



College of Social Sciences, Arts and Humanities
Department of Geography and Environmental Studies

**The Impact of Financial Inclusion on Banking Financial Performance, Banking
Financial Stability and Economic Growth of Ethiopia**

Mohammed Jatoro Arebo

A Dissertation Submitted in Accordance with the Requirements for the Degree of

Doctor of Philosophy

in the Subject

Regional and Local Development and Governance Studies

at

**Addis Ababa University, College of Social Sciences, Arts and Humanities, Department
Geography and Environment Study**

December, 2025

Addis Ababa, Ethiopia

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Geography and Environment Study**

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Principal Supervisor: Ass. Professor **Andualem Goshu (PhD)**

December, 2025

Addis Ababa, Ethiopia

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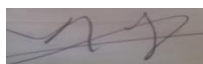
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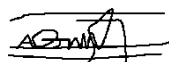


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APPROVAL SHEET

This is to certify that the dissertation entitled: "**The Impact of Financial Inclusion on Banking Financial Performance, Banking Financial Stability and Economic Growth of Ethiopia**" has been submitted for fulfilment of the requirements for the degree of Doctor of Philosophy in (Regional and Local Development and Governance Studies) complies with the regulations of the university and meets the accepted standard with respect to originality and quality.

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DEDICATION

To my beloved mother, **Meymuna Shifa Muksin**,

who, despite being married at a young age and held back by the constraints of her time, never gave up on the power of education. Though denied the opportunity to pursue her own learning, she poured her hopes into mine, teaching me with love, strength, and sacrifice until I reached university. This journey, especially my early pursuit of a PhD, is my way of honoring her dream and making her proud.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AR(2)	Second-order Autoregressive Test
ARDL	Autoregressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
ASEAN	Association of Southeast Asian Nations
ATM	Automated teller machines
BP	Breusch-Pagan
BRICS	Brazil, Russia, India, China and South Africa
CAR	Capital Adequacy Ratio
CBE	Commercial Bank of Ethiopia
CBs	Commercial Banks
CD	Cross-sectional dependence
CFA	Confirmatory Factor Analysis
CRS	Constant Returns to Scale
CSA	Central Statistical Authority
CS-ARDL	Cross-Sectional Autoregressive Distributed Lag
CUSUM	Cumulative SUM
CUSUMSQ	Cumulative SUM square
DCCE	Dynamic common correlated effects
DEA	Data Envelopment Analysis
DFI	Digital FI
DOLS	Dynamic Ordinary Least Squares
ECT	Error-Correction Term
EQA	Equity to Asset
ESS	Ethiopian Socioeconomic Survey
EV	Explained Variance
FE	Fixed Effect
FGLS	Feasible Generalized Least Squares
FI	FI
FMOLS	Fully Modified Ordinary Least Squares
GDP	Gross Domestic Product
GL	General Ledger
GMM	Generalized Method of Moments
HGERA	Home-Grown Economic Reform Agenda
HT	Harris-Tzavalis
I(0)	Stationarity at Level
I(1)	Stationarity at First Difference
IFI	FI Index
KMO	Kaiser-Meyer-Olkin
KYC	Know-Your-Customer
LLC	Levin-Lin-Chu
LMM	Linear Mixed Model
MBIC	Modified Bayesian Information Criterion
MENA	Middle East and North Africa
MSE	Mean Squared Error
NARDL	Nonlinear Autoregressive Distributed Lag
NBE	National Bank of Ethiopia
NDPS	National Digital Payment Strategy
NFIS	National FI Strategy
NIM	Net Interest Margin
NPL	Non-Performing Loans
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square

PCA	Principal Component Analysis
PCSE	Panel-Corrected Standard Error
PL	Profit-Loss
PoS	Point of Sale
PP	Phillips-Perron
PVAR	Panel Vector Autoregression
RE	Random Effect
ROA	Return on Assets
ROE	Return on Equity
SME	Small and Medium Sized Enterprises
TFI	Traditional FI
VAR	Vector Autoregression
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor
WB	World Bank
WEEMU	West African Economic and Monetary Union
χ^2	Chi-Square

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ABSTRACT

Financial inclusion (FI) conceived as increasing the availability, usage, and quality of formal financial services, is essential to sound monetary and fiscal policy. Yet, despite its immense importance, Ethiopia's banking sector remains under explored in the literature on FI's impact across performance, stability, and economic growth. Thus, this dissertation seeks to accomplish four objectives. First, the study constructed a multidimensional FI index, combining ten traditional and five digital indicators employing a two-stage Principal Component Analysis to capture the availability, accessibility and usage of formal financial services from 2015 to 2023. Second, the study examines the impact of traditional and digital dimensions of inclusion on bank performance using a nonlinear two-step system Generalized Method of Moments (GMM) on panel data of 17 commercial banks, uncovering that while traditional FI increase returns, digital channels with high start-up costs depress short-term profitability. Third, employing linear and nonlinear two-step system GMM the study investigates the nexus between FI and bank stability, revealing an inverted-U relationship. The FI improves stability up to a threshold (30.3), beyond which risks from cost overload and adverse selection emerge. Finally, the study employs a Nonlinear ARDL framework on annual macro data from 1991–2023 to analyze asymmetric effects of inclusion on economic growth. The results show a clearly asymmetric relationship, with advantages for economic growth from positive shocks in FI outweighing the disadvantages of negative shocks. In addition, the study used Toda-Yamamoto nonlinear causality tests to confirm bidirectional causation between inclusion and growth. Collectively, these studies demonstrate that a carefully managed through supportive regulation, targeted initiatives, and ongoing data-driven monitoring of FI can significantly strengthen Ethiopia's banking sector (both performance and stability) and catalyze inclusive economic growth.

CHAPTER ONE: GENERAL INTRODUCTION

1.1. Background

Achieving equitable growth presents a challenge that many governments have sought to address (Rewilak, 2013). An inclusive financial system is employed to improve inclusive growth, as it is believed to provide greater benefits to the underserved and marginalized groups within the society (Park & Mercado, 2018; Kebede et al., 2021). In the contemporary market economy, finance plays a natural and significant role (Cristian et al., 2019). The natural role of finance in contemporary market economies is to facilitate the flow of funds and resources between different economic agents, manage risk and uncertainty, and promote wealth creation and allocation (Beck et al., 2000).

The extent to which financial resources are mobilized and distributed to most productive sector depends on the depth and effectiveness of countries financial sector (Levine, 2005). Through financial intermediation, financial sectors have a significant impact on how the overall economy runs (Khaled et al., 2021). It improves the country's economy by acting as intermediaries between savers and investors by creating platforms for a range of economic actors, such as the government, investors, consumers, sellers, and employees, as well as by enabling deposits, loans, capital, and currency exchange for cross-border transactions (Bwigane, 2013). According to Dabla-Norris et al. (2015), a shallow and narrow financial system can create obstacles for achieving macro-financial stability, managing economic volatility, and promoting inclusive growth. Banks and other financial institutions are the main means of mobilizing resources in developing economies, where capital markets typically less developed (Zhuang et al., 2009). In addition to financial intermediation, they also facilitate commerce, enhance policy transmission, and foster resilience against external shocks (Khan, 2011; Sethy & Goyari, 2022; Damane & Ho, 2024).

The financial sector can be broadly discussed considering two aspects; financial development and FI (Lenka, 2021). Even if there is no clear cut distinction between the two terms, scholars conceives financial development as the implementation of practices and the establishment of institutions that aim to address information imbalances, promote market inclusivity, stimulate competition, foster international capital flows and reduce transaction costs within a financial system (Hartmann et al., 2007; Ibrahim & Alagidede 2017; Lenka, 2021; Ifediora et al., 2022). While both concepts are intertwined (FI being a determinant of development), it's important to note that a country may achieve a certain level of financial development while still having a

considerable portion of its population excluded from formal banking systems (Lenka, 2021; Sarma, 2008). Both aspects (i.e. development with FI and development without FI) contribute to growth in varying degrees (Chauvet & Jacolin 2015; Li & Wong 2018; Lenka, 2021). However, Lenka (2021) claims that a country characterized by FI may also exhibit financial development.

The main objective of FI is to provide individuals who are unbanked or underserved with affordable, transparent and reliable financial services that bring about wide-ranging economic benefits (Sarma, 2015; Siddik et al., 2019; Ifediora et al., 2022). Several definitions of FI have been proposed in the literature, with no clear consensus (Chinoda et al., 2019; Nguyen, 2020). Most studies point out credit, savings, payments, and insurance when referring to financial services (Camara & Tuesta, 2014; Ghosh & Ghosh, 2014), but in a broader context, it further refers to service quality, access to facilities, and digital technology (Ozili, 2018). FI is a multidimensional concept that is defined as the availability, accessibility, and use of financial services by all economic stakeholders, with a focus on small businesses, those who are poor and disadvantaged (Sarma & Pais, 2011). Andrianaivo & Kpodar, (2011), Koker & Jentzsch, (2013) and Sarma, (2008) considers FI as a provision of adequate, timely, affordable, and sustainable formal financial services to the most vulnerable members of society.

Conversely, financial exclusion, which is the opposite of FI, is the inability of marginalized communities to access formal financial services (Sinclair, 2001; Cruz-García et al., 2021). Geographic remoteness, low income, poor infrastructure, digital exclusion, and low financial literacy are some of the factors that continue to impede equal access to financial systems (Thathsarani et al., 2021; Pazarbasioglu et al., 2020; Asuming et al., 2018; Ajide, 2017; Soumare et al., 2016). Even when services are available, they are often underutilized due to self-exclusion, mistrust, or a lack of awareness, particularly among marginalized populations (Cruz-García et al., 2021). Moreover, financial exclusion is relating with social exclusion (Barboni et al., 2017; Bernheim et al., 2015). Studies shows that social exclusion factors determine both the status of financial vulnerability and the use of banking services (see Bhukta et al., 2023; Dorjnyambuu, 2023; Ozili, 2020; Fernández-Olit et al., 2018; Changwony et al., 2015). Financial exclusion is a major policy concern for many developing countries (Cruz-García et al., 2012).

Financial exclusion is a problem that inclusive finance aims to address (Abubakar et al., 2020; Zhang et al., 2024). A significant amount of scholarly work exists regarding the concepts of FI and exclusion, encompassing both practical applications and theoretical frameworks. These studies are valuable, especially because they highlight the unique requirements of marginalized groups and the reasons of financial exclusion associated with societal shifts (Fernández-Olit et al., 2019). Over the two decades, FI has drawn more attention from scholars and decision-makers as a possible economic advantage (Barajas et al., 2021). This is evidenced by the growing interest in the subject among academicians, fueled by compelling arguments for its far-reaching impacts. FI piquing a curiosity in policy circles for the following reasons;

First, high levels of FI complement with other development policy goals. For instance, FI allows for efficient transmission of monetary policy through formal channels, leading to better inflation control and financial stability. Research by Mbutor and Uba (2013) on the nexus of monetary policy and FI show that the effectiveness of monetary policy has a causal relationship with FI, inferring that increased FI will improve the efficacy of monetary policy which helps stabilize the macro economy. FI allows the expansion of monetary policy and helps policymakers forecast inflation better. Dienillah et al. (2018), Morgan & Pontines (2014), Neaime & Gaysset (2018), provides a positive linkage of financial stability and FI. Various empirical findings such as (Elsayed 2020; Vo et al., 2021) suggest that strengthening FI will contribute to financial stability.

Second, FI is essential to reducing illegal activities like tax evasion and money laundering that occurs in the informal economy. Financial illicit activities are more likely to go undetected when individuals and businesses operate outside of the formal financial system since are more difficult to maintain track of on (Shehu, 2012). Strong anti-money laundering (AML) measures are necessary because of the vulnerability brought on by illicit financing. Research shows that expanding FI can actually strengthen AML efforts by bringing more people into traceable, regulated financial systems (Koker & Jentzsch, 2013; Didenko et al., 2022; Xu & Yang, 2023; Ajide, 2020). In developing countries, where exclusion is most severe, the widespread use of cash and informal service providers often leaves financial flows difficult to regulate (Hassan, 2024). Shehu (2012) argues that limited access to formal banking channels and the dominance of informal mechanisms present serious obstacles to transaction transparency. However, when individuals gain access to formal financial tools are more likely to move away from untraceable cash transactions and adopt safer payment systems (Demirgüç-Kunt & Klapper, 2012).

Moreover, a well-regulated financial ecosystem can protect consumers from fraud and exploitation, encouraging more actors in the shadow economy to formalize their operations. As Izaguirre (2020) claims, promoting responsible finance and consumer protection is key to building trust in mobile financial services.

Thirdly, FI guarantees fair access to formal financial services for all societal members, especially those underserved such as women, rural populations, and micro-entrepreneurs (Zulfiqar et al., 2016). Ozili (2018) describes it as providing equal access to essential financial services for everyone, regardless of gender, economic status, or nationality. The goal is to integrate the poor and marginalized into the formal economy through sustainable financial services, aiding in poverty reduction and economic growth. Its linkage to social inclusion (Maity, 2023), poverty alleviation (Neaime & Gaysset, 2018), and socio-economic progress (Sarma & Pais, 2011) underscore its importance for countries in Africa and beyond. FI boosts the income of the poor by enabling funding for new businesses (Kara et al., 2021), offering insurance that allows for greater risk-taking (Cole et al., 2013; Karlan et al., 2016), and improving job prospects, particularly for women (Cabeza-García et al., 2019).

However, within emerging economies, the drive for FI poses distinct challenges alongside considerable opportunities (Del Sarto & Ozili, 2025). These emerging economies often grapple with underdeveloped financial infrastructure, high levels of informality, and significant disparities in access to financial services. But the potential impact of expanding FI in these contexts is substantial, offering a pathway to greater economic stability and improved livelihoods for millions (Fitri et al., .2025). Ethiopia, as a developing nation, has placed considerable emphasis on FI as a central pillar of its national development strategies and its broader Homegrown Economic Reform Agenda (HGERA). The government acknowledges that broadening access to and usage of financial services is crucial for fostering inclusive growth and achieving its ambitious economic development goals (Yonis et al., 2025). This commitment is further underscored by Ethiopia's adoption of FI as a key component in its financial system development (Mossie, 2022).

Specifically, the Ethiopian government developed the first National FI Strategy (NFIS) in 2015, acknowledging the multidimensional significance of FI. Adults who were financially included (adults owns an account) rose from 22% in 2014 to 45% in 2020 (NFIS, 2021). And also the gender gap in account ownership narrowed from 11 percentage points in 2011 to 7 percentage points in 2017 (Demirgüç-Kunt et al., 2018). Starting from 2021 to 2025, the

Ethiopian government initiated the second NFIS, based on the rationale of growing economic, social, and technological prospects. The revised NFIS (2021–2025) set a target to raise the percentage of adults who own an account from 46% to 70% in 2025. The expansion of Islamic finance, agent and mobile banking, digital innovation (such as the launch of Telebirr and the licensing of M-Pesa), and regulatory reforms all support these efforts.

The Ethiopian government's efforts to promote FI have been successful in reaching many people who were previously excluded from the formal financial system. However, based on National Bank of Ethiopia's financial stability report (NBE-FSR, 2024), 99.8% of loan and advances are concentrated in urban areas, the top 10 borrowers own 23.5% of all loans and advances, and over 60% of adults still do not have access to formal financial services. Compared to its East African neighbors, Ethiopia still exhibits lower levels of formal FI, with a substantial portion of the adult population yet to gain access to formal financial institutions¹. This underscores the need for continued research to measure, monitor, and enhance FI in ways that are equitable, resilient, and context-specific. To that end, the area with its crucial importance but scarcity in literature² motivated the researcher. Specifically, this article/paper based dissertation delves into the linkages between FI and its far-reaching impact on financial banking performance, financial banking stability and economic growth of Ethiopia³.

1.2. Problem statement

As Sarma (2016) claimed measuring FI is the first step to raise awareness about it. The creation of a comprehensive FI index is vital for the targeted evaluation and monitoring of FI efforts, particularly to support evidence-based policymaking and the formulation of strategies to bridge existing gaps. Additionally, developing such an index facilitates the identification of specific dimensions and indicators of FI that necessitate further attention and improvement. Most studies (such as Alemu, 2016; Mossie, 2022; Dagnachew & Mawugatie, 2022; Hussen & Mohamed, 2023; Desalegn & Yemataw, 2017; Lakew & Azadi, 2020; Adera & Abdisa, 2023; Giday, 2023; Oshora et al., 2021; Rao & Baza, 2017; Abdu & Adem, 2021; Teka et al., 2020;

¹ Global System for Mobile Association (GSMA) (2023) report reveals that Ethiopia's FI score shows remains significantly lower than in other East African countries. As of 2022, Kenya scored (79%), Rwanda (77%), Uganda (66%), Tanzania (52%) and Ethiopia scored (46%). https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/wp-content/uploads/2023/06/GSMA_Mobile-money-in-Ethiopia-Advancing-financial-inclusion-and-driving-growth-report.pdf

² The gap has been tailored to specific topic & discussed in detail in subsequent chapters.

³ Before looking the impact of FI on the stated variables, the researcher developed a composite FI index.

Timbula et al., 2019; Mudessir et al., 2024; Fielding & Regasa, 2024; Hundie & Tulu, 2023; Ruey, 2024; Denegetu, 2024; Menza et al., 2024) focuses on different aspects of FI but failed to construct a multidimensional composite index. While most of the existing international empirical literature across various countries has relied on traditional indicators (e.g., Ghosh, 2011; Adu et al., 2013; Sharma, 2016; Puatwoe & Piabuo, 2017; Kim et al., 2018; Sethi & Acharya, 2018; Azimi, 2022; Agya et al., 2022; Karim et al., 2022; Pal & Bandyopadhyay, 2022; Amaira, 2023; Jima & Makoni, 2023; Hussain et al., 2024; Odame et al., 2024; Boachie & Adu-Darko, 2024), some researchers have also employed digital metrics (e.g., Ahmad et al., 2021; Banna & Alam, 2021; Shen et al., 2021; Demir et al., 2022; Antwi & Kong, 2023; Chinoda & Kapingura, 2023; Du et al., 2023; Xi & Wang, 2023) for measuring FI, leading to a limited understanding of the concept. Mao et al. (2023) and Ismael & Ali, (2021), argue digital and traditional FI as complementary. To provide a comprehensive understanding of FI and to fill the existing gap in the literature, this study combines ten traditional indicators with five digital indicators using a two-stage Principal Component Analysis (PCA).

Financial institutions are crucial for the economy, with a strong banking system being vital for sustainable growth. Banks facilitate financial intermediation by converting deposits into investments, making them key capital sources (Paolucci, 2016; Jajah et al., 2022). The objectives of bank management are to avoid risks, increase earnings, and adhere to rules (Kumar, 2014). Research shows that macroeconomic factors like inflation, interest rates, GDP growth, and tax rates, as well as microeconomic characteristics like balance sheets and income statements, have an impact on bank profitability (Yüksel et al., 2018). The effect of FI on the profitability of Ethiopia's banking industry is not well researched. The factors that influence bank profitability were the subject of several studies conducted in Ethiopia (e.g., Tura, 2023; Mohammed, 2023; Bushashe, 2023; Isayas, 2022; Teshome et al., 2018; Tibebe & Gujral, 2022; Muhammed et al., 2024; Tibebe, 2020; Biru, 2021; Yusuf & Shikur, 2023; Shifa et al., 2019; Merin, 2016; Ayalew, 2021; Mengstie et al., 2024; Addisu et al., 2023; Berhe, 2019). They overlooked the impact FI on bank profitability. Therefore, a nonlinear two-step system robust system generalized method of moments (GMM) technique is used in this study to investigate the asymmetric impact of FI on bank profitability. In addition, the study applies Dumitrescu & Hurlin (2012) and Juodis et al. (2021) causality test to examine the direction of the causation.

There are two contrasting views about the inclusion of previously excluded population in relation to banking sector stability. The first group of scholars argues that improving the flow

of funds, strengthening the transmission of monetary policy, decreasing reliance on informal financial systems, smoothing consumption, increasing liquidity buffers, and lowering the risk of loan concentration are all benefits of including previously excluded segments of society (Khan, 2011; Ahamed & Mallick, 2019; Vo et al., 2020; Sethy & Goyari, 2022; Nguyen & Du, 2022; Wang & Luo, 2022; Chinoda & Kapingura, 2023; Damane & Ho, 2024; Oanh, 2024). However, the second group of scholars' claims that as FI grows, moral hazards and adverse selection will increase, contributing to inefficiencies and credit risk (Khan, 2011; Le et al., 2019; Barik & Pradhan, 2021; Damrah et al., 2023, Umar & Akhtar, 2024). While these debates exist, there is a significant lack of empirical research on how FI affects bank stability in developing countries (Chinoda & Kapingura, 2023; Koudalo & Toure, 2023; Jungo et al., 2022). Ignoring this relationship could have serious repercussions, such as continued financial exclusion or financial instability (Danisman & Tarazi, 2020; Cihák et al., 2016). Although previous studies have examined the stability of the financial sector in Ethiopia (Filatie & Sharma, 2024; Kebede et al., 2024; Fisseha, 2023; Yitayaw et al., 2023; Dress, 2022; Abdu, 2021; Isayas & McMillan, 2021; Aman, 2019; Meher & Getaneh, 2019; Zelig & Wassie, 2019; Meressa, 2018), a critical gap remains in understanding the specific effect of FI on that stability. This study, therefore, aims to fill this critical gap by empirically investigating the effects of FI on bank stability within the Ethiopian context. By employing linear and non-linear two-step robust system GMM to examine the effects of FI, this work contributes to the body of existing literature. The study also explores how macro-prudential regulation affects the relationship between FI and bank stability and applies the tests of Dumitrescu & Hurlin (2012) and Juodis et al. (2021) to examine causality.

