone significant changes, which have been adequately documented in academic literature. The shift in the mix of bank businesses and product lines toward non-interest revenue activities is one major trend. This shift is the result of a more competitive market environment in which banks are actively pursuing cost-cutting and revenue-generating methods. Bank profit patterns have been changed as a result of extensive deregulation and technological innovations. Firms' financial demands have diversified from traditional bank loans to non-bank financing options such as corporate bonds and commercial papers as more efficient means of producing financial information and better strategies for analyzing and pricing risks have become available. Recent research has looked into the variables

which have pushed banks to spread their income structures. Non-interest revenue is negatively associated with core deposits and net-interest profits, according to Rogers and Sinkey (1999), whereas bank size is positively correlated with non-interest income. Traditional interest income sources are less viable for banks with fewer core deposits and smaller net-interest margins; therefore they should shift into non-traditional banking to stay successful. Bank size, according to De Young and Hunter (2003) and De Young et al. (2004), is positively correlated with the extent of non-interest income growth. They suggest that relatively large banks take use of economies of scale to gain an eminence on the supply of consumer loans.

All of a commercial bank's earnings besides interest income are referred to as non-interest income. According to Stiroh's (2002) classification of noninterest income as a heterogeneous category that includes a variety of diverse activities. Revenue from the bank's fiduciary activities, such as managing investments for third parties, Service fees include earnings from deposit accounts, such as costs for using an ATM or a check machine. The majority of trading revenue comes from the trading of cash instruments, off-balance contracts, and mark-to-market adjustments to the carrying value of assets and liabilities. All other fees, such as commitment fees for loans, safe deposit box fees, commissions, and land rental fees, are included under fees and other income.

Stiroh (2006) asserts that US banks are relying more and more on service charges, trading revenue, fiduciary income, fees, and other non-interest sources of income. According to their research, noninterest sources accounted for 42% of the industry's net operating revenue in 2004, a significant rise from 32% in 1990 and 20% in 1980. Banking firms now need to be proactive and innovative in their operations due to recent changes in the banking industry. An essential aspect of this process of financial innovation, according to Nachane and Ghosh (2007), has been a rise in banks' off-balance sheet (OBS) activity. The majority of recent research on income diversification in the banking industry has placed a greater emphasis on the relationship between diversification and bank profitability or the impact of bank income diversification on risk taking (Stiroh 2004).

2.2.1. Non-interest income

Non-interest income is the term for a bank's earnings, which come mostly from service and penalty fees and, to a much lesser extent, from the sales of assets and real estate. Unlike interest income, noninterest income was categorized by Stiroh (2002) into a heterogeneous group that includes a

variety of activities, such as treasury insurance and trading, consultancy and investment banking, as well as other non-interest-earning activities, Consulting fee, collateral release fee, margin utilization fee, guarantee conversion fee, merchandise release fee, audit confirmation fee, swift charge, purchase order approval fee, share related charges, supplier credit handling fee, import, outgoing transfer, supplier credit and freight payment fee.

Additionally, non-interest income was defined by Barbara, Philip, and Claudia (2006) as income from fees, commissions, and trading, and it has grown in importance as a result of the recent focus on this kind of income. Net non-interest income is also described by (Letitia, et al., 2008) as the total of net interest income and non-interest revenue, and net operating income is the difference between non-interest income and non-interest expenses.

2.2.2. Components of Non -Interest Income

The following sub-groups of non-interest income have been identified by Brunnermeier et al. (2010): trading and securitization fees, investment banking and consulting fees, brokerage commissions, venture capital and fiduciary income, and gains on non-hedging derivatives. The mixture of non-interest income, according to Couto (2002), also includes venture capital, fiduciary income, gains on non-hedging derivatives, income from trading and securitization, investment banking and advisory fees, brokerage commissions, and income from venture capital and advisory fees.

According to Tapper (2010), who studied non-interest income sources in Jamaican banks, non-interest income comprises dividends and trading earnings on securities, gains and losses from foreign currency transactions, and other miscellaneous sources.

2.3. Empirical Review

Many scholars' empirical findings on national and regional level analysis have established definitions, composition, general characteristics, and the pros and cons of non-interest income. Joon-Ho (2008) described non-interest revenue as a proportion of total operating income while identifying and characterizing the factors and effects of banks' income diversification in Organization for Economic Cooperation and Development (OECD) nations. Similar to this, (You, 2014) defined Non-Interest Income as divided by the sum of Net Interest Income and Non-Interest Income. Non-Interest Income is broadly referred to as fee-earning operations like insurance, investment banking, mortgage financing, securitization, and other non-banking operations (Eknath Kundlik, 2012). The idea of Non-interest income activities has been advanced by many authors who have connected it to a number of bank-level factors, including bank size, credit risk, and interest rate risk. According to Matthias Kohler's (Matthias, 2013) analysis of German banks, banks with a business orientation, such as savings banks, cooperative banks, and other types of retail-oriented banks, as well as investment-oriented banking, are at the bank level.

Numerous recent research has examined into the variables that influenced banks' decision to diversify their revenue streams. According to Rogers and Sinkey (1999), bank size has a positive correlation with non-interest revenue, whereas core deposits and net-interest margins have a negative correlation with it. As a result of having fewer core deposits and smaller net interest margins, banks must diversify into non-traditional banking in order to maintain their profitability. De Young and Hunter (2003) and De Young et al. (2004) assert that bank size and the expansion of non-interest income are positively associated. Based on their analysis using economies of scale, relatively large banks dominate the production of consumer loans. But, despite their cheap unit costs, the market for these goods is highly tough, and large banks must add non-interest income to their revenue stream to survive.

According to Joon-Ho in 2008, macroeconomic variables, such as real GDP growth, real interest rates, inflation rates, and stock market capitalization relative to nominal GDP, have an impact on bank performance in general and non-interest in particular. The notion that the rate of inflation is significantly low and the stock market capitalization to GDP is relatively high was advanced by Joon-Ho in 2008.

2.3.1 Bank Specific determinants of non-interest income

Exploring factors that could affect a bank's decision regarding non-interest income portion is the first goal. In order to explain the proportion of non-interest revenue for US commercial banks, Rogers and Sinkey (1999) included bank asset size, equity capital to asset ratio, and net interest margin in their regression models. De Young and Rice (2004) were able to include additional variables such as shares of real estate and commercial loans, bank holding company affiliate dummies, and real estate and commercial loan data because they were concentrating on the US experience. Due to the lack of applicability in Ethiopia this study we leave this variable.

2.3.1.1. Bank Size

The extent to which a bank engages in interest- and non-interest-earning activities will undoubtedly depend on the bank's size. According to Rogers (1998), participation in unconventional activities varies significantly between banks due to variations in size and other factors. The most obvious variable in relation to the volume of unconventional activities, according to Rogers and Sinkey (1999), is company size. They contend that involvement in any atypical businesses typically necessitates some level of specialization for the bank, which may be attained by the hiring of personnel with specialized knowledge as well as the acquisition of modern technology. The size of the bank was calculated using the natural log of its total assets (TA). This variable is used under the same presumption as that offered by Rogers and Sinkey (1999), who predict a positive relationship between firm size and the volume of nontraditional activities based on the contention of Hunter and Timme (1986), who also discovered that larger banks are better able to use new technology and exploit the resulting cost savings and/or efficiency gains. As in many empirical research, company size was included as a typical control variable to capture the potential impact of other variables. Using unbalanced panel data from 172 Indian banks, Pennathur and Subrah (2012) investigate how bank ownership structure and size affect non-interest revenue. The study demonstrates that non-interest income in big size banks has more benefit than in small size banks.

2.3.1.2. Liquidity Risk

Liquidity risk, which manifests as unexpected withdrawals from deposits and sudden loan demand, is another unpredictability that banks must deal with. According to Rogers and Sinkey (1999), a

bank is better positioned to handle these unforeseen circumstances if its assets are significantly more liquid. A bank that has enough cash on hand to cover future withdrawals and loan requests is said to be highly liquid. Since a bank is safer if it has enough reserve liquidity, Rogers and Sinkey (1999) claim that this liquidity acts as a cushion or buffer against losses resulting from the "fire-sale" of assets to meet liquidity needs. However, this liquidity causes unused funds, which in turn lowers returns to shareholders. While a bank with a huge portion of liquid assets is less likely to make large profits, it is also less exposed to risk (Goddard et al., 2004). The empirical association between these activities and liquidity would be positive if banks require more liquidity to engage in larger levels of non-interest earning activities. If not, moral hazard behavior could occur as evidenced by less liquid banks engaging in more non-traditional business practices (Rogers and Sinkey, 1999). The proportion of cash and short-term investments to total assets will serve as a proxy for this variable.

2.3.1.3. Capital Adequacy (CAPR)

A bank's total financial soundness is evaluated by its capital adequacy. It is essential to preserve the stability of the banking system since it protects against panic, bank runs, and other uncertainties (Keovongvichith, 2012). Theoretically, a bank acting overly conservatively and passing up potentially lucrative investment possibilities could be indicated by a high capital adequacy ratio (CAPR). Rogers and Sinkey (1999) assert, however, that banks with high capital adequacy have a stronger capacity to withstand asset losses from non-traditional operations. This reasoning suggests that NII and CAPR should have a favorable connection. But if more heavily leveraged banks engage in more unconventional activities, moral hazard behavior may be prevalent, and a bad link between NII and CAPR is about to arrive.

2.3.1. 4. Net Interest Margin

By comparing the revenue, costs, and debt of these investments, interest margin, a profitability ratio, assesses how successfully a business makes investment decisions. To put it another way, this ratio determines how much money a bank or investment firm makes from its investing activities. William and Rajaguru (2007) justify that the rise in noninterest income is used to reward for a fall in the net interest margin in the Australian banking industry by combining interest income and noninterest income, concluding that the ups and downs of the net interest margin may affect banks'

expansion into non-traditional business activities. According to Landi, Venturelli, and Berengario (2001) and Smith, Staikouras, and Wood (2004), European banks likewise exhibit the similar link. According to Albertazzi and Gambacorta (2006), who were referenced by Uzhegova (2010), the fall in interest margins has compelled banks to hunt for alternate sources of income, which has resulted in a diversification into trading activities, other services, and non-traditional financial activity.

In order for banks with lower net interest margins and fewer core deposits to continue to be profitable, they must diversify their business towards non-traditional banking. This is due to the fact that banks with low deposit levels are unable to disburse enough loans to create traditional sources of interest income; as a result, they move to non-traditional sources of income, which raises their income mix toward non-interest income.

2.3.4. Macro-Economic Factors

In addition to bank-specific issues, macroeconomic factors that affect the supply and demand circumstances for banking services can also have an impact on the degree of diversification toward non-interest revenue.

2.3.4.1 Gross domestic product(GDP): According to Hahm (2008), fast-growing emerging economies are more likely to have lower non-interest income than slower-growing ones. This shows that if economic growth slows, banks are likely to shift their focus to non-interest income. Slow economic expansion may reduce investment activity profits, increasing reliance on lending operations. As a result, bank rivalry will rise, which will reduce lending activities' profitability. As a result, borrowers' overall loan risk increases, which lowers the expected profits on lending. Banks will therefore be more motivated to diversify into complementary non-interest income sources like the fee sector. Therefore, we anticipated a negative correlation between GDP growth and non-interest income.

2.3.4.2 Inflation (INFL): An environment with high inflation usually hinders the expansion of long-term capital markets including bonds, mortgages, and retirement income funds (Hahm, 2008). A more active and liquid stock market makes it easier for businesses to get equity capital, but it

also puts more pressure on commercial banks to diversify their revenue streams and engage in more capital-related activities. On the other hand, commercial banks can increase their non-interest revenue in environments with low inflation and rapid capital market growth (DeYoung and Rice, 2004). Therefore, it was anticipated that the inflation rate's coefficient would be negative.

2.3.5. Technological changes

The introduction and growth of financial instruments and markets (high yield bonds, commercial paper, financial derivatives), new intermediation technologies for procedures like loan securitization and credit scoring, and advancements in information and communications technology (such as the Internet and ATMs) have all had an impact on the levels and types of non-interest income at commercial banks. In essence, these modifications allowed banks to charge users of ATMs, the Internet, or both a fee in exchange for their use rather than conducting business at traditional branches. Business enterprises can now borrow money directly from the public by issuing securities because to advancements in information technology, which have made it simpler for individuals, corporations, and financial institutions to assess the quality of securities. To finance their short-term credit needs in particular, many company customers now borrow through the commercial paper market rather than resorting to banks. (Edwards and Mishkin, 1995) With the advent of digital banking, several banks in Ethiopia have diversified their revenue streams to include non-interest income. As a result, technology is crucial in determining non-interest revenue.

2.4 Summary of literature review

Despite numerous empirical studies on the determinants of non-interest income, a review of the literature revealed that these studies primarily focused on developed countries. Few comprehensive studies were conducted in developing countries, particularly in Ethiopia. It is evident that non-interest income determinants vary across countries due to differences in techniques used and the period of investigation. Furthermore, these variations may be influenced by central bank regulations, national economic development, product characteristics, cultural differences, technological impacts, and other factors. In light of this context, this study sought to investigate the relationship between non-interest income and hypothesized determinants, including core deposit ratio, bank size, loan ratio, capital adequacy ratio, bank liquidity, foreign currency

holding ratio, credit risk exposure, GDP, inflation rate, and ATM usage in commercial banks of Ethiopia.

2.5. Conceptual Framework

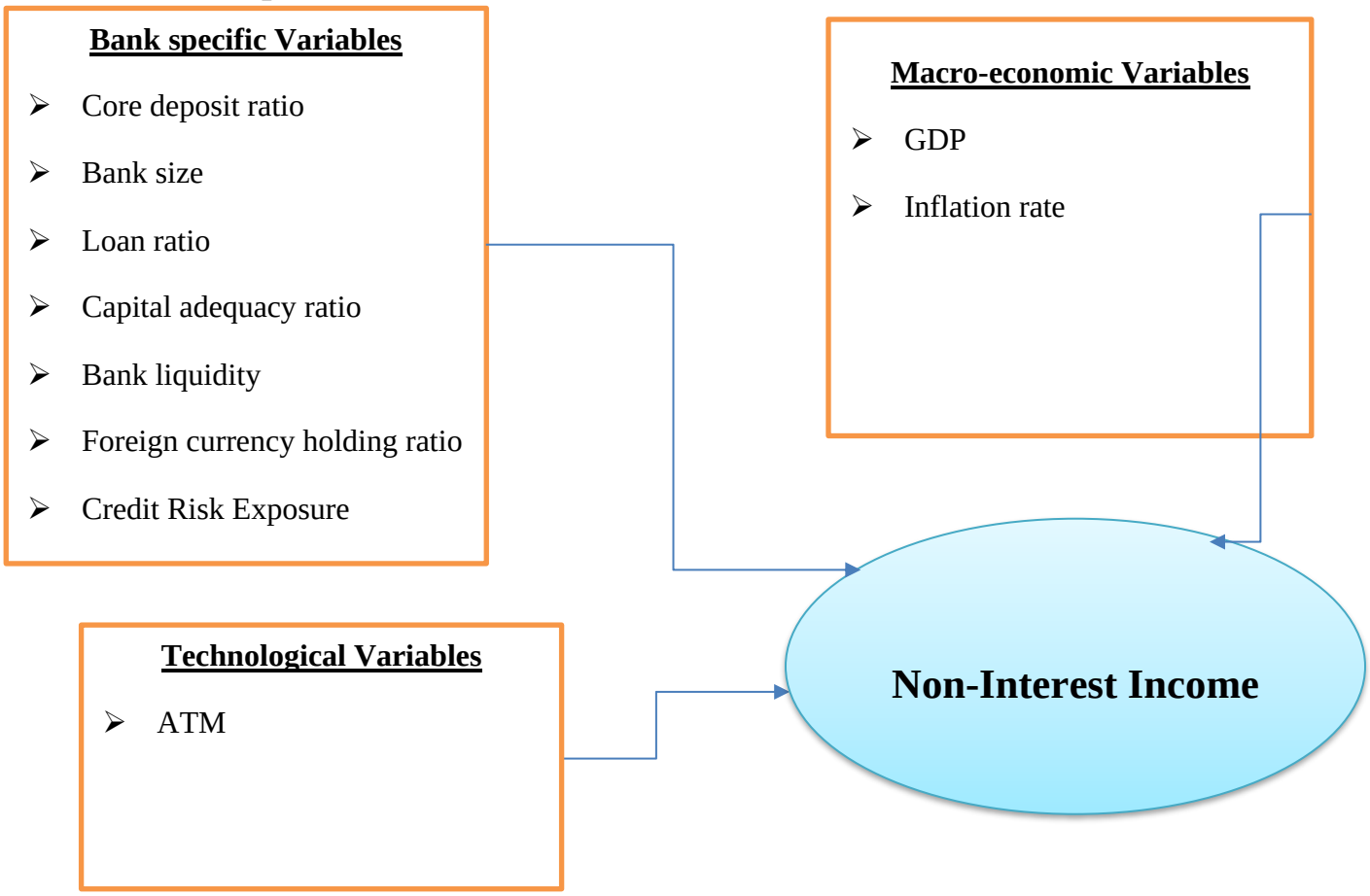

Figure:1 Conceptual Framework

Chapter Three

3. Research Methodology

3.1. Introduction

In this chapter, we delved into the methodology behind our investigation into the determinants of non-interest income in Ethiopia's commercial banks. Here, we took a detailed look at the methods and approaches we had chosen to clarify the determinants of non-interest income in Ethiopia's banking sector.

3.2 Research Design

An explanatory research design was used to accomplish the study's goal. Furthermore, these studies employed a quantitative research approach to investigate a stated objective. Panel data from 2010 to 2021 was used in this study. This was due to the fact that panel data had the potential of having more pertinent information since it included both cross-sectional information, which captured individual variability, and time series information, which captured dynamic adjustment. In order to quantify the correlation between bank-specific characteristics, regulatory factors, and macroeconomic variables with non-interest income, the majority of studies for the non-interest revenue determinants used panel data regressions. The time frame for the analysis was the years 2010 through 2021.

3.3. Research Approach

According to Creswell (2009), there are various approaches to tackling the issue at its core, including quantitative, qualitative, and mixed approaches. Often, the quantitative approach and quantitative empirical research focus on how different variables relate to one another (Theobald et al., 2002). A quantitative research approach, according to Patel and Davidson (2003), entails the use of measurements during the data collection process. The statistical processing and analysis approach, which is based on the gathered data, is next applied. Moreover, according to Aliaga and Gunderson (2002), the quantitative research approach collects numerical data that is then examined using mathematically based methodologies to understand phenomena.

The aim of this research was to draw conclusions about the factors that determine non-interest income discovered in the surveyed Ethiopian commercial banks. This generalization was acquired using the quantitative approach, which focuses on the statistical analysis of numerical data and the methodical pursuit of facts and causes of phenomena. The researcher gathered quantitative data on variables from financial reports submitted by ten commercial banks in Ethiopia over a period of ten years in a row. The study adopted a quantitative methodology to examine business phenomena that have an impact on non-interest income, and STATA statistical software together with a multiple linear regression model was used to evaluate the data that was gathered.

3.4. Sample Design

This study employed purposive sampling, specifically criteria sampling, to ensure a comprehensive representation of the Ethiopian banking sector. The selection criteria were multifaceted, encompassing not only financial strength, technological investment, and market share but also operational diversity and geographic spread. By including banks based on these varied criteria, the research captured a broad spectrum of the sector's landscape, accounting for differences in business models, customer bases, and regional influences.

3.4.1. Population

The target population for this study comprised all commercial banks operating in Ethiopia that are officially registered and regulated by the National Bank of Ethiopia (NBE). This includes both privately-owned and state-owned banks, which together form the framework of the country's financial sector.

3.4.2. Sample Size

A substantial sample size is crucial for generalizing findings and drawing reliable conclusions about the population. This study selected ten commercial banks operating during the study period in Ethiopia to ensure adequate representation and coverage of the banking sector. The chosen banks—Commercial Bank of Ethiopia (CBE), Awash Bank (AB), Bank of Abyssinia (BOA), Berhan Bank (BB), Nib Bank (NIB), Zemen Bank (ZB), Hibret Bank (HB), Cooperative Bank of Oromia (Coop), Dashen Bank (DB), and Wegagen Bank (WB) were selected based on their significant market share and geographical spread across Ethiopia. These banks collectively represent a diverse range of bank sizes, operational strategies, and customer bases within the

Ethiopian banking industry. By analyzing these banks, the study aims to capture a comprehensive view of the factors influencing non-interest income in Ethiopian commercial banks.

3.5. Sources of data

This study used secondary data, which was gathered from both internal and external sources. The study's external data sources included the National Bank of Ethiopia (NBE), the Ministry of Finance, and the annual financial reports of sampled commercial banks. Panel data obtained from 2010 to 2021 was employed in the study.

3.6. Data Analysis and Interpretation

In this study, panel data analysis employing a multiple regression model was utilized to analyze and interpret the data. The panel data framework allowed for the examination of non-interest income determinants across a diverse set of Ethiopian commercial banks over the study period. By employing multiple regression, this study assessed the relationships between non-interest income and various explanatory variables, considering both time-series and cross-sectional variations. This approach facilitated a comprehensive exploration of how factors such as bank-specific characteristics, market conditions, technological changes, and macroeconomic factors influenced non-interest income. The interpretation of results involved examining the coefficients of the explanatory variables to understand their statistical significance and impact on non-interest income. Descriptive statistics provided additional insights into the central tendencies and variability of the data, enhancing the robustness of the findings.

3.7. Model specification

According to William et al. (2008), the process of model development involves defining relationships between multiple variables and extends to formulating descriptive or predictive equations. To achieve the goals of this study, a multiple regression model was employed. Panel data methodology was utilized, combining observations across different banks over several years, which offers insights not achievable through purely time series or cross-sectional studies (Freeman et al., 1982). The general form of the panel data model applied in this study is: $Y_{it=}\alpha_i+\beta X_{it}+\epsilon_{it}$

Here, Yit represents the dependent variable, specifically the non-interest income ratio of banks, and X_{it} denotes the set of regressors. The subscripts i and t denote the cross-sectional and time-

series dimensions, respectively. The term ϵ_{it} represents the error component, assumed constant across time t and specific to each cross-sectional unit i. This model framework draws from established literature and aligns with the selected variables for this study.