Recently, FI recognized as a means of economic growth. Most of empirical research indicates that FI positively increases economic growth (e.g., Levine, 2005; Kim et al., 2018; Ahmad et al., 2021; Van et al., 2021; Ugwuanyi et al., 2022; Jima & Makoni, 2023). Nevertheless, contemporary studies have started to challenge the traditional view that the relationship between finance and growth is linear (Qamruzzaman & Jianguo, 2018; Nandelenga & Oduor, 2020; Lee et al., 2021). Chen et al. (2020) argue that progress in financial development can be pro-cyclical, with economic downturns adversely affecting financial systems during periods of recession. Furthermore, according to Udeagha and Breitenbach (2023) and Mengesha & Berde (2023), a positive shock may have a larger long-term impact, but a negative shock (a decline in FI) may have a greater short-term impact. Siddiki and Bala-Keffi (2024) note that the extent of the positive effects of FI differs across various subcategories based on factors such as income

level, global, regional, and economic fragility. Asymmetry occurs when a shock has an uneven effect on a nation's sectors and economy (Wen et al., 2021). As Nandelenga & Oduor, (2020) suggested, employing an asymmetric approach to analyze the impact of FI on economic growth can reveal non-linear effects, enabling policymakers to formulate more targeted strategies. Further, even while the theoretical nascent suggests varying country elements such policy initiatives, economic endowment, and stages of development (Nandelenga & Oduor, 2020), the existing econometric methodologies used a linear approach (e.g., Ghosh, 2011; Adu et al., 2013; Kyophilavong et al., 2016; Sharma, 2016; Ofori-Abebrese et al., 2017; Puatwoe & Piabuo, 2017; Alexiou et al., 2018; Sethi & Acharya, 2018; Le et al., 2019; Erlando et al., 2020; Marcelin et al., 2021; Ahmad et al., 2021; Shen et al., 2021; Azimi, 2022; Ugwuanyi et al., 2022; Pal & Bandyopadhyay, 2022; Du et al., 2023; Jima & Makoni, 2023; Hussain et al., 2024; Odame et al., 2024; Pal et al., 2025). Consequently, this study investigates the impact of FI on the economic growth in Ethiopia using Nonlinear Autoregressive Distributed Lag (NARDL) model and the Toda-Yamamoto (1995) causality test to ascertain the direction of causation.

To generalize, this dissertation adopts an article writing format to expound upon these issues comprehensively. Each specific topic is structured with its own background, problem statement, objectives, hypothesis, literature review, and methodological approach. However, following Grant's (2011) concept of the "logic of connectivity," the researcher will conduct a synthesis. The last integrated discussion chapter offers an opportunity to synthesize, integrate, and elevate the discourse to a higher level of abstraction, demonstrating coherence among all articles presented in the thesis.

1.3. Objective of the study

The general objective of this study was examining the impact of FI on banking financial performance, banking financial stability and economic growth of Ethiopia.

Specifically, the specific objective of the study was

- ✓ Develop a multidimensional composite FI index
- ✓ Examine the impact of FI on banking financial performance⁴

⁴ As a measure of bank performance, bank profitability reflects the way banks are managed in their particular operating environment (Tan, 2014). Hence, this study develops a performance PCA driven index using ROA, ROE, and NIM as a banking sector performance indicator

- ✓ Examine the impact of FI on banking financial stability⁵
- ✓ Examine the impact of FI on economic growth of Ethiopia

1.4. Hypothesis

The main hypothesis of the study presented as:

- I. HO: Traditional FI has no positive and significant impact on bank financial performance
HO: Digital FI has no positive and significant impact on bank financial performance
- II. HO: FI has no positive and significant impact on bank financial stability
HO: There is no inverted U-shaped relationship between FI and bank stability
HO: The interaction between capital adequacy and FI can't improve bank stability
- III. HO: FI has symmetric impact on economic growth
HO: There exists no causality between FI and economic growth

1.5. Significance of the study

This dissertation carries substantial significance for the following two compelling reasons. First, conducting a study is to solve societal and environmental problems, improve policy and practices, and bring new practice. The international community is increasingly acknowledging FI as a fundamental element of sustainable economic development and an essential mechanism for alleviating poverty (Mossie, 2022). The ability to access and utilize affordable financial products and services empowers both individuals and enterprises, allowing them to mitigate risks, accumulate assets, and invest in opportunities that promote economic advancement. This acknowledgment is reflected in the United Nations' Sustainable Development Goals (SDGs), where FI serves as a driving force for achieving various objectives aimed at poverty reduction, advancing gender equality, and encouraging inclusive economic growth (Kebede, 2022). Indeed, FI is a powerful tool for reducing poverty and improving financial security for marginalized communities globally. The increasing consensus among researchers and development professionals highlights the critical importance of FI in fostering human development across different nations (Mani et al, 2024). Hence, this thesis seeks to find and investigate paths for emerging countries (specifically the case of Ethiopia) to allocate different initiatives for development, focusing on the role of fiscal policy in strengthening development finance. To do so, the researcher attempts to discover how Ethiopian government should

⁵ To avoid self-plagiarisms, the researcher used 7 traditional and 4 digital indicators from the developed index

manage fiscal policy in order to promote macroeconomic stability specifically managing the impact of FI on banking financial performance, banking financial stability and economic growth properly.

This dissertation contributes to both academic scholarship and economic policy by providing a contextual empirical analysis. A review of the existing empirical literature reveals a notable dichotomy in findings. One school of thought posits a positive causal link between FI and several key economic indicators. Specifically, this body of research suggests that FI enhances bank profitability (Saidi et al., 2025; Jajah et al., 2022; Kumar et al., 2021; Vo & Nguyen, 2021), promotes bank stability (Koudalo & Toure, 2023; Oanh et al., 2023; Nguyen & Du, 2022; Vo et al., 2020; Ahamed & Mallick, 2019; Le et al., 2019; Neaime & Gaysset, 2018; Morgan & Pontines, 2014), and fosters overall economic growth (Jima & Makoni, 2023; Ahmad et al., 2021; Nizam et al., 2020; Inoue & Hamori, 2019; Kim et al., 2018; Sethi & Acharya, 2018). Conversely, an alternative perspective presents an opposite evidence, indicating that FI may have a detrimental effect on these same variables. Studies aligned with this view have documented a negative association with bank profitability (Yang & Masron, 2023; Al-Eitan et al., 2022; Yakubu & Musah, 2022), bank stability (Damrah et al., 2023; Oanh et al., 2023; Barik & Pradhan, 2021; Amatus & Alireza, 2015), and economic growth (Odame et al., 2024; Van Wyk & Kapingura, 2021; Seven & Yetkiner, 2016; Nkwede, 2015). This inconsistency in empirical findings underscores a significant gap in the literature and highlights the need for further investigation. A primary limitation of much of the extant research is its reliance on cross-country analyses, which may not adequately capture the unique socio-economic and institutional characteristics of individual nations (e.g., Talbi & Sebai, 2025; Damane & Ho, 2024; Sebai & Talbi, 2024; Chinoda & Kapingura, 2023; Koudalo & Toure, 2023; Jima & Makoni, 2023; Jungo et al., 2022; Malik et al., 2022; Nguyen & Du, 2022; Sethy & Goyari, 2022; Wang & Luo, 2022; Kebede et al., 2021; Anarfo et al., 2020; Pham & Doan, 2020; Vo et al., 2020; Le et al., 2019; Neaime & Gaysset, 2018; Morgan & Pontines, 2017). The present study addresses this lacuna by focusing exclusively on the Ethiopian context, thereby offering a country-specific empirical examination of the channels through which FI influences bank profitability, bank stability, and economic growth.

Moreover, although the few studies that have researched the impact of FI along these two strands offer insightful results, important shortcomings exist. The significance of this study is articulated through the specific types of new knowledge it generates and their subsequent implications:

First, this study generates a methodological contribution through the construction of a multidimensional FI index for Ethiopia. Unlike aggregate national-level metrics, the index developed in Chapter Two disaggregates the contributions of different-sized commercial banks, providing a nuanced dashboard for measurement. This granular data offers academic significance by advancing the methodological literature on measuring FI, as Sarma (2008) suggested measuring FI the first step for comprehending the subsequent initiatives, demonstrating an application that captures the heterogeneity of a banking sector. For policy implications, this index provides the National Bank of Ethiopia (NBE) and other stakeholders with a precise diagnostic tool. It enables evidence-based monitoring of progress, helps identify which bank categories are lagging in outreach, and allows for the targeted evaluation of specific policies, moving beyond simplistic targets like the number of accounts opened.

Second, this research produces critical empirical evidence on the differentiated impact of FI channels. Chapter Three's investigation into the distinct effects of traditional versus digital FI on bank profitability generates a key insight: that these channels are not substitutable but have unique implications for financial institutions' bottom lines. The academic significance here lies in challenging the homogenous treatment of "FI" in extant literature and answering calls for a more disaggregated analysis (Ozili, 2018). For policy and practice, this finding provides crucial guidance for bank executives and regulators. It suggests that commercial banks must strategically optimize their service delivery models, and that policymakers should craft distinct incentives for traditional branch-based expansion and digital finance adoption to ensure the sector's commercial viability.

Third, and perhaps most critically, the study identifies fundamental non-linearities and asymmetries in the FI relationship. Chapter Four's revelation of a non-linear (inverted U-shaped) relationship between inclusion and bank stability is a pivotal finding. It provides empirical validation to theoretical concerns that beyond a certain threshold, rapid inclusion may exacerbate risks through information asymmetries and adverse selection (Damane & Ho, 2024; Sethy & Goyari, 2022; Khan, 2011). The academic significance is substantial, as it moves the debate from a simple "does it help or hurt?" question to a more sophisticated "under what conditions?" inquiry, contributing to the literature on the stability of emerging financial systems (Čihák et al., 2016). The policy implication for the NBE is direct and actionable: it underscores the imperative of balancing expansion with parallel investments in robust prudential regulation, credit information bureaus, and supervisory capacity to mitigate potential systemic risks as inclusion deepens.

Furthermore, Chapter Five's discovery of an asymmetric relationship between FI and economic growth offers profound academic significance. It contextualizes and tests the theoretical pathways of finance-growth nexus literature (Levine, 2005) within a specific low-income economy. For policy implications, this finding warns against expecting immediate growth dividends from superficial inclusion. It provides a rigorous evidence base for Ethiopian policymakers to argue for patient, consistent, and long-term investments in financial infrastructure and literacy, justifying them as essential pre-requisites for unlocking inclusive growth.

1.6. Scope of the study

One possible explanation for the lack of attention paid to the role of financial systems in the literature on FI is the wide range of perspectives regarding the various approaches used to categorize different types of financial systems (Seman, 2016). Historians, economists, and policymakers have studied the relative advantages of market-based (equity, debt, security market) vs bank-based financial systems in their analysis of financial structure and development (Beck, 2000). When it comes to solving the current financial issues, there is a disagreement between market-based and bank-based financial systems. Because of their strong customer relationships, banks typically engage in financial intermediation and assume risks on their own balance sheet. In contrast, markets function as platform for the pricing, distribution, and trading of debt and equity securities, transferring resources straight from savers to borrowers (Bats & Houben, 2020). However, market-based systems might not be as good as bank-based systems at distributing funds to start-ups and creative businesses (Beck et al., 2000).

Since Ethiopia's stock market is still in its beginning stages, this study focuses on the banking sector. In the financial sector, as of June 30, 2022, all 30 commercial banks accounted for 80.5% of equity, 98.3% of deposits, 94.6% of credit, and 92.3% of total assets, according to statistics compiled from the Development Bank of Ethiopia (DBE) and the NBE (2022). In contrast, microfinance institutions only make up 2.4% of assets, 1.7% of deposits, 2.1% of credit, and 5.9% of equity. The current study focuses on commercial banks⁶ that operate in the Ethiopian market. For chapter two to four the research draws upon annual data spanning from

⁶ Due to the availability of data and the newness of all other commercial banks, this study focuses on all (17) commercial banks operating in Ethiopian market since 2015 (sampled banks listed at Table A1).

2015 to 2023, sourced from the audited reports published by each bank, the NBE's audited reports and World Bank database.

The study period from 2015 to 2023 was deliberately selected to capture a phase of profound regulatory, institutional, and accounting transformation in the Ethiopian banking sector. The year 2015 represents a critical inflection point, as it marked the launch of Ethiopia's first National Financial Inclusion (FI) Strategy, which sought to expand access to formal financial services, particularly among previously unbanked populations. This policy shift signaled a broader restructuring of the financial system toward inclusivity and modernization. Concurrently, the banking industry began aligning with international conventions following Proclamation No. 847/2014, which introduced standardized measurement of Financial Soundness Indicators (FSIs) in line with International Financial Reporting Standards (IFRS). Although Ethiopia had earlier adopted only the most basic element of Basel I, namely minimum capital requirements, introduced during the partial liberalization of the mid-1990s (Weis, 2020), these reforms significantly reshaped the regulatory environment governing bank operations and risk management. Nonetheless, owing to a sustained preference for political control over the financial sector, Ethiopia refrained from implementing subsequent Basel accords (Weis, 2020).

Under the previous accounting regime (IAS 39), Ethiopian banks applied an incurred loss model, whereby credit impairments were recognized only after objective evidence of a loss event, such as borrower default, had occurred. This backward-looking approach was widely criticized by banking regulators and scholars for delaying loss recognition and encouraging excessive risk-taking in bank lending (Cohen & Edwards, 2017; Kyiu & Tawiah, 2025). The global financial crisis further exposed the limitations of IAS 39, demonstrating that impairment recognition was often "too little, too late." In response, IFRS 9 replaced IAS 39 with a forward-looking Expected Credit Loss (ECL) framework, requiring banks to recognize credit losses from loan origination based on expectations of future defaults rather than realized losses (Bank & Eder, 2021; Stern, 2024). IFRS 9 mandates continuous reassessment of credit risk using information on past events, current conditions, and forward-looking macroeconomic forecasts (IASB, 2014; Liang, 2019). Consequently, provisioning became more timely and sensitive to deteriorating credit conditions.

Of particular significance within the Ethiopian context is the adoption of IFRS 9 by commercial banks in July 2018, which substantially improved the valuation of financial instruments, asset classification, and loan-loss provisioning practices. This reform was closely aligned with the NBE Directive on Asset Classification and Provisioning (No. SBB/69/2018), reinforcing regulatory consistency and supervisory oversight (IMF, 2020). Together, these developments enhanced the credibility and international comparability of Ethiopian banks' FSIs. In addition to capital adequacy and provisioning reforms, the regulatory framework during the study period was further strengthened by the NBE Liquidity Requirements Directive (No. SBB/57/2014), which obliges commercial banks to maintain liquid assets of at least 15 percent of net current liabilities. This directive underscores the increasing emphasis on liquidity risk management and complements broader prudential reforms implemented throughout the study period.

Furthermore, to address the research objective of chapter five, this study incorporates historical data from the overall banking industry spanning from 1991 to 2023. By tracing the historical trend, the study can analyze assess the effectiveness of current strategies and provide recommendation on the short and the long-term impact of FI on economic growth of Ethiopia.

1.7. Theoretical framework

1.7.1. A critical view of FI

FI is widely promoted as providing all individuals and businesses access to and use of affordable financial products (payments, savings, credit, insurance, etc.) that meet their needs and are delivered responsibly (Mader, 2018; Sarma & Pais, 2011; Sarma, 2008). It is conceived as a catalyst for inclusive growth, job creation, women's economic empowerment, and poverty alleviation (Mishra et al., 2024). The consensus among international bodies like the International Monetary Fund (IMF), World Bank (WB), Alliance for FI (AFI), and Organisation for Economic Co-operation and Development (OECD) is that genuine FI is a multidimensional construct, going beyond mere access to also encompass a service's affordability, timely and regular usage, and its ability to meet clients' needs and mitigate shocks in a dignified manner (WB, 2025; OECD, 2023; AFI, 2013). Different FI definitions emphasize access versus usage, the types of services provided, who the providers are, and whether services are affordable and fit clients' needs (Pesqué-Cela et al., 2021). A critical examination necessitates a clear distinction between financial expansion and genuine FI. While the financial expansion typically refers to the proliferation of financial infrastructure and services, evidenced by metrics such as an increased number of bank accounts, ATM users, or mobile money registrations, it primarily reflects the supply-side reach or availability of financial systems. This

growth, while a foundational step, risks being a superficial measure if it fails to translate into meaningful engagement with appropriate and affordable services for the previously underserved. Beyond mere access, conversely, FI is multidimensional paradigm (Bukari et al., 2024; Barajas et al., 2021; Camara & Tuesta, 2017; Sarma, 2008) and it is not underpinned by a single universal concept. In practice, FI encompasses a wide range of questions like what financial services should be included, to whom they should be delivered, by whom, and through what mechanisms, reflecting its multifaceted nature (Ha et al., 2025; Pesqué-Cela et al., 2021). It implies that individuals are not just offered an account, but are empowered to utilize a diverse financial tools including savings, credit, payments, and insurance in a way that practically enhances their economic well-being, builds resilience, and mitigates financial shocks (Sarma, 2008). Specifically, the WB's definition stresses both access to and use of financial services in a responsible way, while Sarma (2008) defines FI in terms of the ease of access, availability and usage of the formal financial system for all groups. Cámara and Tuesta (2014) build on this by modeling FI with three core dimensions such as usage, barriers, and access to the financial system. Thus, FI understood as a multidimensional construct whose constituent dimensions, ranging from access, usage and affordability, should be carefully disentangled to evaluate their implications for broader development outcomes (Sharma & Changkakati, 2023).

At the same time, critics caution that the enthusiastic mainstream narrative may be oversimplified. Some scholars argue that the FI “movement” often takes for granted that expanding access will automatically yield development and poverty alleviation. For instance, Mader (2018) shows that high expectations of FI are underpinned by shaky logic and scant proof as the questions “Does FI really promote development?”, “Do poor people benefit meaningfully?”, and “Is it good business?” are rarely critically examined. Moreover, the current FI agenda is deeply entwined with new digital technologies and profit motives. The so-called fintech–philanthropy–development initiative uses data-driven platforms to “map, expand and monetise digital footprints” of low-income users (Gabor & Brooks, 2016) while coalitions of payment-card companies and tech firms push a “cashless” agenda to capitalize on transaction fees and user data (Mader, 2016). Critics argue this can increase indebtedness (Mader, 2018; Krumer-Nevo et al., 2016) and commodification of poor households (the very social costs FI was meant to ameliorate) rather than delivering real empowerment (Mader, 2018). Moreover, applying the mainstream model to developing countries risks neglecting structural constraints, such as saturated informal markets and limited human capital, which undermine productivity gains (Reis, 2021; Bateman & Chang, 2012; Taylor, 2012). Adamo et

al., (2024), Mader (2018), Zhang & Valle-Sison (2014) underlines that FI is not a neutral policy goal but a contested paradigm whose developmental impact should be critically evaluated within specific contexts.

1.7.2. Stabilizing and destabilizing effects of FI

The theoretical discourse surrounding FI has increasingly interrelated with core banking and economic development paradigms. Across the theoretical underpinning examined in Chapters three to five of this study, which assess the impacts of FI on banking performance, stability, and economic growth, two dominant strands emerge: one emphasizing its stabilizing potential, and the other cautioning against its destabilizing implications. This synthesis offers an integrated account of these perspectives, as derived from financial intermediation, credit creation, portfolio theory, and macroeconomic finance-growth theories.

1.7.2.1. Stabilizing perspectives of FI

From a stabilizing standpoint, several theoretical foundations highlight how FI enhances banking sector resilience and economic development. Financial intermediation theory (Scholtens & Wensveen, 2003; Diamond, 1984) serves as a cornerstone in this regard, positing that banks play a vital role in channeling funds between savers and borrowers, thereby improving allocative efficiency and fostering economic transformation. Schumpeter's (1911) seminal work emphasized that well-functioning financial intermediaries are essential to economic development, particularly in emerging economies characterized by financial exclusion (Maity & Sahu, 2020).