$NIIRATIO_{it} = \beta 0 + \beta 1 CDTR_{it} + \beta 2 BKSZ_{it} + \beta 3 LOANR_{it} + \beta 4 LIQ_{it} + \beta 5 CAPR_{it} + \beta 6 FXR_{it} + \beta 7 CRE_{it} + \beta 8 GDP_{it} + \beta 9 INFR_{it} + \beta 10 ATMit + \varepsilon_{it}$

Where, $NIIRATIO_{it}$; denotes the non-interest income ratio of bank i at year t.

β0=Constant term

CDTR= Core deposit to total asset ratio

BKSZ = Bank size

LOANR= Loan ratio which is total loan to total asset

LIQ-Bank liquidity

CAPR= Capital adequacy ratio

FXR= Foreign currency holding ratio

CRE= Credit Risk Exposure

GDP= Real growth domestic product growth

INFR= Inflation rate

ATM= Automated teller machine which is technological factor

$\epsilon =$ error term

3.8. Description and Measurement of variables

3.8.1. Dependent Variable

The dependent variable in the equation is defined as NII ratio $_{it}$ and represents the total non-interest income as a percentage of total assets. The subscripts I and t refer to the banks and years,

respectively. The total of fee-based income, trading income, and other non-interest income is referred to as non-interest income.

This is computed as $\frac{\text{Non–Interest Income}}{\text{Total Asset}} \boldsymbol{x100}$

3.8.2. Explanatory Variable

3.8.2.1. Bank Specific Variables

Core deposit to Asset ratio (CDTR): In order to capture the notation conventional banking relationship this study include CORERATIO as one of an explanatory variable measuring by Core deposits to total Asset ratio. Higher core deposits provide a stable funding base, enabling banks to engage in diversified activities that generate non-interest income. Therefore, we anticipate a positive relationship between the core deposit to asset ratio and non-interest income in commercial banks.

$$\frac{\text{Core deposit}}{\text{Total Asset}} \boldsymbol{x100}$$

Bank Size:

It quantifies the effect of commercial bank size and is calculated as the natural logarithm of the total bank's asset. Most research suggests that large banks are generally thought to have more capacity for risk diversification. According to this interpretation, huge banks benefit from economies of scale and can take on riskier projects in a way that medium and small banks cannot. As a result, larger banks may offer better opportunities for growth and risk management; nevertheless, small banks offer greater operational flexibility (Craigwell and Maxwell, 2006; Busch and Kick, 2009; Chiorazzo et al., 2008; Kiweu, 2012). As a result, we anticipate a positive relationship between bank size and non-interest revenue.

Loan Ratio (LOANR)

It measures by total loan to total asset ratio. The bank's income strategy is based on conventional interest income if the amount of total loans and advances compared to total assets is increasing. Instead, when a bank diversifies its sources of income, non-interest income rises, indicating a

negative correlation between the loans ratio and the amount of non-interest income generated by commercial banks (DeYoung and Rice, 2004). Several empirical investigations, including those by Sherene and Bailey (2010), Craigwell and Maxwell (2006), and Stiroh, provide evidence for this association (2004). An increased focus on conventional interest income through loans reduces the emphasis on non-interest income sources. As a result, we anticipate that the loan to asset ratio and non-interest income will be inversely related.

Bank Liquidity

The form of unexpected deposit withdrawals and unexpected loan demand. Demand for loans and unusual deposit outflows are directly correlated with each bank's liquidity strength (Rogers and Sinkey 1999). A bank with relatively more liquid assets is better placed to meet these unforeseen contingencies (Rogers and Sinkey, 1999). This variable was represented by the ratio of cash and short-term investments to total assets (TA). Higher liquidity allows banks to better manage unforeseen contingencies, facilitating engagement in fee-based and other non-interest income-generating activities. Consequently, we expect a positive relationship between bank liquidity and non-interest income.

Capital Adequacy Ratio (CAPR)

The ratio of total equity to total assets is used to calculate this variable. It provides an answer to the query of whether the ownership investment in a bank is sufficient to cover its obligations. This variable shows a bank's level of financial leverage, which reflects the efficiency of banks. A higher capital adequacy ratio signifies a stronger equity base relative to a bank's total assets. This robust capital foundation serves several critical functions that support the generation of non-interest income As a result, banks will expand their sources of income beyond interest. Therefore, we hypothesize that non-interest income is positively correlated with larger equity ratios.

Foreign Currency Holdings (FXR)

Banks facilitate cross-border trade by accepting and offering guarantees and settling payments through correspondent relationships with foreign banks in abroad (Wegagen Bank et al, 2013/14). The amount of income to be obtained from facilitating international trade can be determined by the amount of foreign currency reserves in correspondent banks. Foreign trade financing would be

greater and non-interest income would increase proportionately as foreign currency holdings increased. The ratio of the Birr equivalent total foreign currency holdings in foreign banks to total deposit (FXR/Total Deposit) is used to indicate as an independent variable to each bank.

Credit Risk Exposure

Most banks take risk into serious concern when conducting both regular and unconventional operations. According to Rogers (1998) since there is different risk appetite of banks the extent to which different banks engage in unconventional activities varies substantially. The common method through which banks control their credit risks or non-performing loans is through loan-loss provisions (NPLs). As an assessment of a bank's risk exposure, the ratio of provisions for loan losses to total assets (TA) is utilized. A negative relationship between credit risk exposure and non-interest income in commercial banks is anticipated.

3.8.2.2. Macro-Economic Factors

Real Growth Domestic Product Growth (GDP)

The researcher takes into account the GDP and inflation rate as macroeconomic parameters. It is challenging to identify benchmark models for macroeconomic factors because the majority of prior studies have concentrated on the experiences of specific countries in analyzing the determinants of non-interest income. But take note that De Young and Rice (2004) considered variables from the external environment in addition to bank-specific characteristics when looking into the US experience. According to Hahm (2008), fast-growing emerging economies are more likely to have lower non-interest income than slower-growing ones. This shows that if economic growth slows, banks are likely to shift their focus to non-interest income. Slow economic expansion may reduce investment activity profits, increasing reliance on lending operations. As a result, bank rivalry will rise, which will reduce lending activities' profitability. As a result, borrowers' overall loan risk increases, which lowers the expected profits on lending. Banks will therefore be more motivated to diversify into complementary non-interest income sources like the fee sector. Therefore, we anticipate a negative correlation between GDP growth and non-interest income.

Inflation Rate (INFR)

The availability of long-term capital market instruments as an alternative to bank products is measured using the inflation rate. Bond, mortgage, and pension funds are examples of long-term capital markets. The expansion those long-term capital markets is frequently inhibited by an environment of high inflation (Hahm, 2008). A more active and liquid stock market makes it easier for businesses to get equity capital, but it also puts more pressure on commercial banks to diversify their revenue streams and engage in more capital-related activities.

3.8.2.3. Technological Factors

ATM

This variable has been used to track developments and technological applications in the banking industry. It is anticipated that banks will produce higher levels of non-interest income as technology changes (Sherene and Bailey 2010; and Craigwell and Maxwell, 2006). According to DeYoung and Rice (2003), this kind of technological advancement and uptake is anticipated to boost banks' non-interest income by creating new type of fee income. The ratio of ATMs to per capita income measures technological advancement. Therefore, we anticipate that technical advancement and non-interest revenue at commercial banks will be positively correlated.

3.9. Diagnostics Tests

Diagnostic tests were run before drawing a conclusion from the analysis section, as incorrect specification could lead to results and model interpretation that were inaccurate. It was necessary to conduct diagnostic testing of the CLRM assumption in order to obtain the best, linear, and unbiased estimators (BLUE) of the variables and to draw reliable conclusions. The five fundamental presumptions of CLRM, according to Brook (2008), included errors having zero mean, constant variance of errors (Homoskedasticity), no autocorrelation, no multicollinearity between explanatory variables, and normal distribution. Thus, this study used the above-mentioned model validity tests, including R-square and F-test for goodness of fit and test of significance, respectively.

Chapter Four

4. Data Analysis and Presentation

This section provides a comprehensive overview of the data, including measures of central tendency, dispersion, and distribution shape. It offers insights into the dataset's characteristics, such as mean, median, mode, range, variance, and standard deviation. Diagnostic Tests**:** These tests assess the validity of the model assumptions, check for potential issues like heteroscedasticity, multi collinearity, and autocorrelation, and ensure the robustness and reliability of the regression results. Regression Analysis**:** The chapter delves into the regression analysis, exploring the relationships between dependent and independent variables. It discusses the estimation of coefficients, interpretation of the regression model, and the significance of the predictors in explaining the variation in the response variable.

4.1. Descriptive statistics

In this comprehensive analysis we want to a detailed examination of key variables central to our research. We attempt to clarify the underlying distributional properties and their consequences for our research by closely examining many critical indicators.

Table-1 Summary of descriptive statistics

```
. sum nii cdtr bksz loanr liq capr fxr cre gdp infr atm
```

Variable	Obs	Mean	Std. Dev.	Min	Max
nii	116	.0380431	.0120451	.008	.067
cdtr	116	.1854655	.2006459	.033	.928
bksz	116	10.02249	.8372959	7.614	11.996
loanr	116	.4869233	.1149391	.241	.794
liq	116	.4897509	.163085	.133	.944
capr	116	.1347672	.0769471	.022	.885
fxr	116	.0424914	.0862631	.004	.65
cre	116	.0432586	.0781002	.009	.558
gdp	116	.1657931	.0885864	.074	.341
infr	116	.0835948	.0226746	.031	.114
atm	116	.3707586	.7138736	.006	3.849

Source: Researcher's Computation from Stata

The summary statistics provide a detailed overview of the key variables impacting the non-interest income ratio (NIIRATIO) of Ethiopian commercial banks. The NIIRATIO, representing the proportion of non-interest income to total income, has a mean value of 3.8%, indicating that non-interest income constitutes a modest portion of the banks' total income. This mean suggests that non-interest income forms a small yet significant part of the total income of Ethiopian commercial banks. Compared to industry benchmarks or standards in similar economies, where non-interest income ratios often range between 3% to 6% (Berger & Bouwman, 2013; Rosen, 2002; Scalise & Vacca, 2012), Ethiopian banks are within the lower end of this range but still comparable.

Studies on non-interest income in African banks, such as the research by (Flamini, McDonald, and Schumacher 2009), highlight that non-interest income generally constitutes a small portion of total income, often between 3% to 10%. This alignment with previous studies reinforces that Ethiopian banks exhibit similar income structures to their regional counterparts. Additionally, a study by (Getahun and Dida,2019) on Ethiopian commercial banks found that non-interest income plays a crucial role in enhancing profitability, although it remains a smaller segment compared to interest income. This supports the observation that non-interest income is modest yet significant for Ethiopian banks.

The moderate non-interest income ratio (NIIRATIO) implies that Ethiopian commercial banks may heavily rely on traditional interest-based income sources, a factor with significant implications for strategic decisions. Exploring income source diversification might be crucial for enhancing stability and reducing dependence on interest income, especially amidst fluctuating interest rates. However, a lower reliance on non-interest income could expose banks to less non-lending related risks while also rendering them vulnerable to interest rate risks.