In alignment with this view, the fractional reserve theory further posits that increased FI expands deposit bases, enabling multiple rounds of credit expansion and stimulating macroeconomic activity (Werner, 2016; Sapriza & Temesvary, 2024). This deposit-driven liquidity enhancement not only reinforces banks' lending capacity but also strengthens monetary policy transmission mechanisms (Damane & Ho, 2024). Similarly, the credit creation theory (Werner, 2014) underscores banks' active role in generating credit independent of prior savings, suggesting that FI initiatives facilitate new credit creation, which, if effectively managed, can boost profitability and support inclusive economic growth.

Complementing these views, Markowitz's (1952) portfolio theory introduces the risk-diversification logic underpinning FI. By mobilizing savings from previously excluded populations, banks can diversify their loan portfolios and mitigate exposure to sectoral or borrower-specific risks (Khan, 2011). Lending to small and medium-sized enterprises (SMEs)

and low-income households, when accompanied by robust risk assessment practices, can lower non-performing loans and enhance overall banking stability (Damane & Ho, 2024). The finance-growth literature also supports this stabilizing view, particularly through the supply-leading hypothesis. It posits that a well-developed financial sector, supported by inclusive access to credit and financial services, drives long-term growth and institutional development (Schumpeter, 1911; Pagano, 1993; Ahmad et al., 2021; Jima & Makoni, 2023).

The complementarity hypothesis adds further nuance, suggesting that the finance-growth relationship evolves with the level of economic development. Initially, financial systems may lead growth by mobilizing savings and channeling investments, while at later stages, economic expansion feeds into financial sector development (Patrick, 1966; Mlambo, 2024). This dynamic synergy positions FI as both a catalyst and consequence of economic transformation, particularly in economies transitioning from informal to formal financial ecosystems.

1.7.2.1. Destabilizing perspectives of FI

Despite the optimistic tone of these theories, the destabilizing potential of FI is increasingly recognized in the literature. Akerlof's (1970) information asymmetry theory introduces the foundational concern that extending credit to low-income and informationally opaque segments can exacerbate adverse selection and moral hazard. Damane and Ho (2024) and Sethy and Goyari (2022) caution that rapid FI expansion may outpace the capacity of financial institutions to adequately assess borrower risk, particularly when credit assessments and Know Your Customer (KYC) functions are outsourced or weakly enforced. This can lead to elevated default rates, deteriorating asset quality, and reputational risks, thereby undermining financial stability.

Credit creation theory, while highlighting the profitability benefits of new credit generation, also acknowledges the risk of macroeconomic imbalances when credit expansion is unchecked. The global financial crises have demonstrated how excessive lending without prudent oversight can precipitate systemic vulnerabilities (Schularick & Taylor, 2012; Sutherland & Hoeller, 2012). This aligns with Minsky's (1982) financial instability hypothesis, which asserts that prolonged periods of stable growth encouraged by inclusive lending practices may lead to riskier financial behavior and eventual instability. The spillover risks from non-bank financial institutions (NBFIs) into the formal banking sector further exacerbate systemic risk, especially in financially shallow environments (Sarmiento, 2024).

Moreover, the demand-following hypothesis introduces a nuanced critique of premature FI expansion. It posits that financial development should be demand-driven, emerging in response to rising income levels and economic activity (Robinson, 1979; Lee et al., 2021). In contexts where financial services are introduced without a corresponding rise in productive economic activities, the financial sector may struggle to sustain itself, leading to inefficiencies and resource misallocation. The neutrality hypothesis goes further, suggesting that finance and growth may be unrelated or coincidental, arguing that overemphasizing FI without strengthening institutional and structural fundamentals may yield limited developmental returns (Lucas, 1988; Bara et al., 2016; Opoku et al., 2019).

Taken together, these theoretical foundations present FI as a double-edged instrument. On one hand, FI can catalyze banking stability and inclusive growth through improved intermediation, portfolio diversification, credit creation, and deeper financial markets. On the other hand, if misaligned with institutional capacity, regulatory oversight, and economic fundamentals, FI can trigger destabilizing dynamics such as increased credit risk, asymmetric information problems, and systemic vulnerabilities.

1.8. Conceptual framework

A conceptual framework (illustrated in Figure 1) was developed to guide the study and address the main objectives of the research based on synthesized theoretical insights from the literature. The framework centers on four interrelated pillars: (i) the multidimensional nature of FI, (ii) its relationship with banking performance, (iii) its impact on banking stability, and (iv) its interaction with economic growth.

First, the framework treats FI as a multidimensional construct. The concept of FI, as evidenced by (Beck et al., 2007; Sarma, 2008; and Sarma & Pais, 2011), it encompasses several core elements. Specifically, FI is conceptualized as encompassing the availability, access, and usage of financial products and services (Nguyen, 2021; Pesqué-Cela et al., 2021; Demirgüç-Kunt et al., 2017; Allen et al., 2016; Sarma, 2016; Babajide et al., 2015). This multifaceted nature highlights the importance of looking beyond a single metric to gauge the true extent of FI within a population. In the Ethiopian context, several indicators are employed to measure the level of FI. These include the prevalence of account ownership, the extent to which digital financial services are utilized, and the physical accessibility of financial institutions. While account ownership is frequently used as a primary measure⁷, it is increasingly recognized that the actual usage of financial services and the quality of those services are equally critical aspects of FI. A mere increase in the number of accounts opened does not

⁷ In both the GSMA (2023) and NFIS (2021) reports, FI is principally benchmarked by the penetration rate of formal bank accounts among the adult population.

necessarily translate to meaningful FI unless these accounts are actively used and provide tangible benefits to the account holders. To gain a more holistic understanding of FI in Ethiopia, the research has increasingly turned to developing multidimensional composite indices, often employing a two-stage PCA to synthesize fifteen indicators into a single, more informative metric. The research classified these indicators into traditional and digital grand sub categories. From these categories, the study further classified indicators into three key dimensions: availability, access, and usage. Specifically,

Availability dimension measures the physical and digital infrastructure enabling access to financial services providers to deliver services across geographical and demographic segments (Sarma, 2016; Hanivan & Nasrudin, 2019; Nguyen & Du, 2022). It is computed using:

- Traditional availability dimension: Following the work of Beck et al., (2007), this dimension measured by number of bank branches, ATMs, and PoS machines per 100,000 adults (demographic spread) and per 1,000 km² (geographic spread).
- Digital availability dimension: Following Nguyen (2021) and Tram et al. (2023), this dimension computed using number of agent banking outlets per 100,000 adults and per 1,000 km², which reflects the expansion of financial access points in underserved regions.

Accessibility captures the ease with which individuals can access financial services. It reflects not only the availability but also the extent to which financial services reach society (Sarma, 2016; Shah & Mishra, 2018; Nguyen, 2021; Nguyen & Du, 2022). Following Lenka & Barik (2018), Nguyen (2021), and Sahay et al. (2020), this digital accessibility dimension is measured using:

- Number of mobile banking users, internet banking users, and wallet holders per 1,000 adults.

Usage assesses the depth and actual adoption of financial products (Shah & Mishra, 2018; Nguyen & Du, 2022). It considers both the regularity of usage and the diversity of services accessed. This traditional usage dimension is measured through four indicators.

- Considering the work of (Ahamed & Mallick, 2019; Ismael & Ali, 2021), this dissertation measures this traditional usage dimension using deposit accounts and debit card ownership per 1,000 adults. Furthermore, building on the findings of Sarma (2016) and Nguyen (2021), the study also incorporates outstanding deposits and loans as a percentage of GDP, which reflects the integration of formal financial services into the wider economy.

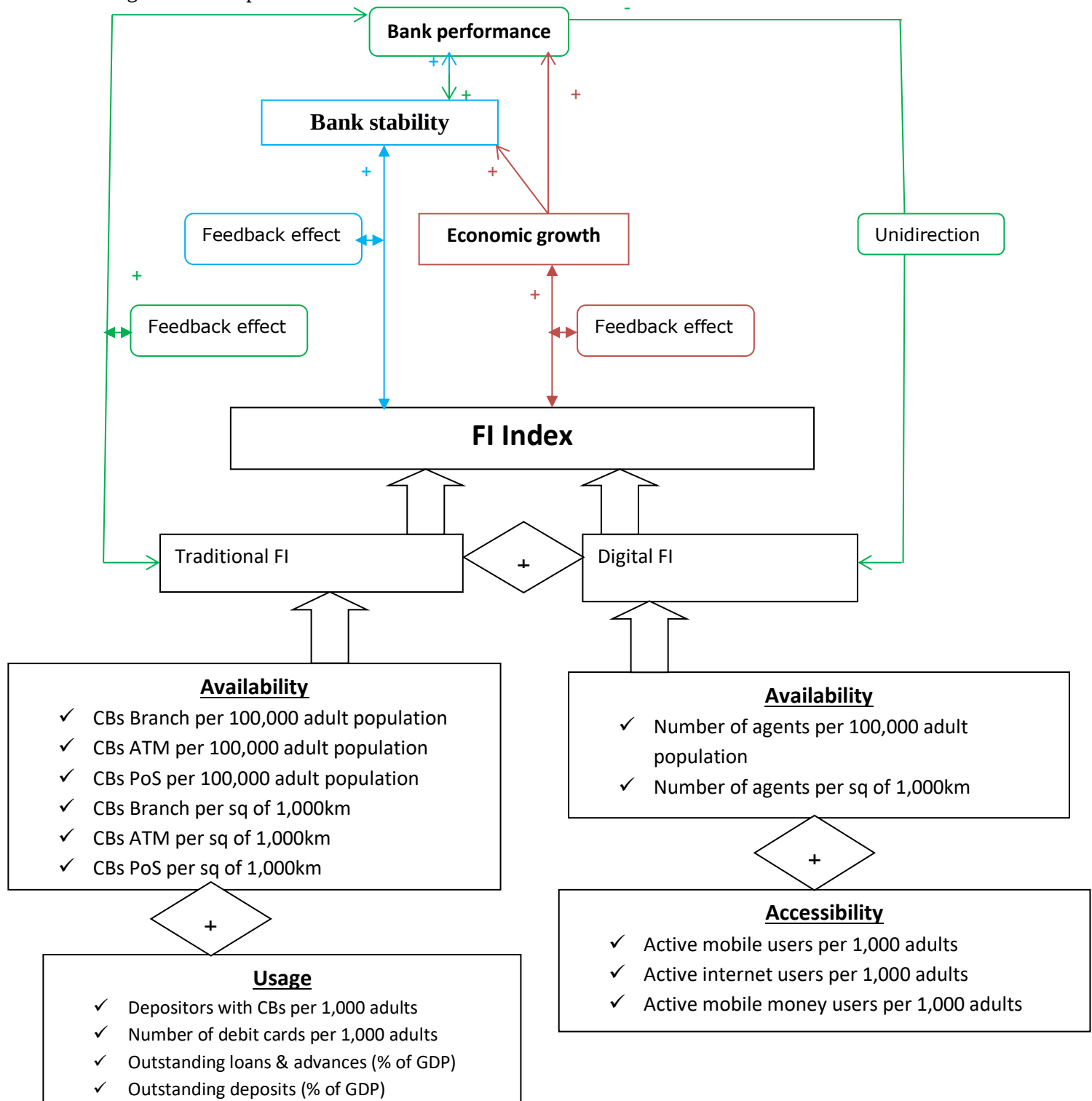
Second, the conceptual framework further illustrates the relationship between FI and banking financial performance. The FI landscape in Ethiopia is currently shaped by the coexistence and interaction of traditional, branch-based financial services and the rapidly evolving digital financial services (DFS) sector. Ethiopia has witnessed a notable increase in its overall FI score, with contributions from both traditional and digital indicators. While traditional aspects hold significant influence in the country's

financial ecosystem, digital finance is increasingly emerging as a promising avenue for bridging the FI gap, offering the potential to reach previously unbanked populations more effectively. Studies like (Mao et al., 2023; Ismael & Ali., 2021) shows that digital FI (DFI) and traditional FI (TFI) function in a complementary manner, each catering to different aspects of individuals' and businesses' financial needs. While DFI is particularly well-suited for facilitating small-scale financial transactions and providing access to microloans, TFI often remains the preferred option for larger capital requirements and more sophisticated financial products (Mao et al., 2023). Ethiopia is indeed experiencing a clear shift towards digital financial channels, evidenced by a substantial surge in the volume and value of digital transactions taking place within the economy. Despite this promising trend, the overall penetration of digital financial services in Ethiopia still lags behind that of some other developing countries (GSMA, 2023). Consequently, this study calls for further examination by distinguishing the effects of traditional versus digital FI on the financial performance of banks. As an indicator of bank performance, profitability reflects the efficacy of management within their operational environment. Bank income is derived from two primary sources, these are operating income, which includes net gains on trading, fees, and commissions; and interest income, which is earned on assets. These revenues are offset by expenses, which include interest paid on liabilities and non-interest expenses like personnel and operating costs (Tan, 2014). The specific impacts of both traditional and digital FI on banking financial performance have not been thoroughly investigated. As illustrated in the conceptual framework, due to the recent implementation of digital financial services in Ethiopia, it is not anticipated to yield profitability, as the causal relationship from digital FI to profitability is unlikely due to high initial costs, digital illiteracy, and inadequate infrastructure in rural regions.

Third, the framework provides the relationship between FI and banking financial stability. Financial stability itself is defined as a system's capacity to efficiently allocate resources, manage risks, and absorb economic shocks without major disruption (Damane & Ho, 2024; Athari et al., 2023; Stewart et al., 2021). Historically viewed as a separate objective, the pursuit of financial stability is now increasingly understood to be deeply intertwined with the promotion of FI (Antwi et al., 2024; Damane & Ho, 2024; Arora, 2020). Conversely, Khan (2011) claims that, it is difficult to envisage a truly stable system when a significant portion of the socio-economic system remains financially excluded. Studies suggest that FI can have a positive effect on the stability of the banking sector by contributing to a larger and more diversified deposit base, which in turn can enhance the sector's resilience to shocks and mitigate liquidity risks (e.g., Chinoda & Kapingura, 2023; Ha & Nguyen, 2023; Jima & Makoni, 2023; Koudalo & Toure, 2023; Nguyenc& Du 2022; Wang & Luo, 2022; Pham & Doan, 2020; Vo et al., 2020; Ahamed & Mallick 2019; Le et al., 2019; Dienillahet al., 2018; Neaime & Gaysset, 2018; Morgan & Pontines, 2014; Hannig & Jansen, 2010). However, some research also indicates the possibility of a non-linear relationship (e.g., Sebai et al., 2025; Talbi & Sebai, 2025; Antwi et al., 2024; Anton & Nucu, 2024; Kebede et al., 2024; Hua et al., 2023; Khémiri et al., 2024; Sebai & Talbi, 2024), implying that

while a certain level of FI can enhance stability, excessive or poorly managed expansion might introduce new risks into the financial system. As visualized in the conceptual framework, this study claims that the relationship between FI and banking financial stability is bidirectional and contingent on broader economic and institutional conditions.

Figure 1: Conceptual framework



Source: Own computation

Fourth, the conceptual framework provides the interaction between FI and economic growth. Real GDP per capita defined as real Gross Domestic Product (GDP) divided by a country's total population, remains the most widely accepted gauge of economic development, as it captures improvements in individual welfare rather than aggregate output alone (Mengesha & Berde, 2023). Research points towards a positive correlation between FI and economic growth, across various emerging economies (e.g., Levine, 2005; Kim et al., 2018; Van et al., 2021). However, recent research findings reveal that the relationship between FI and economic growth may not be linear (Nandelenga & Oduor, 2020; Osuma, 2025), suggesting both positive and negative shocks in FI could yield asymmetric effects on economic growth. The visualized conceptual framework suggests that while FI exerts an asymmetric influence, the benefits derived from positive shocks tend to surpass the drawbacks, particularly when FI is backed by supportive institutions. Furthermore, this study accepts the notion of feedback causation, where economic growth itself generates opportunities for enhanced FI, creating a virtuous cycle beneficial for both the financial sector and the broader economy. This growth, in turn, fosters an environment conducive to increased bank profitability and enhanced financial stability.

1.9. Methodology

1.9.1. Philosophical underpinning

Scientific inquiry, as defined by Ponterotto (2005), is not simply a mechanical application of techniques rather it is a disciplined search for meaning grounded in philosophical assumptions. These assumptions shape how researchers perceive reality (ontology), how they believe knowledge is acquired (epistemology), how they choose methods of inquiry (methodology), how values interact with the research process (axiology), and how findings are communicated (rhetoric). Our views on what exists (ontology) influence what we believe can be known (epistemology), and these in turn shape how we investigate (methodology) and interpret (axiology) our findings (Fleetwood, 2005). Together, they form the bedrock of any coherent research paradigm (Lim, 2023).

For many years, the construction and validation of theories in finance operates within the positivist framework. In contrast, an alternative methodology, which has been absent in financial research until recently, is post-positivism (Bisman, 2010). This dissertation is grounded in post-positivism, a philosophical stance that acknowledges the existence of an objective reality while recognizing that our understanding of it is inevitably shaped by human limitations, contextual factors, and imperfect observations. While positivism asserts that the world can be perfectly measured and known through detached observation and value-free inquiry (Buchanan, 1998; Taylor & Medina, 2013; Maksimovic & Evtimov, 2023), post-

positivism is more modest and reflexive. It moves away from positivist absolutism to the contextual nature of “truth” and accepts that knowledge is probabilistic and that truth can only be approached, not fully captured (Creswell, 2013; Fleetwood, 2005; Lincoln et al., 2011), research philosophy credited to Karl Popper (1963). The post-positivist view adopted within this dissertation due three basic reasons.

First, ontologically, this research adopts a critical realist ontology, which aligns with the post-positivist worldview. Critical realism holds that there is a real world independent of our perceptions, but our ability to perceive it is fallible. Particularly in a context like Ethiopia where FI, economic stability, and external shocks interrelate in complex ways, it would be naïve to assume that social phenomena are governed by universal, context-free laws. Instead, critical realism emphasizes the layered nature of reality, distinguishing between the empirical (what is observed), the actual (what occurs), and the real (the underlying mechanisms). This philosophical anchor supports the integration of contextual shocks (Chapter 3), threshold effects (Chapter 4), and asymmetric long-run relationships (Chapter 5), allowing for a more nuanced engagement with causality and structural transformation in financial systems.

Second, from an epistemological standpoint, this study is committed to modified objectivism. The modified objectivism claims that while objectivity is a legitimate goal, complete detachment is neither possible nor always desirable. Knowledge is not purely discovered; it is also interpreted. In this light, post-positivism departs from the positivist ideal of purely value-free inquiry by embracing methodological reflexivity. For example, in Chapter 3, the contextual approach to analyzing financial behavior under the COVID-19 shock relies on both structural interpretation and data-driven analysis. In Chapter 4, the use of threshold models inherently suggests that relationships are non-linear and dependent on critical values, again reinforcing the notion that truth is context-contingent. And in Chapter 5, the use of a Nonlinear ARDL model recognizes asymmetric adjustments, showing that economic agents do not respond uniformly to shocks further underlining the need for a flexible and context-aware epistemology.

Third, one of the strengths of post-positivism is its methodological openness. While it maintains a strong commitment to empirical evidence and analytical rigor, it does not confine itself to a single method or epistemic tool. As Lim (2023) suggested, unlike positivists, who assume linear cause-effect nexus, post-positivists perceive the result of research as the finding of the complex influence of a large number of causal factors, which interact. This is clearly

reflected in the structure of this dissertation. In Chapter 3, this research adopts a contextual approach, integrating a dummy variable (categorical effect) insight to assess how FI was shaped during the COVID-19 pandemic. Chapter 4 uses threshold regression models to test non-linear relationships, an approach grounded in the empirical tradition but sensitive to complex contextual shifts. Chapter 5 advances further by using the NARDL model, which captures asymmetric long and short-run relationships between FI and economic growth. These chapters demonstrate as Bryman (2012), Schneider (2020) and Lim (2023) claimed layered methodological strategy, consistent with post-positivism's acknowledgment that different tools are needed to uncover different aspects of reality. Together, these methods reflect the post-positivist paradigm that no single method can exhaust the richness of social phenomena (Creswell, 2012:13).

1.9.2. Research approach

The research methodology used in this study is consistent with the deductive technique defined by Saunders et al. 2016. Deductive reasoning entails progressing from a general theory to specific hypotheses, which are then empirically tested. This method is well-suited for theory supporting since it involves developing hypotheses based on pre-existing beliefs (Silverman, 2013). In this context, the deductive approach is preferred because it is compatible with the quantitative method that uses deductive logic or models to explain, predict, and eventually establish causation (Casula et al. 2020). The process usually starts with the development of a general theory or knowledge foundation, after which individual hypotheses are empirically evaluated (Kothari, 2004).

This study employs a deductive logical approach to scientific inquiry. Deductive reasoning entails reaching logical conclusions from hypotheses (Brink et al., 2006). The study tries to support or reject presented hypotheses within a given framework by starting with a general theory and methodically analyzing it against actual data. This deductive strategy is preferred over the inductive approach, which uses exploratory approaches to discover cause and effect relationship between variables (Popper, 1972; Saunders et al., 2011). Furthermore, employing deductive reasoning involves a researcher utilizing a general theory or concept, conducting tests, and ultimately reaching a particular conclusion. This process allows the researcher to establish a sound position of reasoning within a specific context. The chosen investigative and analytical approach in this case was deductive, as opposed to the inductive approach. The inductive approach relies on exploratory techniques to establish relations between constructs,

but it often leads to numerous assumptions and generalizations (Popper, 1972; Saunders et al., 2011).

1.9.3. Research design

This research adopts quantitative research. According to Aliaga and Gunderson (2002), quantitative research design entail explaining issues or phenomena by gathering numerical data and analyzing them were using mathematical methods, notably statistics, for analysis. Leedy & Ormrod (2001) and Williams (2011) define quantitative research as the collection of data for analyse and statistical treatment to either support or refute knowledge claims. This method typically begins with defining a problem, generating hypotheses or research questions, reviewing relevant literature, and then analyzing data quantitatively (Williams, 2011).

Quantitative research employs structured strategies such as experiments and surveys, using predetermined instruments to gather numerical and statistical data (Creswell, 2003; Williams, 2011). The systematic nature of these instruments enhances the scientific rigor of the research by enabling measurable observations and facilitating rigorous statistical analysis (Bryman, 2001). Although the efficiency of quantitative methods may vary with the scale of data collection, standardized tools often make the process more time-effective compared to unstructured approaches. A major strength of quantitative research is its potential for generalizability, as results obtained from a properly selected and representative sample can be extended to broader populations (Williams & May, 1998). Replicability is also supported through clearly defined procedures, operational definitions, and hypothesis-driven designs, allowing other researchers to reproduce the study with consistency (Lichtman, 2013). In experimental settings, the use of control and treatment groups allows researchers to isolate variables and infer causal relationships more effectively (Johnson & Christensen, 2012). Additionally, the structured and distanced nature of quantitative inquiry helps minimize researcher influence during data collection, thereby reducing bias and supporting objectivity. When coupled with procedures that ensure respondent anonymity such as confidential or anonymous surveys, this objectivity can further strengthen the validity and reliability of the findings (Muijs, 2004; Bryman, 2012).

1.9.4. Techniques of data analysis

The goal of research in the social sciences is to gain a deeper understanding of the world and evaluate how well theoretical predictions correspond to empirical realities (Donnellan et al., 2013). Observational studies rely heavily on the availability and quality of empirical

observations. Poor-quality data heightens the risk of drawing inaccurate conclusions, falling into the well-known “garbage in, garbage out” (GIGO) trap (Emanuelson & Egenvall, 2014). The recent growth of empirical inquiry in business and financial research has been accompanied by wider recognition of persistent methodological challenges, especially the difficulty of obtaining valid and reliable primary data (Cowton, 1998). Researchers using pre-existing datasets must therefore possess both general methodological competence and a deep understanding of challenges uniquely associated with analyzing secondary data (Doolan & Froelicher, 2009).

Secondary data analysis is increasingly recognized as a powerful method for generating insights that may not be attainable through primary data collection alone. Primary data often drawn from small samples or narrow geographical areas, may lack the continuity, breadth, or integration required for robust analysis (Cheong et al., 2023). Reflecting the methodological paths of several recent PhD dissertations (Jamila, 2024; Damane, 2023; Meshesha, 2023; Sumanta, 2023; Kebede, 2022; Peng, 2021; Allam, 2020; Bermeo, 2019), this study adopts secondary data analysis as its central empirical approach to examine the effects of FI on banking performance, banking stability, and economic growth in Ethiopia.

Secondary data analysis involves the use of existing datasets to address new research questions, a well-established and widely applied method across disciplines (Donnellan et al., 2013; Emanuelson & Egenvall, 2014; Johnston, 2014; Cheong et al., 2023). Its advantages are particularly relevant to financial research. Primarily, it offers substantial efficiency in terms of time and cost. Primary data collection is often resource-intensive, whereas secondary analysis allows researchers to draw on existing information and avoid logistical challenges such as non-response bias, low participation rates, and recruitment difficulties (Cowton, 1998; Emanuelson & Egenvall, 2014; Cerar et al., 2021). The availability of longitudinal and large-scale datasets also enables researchers to avoid sample selection bias and to apply more sophisticated analytical techniques (Emanuelson & Egenvall, 2014; Cerar et al., 2021). Furthermore, secondary data (particularly when de-identified) presents minimal ethical risks and upholds strong standards of confidentiality and privacy (Doolan & Froelicher, 2009; Dunn et al., 2015). Collectively, these advantages make secondary data particularly well suited to the empirical objectives of this study.

1.9.4.1. Inherent Challenges and Limitations of Secondary Data

Despite its strengths, secondary data analysis presents inherent challenges that require careful methodological consideration. Many secondary datasets originate from surveys and thus inherit survey-related limitations, including inconsistencies in measurement, limited control over original sampling, and constraints in variable construction (Cerar et al., 2021). The rapid growth in the availability of secondary datasets has strengthened their institutional legitimacy, yet this acceptance has sometimes occurred without adequate scrutiny of their drawbacks (Cerar et al., 2021). A major risk is that researchers may shift their focus from answering substantive research questions to merely using the data that are available, a systematic and potentially problematic trend (Cerar et al., 2021).

Cheong et al. (2023) categorize the disadvantages of secondary data into (1) data-related limitations (such as limited knowledge of data collection procedure, data fitness, and data quality) and (2) methodological constraints (data sampling).

A central limitation concerns the researcher's lack of control over the original data collection process, including sampling design, measurement procedures, and data verification. This limited “fidelity” (Thorne, 1998) makes it challenging to confirm whether data have been accurately collected, coded, or cleaned (Heaton, 2008; Cowton, 1998; Johnston, 2014; Wickham, 2019). Metadata, such as definitions, units, measurement precision, coding interpretation, and collection timelines, are crucial for long-term usability (Emanuelson & Egenvall, 2014). Reputable institutions typically provide detailed metadata (Aydın Çolak & Eroğlu, 2025), but inconsistencies or gaps remain common.

Another challenge concerns data fitness. Secondary datasets collected for different research purposes may not perfectly align with the needs of the secondary researcher (Heaton, 2008; Cheong et al., 2023). Construct validity issues frequently arise when complex constructs are measured using archival proxies (Cerar et al., 2021). Examples include the use of patent counts to measure innovation or R&D expenditure to represent absorptive capacity, proxies that may not fully capture the underlying conceptual dimensions. Cross-country studies face even greater challenges due to conceptual and definitional differences across national statistical systems (Cerar et al., 2021). The phenomenon of “reification,” where subjective individual-level constructs are transformed into unquestioned macro-level indicators, further highlights the risks of misinterpretation (Cerar et al., 2021). Nonetheless, methodological flexibility can allow researchers to work effectively with imperfect but relevant data (Cheong et al., 2023).

A third limitation relates to data quality and potential manipulation. Governments or institutions may have incentives to alter or selectively report data (Cerar et al., 2021). A prominent example is the discontinuation of the World Bank's Doing Business report following confirmed data irregularities (Machen et al., 2021). Missing data, high attrition, and inconsistencies may also compromise data integrity (Doolan & Froelicher, 2009; Dina Diatta & Berchtold, 2023). Data quality is typically assessed using dimensions such as accessibility, accuracy, believability, completeness, consistency, interpretability, relevance, and timeliness (Laranjeiro et al., 2015; Cheong et al., 2023).

Sampling-related limitations present additional concerns. In both academic research and business decision-making, scholars face a trade-off between bias and variance (Cabanelas et al., 2025; Wedel & Kannan, 2016). Larger datasets may offer better representation of reality but also introduce complexity and computational burdens (Wedel & Kannan, 2016; Cabanelas et al., 2025). Secondary sampling may inherit distortions from original sampling frames, which may not reflect the true characteristics of the study population (Thorne, 1998; Nielsen et al., 2020). When inconsistencies arise across multiple data sources, qualitative datasets may also suffer from non-comparable questioning structures (Hinds et al., 1997; Szabo & Strang, 1997). This risk reinforces the need for methodological rigor and transparency in secondary research (Braun & Clarke, 2006; Lincoln & Guba, 1986). Ultimately, researchers must accept the constraints of pre-existing data, which may limit the alignment between available variables and the constructs of interest (Dina Diatta & Berchtold, 2023).

1.9.4.2. Contextualized Mitigation Approaches

A thorough review of existing research (including its strengths, weaknesses, and data foundations) is essential before undertaking secondary data analysis (Johnston, 2014; Creswell & Creswell, 2017; Boote & Beile, 2005). To conduct high-quality secondary analysis, researchers must critically evaluate the quality of available data and determine whether the datasets are sufficiently suitable for addressing the research questions (Doolan & Froelicher, 2009; Johnston, 2014; Dunn et al., 2015). The contextual characteristics of this study, namely, its reliance on audited financial statement data from regulated financial institutions and official macroeconomic datasets provide strong methodological safeguards against the limitations outlined above.

First, the use of data from the National Bank of Ethiopia (NBE) and audited financial statements of Ethiopian commercial banks directly mitigates concerns regarding data

manipulation or political influence. Financial reporting in Ethiopia is governed by the IFRS framework and is subject to mandatory independent auditing under both domestic regulations and international standards (Wagaw et al., 2019; Ayalew, 2022). The adoption of IFRS through Proclamation 847/2014 represents Ethiopia's formal commitment to high-quality global accounting standards (Tseganesh, 2019; Ayalew, 2022). IFRS improves disclosure quality, enhances comparability, supports cross-border financial integration, and strengthens the reliability of financial information (Smith & Bushman, 2001; Erin et al., 2017; Abuda & Rudiawarni, 2015; Emeni et al., 2016). Together with the oversight mechanisms established by Regulation No. 332/2014, these institutional arrangements significantly reduce the risk of data irregularities. While variations in IFRS compliance exist across Ethiopian banks, private banks having relatively moderate compliance compared to public ones (Getachew, 2021; Degu et al., 2024), this study mitigates such risks by drawing exclusively from the most authoritative and audited sources available. The selection of reliable datasets is therefore an intentional strength of the research design. In addition, the study's reliance on the World Bank's macroeconomic indicators is underpinned by the institution's stated mission to promote transparency, sound governance, and high-quality internationally comparable statistics (World Bank Group, 2025). The discontinuation of the Doing Business report illustrates the World Bank's institutional commitment to data integrity. Thus, the use of World Bank data is justified not merely by reputation but by the organization's structural mechanisms for maintaining data quality.

Second, the methodological design minimizes common disadvantages associated with both secondary and primary data. Common Method Variance (CMV), variance attributable to measurement methods rather than the constructs themselves, arises when predictor and criterion variables are obtained from the same source under identical conditions (Podsakoff et al., 2003). By drawing on diverse, reputable sources, secondary data analysis largely mitigates CMV (Cooper et al., 2020; Podsakoff et al., 2003). The use of standardized financial ratios and audited metrics further reduces the typical CMV problems, which primarily reflected in a self-reported surveys.

Finally, the study's single-country focus and reliance on objective, objective financial measures eliminate many conceptual equivalence problems observed in multi-country secondary research (Cerar et al., 2021). Constructs such as bank performance, stability, and FI are measured through well-defined, universally recognized financial indicators applied within the IFRS framework rather than abstract proxies prone to reification. This ensures conceptual consistency throughout the analysis.

1.10. Chapter construction

The study will conduct policy-oriented researches (using suitable statistical and econometrical tools) and provide recommendations for policy makers. The paper tries to address these issues by presenting its analysis through **six chapters** in article form. The thesis complies with the requirements set forth by the department of Regional and Local Development and Governance Studies (RLDS) of Addis Ababa University (AAU). Each chapter may have their own background, theoretical and a methodological approach to address the research objective. This study is structured into six chapters to facilitate a comprehensive investigation of the research topic. **Chapter 1** introduces the study's general background. **Chapter 2** measures FI in Ethiopia, covering its concept, measurement literature, methodology, results, and discussions. **Chapter 3** explores the impact of traditional and digital FI on the financial sector's performance, including an introduction, literature review, methods, results, and conclusions. **Chapter 4** investigates FI's effect on banking stability in Ethiopia. **Chapter 5** analyzes the asymmetric effects of FI on economic growth, featuring an introduction, literature review, methodology, and results. The final chapter synthesizes the study's overall findings.

CHAPTER TWO: A MULTIDIMENSIONAL FI INDEX FOR ETHIOPIA

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Abstract

This study develops a multi-dimensional composite index to measure FI in Ethiopia using a two-stage Principal Component Analysis based on ten traditional and five digital indicators from 2015 to 2023. The results reveal a significant increase in Ethiopia's FI score, rising from an average of 10.89% in 2015 to 52.18% in 2023. Among the dimensions, traditional availability (0.2625) is the most influential, followed by traditional usage (0.2616), digital accessibility (0.2505), and digital availability (0.2254). Further analysis reveals that the Commercial Bank of Ethiopia alone contributes 48.99% for FI score, while five medium-sized and eleven small-sized private banks collectively account for 29.26% and 21.75%, respectively. The developed index proves to be a valuable tool for policymaking and evaluation, addressing previous limitations like arbitrary weight selection. It offers a detailed perspective on FI trends among commercial banks in Ethiopia, consistent with existing studies.

Keywords: FI; Multidimensional composite index; Principal component analysis; Ethiopia's commercial banks

JEL classification: G2; G2; C43; G21.

1. Introduction

Recent studies indicate that FI (FI) has become a key policy priority in many countries (Dabla-Norris et al., 2021; Ozili, 2021c; Vo et al., 2021). While definitions of FI vary by socio-economic context (Aduda & Kalunda, 2012; Akileng et al., 2018; Ahamed & Mallick, 2019), it generally refers to providing accessible, timely, adequate, and affordable financial services to all legal entities, especially marginalized communities (Sarma, 2008; De Koker & Jentzsch, 2013).

Having access to financial services is essential for creating economic opportunities, as it allows for savings, investments, and credit access (Subbarao, 2009). Studies show that FI promotes economic growth (Van et al., 2021; Kim et al., 2018; Levine, 2005), greater financial stability (Elsayed 2020; Vo et al., 2021), enhance education (Demirgüç-Kunt & Levine, 2009), financial protection (Ozili, 2021b; Elsayed 2020), increase financial performance (Shihadeh et al., 2018; Sha'ban et al., 2020; and Issaka et al., 2020), decrease poverty (Niaz, 2022; Tran & Le, 2021; Koomson et al., 2020; Omar & Inaba, 2020; Bruhn & Love 2014; Inoue & Hamori, 2012), reduce income inequality (Huang & Zhang, 2019; Omar & Inaba, 2020; Park & Mercado, 2018; Demirgüç-Kunt & Levine, 2009), encourage gender equality (Ohiomu & Ogbeide-Osaretin, 2019; Staveren, 2001).

Recognizing the critical role FI plays in the country's development, Ethiopia's government implemented a National FI Strategy (NFIS) in two stages. The first phase ran from 2015 to 2021, followed by the current phase which began in 2021 and extends to 2025, with the aim of increasing the adult population's access to formal financial services to 70% (NFIS, 2021). Despite efforts, the 2018/2019 Ethiopian Socioeconomic Survey (ESS) shows that only 30.5% of adults have bank accounts, below the African average of 35% and the global average of 61.5% (CSA et al., 2021). The primary barriers identified under the survey includes insufficient funds (36.3%), lack of perceived reasons (15.2%), limited understanding of the benefits of owning an account (12.3%), excessive distance to the nearest financial institution (10.9%), and lack of knowledge about account opening procedures (10.7%) (CSA et al., 2021).

Given the relative low rate of bank account ownership in Ethiopia, which stands at 30.5% (CSA et al., 2021), the study opts for FI as a solution to address financial exclusion. The primary goal of FI is to enable the most disadvantaged populations to access basic financial services at a low cost (Aymar & Fabrice-Gilles, 2021; Hannig & Jensen, 2010; Dabla-Norris et al., 2015). Digital finance, in particular, presents a compelling opportunity to engage individuals who are traditionally excluded from the formal financial system due to geographical, economic, or social barriers (Ozili, 2021b). The rise of digital platforms and mobile banking has been highlighted as a key driver in advancing financial inclusiveness (Aymar & Fabrice-Gilles, 2021; Senou et al., 2019). However, digital FI (DFI) cannot entirely replace traditional FI (TFI). While DFI primarily caters to small-scale financial transactions and loans (Mhlanga, 2020), TFI is often preferred for larger capital needs and more complex financial products. Therefore, DFI and TFI are complementary and mutually dependent; each serving different aspects of financial needs (Mao et al., 2023).

Measuring FI is the first step towards raising awareness about the importance of FI (Sarma, 2016). It is crucial for assessing the impact of stakeholder initiatives and strategizing future actions (Nguyen, 2021). As Gharbi & Kammoun (2023) aptly highlight, a multidimensional FI measure fosters a deeper understanding of its relationship with other relevant macroeconomic variables. However, current approaches employed in Ethiopia primarily rely on micro-level or unidimensional indicators, which restrict a comprehensive understanding of FI. Sarma (2008) underscores that relying on a single indicator to assess the extent and impact of FI can be misleading. Therefore, this study aims to develop a multidimensional FI measurement index to address this critical gap. The proposed index will incorporate both demand-side and supply-side aspects, providing a nuanced and holistic understanding of FI in Ethiopia. Additionally,

this study introduces digital indicators to measure FI that has been overlooked in previous studies. To achieve this, the study employs a two-stage Principal Component Analysis (PCA) approach to construct the first comprehensive FI index for Ethiopia (2015-2023), covering both TFI and DFI dimensions.

The next subsequent part of this paper is organized as follows. The next part presents an overview of the previous studies that measures FI. Part 3 describes methodology. Subsequently, Part 4, presents the obtained result. Finally, Part 5 provides conclusion and recommendation for stakeholders.

2. Measurement of FI

Composite indices enable cross-temporal and cross-spatial comparisons, prompting the need for dimensionality reduction techniques (OECD, 2008). These indices aim to capture multifaceted concepts, encompassing a multitude of indicators under a single, holistic metric (Mishra, 2007). The literature on FI measurement employs parametric, non-parametric, and hybrid techniques (Gharbi & Kammoun, 2023; Nizam et al., 2020; Ahamed & Mallick, 2019; Nuzzo & Piermattei, 2019; Camara & Tuesta, 2017). Using statistical models, studies under parametric methods in FI research calculate weights based on inherent indicator covariation (Nguyen, 2021; Sha'ban et al., 2020; Le et al., 2019; Park & Mercado, 2018). Conversely, studies employing non-parametric methods assign weights based on expert intuition (Chakravarty & Pal, 2013; Sarma, 2008), albeit the yearly changes in the data (Decancq & Lugo, 2013) and weights potentially being assigned prior to data collection (Chen et al., 2019). Hybrid methods, applied in some studies (Van et al., 2021; Nizam et al., 2020), combine parametric and non-parametric techniques, but lack standardized methodologies and theoretical foundations. Table A4 in summarizes selected previous empirical work on the development of a FI.

2.1. Application of principal component analysis

PCA is a cornerstone of modern data analysis, widely applied across scientific disciplines for its capacity to reduce dimensionality and extract key patterns from multivariate datasets (Kurita, 2019; Abdi & Williams, 2010). Originally introduced by Pearson (1901) and advanced by Hotelling (1933), PCA remained underutilized until the proliferation of electronic computing, which facilitated its integration into statistical software packages and cemented its role as a fundamental multivariate statistical method (Mishra et al., 2017; Jolliffe & Cadima, 2016; Maćkiewicz & Ratajczak, 1993). At its core, PCA transforms a dataset of interrelated

variables into a smaller set of uncorrelated variables known as principal components (PCs). These PCs are ordered by the amount of variance they capture, with the first component explaining the greatest share of the total variation. By retaining only the most significant components, PCA reduces the dataset's dimensionality while preserving as much of its informational content as possible (Greenacre et al., 2022). This process enables researchers to distill the essence of high-dimensional data into a more manageable form.

The application of PCA is particularly critical in scenarios involving large, multivariate datasets, where redundancy among variables can impede analysis. High-dimensional data often pose challenges such as multicollinearity, computational inefficiency, and diminished clarity in visualization and interpretation. PCA addresses these issues by systematically removing redundancy while minimizing information loss, enabling clear and actionable insights (Mavungu, 2023). In the financial domain, PCA has emerged as an indispensable tool within the broader field of financial data science. Its precision, efficiency, and cost-effectiveness make it highly suitable for analyzing structured and unstructured financial data (Janićijević et al., 2022). Recent studies have applied PCA to address diverse challenges, including financial risk assessment (Mavungu, 2023; Hamdy & Hussein, 2016), financial reporting (Robu & Istrate, 2015; Li & Zhang, 2011), customer analytics (Bandyopadhyay et al., 2021), trading predictions (Ghorbani & Chong, 2020; Ingrassia et al., 2005), and FI (Gharbi & Kammoun, 2023; Nguyen, 2021; Nizam et al., 2020; Ahamed & Mallick, 2019; Camara & Tusta, 2017). This study builds on these advancements by leveraging PCA to construct a multidimensional FI index for Ethiopia, integrating bank-level data across traditional and digital financial dimensions. By addressing the challenges of dimensionality and ensuring robust variance capture, PCA offers a methodologically sound approach to analyze FI trends and inform policymaking in Ethiopia.