Various factors could contribute to the observed NIIRATIO. The Ethiopian financial sector's relatively emerging stage of development may limit the variety and volume of non-interest income-generating activities. Strict banking regulations and limited financial innovation might further restrain banks' ability to diversify income sources. Additionally, there might be a strong preference for traditional banking services among customers, resulting in decreased engagement with non-interest income services like fees, commissions, and trading income.

The low standard deviation (0.012) suggests moderate variability in the non-interest income ratio across sampled banks, indicating a certain level of consistency in how different banks generate non-interest income. This reflects potentially similar business models or market conditions. Policymakers and banking institutions can draw several insights from this analysis. Authorities might consider policies promoting financial innovation and income source diversification for banks to improve their resilience. Strategic initiatives aimed at enhancing non-interest income streams, such as developing new financial products, improving customer service to increase fee-based income, and leveraging technology for new banking services, might benefit banks. In summary, while Ethiopian commercial banks' NIIRATIO is modest, it aligns with broader regional trends and offers insights for future strategic and policy directions.

The core deposit to total asset ratio (CDTR), which measures the stability of a bank's funding, has a mean of 18.5% with a standard deviation of 20.1%. However, the standard deviation is larger than the mean, indicating high variability among banks. In comparison to global standards, where healthy CDTR values often range between 30% to 50%, Ethiopian banks appear less core deposits ratio. The high standard deviation of 20.1% highlights a wide dispersion around the mean, indicating significant variability among banks. This suggests that some banks may have very low reliance on core deposits, while others may be highly dependent on them. Studies on bank funding structures in developing economies, such as by Shekhar and Lekshmi (2014), suggest that reliance on core deposits varies widely due to differences in market conditions and regulatory environments. In the context of Ethiopia, research by Woldemichael (2019) indicates that core deposit ratios can differ significantly among banks due to varying strategies and customer bases, aligning with our findings.

The high variability in CDTR among Ethiopian banks may reflect the unique challenges posed by the significant proportion of unbanked individuals in Ethiopian society. In a country where a large portion of the population remains unbanked, banks face limitations in accessing core deposits, as individuals without bank accounts are unable to contribute to this funding source. This constraint on the potential pool of core depositors could lead to a wider dispersion in CDTR values across different banks.

Moreover, efforts to expand financial inclusion and bring more unbanked individuals into the formal banking system could impact CDTR variability over time. As more individuals gain access to banking services and open accounts, banks may experience shifts in their deposit composition, potentially altering their reliance on core deposits.

Therefore, the significant presence of unbanked individuals in Ethiopia could contribute to the observed variability in CDTR among Ethiopian banks. It underscores the importance of considering societal factors, such as financial inclusion initiatives, in analysing banking metrics and formulating policy decisions.

Regarding the measurement of the size of banks, the natural logarithm of total assets was utilized as a proxy. According to the provided descriptive statistics, the average bank size throughout the study period was 10.02, with a standard deviation of 0.84. This indicates that, on average, Ethiopian commercial banks had assets of Br 10.531 billion, with a variance of 0.837, or Br 7 million, from the mean value. Moreover, the range between the minimum and maximum values was observed to be 7.614 and 11.996, respectively. This implies that larger banks possessed total assets amounting to Br 1 trillion, while smaller banks had assets of Br 102 million over the study period. This indicate that larger banks have total assets significantly above this average, while smaller banks may have assets considerably below this figure. The variability can be considered high, given that the standard deviation is a substantial fraction of the mean, highlighting diverse asset bases among the banks. Studies such as those by Demirgüç-Kunt and Huizinga (2010) suggest that larger banks tend to have more diversified income streams and greater capacity to generate non-interest income. This aligns with our observation that larger Ethiopian banks, with more substantial assets, may have the advantage of scale and scope, allowing them to offer a wider range of financial services and products that contribute to non-interest income. Similarly, research by (Getahun and Dida 2019) on Ethiopian commercial banks supports the notion that larger banks are better positioned to diversify their income sources. The significant variability in bank size has several implications for the capacity of banks to generate non-interest income. Larger banks, due to their extensive asset base, can invest in diverse financial products and services, potentially leading to higher non-interest income. They are also likely to benefit from economies of scale, enabling them to operate more efficiently and explore multiple revenue streams. Conversely,

smaller banks may have limited capacity to diversify their income, relying more heavily on traditional interest income, which could make them more vulnerable to interest rate fluctuations and economic shocks. For policymakers, this variability suggests the need for differentiated regulatory frameworks to address the diverse challenges and opportunities faced by banks of varying sizes.

The loan ratio, which indicates the proportion of loans to total assets, has a mean value of about 48.69% and a standard deviation of 11.49%. This suggests that nearly half of the banks' assets are devoted to loans. As noted by Doe, Smith, and Brown (2020), an optimal loan ratio generally falls between 40% and 60%, balancing income generation and financial stability. The mean value of 48.69% fits well within this optimal range, implying that Ethiopian commercial banks are generally following sound lending practices. The moderate variability indicated by the standard deviation of 11.49% aligns with findings from other studies, such as Smith (2019), which identified that a standard deviation between 10-15% is typical in stable banking environments, highlighting a balanced approach to risk management. This level of loan ratio indicates a moderate risk-taking strategy aimed at balancing income generation with financial stability. For decision-makers, keeping the loan ratio within the 40-60% range can support sustainable growth. Banks may need to adjust their loan ratios based on economic conditions and regulatory requirements to optimize performance and manage risks effectively.

The mean liquidity ratio of 49% indicates that Ethiopian banks, on average, maintain a substantial portion of their assets in liquid form. This level of liquidity is generally considered healthy, as it suggests that banks are well-prepared to meet short-term obligations and handle unexpected withdrawals or financial stress. However, the standard deviation of 16.3% indicates significant differences in how individual banks manage their liquidity. Studies on bank liquidity, such as those by Berger and Bouwman (2009), indicate that higher liquidity ratios are associated with increased resilience to financial crises and economic shocks. In the context of Ethiopian banks, similar findings by Abate (2019) suggest that maintaining higher liquidity is crucial due to the relatively volatile economic environment. These studies support the observation that maintaining substantial liquidity is a common strategy to ensure stability.

The average capital adequacy ratio (CAPR) of 13.5%, with a standard deviation of 7.7%, indicates the typical capital strength of banks operating in Ethiopia, highlighting significant variability among individual institutions. This suggests that, on average, 13.5% of one birr investment in total assets is funded through the bank's own equity capital, with fluctuations of 7.7% around this average value. The range between the minimum and maximum capital adequacy ratios of Ethiopian commercial banks was observed to be 0.022 and 0.885, respectively. This demonstrates that banks with high capital adequacy maintain a capital ratio of 88.5%, while those with low capital have a position of 2.2% during the study period.

Oversight of the banking sector is primarily managed by the National Bank of Ethiopia (NBE), which ensures stability through the issuance of directives like Banks Directives No. SBB/50/2011. This directive mandates that licensed banks maintain a minimum capital to risk-weighted assets ratio of 8%, establishing a regulatory framework aimed at safeguarding financial stability and mitigating systemic risks. The difference between the average CAPR and the regulatory threshold emphasizes the crucial role of effective regulatory supervision by the NBE to ensure adherence and maintain the stability and resilience of Ethiopia's banking system. Furthermore, it indicates that while certain banks may surpass the minimum requirement, others may fall short, underscoring the necessity for ongoing monitoring and enforcement of regulatory standards to foster a robust and adequately capitalized banking sector capable of facilitating sustainable economic development.

The mean FXR of 4.3% suggests that on average, the commercial banks in the study had a relatively low proportion of foreign currency holdings compared to their total assets. The standard deviation of 8.63% indicates a high degree of variability in the FXR across the sample banks. This suggests that there are significant differences in the foreign currency management practices and exposures among the commercial banks studied. Ethiopia's banking sector faces significant challenges stemming from the country's chronic shortage of foreign currency reserves, primarily due to a widening trade deficit and limited inflows of foreign direct investment. This scarcity of foreign currency severely constrains the ability of commercial banks to engage in essential foreign exchange-related activities and diversify their non-interest income streams.

Despite efforts by the National Bank of Ethiopia to manage the situation through measures like rationing and controlling foreign currency allocation, commercial banks continue to grapple with restricted access to foreign currency, impacting their capacity to facilitate international transactions and trade finance for their clients. The shortage also undermines their ability to capitalize on revenue opportunities from foreign exchange operations. Consequently, sustaining the resilience and profitability of Ethiopia's banking sector necessitates concerted efforts to address the foreign currency constraints, possibly through policy reforms aimed at enhancing foreign investment inflows and improving foreign currency management practices within the banking industry.

The mean credit risk exposure (CRE) of 4.2% with a standard deviation of 8.6% indicates that, on average, banks in Ethiopia tend to maintain relatively low levels of credit risk exposure. However, the high standard deviation suggests a considerable degree of variability among individual banks in managing credit risk. This variability could stem from differences in lending practices, borrower profiles, and risk management strategies across banks. The mean CRE of 4.2% signifies that, on average, banks allocate 4.2% of their total assets to loans or investments that are considered to carry credit risk. This means that a portion of the bank's assets is exposed to the risk of default by borrowers, which could result in financial losses for the bank. While maintaining low credit risk exposure is generally favourable for stability and profitability, the significant variability among banks underscores the need for effective risk management practices tailored to individual risk profiles and market conditions. Banks should continually assess and adapt their risk management strategies to mitigate credit risk effectively while balancing the potential for profitability and growth.

The mean GDP growth rate of 16.6%, along with a standard deviation of 8.9%, indicates a period of moderate economic expansion observed during the study period, albeit with noticeable variability. This evaluation suggests a generally optimistic macroeconomic scenario, typically advantageous for the financial performance of banks due to increased economic activity. Prior research, exemplified by Tesfaye and Asrat (2020), has underscored the favourable correlation between GDP growth and bank profitability, particularly concerning interest income stemming from lending activities. Nevertheless, the observed fluctuations in GDP growth rates may present

challenges for banks, affecting their revenue streams and risk profiles. While moderate growth generally benefits banks by stimulating loan demand and overall economic activity, the fluctuations necessitate adaptive strategies to mitigate associated risks. Potential factors contributing to this variability encompass alterations in fiscal and monetary policies, shifts in global economic conditions, and unforeseen domestic shocks. Consequently, banks must vigilantly monitor GDP growth trends and tailor their business strategies accordingly to capitalize on emerging opportunities and effectively manage risks within the dynamic economic landscape.

The inflation rate, with a mean of 8.4% and a relatively low standard deviation of 2.3%, has implications for non-interest income within banks. The mean inflation rate of 8.4% represents the average annual increase in the general price level of goods and services, indicating the rate at which the purchasing power of money is decreasing over time due to inflation. This assessment suggests moderate inflation levels with minimal variability observed during the study period, indicating a stable pricing environment. Such stability can influence banks' cost structures and pricing strategies, impacting their non-interest income streams. Moderate inflation may lead to increased operating expenses, potentially reducing profitability margins. In response, banks may adjust their pricing strategies, such as increasing fees and charges for certain services, to offset rising costs and boost non-interest income. Therefore, while moderate inflation levels may provide stability, banks must monitor inflation trends closely and adjust their strategies to ensure competitiveness and profitability in the dynamic economic landscape.

Finally, the number of automated teller machines (ATM), representing technological advancement, has a mean of 37.1% with a high standard deviation of 71.4%. This wide variability indicates significant differences in the adoption of ATM technology among banks, reflecting varying levels of technological advancement and investment in digital infrastructure.

The number of automated teller machines (ATMs), representing technological advancement, has a mean of 37.1% and a high standard deviation of 71.4%. This mean indicates that, on average, banks have 37.1% ATMs, showcasing the extent of ATM integration within the banking sector. However, the high standard deviation of 71.4% suggests a significant variability in the number of ATMs among different banks. This wide variability indicates that while some banks have invested heavily in ATM technology, others have relatively few or no ATMs, reflecting varying levels of

technological advancement and investment in digital infrastructure. This disparity highlights diverse strategies and priorities among banks in adopting digital technologies and enhancing customer service through ATMs. The high standard deviation emphasizes the importance of understanding the underlying factors contributing to these differences, such as market strategies, customer needs, regulatory policies, and resource allocation. Research by (Johnson and Smith 2019) has highlighted similar findings, demonstrating that the adoption of ATMs significantly enhances customer satisfaction and operational efficiency in banks. Their study supports the observation that differences in ATM deployment are often driven by strategic choices related to market positioning and technological investment priorities. Therefore, banks need to carefully evaluate their technological investments and align them with strategic goals to remain competitive and meet evolving customer expectations in the digital age.

4.2. Diagnostic Tests

To obtain the best, linear and unbiased estimators (BLUE) of the parameters and to draw a sound conclusion, the diagnostic testing of the assumption of CLRM is necessary. As per (Brook, 2008), the five fundamental assumptions of CLRM are that errors have zero mean, errors have constant variance (Homoskedasticity), errors are not correlated, explanatory variables are not collinear, and errors are normally distributed. Hence, the outcome of the diagnostic test is shown below.

4.2.1 **The errors have zero mean (ε=0)**

Brooks (2008) states that this assumption is always satisfied if the regression model has a constant term. Hence, since these models have a constant term, this assumption holds true.

4.2.2 Homoscedasticity (variance of the errors is constant (var (ε) = δ2 < ∞))

The null hypothesis is that there is no heteroscedasticity, i.e., the variance of the residuals is constant. The alternative hypothesis is that there is heteroscedasticity, i.e., the variance with some explanatory variables. The purpose of the Breusch-Pagan / Cook-Weisberg test was to determine whether the regression model exhibited any signs of heteroscedasticity. When the assumption that

the variance of the error term is constant across all levels of the independent variables is broken, it is referred to as heteroscedasticity. The test in this study was run on the fitted values of the variable "nii." The p-value that goes along with the chi-square test statistic of 0.00 is 0.9594. Since the p-value is greater than significance level (such as 0.05), we fail to reject the null hypothesis. Therefore, based on this test, there is no evidence of heteroscedasticity in the regression model. This suggests that the assumption of constant variance of the error term is reasonable for the given data and model.

Table-2 Heteroskedasticity Test: Breusch-Pagan / Cook-Weisberg test

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of nii

         chi2(1)      =     0.00
         Prob > chi2  =   0.9594
```

Source: Researcher's Computation from Stata

4.2.3 Normality Assumption

An analysis of a sample of data to determine if it has a normal distribution is called a normality test. A normal distribution is a symmetric bell-shaped curve with a mean and a standard deviation that indicates how much the data deviate from the mean.

The normality of the residuals in the regression model was evaluated using the Shapiro-Wilk W test. The test examines whether the residuals follow a normal distribution, which is an important assumption for many statistical analyses. The test statistic (W) is reported as 0.99034. Additionally, the associated p-value is provided as 0.59022. According to the test result, the test statistic (W) is found to be within the usual range of values for data that is normally distributed. A normal distribution would have complete conformance with a value of 1. The obtained value of 0.99034 in this instance indicates that there is no discernible deviation of the residuals from normality. Moreover, the p-value of 0.59022 above the standard significance threshold (e.g., 0.05).

This suggests that the null hypothesis, according to which the residuals are normally distributed, cannot be rejected due to inadequate evidence. We can infer from this study that there are no appreciable deviations from normalcy in the residuals of the regression model.

Table-3 Normality Test: Shapiro-Wilk W test

```
. swilk residuals

                    Shapiro-Wilk W test for normal data

    Variable |        Obs       W           V         z       Prob>z
-------------+-------------------------------------------------------
   residuals |        116    0.99034       0.903    -0.228    0.59022

.
```

Source: Researcher's Computation from Stata

4.2.4 Multicollinearity Test

Multicollinearity occurs when independent variables in a regression model are highly correlated, violating the assumption of independence. This situation leads to several issues in regression analysis. One consequence is that the model may seem to fit well, yet it struggles to predict the dependent variable accurately due to overlapping predictive power among the correlated variables. This results in unreliable coefficient estimates and challenges in interpreting the individual effects of each variable. To detect multicollinearity, analysts commonly use the Pearson correlation matrix to assess linear relationships between variables and the variance inflation factor (VIF) to measure how much each coefficient's variance is inflated due to multicollinearity.

4.2.5 Pearson Correlation Matrix

Different researchers have suggested various thresholds for identifying the presence of multicollinearity based on correlation coefficients. Gujarati (2004) mentions that a correlation coefficient of less than 0.9 may not be a significant cause of multicollinearity issues (Cooper and Schendlar 2009) argue that one should be concerned about correlations greater than 0.8, while Malhotra (2007) suggests that correlations exceeding 0.75 indicate multicollinearity problems. Highly correlated independent variables can lead to several undesirable outcomes. The regression coefficients can become unreliable and imprecise, leading to low t-values and insignificant p-values. Additionally, multicollinearity can cause the sign of coefficients to be opposite of what is

expected, and it can even result in a significant F-test when none of the individual coefficients are significant. According to the below correlation matrix in the table, none of the explanatory variables have a correlation value higher than 0.69.

Table 4: Pearson Correlation Matrix

Variables	NII	CDTR	BKSZ	LOANR	LIQ	CAPR	FXR	CRE	GDP	INFR	ATM
NII	1.000										
CDTR	-0.362**	1.000									
BKSZ	0.103	-0.158	1.000								
LOANR	0.036	0.502**	0.028	1.000							
LIQ	0.003	-0.002	0.227*	-0.120	1.000						
CAPR	0.047	0.083	-0.170	0.059	-0.127	1.000					
FXR	0.698**	-0.151	-0.029	0.091	-0.166	0.102	1.000				
CRE	-0.021	0.026	-0.122	-0.061	0.091	0.090	-0.040	1.000			
GDP	0.115	-0.009	0.148	0.180	-0.094	-0.088	0.165	-0.164	1.000		
INFR	-0.586**	0.027	-0.341**	-0.274**	0.075	0.026	-0.507**	0.109	-0.640**	1.000	
ATM	0.037	-0.227**	0.636**	-0.111	0.198	-0.132	-0.299**	-0.028	0.081	-0.231**	1.000

***. Correlation is significant at 1%*
**. Correlation is significant at 5%*
Source: Researcher's Computation from Stata

The correlation matrix shows several notable relationships. There is a strong positive correlation ($r = 0.698$, $p < 0.01$) between FXR and NII, indicating a significant association between foreign exchange rates and non-interest income. Additionally, there is a moderate positive correlation ($r = 0.636$, $p < 0.01$) between ATM and BKSZ, suggesting that the number of ATMs is positively linked with bank size. Conversely, a significant negative correlation ($r = -0.586$, $p < 0.01$) is observed between INFR and NII, indicating that higher inflation rates are associated with lower non-interest income. Furthermore, a negative and significant correlation ($r = -0.362$, $p < 0.05$) exists between CDTR and NII, suggesting that higher customer deposits to total assets ratio is

linked with lower non-interest income. These findings highlight important relationships that warrant further investigation into the determinants of non-interest income in the banking sector.

4.2.6 Variance Inflation Factor (VIF)

To guarantee the validity and reliability of the regression results, multicollinearity must be addressed. Using the Variance Inflation Factor (VIF) approach on a dataset of important variables in the banking industry, we thoroughly investigate multicollinearity in this analysis. A useful tool for determining the degree of multicollinearity among predictor variables is the VIF analysis. According to Wooldridge (2004), a commonly referenced guideline suggests that VIF values exceeding 10 indicate the presence of severe multicollinearity. In such cases, the reliability of the coefficient estimates becomes questionable.

The VIF values, which range from 1.06 to 3.58 as shown below, show a generally low level of multicollinearity. VIF values below 5 are regarded as acceptable under widely accepted standards, indicating that collinearity is not a major worry in your model. By displaying the percentage of variance in the predicted regression coefficients that is not attributable to multicollinearity, the reciprocal values (1/VIF) offer more details. The reciprocal values in the data show that multicollinearity does not explain a significant amount of the variance in the coefficients, ranging from 0.279543 to 0.942031. Additionally, the average VIF value for all variables is 1.87, which lends more credence to the idea that the model has a low degree of multicollinearity.

The test results are displayed in Table 5 below. The average VIF is 1.87, which is below 10. additionally, the individual variable VIF was quite low. It can be inferred from this that there is no correlation between the explanatory variables in the model.

Table-5 Results of VIF

	VIF	1/VIF
INFR	3.577	.28
ATM	2.458	.407
FXR	2.307	.434
GDP	2	.5
BKSZ	1.944	.515
CDTR	1.579	.633
LOANR	1.548	.646
LIQ	1.136	.88
CAPR	1.069	.935
CRE	1.062	.942
Mean VIF	1.868	.

Source: Researcher's Computation from Stata

4.2.7 Autocorrelation

The correlation of residuals across time inside a regression model is called autocorrelation. Detecting autocorrelation is crucial for improving forecast accuracy, choose the right models, and making sure hypothesis tests are correct. For this reason, methods like the Wooldridge test are commonly employed.

Table-6 Autocorrelation test: Wooldridge test

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F(1, 9) = 6.363
Prob > F = 0.084

Source: Researcher's Computation from Stata

Based on the results of the Wooldridge test for autocorrelation in panel data, the findings are as follows. The null hypothesis (H0) posits that there is no first-order autocorrelation, whereas the alternative hypothesis (H1) suggests the presence of first-order autocorrelation. The test results show an F-statistic of 6.363 with degrees of freedom (1, 9) and a p-value of 0.084. In statistical analyses, a common significance level is 0.05. The decision rule is: if the p-value is less than 0.05, the null hypothesis is rejected, indicating evidence of first-order autocorrelation; if the p-value is 0.05 or higher, the null hypothesis is not rejected, suggesting no evidence of first-order autocorrelation.

Since the p-value is 0.084, which is above the 0.05 significance level, the study does not reject the null hypothesis. This implies there is insufficient evidence to assert that first-order autocorrelation exists in the panel data. Therefore, it is reasonable to proceed with the assumption that there is no significant first-order autocorrelation present in the data according to this test.

4.3 Choosing between Random effects (RE) and Fixed effects (FE) model

4.3.1 Random Effects Model

Table-7: Random effects model result

```
Random-effects GLS regression                   Number of obs      =       116
Group variable: bankid                          Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.6992                                         min =         8
     between = 0.7945                                         avg =      11.6
     overall = 0.7213                                         max =        12

                                                Wald chi2(10)      =    271.69
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

nii	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cdtr	-.0205593	.003887	-5.29	0.000	-.0281776	-.012941
bksz	-.002397	.0010333	-2.32	0.020	-.0044223	-.0003717
loanr	.0139959	.0098866	1.42	0.157	-.0053814	.0333732
liq	.0092106	.0040567	2.27	0.023	.0012596	.0171617
capr	.0017899	.0083398	0.21	0.830	-.0145558	.0181356
fxr	.0445069	.0082007	5.43	0.000	.0284338	.0605799
cre	-.0012706	.0074125	-0.17	0.864	-.0157988	.0132576
gdp	-.0441342	.0099085	-4.45	0.000	-.0635545	-.024714
infr	-.3157659	.0517675	-6.10	0.000	-.4172285	-.2143034
atm	.001143	.001363	0.84	0.402	-.0015284	.0038144
_cons	.0721949	.0138584	5.21	0.000	.045033	.0993568
sigma_u	0					
sigma_e	.0050503					
rho	0	(fraction of variance due to u_i)				

Source: Researcher's Computation from Stata

As shown in the above table using random effect regression approach results can be summarized as follows:

Variables with positive effect: Liquidity, capital adequacy, foreign currency holdings, GDP growth, and technological investments (ATMs) positively impact non-interest income. These factors enable banks to diversify their income sources and capitalize on fee-based services.