3. Methods and Materials

3.1. Data Source and Type of Data

Based on the data compiled from National Bank of Ethiopia financial stability report (NBE-FSR) (2024), commercial banks hold for 91.2% of total assets, 97.8% of deposits, 93.9% of credit, and 76.1% of equity in the financial sector, as of June 30, 2023. In light of this dominance, the researchers deal with data on commercial banks, which is explained by the fact that commercial banking institutions are the most dominant and basic point of access to the most basic forms of financial services. Due to data availability concern the researchers' focuses on 17 commercial banks. The study used the secondary data. Data for the study sourced from various reliable institutions, like NBE, Commercial banks (CBs) annual report, and World

Bank (WB). Table 1 summarizes the measurement variables and data sources for both the traditional and digital indices covering the period 2015-2023.

3.2. Index measurement

The process of constructing an index involves careful steps such as selecting indicators, normalizing data, assigning weights, and aggregating the final results (OECD, 2008). This study starts index development process through selecting critical indicators. Secondly, normalization ensures all indicators are on a comparable scale. Thirdly, weights are assigned to each indicators and dimension, reflecting their relative importance. Finally, researchers aggregate these weighted dimensions into a single FI, providing a composite FI measure of the phenomenon under study.

3.2.1. Identification of indicators

Recognizing the pioneering work of Beck et al. (2007), Sarma (2008), and Sarma & Pais (2011) in developing FI indices, this study employs indicators across three key dimensions: availability (outreach), access (penetration), and usage.

Table 1: Overview of indicators and data sources used in the study

Dimensions	Indicators	Abbreviations	Sources
Traditional Availability	Commercial bank branches (per 100,000 adults)	BrP	NBE; WB
	Commercial bank branches (per 1000km ²)	BrA	NBE; WB
	Automated teller machines (ATMs) (per 100,000 adults)	AtP	NBE; WB
	Number of ATMs (per 1000km ²)	AtA	NBE; WB
	Number of PoSs (per 100,000 adults)	PoP	NBE; WB
	Number of PoSs (per 1000km ²)	PoA	NBE; WB
Digital Availability	Number of agents (per 1,000 adults)	AP	NBE; WB
	Number of agents (per 1,000km ²)	AA	NBE; WB
Digital Accessibility	No of mobile active users (per 1,000 adults)	MBP	NBE; WB
	No of internet active users (per 1,000 adults)	IBP	NBE; WB
	No of mobile money (wallet) users (per 1,000 adults)	WP	NBE; WB
Traditional Usage	Depositors with commercial banks (per 1,000 adults)	DCP	CBE; WB
	Number of debit cards per 1,000 adults.	AcP	NBE; WB
	Outstanding loans and advances (% of GDP)	LGDP	NBE
	Outstanding deposits (% of GDP)	DGDP	NBE

Source: Prepared by authors

A. Availability

This dimension measures the unimpeded utilization of basic banking services for all customers. It reflects the infrastructure preparedness of the bank to ensure reachability (Hanivan & Nasrudin, 2019). The availability dimension of FI is typically assessed through geographic or demographic penetration metrics (Beck et al., 2007). Beck et al. (2007) operationalized this dimension by using indicators such as the density of ATMs and commercial bank branches.

These indicators were scaled based on demographic factors (number of ATMs and branches per 100,000 adults) and geographic factors (number of ATMs and branches per 1,000 square kilometers). Consequently, for measuring this dimension, researchers analyze data on the number of branches, ATMs, and point-of-sale (PoS) machines, considering both the demographic density (per 100,000 adult people) and geographic distribution (per 1,000 km²). In addition, Tram et al. (2023) and Nguyen (2021) used mobile money agents to measure digital availability dimension. This study uses agent banking per 1000 adult population (demographic spread) and per 1000km² (geographic spread) as a proxy to measure digital availability dimensions. This approach aims to offer financial services in areas lacking bank branches and ATM facilities.

B. Accessibility

The accessibility aspect of FI goes beyond just the presence of financial institutions. It focuses on how easily individuals can make use of the services provided, with a primary focus on the ability to access financial services and products from formal institutions (Mushtaq and Shah, 2018). Therefore, utilizing digital channels to enhance the accessibility of financial services emerges as a highly accessible tool for FI (Lenka & Barik, 2018). Nguyen (2021) and Ismael & Ali (2021) used the number of mobile money accounts per 1,000 people to measure the accessibility aspect. Additionally, Ismael & Ali (2021) used internet banking service users as a proxy to measure this dimension. As a result, this study employs mobile banking, internet banking, and mobile money (wallet) accounts per 1,000 adult populations as a proxy to measure digital accessibility dimension.

C. Usage

Usage focuses more on the permanence and depth of financial services and/or products use. It requires detailed analysis of the regularity, frequency, and duration of usage over time, as well as the specific combination of financial products adopted by individuals or households (Mushtaq and Shah, 2018). As Kempson et al. (2004) aptly demonstrate, mere access may be insufficient due to factors like service quality or geographic remoteness, active utilization is essential. To measure the extent of usage, Ahamed & Mallick (2019) and Camara & Tusta (2017) utilized the indicator of deposit bank accounts, while Ismael & Ali (2021) focus on the number of debit cards per 1,000 adults. To capture the financial depth, which reflects the level of financial institution involvement within an economy, scholars have employed alternative metrics. As a proxy, Sarma (2016), Sarma & Pais (2011), and Nguyen (2021) all adopted the volume of credit and deposits relative to GDP. Specifically, outstanding deposits as a

percentage of GDP and outstanding loans and advances as a percentage of GDP have been established as metrics to measure this dimension. To that end, this study uses deposit accounts and debit cards per 1,000 adult populations, along with the loan/GDP and deposit/GDP ratio, as indicators to measure the usage aspects of traditional FI dimension.

3.2.2. Normalization of selected variables

Normalization is crucial for comparing indicators with different measurement units and ranges. Various normalization methods include ranking, standardization (z-score), min-max (rescaled index), and logarithmic transformation (Carrino, 2015; Freudenberg, 2003; OECD, 2008). For this study, the min-max approach is used to normalize the indicators to values between 0 and 1, where the minimum value 0 indicates financial exclusion and the maximum value 1 indicates FI. To put all indicators in the same comparable scale, this study uses the following formula.

$$\text{Min – Max Approach} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

3.2.3. Indicator weighting

Indicator weighting is the most sensitive step in index construction (Papathoma-Kohle et al., 2019; Lockwood, 2004). Data-driven weights allow the data to determine the weights using statistical methods like PCA. PCA offers a data-driven technique, ensuring the index accurately reflects the underlying FI phenomena (Camara & Tuesta, 2017). It effectively reduces data dimensionality while preserving much information (Hair et al., 2019). Unlike pre-specified methods, PCA avoids subjective decisions on common factor structure, enhancing objectivity and robustness (Steiger, 1979; Jolliffe & Cadima, 2016), where the optimal number of common factors may not be evident or may vary across time and space. Additionally, PCA endogenously determines component weights, capturing the inherent variability within the data (Hanivan & Nasrudin, 2019). To that end, this study uses PCA, a data-driven approach, to assign weights and construct the FI index (FII).

3.2.4. FI index aggregation and development

Disaggregating the overall index into sub-indices for traditional and digital inclusion provides policymakers with granular insights in directing their efforts to the areas that need improvement. While single-level multivariate analysis offers dimensionality reduction, it can struggle with nested data structures (Yang et al., 2022). This limitation arises from the assumption of independent and identically distributed (iid) data, potentially overlooking valuable information specific to different groups. To address this challenge, a multi-stage

multivariate approach is employed. This approach acknowledges the hierarchical structure of the data, leading to a more precise analysis (Yang et al., 2022; Hox, 2013). As well, single-stage statistical approach PCA can be biased towards the weights of individual indicators. However, employing a multilevel (stage-based) parametric approach helps mitigate this issue. This strategy is preferred because each sub-index is defined by a set of correlated indicators, making it more advantageous to estimate the sub-indices first rather than estimating the overall index in one stage with all the indicators at one time (Ismael & Ali, 2021; Camara & Tuesta, 2017; Nagar & Basu, 2002).

3.2.4.1. The first stage PCA

This intra-group (first stage) stage focuses on using individual indicators within each dimension of FI to create sub-indices. This stage allows including correlated indicators within each dimension to capture the underlying structure effectively. PCA helps reduce redundancy and identify the most important factors explaining the variance within that dimension. So, the researchers classified 10 indicators for traditional sub-indices (6 indicators for availability and 4 indicators for usage) and 5 indicators for digital approach (2 indicators for availability and 3 for accessibility). For each index, the three unobserved endogenous variables (Y_i^a, Y_i^p, Y_i^u) are estimated along with their corresponding parameters (γ, δ) for TFI and (ρ, θ) for DFI using the equation as:

- I. The dimensions of “availability”, and “usage” of the traditional FI index are computed by the following equation system:

$$Y_i^a = \gamma_1 BrP_i + \gamma_2 BrA_i + \gamma_3 AtP_i + \gamma_4 AtA_i + \gamma_5 PoP_i + \gamma_6 PoA_i + u_i \quad (1)$$

$$Y_i^u = \delta_1 DCP_i + \delta_2 AcP_i + \delta_3 DGDP_i + \delta_4 LGDP_i + \varepsilon_i \quad (2)$$

- II. The dimensions of “availability”, and “penetration” of the digital FI index are computed by the following equation system:

$$Y_i^a = \rho_1 AP_i + \rho_2 AA_i + \epsilon_i \quad (3)$$

$$Y_i^p = \theta_1 MBP_i + \theta_2 IBP_i + \theta_3 WP_i + \epsilon_i \quad (4)$$

Each indicators weight will be extracted based on eq (1, 2, 3, 4).

3.2.4.2. The second stage PCA

In the second stage, the researchers apply the same procedure as in the first stage to perform inter-group analysis. This involves computing the cumulative weights for overall FI,

integrating both traditional and digital financial dimensions. The study follows such approaches as:

$$FII_T = \omega_1 Y^a + \omega_2 Y^p + \omega_3 Y^u + \varpi_1 Y^a + \varpi_1 Y^p + \epsilon_i \quad (5)$$

Where FII_i is the overall FI index for each bank; ω_i , represents weights of traditional FI and ϖ_1 represents weights of accessibility digital FI, ϵ_i is variation due to error. These weights represent the significance of each dimension in the overall FI index. Consequently, higher weights indicate greater importance of a dimension, suggesting that policymakers should focus more on this dimension to effectively enhance FI.

4. Result and Discussion

4.1. Descriptive Analysis

The descriptive statistics in Table 2 summarizes the basic characteristics of the variables used to construct the TFI and DFI sub-indices of overall FI index. There are 153 sample sizes (taking 8 years for 17 commercial banks) used to develop FI index. It provides information on the mean, mean squared error (MSE), minimum, and maximum values for each variable.

Table 2: Summary descriptive statistics

Dimensions	Variable	Obs	Mean	MSE	Min	Max
Availability TFI	BrP	153	0.4840	0.0337	0.0054	2.6737
	BrA	153	0.2827	0.0276	0.0027	1.7261
	AtP	153	0.4039	0.0226	0	5.9626
	AtA	153	0.2383	0.0233	0	3.5018
	PoP	153	0.8161	0.0309	0	11.6824
	PoA	153	0.4699	0.0323	0	6.4249
Usage TFI	DCP	153	13.1927	0.0151	0	361.0142
	AcP	153	42.3526	0.0245	0.2991	553.2191
	LGDP	153	0.0093	0.0344	0.0003	0.0876
	DGDP	153	0.0174	0.0391	0.0006	0.2052
Availability DFI	AP	153	2.5187	0.0106	0	100.5907
	AA	153	1.5621	0.0103	0	64.9387
Accessibility DFI	MBP	153	7.5166	0.0161	0	130.7813
	IBP	153	1.4200	0.0103	0	53.7799
	WP	153	7.7405	0.0159	0	191.9803

Source: Computed based on Stata 14 output

4.4.1. Pre-principal component analysis tests

The researchers used a max-min normalization method to address scale differences among the FI sub-indicators while constructing the FI index before applying PCA. PCA can be carried out by performing eigenvalue decomposition on a data covariance matrix or singular value decomposition on a data matrix, usually after normalization of the data matrix for each attribute (Osawaru et al., 2015).

4.4.1.1. Adequacy tests

Before using PCA, certain preliminary tests must be conducted. Firstly, the Kaiser–Meyer–Olkin (KMO) measure and Bartlett’s test of sphericity should be performed. These tests ensure that the sample size is adequate and that the selected indicators are sufficiently intercorrelated (Ismael and Ali, 2021; Taherdoost et al., 2014). A KMO (Measure of sampling adequacy) value greater than or equal to 0.5 and a statistically significant chi-square statistic in Bartlett’s (1950) test indicate suitability for factorization; otherwise, factorization is not recommended (Hair et al., 2019). Additionally, the Kaiser criterion is often employed alongside a scree plot, where eigenvalues are plotted against the number of factors. This graphical method helps identify the optimal number of factors by observing the point where the plot’s curve shows an elbow, indicating a less steep decline. Factors beyond this elbow point are typically excluded (Cleff, 2019).

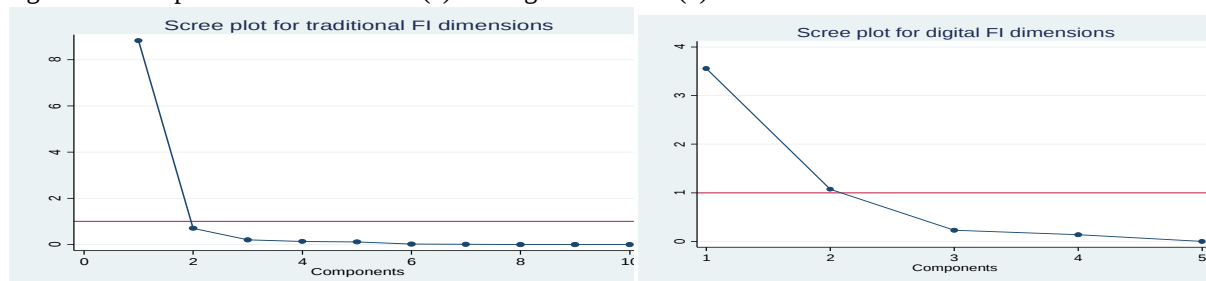
Table 3: KMO Measure & Bartlett’s Test of Sphericity for traditional & digital datasets

Dimensions	Abbreviations	KMO	Overall KMO	Bartlett’s test of sphericity
Traditional Availability	BrP	0.6974	0.69430	P value= 0.000 Chi-square= 3347.798(15*)
	BrA	0.6875		
	AtP	0.6929		
	AtA	0.6851		
	PoP	0.6931		
	PoA	0.7104		
Digital Availability	AP	0.5	0.5	P value= 0.000 Chi-square= 1,119.314 (1*)
	AA	0.5		
Digital Accessibility	MBP	0.5370	0.5569	P value= 0.000 Chi-square= 221.805 (3*)
	IBP	0.7997		
	WP	0.5332		
Traditional Usage	DCP	0.5593	0.6168	P value= 0.000 Chi-square= 1,111.108 (6*)
	AcP	0.6725		
	LGDP	0.5795		
	DGDP	0.6540		

Source: Calculated based Stata result, parentheses indicate the degree of freedom

The result mentioned on Table 3 and figure 2 reveals that all components meet KMO, sphericity test requirements ($KMO \geq 0.5$, $sphericity \leq 0.05$ and scree plot line separates from the ideal eigenvalue line i.e., 1) to use PCA for FI development.

Figure 2: Scree plot of both traditional (a) and digital financial (b) inclusion dimensions



(a)

(b)

Source: Stata scree plot result

Lastly, an evaluation of the index's internal consistency was carried out through a reliability test. Reliability pertains to the level of uniformity in measurement among comparable subjects

in comparable circumstances (Ursachi et al., 2015). Cronbach's alpha, a widely used reliability measure, was computed for the entire scale in this research. The examination of the reliability of the variables considered in this study is assessed using Cronbach's alpha coefficient (CA), as recommended by Hair et al. (2019). According to Kline (2015), a CA value greater than 0.6 is deemed acceptable for scales under development. The obtained value of 0.9721 in the above (Table A3), surpassing the suggested threshold of 0.6, demonstrates outstanding internal consistency and bolsters the trustworthiness of our data.

4.4.2. Principal component analysis

4.4.2.1. First stage principal component analysis

Following the verification of data adequacy, a two-stage PCA was employed to extract latent variables representing key dimensions of FI. In the first stage, as shown in Table 5, intra-group eigenvalues were calculated for both traditional (availability and usage) and digital (availability and accessibility) dimensions within each sub-index. According to Kaiser's criterion (1960), eigenvalues greater than 1 indicate components that capture a significant portion of the variance.

This study finding identified that only the first principal component (PC1) for each dimension had an eigenvalue exceeding 1. Therefore, subsequent analysis focused exclusively on these first principal components. The weights associated with these components were utilized to estimate latent variables representing penetration (Yp), availability (Ya), and usage (Yu).

Table 4: Estimation of PC and eigenvalue of sub-indices of TFI and DFI

Component	Eigenvalue	Difference	Explained variance (EV)	Cumulative EV
Availability TFI				
Comp1	5.4682	5.1268	0.9114	0.9114
Comp2	0.3415	0.1566	0.0569	0.9683
Comp3	0.1849	0.1801	0.0308	0.9991
Comp4	0.0048	0.0043	0.0008	0.9998
Comp5	0.0004	0.0002	0.0001	0.9999
Comp6	0.0003		0.0000	1
Availability DFI				
Comp1	1.9997	1.9994	0.9999	0.9999
Comp2	0.0003		0.0001	1
Accessibility DFI				
Comp1	2.0686	1.2765	0.6895	0.6895
Comp2	0.7921	0.6528	0.2640	0.9536
Comp3	0.1373		0.0464	1
Usage DFI				
Comp1	3.4725	2.9920	0.8681	0.8681
Comp2	0.4804	0.4430	0.1201	0.9882
Comp3	0.0374	0.0278	0.0094	0.9976
Comp4	0.0096		0.0024	1

Source: Computed based Stata 14 result

Hair et al. (2019) considered acceptable solutions with an explained variance (EV) of 60% or higher. It is noteworthy that the traditional availability and usage dimensions', as represented by PC1, account for a significant portion of the variance (91.1% and 86.8%, respectively),

indicating a strong explained information they capture (Table 4). This aligns with the expectation that indicators in both availability and usage dimension contribute to FI index development.

For the digital inclusion dimensions, PC1 explains a near-perfect 99.9% of availability-related information, highlighting its dominance. However, for accessibility, PC1 explains a more moderate 69% of the variance. This suggests that indicators under digital availability and accessibility contribute a significant role in financial index development.

Table 5: Scoring coefficients for orthogonal varimax rotation (weights)

Dimensions	Indicators	Comp1	Unexplained	Normalized weights
Traditional Availability	BrP	0.4146	0.0600	0.16927
	BrA	0.4105	0.0786	0.16759
	AtP	0.4112	0.0753	0.16790
	AtA	0.4078	0.0908	0.16649
	PoP	0.3983	0.1324	0.16263
	PoA	0.4069	0.0948	0.16612
Digital Availability	AP	0.7071	0.0001	0.5
	AA	0.7071	0.0001	0.5
Digital Accessibility	MBP	0.6382	0.1574	0.375736
	IBP	0.4067	0.6578	0.239446
	WP	0.6536	0.1162	0.384818
Traditional Usage	DCP	0.4691	0.2360	0.234706
	AcP	0.5195	0.0627	0.259963
	LGDP	0.4978	0.1396	0.249065
	DGDP	0.5121	0.0892	0.256266

Source: Computed based Stata 14 result

The normalized weights derived from the intra-group PCA are shown in Table 5. These weights indicate the significance of each indicator in elucidating the variance associated with each principal component 1.