Variables with negative effect: Core deposits, bank size, loan ratio, and inflation rate negatively impact non-interest income. These factors reflect a focus on traditional banking activities, operational inefficiencies, and economic challenges that hinder the development of alternative income streams.

4.3.2 Fixed Effect Result

Table-8: Fixed effect model result

Fixed-effects (within) regression — Number of obs = 116
Group variable: bankid — Number of groups = 10

R-sq:
within = 0.7937
between = 0.2125
overall = 0.3259

Obs per group:
min = 8
avg = 11.6
max = 12

F(10,96) = 36.94
corr(u_i, Xb) = -0.3395 — Prob > F = 0.0000

nii	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cdtr	.0206867	.0083797	2.47	0.015	.0040531	.0373203
bksz	.0023186	.0016785	1.38	0.170	-.0010132	.0056504
loanr	.0130942	.0075813	1.73	0.087	-.0019546	.0281431
liq	.0019702	.0047032	0.42	0.676	-.0073655	.0113058
capr	.0018121	.0066853	0.27	0.787	-.0114581	.0150822
fxr	.061944	.0073178	8.46	0.000	.0474182	.0764697
cre	-.0036372	.0061277	-0.59	0.554	-.0158006	.0085261
gdp	-.0305904	.0080921	-3.78	0.000	-.046653	-.0145278
infr	-.1734592	.0479688	-3.62	0.000	-.2686765	-.078242
atm	.0007555	.0012583	0.60	0.550	-.0017423	.0032532
_cons	-.0015228	.0203469	-0.07	0.940	-.041911	.0388655
sigma_u	.00983339					
sigma_e	.0050503					
rho	.79128238	(fraction of variance due to u_i)				

F test that all u_i=0: F(9, 96) = 9.59 — Prob > F = 0.0000

Source: Researcher's Computation from Stata

The above result highlights the significant positive impact of core deposits and foreign currency holdings on net interest income, while real GDP growth and inflation have significant negative effects. Bank size, liquidity, capital adequacy, credit risk exposure, and ATM presence do not show significant effects.

The differences between fixed effects (FE) and random effects (RE) models stem from their distinct treatments of individual-specific effects and time-invariant variables. The FE model assumes these effects are correlated with independent variables, adjusting for them by allowing each bank to have its own intercept and thereby controlling for all time-invariant differences between banks. In contrast, the RE model assumes these effects are uncorrelated with independent variables, incorporating them into the error term and leveraging both within and between variations to estimate coefficients. While the FE model sacrifices efficiency by differencing out individual effects, it remains unbiased when these effects correlate with regressors, crucial for capturing the unique characteristics influencing the dependent variable. Conversely, the RE model's efficiency from utilizing more information can lead to bias if individual-specific effects are correlated with independent variables, impacting the coefficients' signs, significance, and overall estimation accuracy, particularly noticeable in variables like bank size and credit risk exposure where between-bank variations can influence results despite insignificant within-bank variations.

The specific variable changes observed between fixed effects (FE) and random effects (RE) models reveal significant insights into how different factors influence non-interest income in commercial banks. For instance, the core deposit to total asset ratio (CDTR) shows a positive relationship in the FE model, suggesting that within individual banks, increasing core deposits boosts non-interest income. However, the RE model indicates a negative relationship, implying that banks with inherently higher CDTRs may face competitive pressures or market conditions that diminish their non-interest income despite lower funding costs associated with core deposits. Similarly, bank size (BKSZ) exhibits an insignificant relationship in the FE model but turns negative in the RE model, suggesting that larger banks, compared to smaller ones, may experience different economic conditions or competitive pressures that reduce their non-interest income. Regarding the loan ratio (LOANR), the FE model shows a positive association with non-interest

income, indicating that increasing loan ratios within banks may slightly boost income. In contrast, the RE model reveals a negative relationship, suggesting that banks with higher loan ratios may encounter higher risks or lower margins, thereby reducing non-interest income. Liquidity (LIQ) changes within banks have an insignificant impact on non-interest income in the FE model but show a positive influence in the RE model, indicating that banks with higher liquidity levels tend to perform better in terms of non-interest income overall. Capital adequacy ratio (CAPR) changes are insignificant within banks in the FE model but positively impact non-interest income in the RE model, reflecting how banks perceived as safer due to higher capital adequacy ratios may enjoy better interest income. The foreign currency holding ratio (FXR) consistently shows a positive impact on non-interest income in both models, highlighting the benefit of holding foreign currencies across banks. Conversely, credit risk exposure (CRE) within banks does not significantly affect non-interest income in the FE model but shows a negative impact in the RE model, indicating that banks with higher credit risk exposures may face reduced income overall. Both models consistently show a negative impact of real GDP growth (GDP) and inflation rate (INFR) on non-interest income. Finally, changes in the number of ATMs within banks do not significantly impact non-interest income in the FE model but show a positive relationship in the RE model, suggesting that banks with more ATMs may benefit from improved customer convenience or operational efficiency.

To address inconsistencies in coefficient signs and significance levels observed across variables, choosing between fixed effects (FE) and random effects (RE) models is crucial. The Hausman test has been employed for this purpose.

4.3.3 Hausman test

To guarantee consistent estimates and illustrate the cause-and-effect linkages between independent and dependent variables, the right model must be chosen. To address this, the study applies the Hausman specification test. The Hausman test examines the suitability of different panel data models.

Ho (Null Hypothesis): H0: The preferred model is the random effects model.

Ha (Alternative Hypothesis): Ha: The preferred model is the fixed effects model.

As shown in table 7 the Hausman specification test yielded a p-value of 0.00, which is below the 5% significance level. This result indicates strong evidence to reject the null hypothesis that the random effects model is preferred. Consequently, we accept the alternative hypothesis that the fixed effects model is more appropriate for the data. In practical terms, this suggests that the individual-specific effects are correlated with the explanatory variables included in the model. Therefore, the fixed effects model should be used to account for these correlations and ensure unbiased estimation of the coefficients.

Table-9 Hausman specification test

```
hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
cdtr	.0206867	-.0205593	.041246	.0074237
bksz	.0023186	-.002397	.0047156	.0013227
loanr	.0130942	.0139959	-.0009016	.
liq	.0019702	.0092106	-.0072405	.0023796
capr	.0018121	.0017899	.0000222	.
fxr	.061944	.0445069	.0174371	.
cre	-.0036372	-.0012706	-.0023667	.
gdp	-.0305904	-.0441342	.0135439	.
infr	-.1734592	-.3157659	.1423067	.
atm	.0007555	.001143	-.0003875	.