With regard to the traditional availability dimension, the weights assigned to the first component are as follows: 0.1693 (BrP); 0.1676 (BrA); 0.1679 (AtP); 0.1665 (AtA); 0.1626 (PoP); 0.1661 (PoA). The study revealed that branch availability has the highest relative weight compared to ATMs and PoS machines in both demographic and geographic analyses. This indicates that branch expansion plays a crucial role in overall availability in the Ethiopian context, surpassing the importance of alternative channels such as ATMs and PoS. This dominance aligns with contextual realities such as high adult illiteracy rates (48.2%) (Abate & Adamu, 2022) that necessitate in-person banking services. Furthermore, the ad hoc policy measures such as (NBE directive-SBB/66/2018) mandating the preservation and expansion of branch network, have led to an increase of over 137% in the total number of bank branches,

rising from 4,757 in 2018 to 11,281 in 2023. Supporting the findings of Alemu (2014), CSA et al., (2021) and Mossie (2022), the lack of physical access to banking services is a main factor contributing to the exclusion of the most vulnerable segments of society. These initiatives underscore the critical need to maintain and expand branch networks, reflecting reactive policy strategies aimed at improving access to financial services, particularly in underserved regions. Consequently, transaction volumes processed through branches (Birr 10.3 trillion) significantly outpace those through ATMs and PoS (Birr 519.1 billion) (NBE-FSR, 2024), emphasizing the importance of branch-based banking in developing economies. While such initiatives support availability, they also entail high operational costs. Therefore, complementary measures like financial literacy programs are crucial to transition users toward digital platforms. Evidence from Mishra et al. (2024) suggests that targeted literacy campaigns can significantly enhance FI in contexts with low formal education levels.

In addition, the intra-group analysis reveals that deposit accounts (0.26) hold the highest weight within the traditional usage dimension, followed by the DGDP ratio (0.2563). This trend aligns with targeted initiatives and supports the findings of Fielding & Regasa (2024), highlighting the increasing competition in the banking sector. Specifically, it underscores the Ethiopian banking industry's focus on deposit mobilization, which has been intensified by heightened competition. The number of commercial banks nearly doubled from 17 in 2015 to 31 in 2023, resulting in a 500% growth in total deposits (24.8% of GDP) by 2023 (NBE-FSR, 2024). Based on the second NFIS strategic plan (NFIS, 2021), the government has set an objective to enhance and expand FI, aiming for 70% of adults to possess a bank account by 2025. In pursuit of this goal and to attract more deposits, banks employed aggressive customer acquisition strategies, while government initiatives such as (NBE directive- FXD/49/2017 & FXD/81/2022) have also encouraged deposit retention by restricting cash withdrawals. However, the lower weights of the LGDP ratio (0.2491) and debit card penetration (0.2347) point to challenges in achieving balanced geographical and demographic inclusion. The NBE-FSR (2024) highlights that 99.8% of loans are disbursed in urban areas, with the top ten borrowers accounting for 23.5% of total outstanding loans. This urban-centric and cream-screaming lending pattern underscores the need for broader outreach strategies to ensure equitable financial access. This observation is consistent with the findings of Kappeler et al. (2018), who noted that 70% of micro-firms and 40% of SMEs in Ethiopia encounter difficulties in securing credit.

With regards to digital availability dimension, both agency banking indicators (disaggregated demographically and geographically) receive equal weights (0.5), indicating their shared

prominence. The rapid growth of Ethiopia's agent network, which expanded from three agents per 100,000 adults in 2016 to 77 per 100,000 by 2020 (NFIS, 2021), reflects the government's targeted intervention to enhance FI. Ethiopia's agent banking model, introduced under directive (NBE directive-FIS/02/2020) has provided a regulatory framework to facilitate this growth. Although still in its nascent stages, the adoption of scalable and efficient agent banking models is critical for overcoming infrastructural constraints and fostering value creation through innovative financial services (Mishra et al., 2024; Diniz et al., 2012).

Geographical disparities in FI remain significant, particularly in rural areas where limited infrastructure restricts access to financial services (Beck et al., 2007). Technological innovations such as mobile and internet banking are beginning to address this urban-rural divide, as documented in studies of mobile money adoption across Africa (Mishra et al., 2024). To that end, within digital accessibility dimension, WP holds the highest weight (0.3848), followed by MBP (0.3757) and IBP (0.2394). This suggests that mobile money wallets are the most preferred mode of digital financial access for the mass population. This aligns with the ease of opening mobile money accounts using just a phone number, in contrast to the more intricate processes involved in mobile and internet banking. Consequently, mobile wallets have become the preferred mode of digital financial access, facilitating transactions such as bill payments, mobile data charges, and peer-to-peer transfers. In contrast, internet banking's lower weight suggests it primarily caters to high-net-worth clients, reflecting a deliberate targeting strategy by Ethiopian banks. This finding aligns with observations by Mishra et al. (2024), who noted similar patterns in other developing economies where internet banking remains a premium service. Meanwhile, mobile banking adoption has been bolstered by cash limit directives (Directive Nos. FXD/49/2017 and FXD/81/2022), which incentivize digital transactions due to their enhanced security features compared to mobile wallets. The prevailing market position of mobile payment services signals a broader shift toward the dematerialization of payment methods, a trend with significant implications for advancing FI in Ethiopia.

4.4.2.2. Second stage principal component analysis

Building upon the first-stage analysis, the study employed the second stage-PCA to establish the weights of the four dimensions in developing the overall FI index. Similar to the first stage, adequacy tests were conducted to ensure the suitability of PCA for this analysis. As presented in Table A2 & Figure B1, the KMO measure (0.6361) satisfies $KMO > 0.5$ (Hair et al., 2019), Bartlett's (1950) test of sphericity ($p\text{-value} < 0.0001$), and the scree plot (Cattell, 1966) all satisfied the criteria for applying PCA.

It's important to clarify that the second-stage analysis focuses on inter-group rather than intra-group comparisons. This approach aims to identify group-specific drivers of FI. While intra-group PCA provides insights into the internal structure of the FI index within each group, inter-group PCA addresses how these dimensions differentiate FI levels across groups.

The extraction of a dominant principal component (PC1), based on eigenvalues presented in Table 6 (3.20, 0.53, 0.25, and 0.02), captures the most significant variation in the data across groups. Following the criterion (eigenvalue > 1), only PC1 is retained for further analysis. The weights assigned to each dimension within PC1 are critical indicators of their influence on the overall FI index in a group-specific context. This PC1 determines the weights assigned to each of the four dimensions in the overall FI index development, ensuring a comprehensive understanding of FI dynamics across different groups.

Table 6: Overall principal component analysis

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.20293	2.67426	0.8007	0.8007
Comp2	0.528673	0.281266	0.1322	0.9329
Comp3	0.247407	0.226421	0.0619	0.9948
Comp4	0.0209866		0.0052	1

Source: Computed based Stata 14 result

Concerning the principal components' structure, in Table 6, it is noted that the first component, responsible for 80.07% of the total data variation, indicates that only 19.97% of the variation is not accounted for; hence, it is considered a satisfactory extraction based on Hair et al. (2019). This result helps in reducing the number of selected components, as out of four components, one component has an eigenvalue exceeding 1, which the researchers retains to establish the FI index.

Table 7: Scoring coefficients (weights) using orthogonal varimax rotation

Indicators	Comp1	Unexplained	Normalized weights
tAvailability	0.5240	0.1205	0.2625
tUsage	0.5223	0.1263	0.2616
dAvailability	0.4500	0.3515	0.2254
dAccessibility	0.5002	0.1987	0.2505

Source: Computed based Stata 14 result

Based on the findings presented in Table 7, Equation (6) constructs the composite FI index (FII), emphasizing different dimensions' contributions:

$$FII = 0.2625Y_i^{at} + 0.2616Y_i^{ut} + 0.2254Y_i^{ad} + 0.2505Y_i^{pd} + E_i \quad (6)$$

Where,

- FII, represents overall FI index.
- Y_i^{at} , denotes traditional availability dimension.
- Y_i^{ut} , denotes traditional usage dimension.
- Y_i^{ad} , represents digital availability dimension
- Y_i^{pd} , represents penetration (accessibility) dimension.

The equation reveals that traditional availability (0.2625) has the highest normalized weight, indicating that expanding financial institution infrastructure significantly impacts the overall FII. This finding aligns with existing literature (e.g., Nguyen, 2021; Gharbi & Kammoun, 2023) and the researchers' expectations, emphasizing the importance of infrastructure development alongside financial literacy and user adoption. Usage (0.2616) is the second most significant dimension for overall FI, highlighting the importance of account usage and engagement with formal financial services. Digital accessibility (0.2505) ranks third, reflecting the growing role of digital tools in FI. However, agency banking has the lowest weight (0.2254), suggesting that while digital tools are cost-effective, targeted efforts are needed to reach vulnerable populations, such as women, rural residents, and those with low literacy.

4.4.3. Measuring commercial banks contribution for financial inclusiveness

Table 8 details the estimation of dimensions of the FI index. Notably, on average, the national FI score exhibits a substantial increase, rising from 10.89% in 2015 to 52.18% in 2023. This upward trajectory aligns with the launch of Ethiopia's National FI Strategy in 2015, which demonstrably facilitated broader entry to the formal financial sector. Historically, financial exclusion in Ethiopia has been both voluntary and involuntary (Desalegn & Yemataw, 2017). However, the observed improvement in FI score reflects a combination of technological advancements, socio-economic progress, and targeted government interventions.

A. Role of technological innovations

The adoption of core banking systems, particularly Temenos' T24 platform since 2012 by the Commercial Bank of Ethiopia (CBE), has been instrumental in expanding access. Innovations like Temenos' Arc Mobile have enabled banks to deliver advanced mobile banking services, such as SMS alerts, interactive SMS capabilities, and web-based financial services, thereby addressing the needs of previously unbanked populations. As more banks digitalized their operations, FI scores steadily improved across all dimensions, underscoring the transformative impact of digital technology.

B. Impact of government policies

Government-led initiatives have been instrumental in advancing FI through targeted policies. One notable measure was the introduction of interest-free banking within the conventional banking framework in 2011, which was later expanded by the Banking Business Proclamation Amendment (No. 1159/2019) to permit fully-fledged interest-free banks (Ahmed, 2020). This initiative widened the scope of formal financial services, particularly among communities with preferences for Sharia-compliant banking. Additionally, the licensing of Safaricom Ethiopia under the National Digital Payment Strategy (NDPS) marked a significant milestone in strengthening Ethiopia's telecom infrastructure. The subsequent introduction of mobile payment platforms, such as TeleBirr by Ethio-telecom in 2021, further propelled digital accessibility. By June 2023, TeleBirr had amassed over 36 million users, facilitating transactions worth Birr 856.22 billion (approximately USD 15 billion) and integrating with 23 banks. Consequently, the banking sector made substantial investments in digital technologies, particularly in mobile wallets. This expansion is reflected in the digital accessibility FI score, which increased from 0.09 in 2019 to 0.57 in 2023, reflecting an increase of over 533% (see Table 8). These findings underscore the effectiveness of policy reforms in enhancing DFI.

Table 8: Estimation of FI dimensions

	tAvailability	tUsage	dAvailability	dAccessibility	Mean
2015	0.2014	0.2257	0.0013	0.0071	0.1089
2016	0.2980	0.2476	0.0078	0.0170	0.1426
2017	0.3639	0.2812	0.0158	0.0304	0.1728
2018	0.4038	0.3061	0.0326	0.0448	0.1968
2019	0.4638	0.3355	0.0423	0.0899	0.2329
2020	0.5320	0.3540	0.0734	0.1925	0.2880
2021	0.5541	0.4074	0.0507	0.2859	0.3245
2022	0.6364	0.4178	0.2574	0.4253	0.4342
2023	0.7152	0.4346	0.3654	0.5720	0.5218

Source: Computed based Stata 14 result

C. Enabling infrastructure for FI

Infrastructure initiatives have further addressed critical barriers to FI. The National Electrification Program (2017) aims for universal electricity access by 2025, providing 65% of households with grid connections and 35% with off-grid solutions (Gebremeskel et al., 2021). Electricity availability is foundational for the growth of digital financial services, including Pay-As-You-Go (PAYGo) solar solutions, which also facilitate micro-credit access. Concurrently, the government's Digital Ethiopia strategy has introduced revised digital payment directives (ONPS/01/2020 and ONPS/09/2023), enabling a regulatory framework for fintech companies. These structural changes create an ecosystem conducive to FI.

The Fayda Digital ID initiative, launched in 2021, is another transformative development. This biometric ID system is designed to enhance KYC compliance and reduce identity fraud, enabling banks to expand services to unbanked populations. Once fully operationalized, this initiative is expected to significantly enhance FI by addressing accessibility barriers.

D. Socio-economic dynamics and autonomous developments

Socio-economic and technological advancements have also played a crucial role in shaping Ethiopia's FI landscape. The COVID-19 pandemic acted as a catalyst, accelerating the adoption of digital financial services as physical interactions became restricted prompted increased reliance on mobile and internet banking. This shift was facilitated by substantial growth in mobile and internet subscribers. Based on Ethio-telecom annual performance report for (2023), between 2019 and 2023, mobile subscribers increased by 66%, rising from 41.9 million to 69.5 million, while data and internet subscribers grew by 40%, from 22.3 million to 31.3 million. Consequently, the average FI score rose from 23.3% in 2019 to 52.18% in 2023, representing a 124% increase. This upward trend underscores the synergistic effects of autonomous developments, such as the expansion of mobile networks, alongside ad hoc measures like regulatory reforms.

The analysis of banking institution rankings by FI index in (Table A4) reveals a pronounced disparity in FI across bank sizes. Notably, the Commercial Bank of Ethiopia (CBE), the only large-sized bank in Ethiopia as revealed by NBE, on average contributes a substantial 48.99% to the overall national FI score. Conversely, as detailed in (Table A1), five medium-sized commercial banks collectively contribute 29.26%, as well the contribution of eleven small-sized banks is even lower at 21.75%.

Table 9: FI Score of Ethiopian commercial banks

CBEs/Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average Share	Rank
CBE	0.2438	0.3332	0.3764	0.4047	0.4578	0.5641	0.5423	0.7380	0.7989	0.4955	1
Dashen	0.0394	0.0432	0.0475	0.0561	0.0830	0.1005	0.1148	0.1559	0.2226	0.0959	2
Awash	0.0288	0.0355	0.0455	0.0544	0.0642	0.0782	0.1259	0.1792	0.2222	0.0926	3
Abyssinia	0.0155	0.0211	0.0289	0.0346	0.0414	0.0596	0.0972	0.1703	0.2052	0.0749	4
CBO	0.0139	0.0173	0.0333	0.0448	0.0535	0.0715	0.0864	0.1180	0.1703	0.0677	5
Wogagen	0.0172	0.0209	0.0276	0.0334	0.0405	0.0514	0.0599	0.0658	0.0736	0.0434	6
United	0.0171	0.0185	0.0245	0.0288	0.0339	0.0393	0.0436	0.0484	0.0543	0.0343	7
Nib	0.0138	0.0157	0.0215	0.0261	0.0310	0.0348	0.0411	0.0428	0.0514	0.0309	8
OIB	0.0128	0.0160	0.0185	0.0224	0.0273	0.0289	0.0340	0.0420	0.0630	0.0294	9
Lion	0.0079	0.0125	0.0176	0.0218	0.0260	0.0361	0.0404	0.0404	0.0403	0.0270	10
Abay	0.0070	0.0101	0.0124	0.0150	0.0180	0.0211	0.0276	0.0373	0.0497	0.0220	11
Bunna	0.0061	0.0079	0.0110	0.0137	0.0156	0.0195	0.0268	0.0289	0.0517	0.0201	12
Birhan	0.0054	0.0086	0.0133	0.0150	0.0186	0.0214	0.0257	0.0310	0.0360	0.0194	13
Zemen	0.0028	0.0042	0.0048	0.0057	0.0075	0.0087	0.0110	0.0139	0.0181	0.0085	14
Addis	0.0018	0.0027	0.0039	0.0046	0.0052	0.0060	0.0069	0.0080	0.0088	0.0053	15
Debab	0.0010	0.0014	0.0020	0.0026	0.0036	0.0058	0.0080	0.0090	0.0106	0.0049	16
Enat	0.0011	0.0018	0.0025	0.0037	0.0043	0.0049	0.0066	0.0079	0.0104	0.0048	17

Source: Computed based on Stata 14 result

This observed pattern aligns with the researchers' expectation, suggesting that large banks currently offer more inclusive financial services and possess a more extensive infrastructure compared to their medium and small-sized counterparts. This finding underscores the potential presence of inclusion gaps among small and medium-sized commercial banks in Ethiopia. To address this disparity and promote shared prosperity, the implementation of tailored FI initiatives as a national strategy appears highly recommended.

4.4.4. Verifying the strength of the FI index

Building on the work of Ahamed & Mallick (2019), Nguyen (2021), and Gharbi & Kammoun (2023), the researchers perform a robustness test to assess the validity and stability of the newly developed FI index compared to existing FI indices. This involves conducting a validity test to confirm the reliability of the new FI index.

The researchers used deposit and real lending interest rates (RLIR) as essential variables to validate the developed FI index from Ethiopian context. Deposits are vital for banks, as they are the primary source of working capital and crucial for bank sustainability and profitability (Nesru & Mekonnen, 2022; Namazi & Salehi, 2010). They also play a significant role in economic growth by increasing investment (Tun, 2019; Gunasekara & Kumari, 2018) and enabling banks to extend credit, which is their main revenue stream (Viswanadham et al., 2013). Additionally, understanding RLIR helps individuals and businesses make informed financial decisions and strengthen banks' monitoring mechanisms (Moyo & Phiri, 2024).

To that end, the researchers used the overall average of FI of the country and measured the correlation between the saving and real lending interest rate and newly developed FI index. The Pearson correlation results presented in Table 10 show p-values of 0.0000 and 0.0002, respectively, indicating that the correlations are statistically significant at the 1% level (0.9617 for saving) and (-0.9391 for real lending interest rate). These results therefore demonstrate the highly robustness of the newly created index.

Table 10: Pearson correlation between FI index, saving and real deposit interest rate

		FII
FII	Pearson Correlation	1
Saving	Pearson Correlation	0.9617***
	Sig. (bilateral)	0.0000
RLIR	Pearson Correlation	-0.9391***
	Sig. (bilateral)	0.0002

Source: Computed based on Stata 14 result

Table 10 presents the correlation coefficients between this study PCA-derived FI index and both saving and real lending interest rates. The results reveal a remarkably strong positive association between FI and savings (correlation coefficient = 0.96) and a strong negative association between FI and real lending interest rates (correlation coefficient = -0.93). Notably, these associations are significantly stronger than those reported by Gharbi & Kammoun (2023) (0.62 for FI and savings, -0.13 for FI and real interest rate). Moreover, this study result demonstrates statistically significant correlations at the 0.1% level for both variables.

The direction of the correlations aligns with theoretical expectations. Real lending interest rates are negatively correlated with FI, as high rates make loans more expensive and discourage access, particularly for low-income populations (Uddin et al., 2017). Conversely, in relation to deposits, a positive higher FI scores are associated with increased savings, likely due to a greater number of households having access to financial institutions and associated saving products (Gharbi & Kammoun, 2023). These robust correlations provide strong evidence for the construct validity of the newly developed FI index.

5. Conclusion and Recommendation

Recognizing the critical importance of FI, Ethiopia has extended its commitment with the second NFIS in 2021, building upon the initial strategy from 2015 to 2021. This study addresses a significant gap by developing a composite multidimensional index to measure FI in Ethiopia, using annual commercial bank data spanning from 2015 to 2023. The methodology employed a two-stage PCA approach, focusing on both traditional and digital indicators.

The result indicates that traditional dimensions of availability (0.2625) and usage (0.2616) are significant in determining the degree of the traditional financial index. In the digital aspect, digital accessibility (0.2254) encompassing tools like digital wallets, mobile banking, and internet banking, proves more determining than digital availability (0.2505), highlighting that the presence of banking institutions in remote areas remains limited. For enhanced FI, policymakers must address the needs of those involuntarily excluded from formal financial services. The evidence suggests that digitalization is a crucial strategy to engage these excluded groups. The findings also demonstrate that Ethiopia's efforts to improve financial inclusivity have markedly improved the country's FI score, rising from a low average of 10.9% in 2015 to a relatively high 52.2% in 2023. This study's FI index underscores that increasing both traditional and digital financial services is key to expanding the inclusiveness of the formal financial system.

The paper contributes significantly to the existing literature as the first comprehensive measurement of FI in Ethiopia using both traditional and digital indicators. By evaluating the performance of commercial banks in providing financial services to underserved populations, it provides valuable insights for policy makers and financial institutions to make informed decisions and implement dimensionally tailored initiatives. Improving access to and building robust FI systems is crucial for integrating underserved and underbanked populations into the formal financial sector. Moreover, the incorporation of digital indicators such as mobile money and agency banking in the calculation of the FI index represents a significant contribution of this study. This highlights the crucial role that digital tools play in enabling low-income individuals to access and use financial products and services.

Based on the study empirical results, the researchers provided the following government and commercial bank specific recommendations. First, the government should prioritize the expansion of the digital ecosystem and infrastructure while fostering an innovation-conducive environment to enhance FI. This will facilitate the implementation of the multidimensional FI measurement index, serving as a dynamic tool for monitoring progress, identifying gaps, and informing evidence-based policy decisions. Commercial banks, meanwhile, should prioritize expanding their reach in remote areas. Providing formal financial services through cost-effective approaches like agency banking and tailored digital solutions can increase accessibility and promote social inclusion.