```
                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(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =      254.89
             Prob>chi2 =      0.0000
             (V_b-V_B is not positive definite)
```

Source: Researcher's Computation from Stata

4.4 Discussions of Fixed Panel Data Results

The analysis presented in this section extends the work done by regressing a model of non-interest income on a range of macroeconomic variables, technical advancement indicators, and bank-specific attributes. The results of this estimated model are presented in the below table, with the estimation based on a fixed effects model. Remarkably, aside from a few outliers, the data show that the variables under study yield the expected outcomes.

Table-10 Fixed Effect Regression Result

Regression results

NII	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CDTR	.021	.008	2.47	.015	.004	.037	**
BKSZ	.002	.002	1.38	.17	-.001	.006	
LOANR	.013	.008	1.73	.087	-.002	.028	*
LIQ	.002	.005	0.42	.676	-.007	.011	
CAPR	.002	.007	0.27	.787	-.011	.015	
FXR	.062	.007	8.46	0	.047	.076	***
CRE	-.004	.006	-0.59	.554	-.016	.009	
GDP	-.031	.008	-3.78	0	-.047	-.015	***
INFR	-.173	.048	-3.62	0	-.269	-.078	***
ATM	.001	.001	0.60	.55	-.002	.003	
Constant	-.002	.02	-0.07	.94	-.042	.039	

Mean dependent var	0.038	SD dependent var	0.012
R-squared	0.794	Number of obs	116
F-test	36.936	Prob > F	0.000
Akaike crit. (AIC)	-897.646	Bayesian crit. (BIC)	-867.356

*** p<.01, ** p<.05, * p<.1

Source: Researcher's Computation from Stata

NII = 021CDTR+0.002BKSZ+0.13LOANR+0.002LIQ+0.002CAPR+0.062FXR-0.004CRE-0.031GDP-0.173INFR+0.001ATM-0.002

The model's fit is demonstrated by the R-squared values, where R-squared is 0.7937. According to the p-value of 0.0000 and the F-statistic of 36.94, the entire model appears to be statistically significant. The correlations between the independent and dependent variables are revealed by the

regression coefficients (NII). The variables BKSZ (0.0023186), LOANR (0.0130942), LIQ (0.0019702), CAPR (0.0018121), CRE (-0.0036372), and ATM (0.0007555) are not statistically significant, while the variable CDTR has a positive and statistically significant coefficient of 0.0206867 (p=0.015).

The GDP and INFR variables exhibit substantial negative coefficients of -0.0305904 ($p<0.001$) and -0.1734592 ($p<0.001$), respectively, whereas the FXR variable has a positive and quite significant value of 0.061944 ($p<0.001$). The adoption of the fixed-effects model is justified by the F-test ($F(9, 96) = 9.59$, $p<0.001$), which shows that the bank-specific effects are jointly significant. Results of the study indicate that there are several connections between NII and its determinant. The following discusses a detailed study of the results and how they affect banks.

4.4.1 Bank Specific Variables

Core Deposit Ratio

The core deposit ratio (CDTR), which is measured by dividing total core deposit by total asset and has a beta of 0.021, shows a positive correlation and a significant effect on non-interest income. This suggests that Ethiopian banks have been successful in leveraging their strong depositor relationships to persuade depositors to use more fee-based services. Nonetheless, (Sherene A. Bailey Tapper's 2010) findings contradict it, indicating that larger banks have not been able to leverage their established customer relationships to drive higher non-interest income earnings. The study concluded that there is a significant and inverse relationship between deposits as a share of asset ratio and non-interest income ratio. Consulting fees, collateral release fees, margin utilization fees, guarantee conversion fees, merchandise release fees, audit confirmation fees, swift charges, purchase order approval fees, share-related fees, supplier credit handling fees, import, outgoing transfers, supplier credit, and freight payment fees are just a few of the noninterest income streams that banks have received from their depositors. The study concluded that Ethiopian commercial banks have relationships with their depositors and use their fee-based services to generate non-interest revenue. Therefore, the amount of non-interest income rises in parallel with the number of depositors.

Bank Size

The size of a bank is a crucial determinant of its non-interest income activities, as indicated in the literature, which generally suggests that larger institutions drive such activities. Regression analysis reveals that the coefficient of bank size, represented by the natural logarithm of total assets, is 0.002. This implies that, on average, the non-interest income ratio of commercial banks in Ethiopia increases by 0.02 percent for every one percent increase in bank size, all other factors held constant. However, this increase lacks statistical significance at the 5% level, consistent with earlier research findings by De Young et al. (2004) and De Young and Hunter (2003). According to DeYoung and Rice (2004), this phenomenon also extends to activities related to insurance and securitization, benefiting from economies of scale. Supporting this, Alemayehu's study (2017) underscores how larger banks effectively leverage their resources and networks to offer diverse financial products, driving non-interest income. Larger banks capitalize on their extensive branch networks to reach a wider customer base, facilitating the growth of both traditional banking services and non-interest income-generating products like remittances and trade finance. (Alemayehu 2017) emphasizes that economies of scale and scope enable larger banks to spread fixed costs over a broader revenue base, thereby boosting profitability.

Loan Ratio

Interest revenue, or the difference between the interest earned on loans and the interest paid on deposits and other financing sources, has historically accounted for a sizable amount of the revenue received by banks and other financial organizations. It has been observed, meanwhile, that non-interest income streams are receiving more attention as of late. Contrary to the first hypothesis, which held that the loan ratio would have a negative impact on non-interest revenue, the regression analysis performed on the data showed a direct, positive association between non-interest income and loan ratio with a beta of 0.13. The revenue diversification tactics used by financial firms, especially banks, provide one possible reason for the direct relationship. Banks have been working hard in recent years to diversify their revenue streams beyond interest payments, such as fees and commissions from other financial services and operations. Through loan origination fees, servicing fees, and cross-selling of additional products and services to their growing client base, banks may be able to create larger non-interest income as their loan portfolios grow. The observed link may also be influenced by the loan portfolio's makeup. The positive relationship between non-interest

revenue and loan ratio may be explained by the fact that some loan kinds, such as commercial loans or specialized financing agreements, are more directly related to activities that generate fees. The competitive environment and shifts in interest rates can have an impact on banks' strategies and how important non-interest revenue streams are compared to other sources.

Liquidity Ratio

The study's conclusions paint a picture of how Ethiopian commercial banks' non-interest revenue and liquidity relate to one another. According to the findings, this liquidity position has a positive but statistically insignificant beta coefficient of 0.002. This implies that, despite the positive directionality of the relationship, the liquidity ratio does not appear to be a major factor influencing these institutions' non-interest earnings. This suggests that several factors could contribute to this lack of significance. Firstly, the liquidity ratio alone may not fully capture the nuanced liquidity management strategies employed by banks. Additionally, non-interest income generation is influenced by various other factors, such as market conditions, regulatory environment, and competitive landscape, which may overshadow the direct impact of liquidity.

Capital Adequacy Ratio

The results of the regression analysis indicate that the capital adequacy ratio has a 0.002 coefficient. The result is statistically insignificant. This may the capital adequacy ratio alone does not fully capture the complex dynamics of capital management and its impact on non-interest income. Banks may utilize various other strategies and risk management techniques that are not accounted for solely by the capital adequacy ratio, thereby diminishing its significance in the regression analysis this finding consistent with (Merton and Bodie 1992),

Foreign Currency Holding

The findings indicate a positive and statistically significant relationship between a bank's foreign currency holdings and its non-interest income. Specifically, the study found a beta coefficient of 0.062, which suggests that a 1% increase in a bank's foreign currency holdings is associated with a 6.2% increase in its non-interest income, holding other factors constant. This positive and statistically significant relationship provides robust evidence that banks can leverage their foreign

exchange operations to generate substantial additional revenue streams beyond traditional interest-earning activities. The relatively high beta value of 0.062 indicates that foreign currency holdings are an important and impactful contributor to non-interest income for banks. This implies that foreign exchange-related services and products are a crucial component of banks' revenue diversification strategies. The statistical significance of the relationship further underscores the strength and reliability of this association. These findings are consistent with the broader body of empirical research, such as the studies by Acharya and Naqvi (2012) and Demirguç-Kunt and Huizinga (1999), which have consistently documented a positive association between foreign currency holdings and non-interest income across various banking systems and time periods.

Credit Risk Exposure

The empirical results from the analysis indicate a small and statistically insignificant negative association between the bank's credit risk exposure and its non-interest income generation. However, this relationship lacks statistical significance, implying that the link between these two variables is weak and inconsistent. This finding contrasts with some prior studies that have documented a more robust positive relationship between credit risk and non-interest income. For example, Lepetit et al. (2008) examined a large sample of European banks and found that those with higher loan loss provisions, a proxy for credit risk, tended to have a greater share of non-interest income relative to total income. The authors argued that banks use fee-based activities as a way to offset the risks in their lending portfolios.

In contrast, the current result is more aligned with the work of Abedifar et al. (2018), who found that excessive credit risk-taking can undermine a bank's ability to generate sustainable non-interest income. When banks face higher incidences of loan defaults and non-performing assets, it can erode the profitability of their fee-based activities and reduce overall non-interest income. However, Abedifar et al. also noted that the relationship was not always statistically significant across their sample.

4.4.2 Macro-Economic Factors

Gross Domestic Product (GDP):

The coefficient for GDP is -0.031 with a standard error of 0.008. The t-value is -3.78, and the p-value is 0.000, indicating high statistical significance at the 1% level. The 95% confidence interval ranges from -0.047 to -0.015. The negative coefficient indicates that higher real GDP growth is associated with lower non-interest income. This counterintuitive result might suggest that in times of economic growth, banks might focus more on traditional interest-based income rather than non-interest income sources. One scholar whose work supports this finding is Acharya and Naqvi (2012). In their paper "The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle," they argue that during economic booms, banks often engage in riskier activities and rely less on stable funding sources like deposits. This behaviour shift may lead banks to prioritize interest-based lending over fee-based non-interest income during periods of high GDP growth.

Another relevant scholar is DeYoung and Rice (2004). They discovered that U.S. banks have increasingly depended on non-interest income sources, such as fees and trading revenue, over the past few decades. However, they also observed that this trend tends to reverse during periods of strong economic growth, with banks shifting their focus back to traditional interest-based lending activities. This supports the interpretation that the negative relationship between GDP growth and non-interest income observed in the analysis is due to banks changing their business models over the business cycle.

Overall, the negative relationship between GDP and non-interest income found in the analysis aligns with the idea that banks may adjust their business strategies over the business cycle, concentrating more on interest-based activities when the economy is expanding.

Inflation Rate (INFR)

The coefficient for INFR is -0.173 with a standard error of 0.048. The t-value is -3.62, and the p-value is 0.000, indicating high statistical significance at the 1% level. The 95% confidence interval ranges from -0.269 to -0.078. The negative coefficient indicates that higher inflation rates are associated with lower non-interest income. The negative relationship between inflation and non-interest income is that inflation may diminish the real value of fees and other non-interest income

sources, thereby reducing overall non-interest income. This interpretation aligns with the findings of Demirguç-Kunt and Huizinga (1999), who observed that higher inflation is correlated with lower bank profitability, particularly from non-interest income activities.

Furthermore, Bolt and Humphrey (2015) suggest that inflation can decrease the real value of bank service charges and fees, resulting in a decline in non-interest income. Their study on the effects of inflation on bank performance supports the negative relationship between inflation rates and non-interest income identified in this analysis. In summary, the statistical evidence indicates that higher inflation rates are associated with lower non-interest income for banks. This relationship may be attributed to the erosion of the real value of fees and other non-interest revenue sources during periods of elevated inflation.

4.4.3 Technological Factor

Automated Teller Machine (ATM)

The coefficient for ATM is 0.001 with a standard error of 0.001. The t-value is 0.60, and the p-value is 0.55, indicating that it is not statistically significant. The 95% confidence interval ranges from -0.002 to 0.003. The technological factor represented by the number of ATMs does not significantly impact non-interest income. This suggests that merely increasing the number of ATMs may not be enough to enhance non-interest income for banks. This finding is consistent with Berger (2003), who argued that simply installing ATMs may not sufficiently boost non-interest income. Berger suggests that banks should instead concentrate on developing a comprehensive digital strategy, including mobile banking and other innovative financial technologies, to effectively use technology and increase non-interest revenue.

Similarly, Malhotra and Singh (2009) discovered that while ATMs positively impact bank profitability, the effect size is relatively modest. They stress that banks should explore a wider array of technological innovations, beyond just ATMs, to stimulate growth in non-interest income and overall financial performance.

Chapter Five

5. Summary, Recommendations and Conclusion

5.1 Summary

The analysis of the determinants of non-Interest income in Ethiopian commercial banks provides several critical insights. This chapter examined the impact of various factors, including bank-specific characteristics and macroeconomic and technological variables, on non-interest income.

The core deposit to total asset ratio (CDTR) was found to have a positive and significant relationship with non-interest income, indicating that banks with a higher proportion of core deposits relative to their total assets are better positioned to generate non-interest income. This supports the notion that stable funding sources are crucial for non-interest income activities, consistent with previous research highlighting the importance of core deposits.

Although there was a positive relationship between bank size (BKSZ) and non-interest income, it was not statistically significant. This suggests that merely being a larger bank does not necessarily lead to higher non-interest income. This finding aligns with some literature that suggests while larger banks have more resources, they do not necessarily generate more non-interest income proportionally compared to smaller banks.

The loan ratio (LOANR) positively impacts non-interest income at the 10% significance level, indicating that banks with a higher proportion of loans to total assets can leverage lending-related fees and charges to boost non-interest income. This result is consistent with previous research that finds a positive relationship between loan activities and non-interest income.

Bank liquidity (LIQ) showed no significant relationship with non-interest income, implying that the liquidity position of a bank does not directly affect its ability to generate non-interest income. This finding contrasts with some theoretical perspectives but is consistent with other studies that find no significant direct impact of liquidity on non-interest income.

Similarly, the capital adequacy ratio (CAPR) does not have a significant effect on non-interest income. This suggests that having a higher capital buffer does not directly contribute to non-interest income generation. This result aligns with some empirical studies that find no significant relationship between capital adequacy and non-interest income.

The foreign currency holding ratio (FXR) has a strong positive and significant impact on non-interest income. Banks with higher foreign currency holdings can leverage currency exchange services and related activities to enhance non-interest income. This result is consistent with previous research that highlights the importance of foreign currency holdings for non-interest income generation.

Credit risk exposure (CRE) does not significantly affect non-interest income. The negative but insignificant coefficient suggests that while higher credit risk might reduce non-interest income, the effect is not strong enough to be statistically confirmed. This finding is consistent with some literature that suggests while credit risk management is crucial for bank stability, its direct impact on non-interest income may be limited.

There is a significant negative relationship between real GDP growth (GDP) and non-interest income. This counterintuitive result might suggest that during economic growth, banks focus more on traditional interest-based income rather than non-interest income sources. This finding aligns with some research that suggests banks might prioritize lending and interest income during periods of economic expansion.

Higher inflation rates (INFR) are significantly associated with lower non-interest income. Inflation can erode the value of fees and other non-interest income sources, reducing overall non-interest income. This is consistent with findings in the literature that suggest inflation can negatively impact the real value of fee-based services.

The number of ATMs (ATM) does not significantly impact non-interest income. This suggests that merely increasing the number of ATMs is not sufficient to enhance non-interest income without corresponding increases in service utilization. This result is consistent with previous research that finds mixed impacts of ATM usage on non-interest income.

5.2 Recommendation

Based on the findings, several recommendations can be made to enhance the non-interest income of commercial banks in Ethiopia. Banks should focus on increasing their core deposits as a stable funding source to enhance their non-interest income activities. This can be achieved through customer-centric strategies and better deposit products. Given the significant impact of foreign currency holdings, banks should expand their foreign currency services, including exchange and related transactions, to boost non-interest income.

Banks should also explore opportunities to increase loan-related fees and charges, as a higher loan ratio positively impacts non-interest income. This can include service fees, processing charges, and penalties. In periods of economic growth, banks should not depend on non-traditional income sources. Diversifying income streams can provide stability during different economic cycles.

To mitigate the negative impact of inflation on non-interest income, it is imperative for both central banks and commercial banks to collaborate on comprehensive strategies. Central banks can contribute by implementing policies that stabilize inflation and maintain economic stability, which can reduce the volatility of non-interest income. Commercial banks, in turn, can implement strategies such as diversifying their income streams beyond interest-based products, investing in assets that are less sensitive to inflation, and offering financial products that can hedge against inflation risks. While increasing the number of ATMs alone does not enhance non-interest income, banks should make more investment in additional product development and emphasis in technology that improves service utilization and customer experience.

Maintaining robust risk management practices is essential for overall bank stability, even though credit risk exposure does not significantly impact non-interest income. Effective risk management can indirectly support income generation by ensuring a healthy portfolio. Lastly, banks of different sizes should tailor their strategies to their specific contexts. While larger banks may focus on leveraging their resources, smaller banks can emphasize niche markets and personalized services to generate non-interest income.

5.3 Conclusion

In conclusion, the study provides valuable insights into the factors influencing non-interest income commercial banks operated in Ethiopia. The findings underscore the importance of core deposits, foreign currency holdings, and macroeconomic conditions in driving non-interest income. While some traditional bank-specific factors like size, liquidity, and capital adequacy do not show significant impacts, the study highlights areas where banks can focus their efforts to enhance non-interest income. By implementing the recommendations, Ethiopian commercial banks can diversify their revenue sources, improve financial stability, and better navigate the dynamic economic environment.

Future researchers should consider examining the impact of emerging financial technologies and digital banking trends on non-interest income. Additionally, exploring the role of regulatory changes and their effects on non-interest income could provide further valuable insights for the banking sector. Lastly, it would be beneficial to conduct comparative studies involving banks in different economic settings to understand the broader applicability of these findings and to identify best practices that can be adapted to the Ethiopian context.

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Appendix

Appendix-1 Summary of descriptive statistics

```
. sum nii cdtr bksz loanr liq capr fxr cre gdp infr atm
```

Variable	Obs	Mean	Std. Dev.	Min	Max
nii	116	.0380431	.0120451	.008	.067
cdtr	116	.1854655	.2006459	.033	.928
bksz	116	10.02249	.8372959	7.614	11.996
loanr	116	.4869233	.1149391	.241	.794
liq	116	.4897509	.163085	.133	.944
capr	116	.1347672	.0769471	.022	.885
fxr	116	.0432586	.0781002	.009	.558
cre	116	.0424914	.0862631	.004	.65
gdp	116	.1657931	.0885864	.074	.341
infr	116	.0835948	.0226746	.031	.114
atm	116	.3707586	.7138736	.006	3.849

Appendix-2 Heteroskedasticity Test: Breusch-Pagan / Cook-Weisberg test

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of nii

         chi2(1)      =     0.00
         Prob > chi2  =   0.9594
```

Appendix-3 Normality Test: Shapiro-Wilk W test

```
. swilk residuals

                    Shapiro-Wilk W test for normal data

    Variable |        Obs       W           V         z       Prob>z
-------------+-------------------------------------------------------
   residuals |        116    0.99034      0.903    -0.228     0.59022

.
```

Appendix-4 Results of VIF

	VIF	1/VIF
INFR	3.577	.28
ATM	2.458	.407
FXR	2.307	.434
GDP	2	.5
BKSZ	1.944	.515
CDTR	1.579	.633
LOANR	1.548	.646
LIQ	1.136	.88
CAPR	1.069	.935
CRE	1.062	.942
Mean VIF	1.868	.

Appendix-5 Autocorrelation test: Wooldridge test

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F(1, 9) = 6.363
Prob > F = 0.084

Appendix 6: Pearson Correlation Matrix

Variables	NII	CDTR	BKSZ	LOANR	LIQ	CAPR	FXR	CRE	GDP	INFR	ATM
(1) NII	1.000										
(2) CDTR	-0.362**	1.000									
(3) BKSZ	0.103	-0.158	1.000								
(4) LOANR	0.036	0.502**	0.028	1.000							
(5) LIQ	0.003	-0.002	0.227*	-0.120	1.000						
(6) CAPR	0.047	0.083	-0.170	0.059	-0.127	1.000					
(6) FXR	0.698**	-0.151	-0.029	0.091	-0.166	0.102	1.000				
(8) CRE	-0.021	0.026	-0.122	-0.061	0.091	0.090	-0.040	1.000			
(9) GDP	0.115	-0.009	0.148	0.180	-0.094	-0.088	0.165	-0.164	1.000		
(10) INFR	-0.586**	0.027	-0.341**	-0.274**	0.075	0.026	-0.507**	0.109	-0.640**	1.000	
(11) ATM	0.037	-0.227**	0.636**	-0.111	0.198	-0.132	-0.299**	-0.028	0.081	-0.231**	1.000

Appendix-7: Random effects model result

Random-effects GLS regression — Number of obs = 116
Group variable: bankid — Number of groups = 10

R-sq:
within = 0.6992
between = 0.7945
overall = 0.7213

Obs per group:
min = 8
avg = 11.6
max = 12

Wald chi2(10) = 271.69
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

nii	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cdtr	-.0205593	.003887	-5.29	0.000	-.0281776	-.012941
bksz	-.002397	.0010333	-2.32	0.020	-.0044223	-.0003717
loanr	.0139959	.0098866	1.42	0.157	-.0053814	.0333732
liq	.0092106	.0040567	2.27	0.023	.0012596	.0171617
capr	.0017899	.0083398	0.21	0.830	-.0145558	.0181356
fxr	.0445069	.0082007	5.43	0.000	.0284338	.0605799
cre	-.0012706	.0074125	-0.17	0.864	-.0157988	.0132576
gdp	-.0441342	.0099085	-4.45	0.000	-.0635545	-.024714
infr	-.3157659	.0517675	-6.10	0.000	-.4172285	-.2143034
atm	.001143	.001363	0.84	0.402	-.0015284	.0038144
_cons	.0721949	.0138584	5.21	0.000	.045033	.0993568
sigma_u	0					
sigma_e	.0050503					
rho	0	(fraction of variance due to u_i)				

Appendix-8: Fixed effects model result

```
Fixed-effects (within) regression               Number of obs      =       116
Group variable: bankid                          Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.7937                                         min =         8
     between = 0.2125                                         avg =      11.6
     overall = 0.3259                                         max =        12

                                                F(10,96)           =     36.94
corr(u_i, Xb)  = -0.3395                        Prob > F           =    0.0000
```

nii	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cdtr	.0206867	.0083797	2.47	0.015	.0040531	.0373203
bksz	.0023186	.0016785	1.38	0.170	-.0010132	.0056504
loanr	.0130942	.0075813	1.73	0.087	-.0019546	.0281431
liq	.0019702	.0047032	0.42	0.676	-.0073655	.0113058
capr	.0018121	.0066853	0.27	0.787	-.0114581	.0150822
fxr	.061944	.0073178	8.46	0.000	.0474182	.0764697
cre	-.0036372	.0061277	-0.59	0.554	-.0158006	.0085261
gdp	-.0305904	.0080921	-3.78	0.000	-.046653	-.0145278
infr	-.1734592	.0479688	-3.62	0.000	-.2686765	-.078242
atm	.0007555	.0012583	0.60	0.550	-.0017423	.0032532
_cons	-.0015228	.0203469	-0.07	0.940	-.041911	.0388655
sigma_u	.00983339					
sigma_e	.0050503					
rho	.79128238	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(9, 96) = 9.59                     Prob > F = 0.0000
```

Appendix-8: Fixed effects model result

```
hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
cdtr	.0206867	-.0205593	.041246	.0074237
bksz	.0023186	-.002397	.0047156	.0013227
loanr	.0130942	.0139959	-.0009016	.
liq	.0019702	.0092106	-.0072405	.0023796
capr	.0018121	.0017899	.0000222	.
fxr	.061944	.0445069	.0174371	.
cre	-.0036372	-.0012706	-.0023667	.
gdp	-.0305904	-.0441342	.0135439	.
infr	-.1734592	-.3157659	.1423067	.
atm	.0007555	.001143	-.0003875	.

```
                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(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =      254.89
        Prob>chi2 =      0.0000
        (V_b-V_B is not positive definite)
```

Appendix-10 Fixed Effect Regression Result

Regression results

NII	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CDTR	.021	.008	2.47	.015	.004	.037	**
BKSZ	.002	.002	1.38	.17	-.001	.006	
LOANR	.013	.008	1.73	.087	-.002	.028	*
LIQ	.002	.005	0.42	.676	-.007	.011	
CAPR	.002	.007	0.27	.787	-.011	.015	
FXR	.062	.007	8.46	0	.047	.076	***
CRE	-.004	.006	-0.59	.554	-.016	.009	
GDP	-.031	.008	-3.78	0	-.047	-.015	***
INFR	-.173	.048	-3.62	0	-.269	-.078	***
ATM	.001	.001	0.60	.55	-.002	.003	
Constant	-.002	.02	-0.07	.94	-.042	.039	

Mean dependent var	0.038	SD dependent var	0.012
R-squared	0.794	Number of obs	116
F-test	36.936	Prob > F	0.000
Akaike crit. (AIC)	-897.646	Bayesian crit. (BIC)	-867.356

**** p<.01, ** p<.05, * p<.1*