For future studies may explore regional variations within Ethiopia, which might differ by the economic and social heterogeneity of the regions. Also, deeper insights require analysis of policy perspectives in the sector, and inform tailored interventions to advance inclusive financial practices at regional and national levels.

Appendix

Table A 1: List commercial banks in their type

Name of Commercial banks of Ethiopia	Short code	NBE-Category
Commercial Bank of Ethiopia	CBE	Large-sized
Awash International Bank	Awash	Medium-sized
Dashen Bank	Dashen	Medium-sized
Bank of Abyssinia	Abyssinia	Medium-sized
Wegagen Bank	Wogagen	Small-sized
United Bank	United	Medium-sized
Nib International Bank	Nib	Small-sized
Cooperative Bank of Oromia	CBO	Medium-sized
Lion International Bank	Lion	Small-sized
Buna International Bank	Bunna	Small-sized
Oromia International Bank	OIB	Small-sized
Zemen Bank	Zemen	Small-sized
Berhan International Bank	Berhan	Small-sized
Addis International Bank	Addis	Small-sized
Abay Bank	Abay	Small-sized
Debub Global Bank	Debub	Small-sized
Enat Bank	Enat	Small-sized

Source: Prepared by authors

Table A 2: KMO Measure & Bartlett's Test of Sphericity for traditional & digital datasets

	Dimensions	KMO	Overall KMO	Bartlett's test of sphericity
Traditional Usage	tAvailability	0.5948	0.6361	P value= 0.000 Chi-square= 709.297(6*)
	tUsage	0.6121		
	dAvailability	0.6663		
	dAccessibility	0.6991		

Source: Computed based on Stata 14 result

Table A 3: Data reliability test

Traditional indicators Scale reliability coefficient	0.9839
Digital indicators Scale reliability coefficient	0.8770
Overall FI indicators Scale reliability coefficient	0.9721

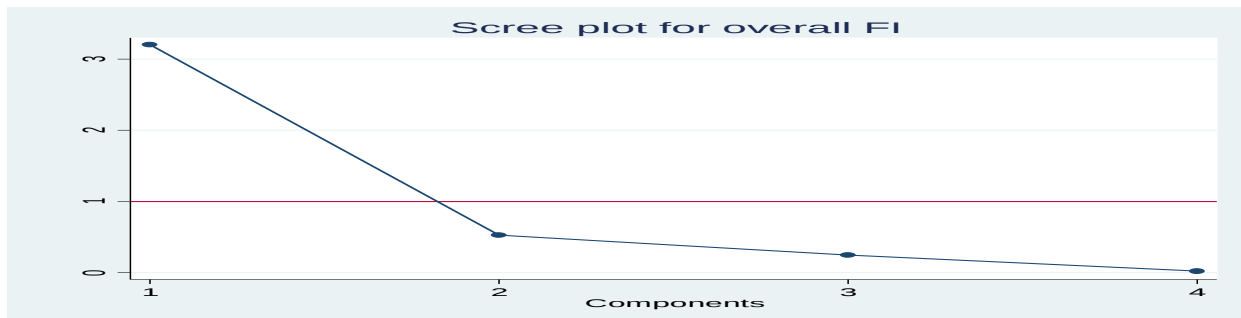
Source: Computed based on Stata 14 result

Table A 4: Average contribution of each commercial bank from FI score

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average score
CBE	0.5599	0.5840	0.5446	0.5140	0.4915	0.4897	0.4177	0.4249	0.3828	0.4899
Awash	0.0661	0.0622	0.0659	0.0691	0.0689	0.0679	0.0970	0.1031	0.1065	0.0785
Dashen	0.0905	0.0757	0.0687	0.0713	0.0891	0.0873	0.0884	0.0898	0.1067	0.0853
Abyssinia	0.0356	0.0370	0.0417	0.0440	0.0444	0.0518	0.0749	0.0981	0.0983	0.0584
Wogagen	0.0395	0.0367	0.0399	0.0424	0.0435	0.0446	0.0461	0.0379	0.0353	0.0406
United	0.0393	0.0325	0.0355	0.0365	0.0364	0.0341	0.0336	0.0279	0.0260	0.0335
Nib	0.0317	0.0275	0.0311	0.0331	0.0333	0.0302	0.0317	0.0247	0.0246	0.0298
CBO	0.0318	0.0302	0.0481	0.0569	0.0575	0.0621	0.0666	0.0680	0.0816	0.0559
Lion	0.0181	0.0218	0.0255	0.0276	0.0279	0.0313	0.0311	0.0232	0.0193	0.0251
Bunna	0.0141	0.0139	0.0158	0.0174	0.0167	0.0169	0.0206	0.0167	0.0248	0.0174
OIB	0.0293	0.0280	0.0267	0.0285	0.0293	0.0251	0.0262	0.0242	0.0302	0.0275
Zemen	0.0065	0.0074	0.0070	0.0073	0.0080	0.0076	0.0085	0.0080	0.0087	0.0077
Birhan	0.0124	0.0151	0.0192	0.0190	0.0200	0.0186	0.0198	0.0178	0.0172	0.0177
Addis	0.0042	0.0047	0.0056	0.0058	0.0056	0.0052	0.0054	0.0046	0.0042	0.0050
Abay	0.0161	0.0177	0.0180	0.0190	0.0193	0.0183	0.0212	0.0215	0.0238	0.0194
Debub	0.0024	0.0025	0.0029	0.0033	0.0038	0.0050	0.0062	0.0052	0.0051	0.0040
Enat	0.0025	0.0032	0.0037	0.0047	0.0047	0.0042	0.0051	0.0045	0.0050	0.0042

Source: Computed based on Stata 14 result

Figure B 1: Scree plot for overall FI dimensions



Source: Computed based on Stata 14 result

Table A 5: Overview of indicators and methods used in prior studies on FI measurement.

Author(s)	Methodology	Normalization and Aggregation Method	Dimensions	Components
Sarma (2008)	UNDP approach: inverse euclidean distance method	$1 - \frac{\sqrt{(1 - BP)^2 + (1 - A)^2 + (1 - U)^2}}{\sqrt{n}}$ Where Using weights: 1 for the index of banking penetration (BP), 1 for availability (A) and 1 for of usage (U). In the three-dimensional Cartesian space (ideal displaced method), the point (0, 0, 0) indicate the worst and the point (1, 1, 1) indicate the best. Normalized as; $D_i = \frac{A_i - m_i}{M_i - m_i}$, Where: D_i= ith dimension; A_i = Actual value of dimension i, M_i = Maximum value of dimension i, m_i = Minimum value of dimension i	Availability	Number of bank branches per 100,000 adults
			Banking penetration	Number of bank deposit accounts per 1000 adults
			Usage	Volume of deposits to adults as a proportion of GDP
				Volume of credit to adults as a proportion of GDP
Sarma (2012 & 2015)	UNDP Approach: inverse Euclidean distance method with some Sarma 2008 improvement	$IFI = 1/2 \left[\left(\frac{\sqrt{BP^2 + A^2 + U^2}}{\sqrt{n}} \right) + \left(1 - \frac{\sqrt{(1 - BP)^2 + (1 - A)^2 + (1 - U)^2}}{\sqrt{n}} \right) \right]$ Where Similar to Sarma (2008), but there is more improvement by using approaches of displacement from both the ideal and worst point. Normalized as; $D_i = \omega_i \frac{A_i - m_i}{M_i - m_i}$, Where: ω_i= weight attached to the dimension i, A_i= Actual value of dimension i, M_i = upper limit on the value of dimension i, m_i = lower limit on the value of dimension i	Availability	Number of bank branches per 100,000 adults (using 2/3rd weight for bank branch index)
				Number of bank ATMs per 100,000 adults (using 1/3rd weights for ATM index)
			Bank penetration	Number of bank deposit accounts per 1000 adults
			Usage	Volume of deposits to adults as a proportion of GDP
				Volume of credit to adults as a proportion of GDP
Sarma (2016)	UNDP Approach: inverse Euclidean distance method with some Sarma 2015 improvement	$IFI = 1/2 \left[\left(\frac{\sqrt{BP^2 + A^2 + U^2}}{\sqrt{1.5}} \right) + \left(1 - \frac{\sqrt{(1 - BP)^2 + (0.5 - A)^2 + (0.5 - U)^2}}{\sqrt{1.5}} \right) \right]$ Where Similar to Sarma (2015), there is more improvement than using the distance from the lowest point (0, 0, 0) to the ideal point (1, 0.5, 0.5). Normalized as;	Availability	Number of bank branches per 100,000 adults (using 2/3rd weight for bank branch index)
				Number of bank ATMs per 100,000 adults (using 1/3rd weights for ATM index)
			Banking penetration	Number of bank deposit accounts per 1000 adults
			Usage	Volume of deposits to adults as a proportion of GDP

		$D_i = \omega_i \frac{A_i - m_i}{M_i - m_i}$, Where: ω_i = weight attached to the dimension i, A_i = Actual value of dimension i, M_i = upper limit on the value of dimension i, m_i = lower limit on the value of dimension i		Volume of credit to adults as a proportion of GDP
Chakravarty & Pal, 2013	An axiomatic approach	$IFI = \frac{1}{n} \sum_{i=1}^n d_i$ Normalized as; $A(x_i, m_i, M_i) = \left(\frac{x_i - m_i}{M_i - m_i} \right)^r$, Where, x_i : the actual value of indicator i, m_i : the minimum value of indicator i, M_i : the maximum value of dimension i, r : inclusion sensitivity ($0 < r < 1$).	Access	i) Number of bank branches and ATMs per 100,000 adults; ii) Number of bank branches and ATMs per 1,000KM
			Usage	i) Number of loans and deposits per 1,000 people; ii) Average size of loans and deposits to GDP per capita
Wang & Guan (2017)	UNDP approach: inverse Euclidean distance method but uses coefficient of variation (CV) to assign weights for each dimensions	Normalized by using (Max-Min approach) $x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}}$ Aggregated by $w_{ij} = \frac{V_{ij}}{\sum_j V_{ij}}$ Computed by $IFI_i = 1 - \frac{\sqrt{W_{i1}^2(1 - x_{i1})^2 + W_{i2}^2(1 - x_{i2})^2 + \dots + W_{in}^2(1 - x_{in})^2}}{\sqrt{W_{i1}^2 + W_{i2}^2 + \dots + W_{in}^2}}$ Where W_{i1} =Weight of indicator 1 in dimension i, squared; V_{ij} =the CV(the ratio of the standard deviation σ to the mean value μ) of dimension i; w_1 = the weight of dimension 1 (access); w_2 =the weight of dimension 2 (usage)	Access	Possession of a debit card (% age 15+) account at a formal financial institution (% age 15+) (account) ATMs per 100,000 adults branches of commercial banks per 100,000 adults (facility)
			Usage	Checks used to make payments (% age 15+) electronic payments used to make payments (% age 15+) (Payment) (i) Saved at a financial institution in the past year (% age 15+); (ii) Outstanding deposits with commercial banks (% of GDP (Saving))
				(i) Loan from a financial institution in the past year (% age 15+); (ii) Outstanding loans with commercial banks (% of GDP)
Amidzic et al. (2014) and Mialou et al (2017)	Weighted geometric average; weights derived from factor analysis	Normalized as $n_{xic} = \frac{XIC}{M_i}$ Aggregated as	Outreach	(i) ATMs per 1000 sq km; (ii) other depository corporations (ODC) branches per 1000 sq km
			Usage	(i) total number of resident household depositors with ODCs per 1000 adults; (ii)

		$A = e^{\frac{\sum_1^n w_i \log x_i}{\sum_1^n w_i}}$ Determining dimensions using factor analysis (FA) as; $\vec{Y} = L\vec{F} + \vec{E}$ Where: xiC =value of variable/dimension i for country c; $nx iC$ = normalized value of i for country c; Mi = Maximum value of i across countries; A = weighted geometric aggregator; wi = weight given to variable/dimension		total number of resident household borrowers with ODCs per 1000 adults
Nguyen (2020)	Two stage PCA (based on Camara & Tusta, 2014) approach	Before using PCA, indicators of each dimension are normalized to have values between zero and one. At first stage: they calculated eigenvalues of each sub-index and estimate the latent variables: penetration, availability and usage, (Y_i^p, Y_i^a, Y_i^u) respectively are computed as: $Y_i^p = \beta_1 \text{deposit accounts}_i + \beta_2 \text{mobile money accounts}_i + u_i$ $Y_i^a = \theta_1 \text{branches}_i + \theta_2 \text{ATMs}_i + \theta_3 \text{mobile money agents}_i + \varepsilon_i$ $Y_i^u = \gamma_1 \text{deposits}_i + \gamma_2 \text{loans}_i + \gamma_3 \text{mobile money transactions}_i + v_i$ Then at second stage: they estimated dimensions' weights and latent variable FII is linearly determined as follows: $IF_i = \omega_1 Y_i^p + \omega_2 Y_i^a + \omega_3 Y_i^u + e_i$, where e FII _i is composite FI index of country i; $\omega_1; \omega_2; \omega_3$: the relative weights of each dimension. e_i is variation due to error	Availability	Branches
				ATMs
				Mobile money agents
			Penetration	Deposit accounts
				Mobile money accounts
			Usage	Deposits
Park Mercado & (2018)	Combining the approaches of Sarma (2016) and Camara & Tusta (2014)	Normalization Normalized each indicators in each dimensions $x_{id} = \frac{x_i - m_i}{M_i - m_i}$ Where: x_i: the actual value of indicator i; m_i: the minimum value of indicator i; M_i: the maximum value of dimension i; X_i, d: the standardized value of indicator i of dimension d. Determined using PCA as; $IFI_i = \omega_1 D_{1i} + \omega_2 D_{2i} + \omega_3 D_{3i}$ Where IFI_i: the aggregate FI index for country i; w: the weights derived from PCA; D_i: the dimensions	Access	Percentage of the adult population with financial accounts to total adult population.
				Percentage of the adult population with financial Credit card to total adult population.
				Percentage of the adult population with financial Debit card to total adult population.
				Percentage share of the adult population with a mobile money account
			Availability	ATMs per 100,000 adults
				Commercial bank branches per 100,000 adults

			Usage	Borrowers from commercial banks per 1,000 adults
				Depositors with commercial banks per 1,000 adults
				Domestic credit/GDP ratio
Camara and Tuesta (2014)	PCA	FI Computed by using 2 stage PCA method At the first stage: they estimated the three sub-indices: usage, barriers and access, respectively $Y_i^u = \beta_1 \text{account}_i + \beta_2 \text{saving}_i + \beta_3 \text{loan}_i + u_i$ $Y_i^b = \theta_1 \text{distance}_i + \theta_2 \text{affordability}_i + \theta_3 \text{documents}_i + \theta_4 \text{trust}_i + \varepsilon_i$ $Y_i^a = \gamma_1 \text{ATM}_{\text{pop}i} + \gamma_2 \text{branch}_{\text{pop}i} + \gamma_3 \text{ATM}_{\text{km}^2i} + \gamma_4 \text{branch}_{\text{km}^2i} + v_i$ Then at second stage: they estimated dimensions' weights and the overall FI index using $\text{FI}_i = \omega_1 Y_i^u + \omega_2 Y_i^b + \omega_3 Y_i^a + e_i$	Access	Commercial bank branches per 100,000 adults
				ATMs per 100,000 adults
				Commercial bank branches per 1000 km2
				ATMs per 1000 km2
			Usage	% of adults who hold at least one financial product (account);
				Saved at a financial institution in the past year (% age 15+) (savings);
				Loan from a financial institution in the past year (% age 15+) (loan)
			Barriers	Distance
				Affordability
				Documentation
				Lack of trust
Ahmed and Mallick (2017)	PCA	First, the researchers Winsorized each indicator at the 95th percentile levels to reduce the influence of outliers at the upper tail. And indicators of each dimension are normalised between 0 to 1 scale FI Construction using $\text{FI index} = \sum_i^n \omega_{ij} X_i$ Where: ω_{ij} are the component's loadings or weights; and X_i are the original variables.	Outreach	i) the number of bank branches per 100,000 people;
				ii) the number of ATMs/100,000 people;
				iii) the number of bank branches per 1,000 km
				iv) the number of ATMs per 1,000 km
			Usage	number of bank accounts per 1,000 populations
Gupte et al. (2012)	UNDP approach : used geometric mean method to	Normalization Normalized each indicators in each dimensions $x_{id} = \frac{x_i - m_i}{M_i - m_i},$	Outreach (D1)	Accessibility
				i) the number of bank branches per 1,000 l (Availability)
				ii) the number of bank branches ATMs per 1, km2

	compute weights of the dimensions	Where: x_i: the actual value of indicator i; m_i: the minimum value of indicator i; M_i: the maximum value of dimension i; X_i, d: the standardized value of indicator i of dimension d. FI constructed using geometric mean as; $FII = (D_1^{\frac{1}{5}} * D_2^{\frac{1}{5}} * D_{3a}^{\frac{1}{5}} * D_{3b}^{\frac{1}{5}} * D_4^{\frac{1}{5}}$, where; D_1: is the Dimension index for Outreach; D_2: is the Dimension index for Usage; D_{3a}: is directly related variables to ease of transaction dimensions; D_{3b}: inversely related variables to ease of transaction dimensions; D_4: considered as the dimension relating to the cost of transactions		Usage	iii) the number of bank branches per 100,000 people
					iv) the number of bank ATMs per 100,000 people
					v) the number of accounts (deposits and loans) per 1,000 adults
			Usage (D2)		volume of deposits and loans as % of GDP
			Ease of transaction	Directly related variables (D3a)	i) locations to open deposit account (out of 3)
					ii) locations to submit loan applications deposit account (out of 5)
				Inversely related variables (D3b)	i) minimum amount to open savings accounts (% of GDPPC)
					ii) minimum amount to open checking accounts (% of GDPPC)
					iii) minimum Amount to be maintained in checking accounts (% of GDPPC)
					iv) minimum Amount to be maintained in savings accounts (% of GDPPC)
					v) minimum amount of consumer loan (% of GDPPC)
					vi) minimum amount of mortgage loan (% of GDPPC)
					vii) number of documents to open checking account (out of 5);
					viii) number of documents to open saving account (out of 5)
					ix) Days to process consumer loan application
x) Days to process mortgage loan application					
Cost of transaction (D4)		i)Fees associated with consumer loans (as % of GDP per capita)			
		ii) Fees associated with mortgage loans (as% of GDP per capita)			

				iii) The fees associated with maintaining the checking account iv) The fees associated with maintaining savings account v) The fees banks charge to transfer funds internationally (% of \$250) vi) Amt of fees for using ATM cards (% of \$ 100
Ismail and Ali (2021)	Three stage PCA	Normalization The researcher used standard score normalization before using PCA, indicators of each dimension are normalized to have values between zero and one FI construction At first stage of PCA: estimate the dimensions (three sub-indices: Access, Usage and Barriers) for both traditional & digital FI index, 1. The dimensions of “usage”, “access” and “barriers” of the traditional FI index are computed as; $Y^a = \beta_1 \text{ATMs} + \beta_2 \text{bank branches}$ $Y^u = \alpha_1 \text{credit cards} + \alpha_2 \text{debit cards} + \alpha_3 \text{deposit accounts} + \alpha_4 \text{loans}$ $Y^b = \varphi_1 \text{branches}_{\text{km}^2} + \varphi_2 \text{ATMs}_{\text{km}^2} + \varphi_3 \text{savings} + \varphi_4 \text{borrowings}$ 2. The dimensions of “usage”, and “access” of the Digital FI index are computed as; $Y^a = \beta_1 \text{mobile subscriptions} + \beta_2 \text{mobile money accounts} + \beta_3 \text{mobile internet users}$ $Y^u = \alpha_1 \text{mobile payment accounts} + \alpha_2 \text{mobile money transactions} + \alpha_3 \text{online payments} + \alpha_4 \text{mobile online payments}$ The Second Stage PCA: it combines the sub – indices from the first stage PCA to compute a separate index for overall traditional (FIT) and digital FI index (FID). $IF_T = \omega Y^a + \omega Y^u + \omega Y^b + \varepsilon$ $IF_D = \omega Y^a + \omega Y^u + \varepsilon$ The third stage PCA: the overall FI is produced as; $IF_i = \omega_1 (FI_T) + \omega_2 (FI_D) + \varepsilon$	Access (traditional FI dimension)	No. of ATMs per 100,000 adults. No. of branches per 100,000 adults
			Access (digital FI dimension)	Mobile cellular subscription per 100 people Number of registered mobile money accounts. % of mobile internet users
			Usage (traditional FI dimension)	No. of deposit accounts with commercial banks per 1,000 adults. No. of borrowers from commercial banks per 1,000 adults. No. of debit cards per 1,000 adults. No. of credit cards per 1,000 adults
			Usage (digital FI dimension)	Mobile payments accounts. No. of mobile money transactions per 1000 adults. Makes online purchases or pay an online bill. Made an online purchase via a mobile.
			Barriers (traditional FI dimension)	No. of commercial bank branches per 1000km ² No. of ATMs per 1000km ² Borrowed from a FI in rural areas Saved at FI rural aged 15+

TTH Nguyen	Two stage PCA	Normalization The researcher used standard score normalization before using PCA, indicators of each dimension are normalized to have values between zero and one, FI construction The first stage of the PCA: estimate the dimensions (three sub-indices: Access (penetration), Availability and Usage), respectively $Y_i^p = \beta_1 \text{deposit accounts}_i + \beta_2 \text{mobile money accounts}_i + u_i$ $Y_i^b = \theta_1 \text{branches}_i + \theta_2 \text{ATMs}_i + \theta_3 \text{mobile money agents}_i + \epsilon_i$ $Y_i^a = \gamma_1 \text{deposits}_i + \gamma_2 \text{loan}_i + \gamma_3 \text{mobile money transactions}_i + v_i$ Then at second stage: they estimated dimensions' weights and the overall FI index using $FII_i = \omega_1 Y_i^u + \omega_2 Y_i^b + \omega_3 Y_i^a + e_i,$ Where; FII_i is composite FI index of country i; ω_1; ω_2; ω_3; the relative weights of each dimension. e_i is variation due to error.	Access	Number of deposit accounts with commercial banks, credit unions and credit cooperatives per 1,000 adults
				Number of registered mobile money accounts per 1,000 adults
			Availiablity	Number of commercial bank, credit union, credit cooperative and all microfinance institution branches per 100,000 adult
				Number of Automated Teller Machines (ATMs) per 100,000 Adults
				Number of registered mobile money agent outlets per 100,000 Adults
			Usage	Outstanding deposits with commercial banks, credit unions and credit cooperatives (% of GDP)
Nizam et al (2020)	Combination of parametric method (Principle Component Analysis (PCA) and non-parametric method (multidimensional)	Normalization $D_i = \omega_i \frac{A_i - m_i}{M_i - m_i},$ Where: ω_i= weight attached to the dimension i (determined endogenously through PCA analysis), A_i= Actual value of dimension i, M_i = upper limit on the value of dimension i, m_i = lower limit on the value of dimension i Then, two stage PCA applied 1. At first stage PCA: the estimation of parameters or weights of four index dimensions which are banking penetration, availability, usage, and fintech 2. At second stage PCA: involves the estimation on dimension (banking penetration, availability, usage, and fintech dimension) weights and the overall FI index as;	Bank Penetration (d _i 1)	The number of deposit bank account per 1000 adult population
			Availability(d _i 2)	The number of ATM per 100,000 people
				The number of bank outlets per 100,000 populations
			Usage (d _i 3)	Deposit from a commercial bank (% of GDP) in a country
				Credit from a commercial bank (% of GDP) in a country
			Digital (d _i 4)	Used internet to pay bills or to buy something online in the past year (% age 15+),

$FI_i = \omega_1 Y_i^p + \omega_2 Y_i^a + \omega_3 Y_i^u + \omega_4 Y_i^f + e_i$, Where; FI_i is composite FI index of country i ; ω_1 ; ω_2 ; ω_3 ; ω_4 the relative weights of each dimension. e_i is variation due to error.

At the last, the final formula for constructing IFI index for a country calculated as;

$$IFI_k = 1/2 \left[\left(\frac{\sqrt{p_k^2 + a_k^2 + u_k^2 + f_k^2}}{\sqrt{n}} \right) + \left(1 - \frac{\sqrt{(z - p_k)^2 + (z - a_k)^2 + (z - u_k)^2 + (z - f_k)^2}}{\sqrt{n}} \right) \right]$$

Where p_k , a_k , u_k and f_k denote respectively the weighted dimension indexes for the dimensions penetration, availability, usage, and fintech.

Paid utility bills using a mobile phone (% age 15+)

Made or received digital payments in the past year (% age 15+).

CHAPTER THREE: THE IMPACT OF TRADITIONAL AND DIGITAL FI ON BANK PROFITABILITY: EVIDENCE FROM ETHIOPIAN COMMERCIAL BANKS

Submit to Prague Economic Papers (Under Review Stage)

Abstract

While prior research emphasizes the socio-economic benefits of financial inclusion, its implications for bank profitability remain underexplored. This paper employs seven traditional and four digital indicators to create a financial inclusion index through principal component analysis (PCA). To capture potential nonlinearities, quadratic specifications are incorporated within a two-step system generalized method of moments (GMM) framework and validated using the Lind and Mehlum (2010) U-shape test, while Granger causality tests examine directional effects over the 2015–2023 period. Results indicate that traditional financial inclusion positively influences profitability, although the hypothesized inverted U-shaped effect is economically plausible but not statistically confirmed. Digital financial inclusion initially reduces profitability, but its squared term reveals a statistically significant U-shaped effect, indicating gains after reaching a critical threshold. Granger causality test indicates a bi-directional relationship for traditional inclusion and a uni-directional for digital inclusion. The results emphasize the need for banks to integrate cost-effective digital tools alongside traditional services. Policymakers recommended adopting supportive regulatory frameworks, enhancing financial literacy, and ensuring consumer protection to foster digital transformation without undermining profitability. An integrated and phased approach aligning financial inclusion with profitability strategies is essential for promoting a resilient and inclusive banking sector.

Key word: Traditional FI; digital FI; principal component analysis; bank profitability; GMM; Ethiopia

JEL Classifications: G21; C38; C13; O55

1. Introduction

Banks serve as critical components of the financial system, acting as intermediaries that channel surplus capital into productive investments, thereby facilitating efficient resource allocation and serving as a key driver of economic growth (Jajah et al., 2022; Guo & He, 2019; Bayiley, 2013). Beyond their direct contributions to growth, banks influence financial markets, controlling significant portions of the money supply and shaping the production landscape through the regulation of money circulation (Al Karim & Alam, 2013; Brigham & Houston, 2011). Furthermore, banks serve as conduits for transmitting government economic policies, particularly monetary policy, into the broader economy (Musau et al., 2018). Consequently, a well-functioning banking sector is essential for sustained economic progress, while poorly functioning banks can impede development and exacerbate poverty (Joseph et al., 2012).

The full potential of the financial sector can be realized if it is inclusive (Jajah et al., 2022). Financial inclusion (FI), facilitated largely by financial institutions, plays an important role in providing vulnerable and underserved populations with access to affordable financial services (Kanungo & Gupta, 2021; Demirguc-Kunt et al., 2018). This access is instrumental in elevating both individual economic standing and societal welfare, particularly for low-income society (Demirguc-Kunt et al., 2018; Lal, 2018). FI is commonly examined through access, availability, and usage of banking products and services (Erlando et al., 2020). 'Access' pertains to the penetration of financial services into the society, 'availability' to the infrastructure that supports these services, and 'usage' to the actual adoption and utilization of financial products (Sedera et al., 2022). While banks strive to maximize shareholder value (Pilloff, 1996; Kumar, 2016; Pennacchi & Santos, 2021), there is an increasing demand from underserved segments of society for affordable, innovative financial services with flexible terms (Shihadeh, 2021; Arner, 2020; Fernandez-Olit et al., 2019). Governments are instrumental in promoting FI through initiatives that enhance financial literacy and incentivize banks to extend their services, particularly in rural areas (Shihadeh, 2021).

Historically, commercial banks have centered their business models on urban, formally employed, and well-documented clients, leaving vast segments of the population excluded from formal finance (Perdana et al., 2025). Efforts to extend conventional services to these underserved groups have increased workforce requirements, operational burdens, and risk exposure. As banks allocate more resources to long-tail customers, their ability to maintain service quality for high-value clients may weaken, contributing to deteriorating overall performance (Zhao et al., 2024). For decades, these customers were considered unprofitable

due to high transaction costs, regulatory barriers, and perceived risks (Perdana et al., 2025). Expanding outreach often elevates operational costs and capital expenditures (Mehrotra & Yetman, 2015; Shihadeh, 2020), and lending to individuals and SMEs involves heightened credit risks arising from inadequate collateral, competition, and volatile income (Shihadeh et al., 2019). However, emerging evidence points to a structural transformation. Advances in digital finance, data analytics, and alternative delivery channels are enabling banks to serve previously excluded populations in commercially viable ways. Digital transformation has reduced marginal service costs, strengthened risk assessment, and broadened access for millions of consumers (Perdana et al., 2025; Zhao et al., 2024). In parallel, incorporating unbanked individuals and firms into the formal system can expand customer bases, mobilize deposits, and create new lending opportunities, thereby enhancing profitability (Ahamed et al., 2021; Shihadeh, 2020). Accordingly, the relationship between FI and bank profitability remains multifaceted, context-dependent, and theoretically contested (Jajah et al., 2022), underscoring the need to balance outreach with prudent risk management (Shihadeh, 2020).

This study offers several significant contributions to the broader literature. First, despite the growing recognition FI's importance, research on its effect on bank profitability remains sparse, particularly in the emerging economies context (Yakubu & Musah, 2022; Vo & Nguyen, 2021). Several empirical studies in Ethiopia have examined bank profitability (e.g., Mengstie et al., 2024; Muhammed et al., 2024; Addisu et al., 2023; Bushashe, 2023; Mohammed, 2023; Tura, 2023; Yusuf & Shikur, 2023; Isayas, 2022; Tibebe & Gujral, 2022; Ayalew, 2021; Biru, 2021; Tibebe, 2020; Berhe, 2019; Shifa et al., 2019; Teshome et al., 2018; Merin, 2016). These studies predominantly focus on macroeconomic and bank-specific factors affecting profitability, yet they fail to link bank profitability with FI. Similarly, research on FI in Ethiopia is emerging, with studies focusing on various aspects of FI, such as access to banking services, usage, and inclusion in rural areas (e.g., Denegetu, 2024; Fielding & Regasa, 2024; Menza et al., 2024; Mudessir et al., 2024; Ruey, 2024; Adera & Abdisa, 2023; Giday, 2023; Hundie & Tulu, 2023; Hussen & Mohamed, 2023; Dagnachew & Mawugatie, 2022; Mossie, 2022; Abdu & Adem, 2021; Oshora et al., 2021; Lakew & Azadi, 2020; Teka et al., 2020; Timbula et al., 2019; Desalegn & Yemataw, 2017; Rao & Baza, 2017; Alemu, 2014). However, these studies, too, overlook the critical intersection between FI and bank profitability.

Moreover, existing international studies provide mixed evidence. Some find FI enhances performance (e.g., Ayele et al., 2025; Guo & Ma, 2025; Aziz et al., 2024; Zhao et al., 2024; Zheng et al., 2023; Al-Eitan et al., 2022; Erülgen et al., 2022; Jajah et al., 2022; Sedera et al., 2022; Pal & Bandyopadhyay, 2022; Shihadeh, 2021; Vo & Nguyen, 2021; Shihadeh et al., 2018), while others document profitability-reducing effects (e.g., Djani-Feuzeu et al., 2025; Nguyen et al., 2025; Yakubu & Musah, 2022). A major gap in this literature is the neglect of potential nonlinearities, limiting understanding of how FI affects profitability across different levels of development, scale and adoption stages. Most existing works (e.g., Ayele et al., 2025; Guo & Ma, 2025; Aziz et al., 2024; Zheng et al., 2023; Erülgen et al., 2022; Jajah et al., 2022; Khatib et al., 2022; Yakubu & Musah, 2022; Kumar et al., 2021; Vo & Nguyen, 2021) apply linear GMM methods to address endogeneity arising from simultaneity, dynamism and heteroscedasticity in panel data. To the best of the researcher's knowledge, this study is the first to examine the nonlinear FI–profitability relationship in Ethiopia using a nonlinear two-step system GMM framework, with the turning point validated through Lind and Mehlum's (2010) U-test.

Secondly, a significant challenge in FI studies lies in the limited and often inconsistent metrics used to construct FI indices (Zheng et al., 2023; Jajah et al., 2022). Cross-country analyses relying on various datasets such as FAS, GFDD, or Findex often suffer from inconsistent periodicity, heterogeneous measurement scales, and limited sectoral coverage than single-country banking data. As a result, most studies employ only a few traditional indicators (such as branches, ATMs, accounts, cards, loan, deposits) to construct FI indices (e.g., Ayele et al., 2025; Bhattar et al., 2025; Djani-Feuzeu & Nguena, 2025; Hassan et al., 2025; Nguyen et al., 2025; Saidi et al., 2025; Sha'ban et al., 2023; Al-Eitan et al., 2022; Khatib et al., 2022; Jajah et al., 2022; Yakubu & Musah, 2022; Kumar et al., 2021; Vo & Nguyen, 2021). Although recent studies (e.g., Guo & Ma, 2025; Aziz et al., 2024; Zhao et al., 2024; Zheng et al., 2023) have begun to recognize the growing importance of digitalized banking services incorporating metrics (such as mobile banking, internet banking, agent banking, or mobile money), the integration of these metrics often overlooks the foundational role of traditional banking infrastructure, which underpins and enables digital expansion. As a result, most FI measurement frameworks still fall short of capturing the full spectrum of traditional and digital inclusion. This study addresses these gaps by constructing a comprehensive, data-driven FI index for Ethiopian commercial banks using PCA, combining seven traditional and four digital indicators from 2015–2023. It develops separate indices for traditional FI (TFI) and digital FI

(DFI) to capture their distinct asymmetric returns for the banking sector. Finally, this study tests the causality between FI and profitability to understand the directional relationship.

The remainder of the study is structured as: Section 2 presents literature reviews. Section 3 outlines the methodology aspects. Section 4 presents the empirical findings, and Section 5 concludes with policy implications.

2. Literature review

2.1. Theoretical literature review

The discourse surrounding FI has increasingly aligned with core banking theories, offering varied perspectives on the linkage between FI and bank performance. Three predominant schools of thought elucidate the banking sector's role in fostering financial development and stimulating economic growth. The relationship between FI and bank performance is illuminated through three major theoretical frameworks.

First, financial intermediation theory posits that banks function as crucial intermediaries between savers and borrowers, optimizing capital allocation and minimizing transaction costs linked to asymmetric information (Scholtens & Wensveen, 2003). This perspective highlights the role of banks in improving savings mobilization and credit allocation efficiency, particularly in emerging economies where financial exclusion is rampant (Maity & Sahu, 2020; Collard, 2007). As Mester (1992) and Allen & Santomero (1997) note, intermediation theory has expanded alongside changes in banking practice. Recent scholarship distinguishes between traditional and digital intermediation channels (Wang et al., 2024; Mao et al., 2023; Ren et al., 2023), with traditional finance relying on physical delivery mechanisms (Wang et al., 2024; Jin et al., 2023) and digital finance supplementing these through technological innovation (Wang et al., 2024; Yu & Wang, 2021). Within this theoretical frame, TFI can enhance profitability by expanding deposits, strengthening credit allocation, and reducing information frictions, particularly at early or moderate levels of expansion. However, as Babilla (2023) argues, TFI also imposes rising costs once outreach becomes geographically stretched as branch proliferation increases monitoring burdens, aggravates agency problems, dilutes managerial efficiency, and generates diminishing marginal returns. Consistent with Hong et al. (2025), financialization may therefore follow a nonlinear pattern due to early-stage gains in resource mobilization improve performance, but extensive expansion raises operating complexity, credit risk, and cost burdens, weakening profitability at higher inclusion levels.

From a digital intermediation perspective, the concept of technology spillover suggests that digital innovation through data analytics, AI, mobile platforms, or blockchain, can enhance banks' efficiency and convenience through knowledge diffusion, competition, and collaborative learning. Yet in early-stage markets, digital expansion typically lowers profitability because financial institutions must commit substantial resources to technology, infrastructure, cybersecurity, system integration, and human capital development (Yuan et al., 2025; Song et al., 2023). Yin et al. (2024) argue that digital finance initially exerts negative effects because scale requirements exceed technological gains, while digital adoption remains uneven across customer segments. This generates “tool exclusion” and “evaluation exclusion” (Yin et al., 2024) or a general “digital divide” (Putra et al., 2024), wherein low-income, rural, or digitally-illiterate customers cannot fully access digital services. In such settings, digital finance becomes dependent on traditional banking users, limiting its ability to generate new business and inflating short-term costs. The early-stage cost burden is further amplified in banking because digital finance requires robust infrastructure, interoperable payment systems, high supervisory capacity, and regulatory alignment (Yin et al., 2024). Under weak digital endowment, the digital divide deepens access inequality and restricts the effective use of digital financial services, especially in rural and vulnerable communities (Putra et al., 2024). These dynamics explain why DFI may exhibit a nonlinear relationship with profitability during its formative stages. As digital systems mature, however, the mechanisms predicted by financial intermediation theory reemerge in digital form (Yin et al., 2024). Digital platforms reduce information asymmetry, strengthen risk monitoring, enhance credit scoring, lower transaction costs, and expand the long-tail customer base, thereby improving the profitability of banks (Hassan et al., 2025; Yin et al., 2024; Zhao et al., 2024; Babilla, 2023). Digital channels relax temporal and spatial constraints, reduce marginal service costs, and unlock previously latent demand among underserved customers (Wang et al., 2024; Mao et al., 2023). Once learning effects accumulate and “break-in” periods dissipate, digital finance enhances operational efficiency, reduces resource wastage, and supports sustainable growth (Yin et al., 2024).

Second, fractional reserve theory extends intermediation view by emphasizing the systemic ability of banks to generate money through multiple deposit expansion (Werner, 2016; Humphrey, 1986), which is enhanced by FI initiatives that enhance deposit growth and subsequently credit expansion. This systemic credit creation underpins economic activity and banks' financial performance (Sapriza & Temesvary, 2024). In contrast, credit creation theory asserts bank as active creators of credit, asserting that lending activities generate new deposits

irrespective of prior reserves (Werner, 2014), which significantly impacts profitability (Nair & Von Pischke, 2007; Jakab & Kumhof, 2014). This theory suggests that FI initiatives can significantly boost bank profitability by facilitating new credit creation, although it also cautions against the risks of macroeconomic instability stemming from unchecked credit expansion, as evidenced by past financial crises (Schularick & Taylor, 2012; Sutherland & Hoeller, 2012). Collectively, based these theories, it can be argued that FI is not merely about expanding access but fundamentally transforms the mechanisms of money creation and credit allocation, thereby reshaping bank performance and economic development.

2.2. Empirical literature review

In the growing body of empirical research, FI has emerged as a key component of financial sector development (Collard, 2007), particularly in its intersection with bank profitability. The relationship between FI and profitability remains an intricate subject, as empirical studies across various contexts yield mixed results. A robust review of recent literature underscores this dynamism, highlighting variations across regions, methodologies, and specific indicators of FI. Recognizing this conceptual and empirical heterogeneity, the present review classifies prior evidence based on the specific indicators used to construct FI indices and the linear versus nonlinear mechanisms underlying FI–performance linkages.

2.2.1. Nexus between traditional FI and bank performance

Analyzing a developed market, Kumar et al. (2021), for instance, examined the profitability of 122 Japanese banks from 2004 to 2018, revealing that FI, when measured through branch contraction, negatively impacts profitability. However, other indicators like loan accounts and ATM penetration showed no significant effect. Their study challenges the broad assumption that FI uniformly enhances profitability, particularly in developed markets where the maturity of financial services may reduce the incremental benefits of expanding access. This highlights the importance of country-specific factors such as cost management and bank size, which play more dominant roles in established financial ecosystems. Consistently, Sha’ban et al. (2023), using OLS for 88 high- and 43 low-income countries (2005–2014), find a trade-off between bank performance and credit deepening in high-income nations, whereas in low-income counterparts, FI (captured by deposits to GDP, number of deposits, and borrower accounts) does not harm profitability. Saidi et al. (2025) further reveal that FI improves bank performance in GCC economies and raises ROA (but not ROE) in non-GCC countries, implying that the profitability effects of FI depend on countries’ structural characteristics and financial maturity.

In the context of emerging markets, empirical evidence presents a mixed result. Vo & Nguyen (2021), studying 1507 Asian banks, employed PCA and GMM to demonstrate a positive relationship between FI and bank profitability. Their research underscores the importance of financial product penetration and utilization as key drivers of profitability. However, in Jordan, even though the overall FI index has a positive effect, Al-Eitan et al. (2022) reported a negative relationship between usage of financial services (measured through loan and deposit size) and profitability, with financial leverage and bank size emerging as the most important determinants. These regional differences suggest that FI alone may not always suffice to boost profitability, particularly in economies where banking structures are heavily deposit accumulation and credit-driven. This is corroborated by Shihadeh et al. (2018), who explored the Jordanian banking sector and found that while certain dimensions of FI, such as SME credit and ATM proliferation, positively affected bank performance, results varied depending on the specific measure of FI employed. These findings underscore that FI's profitability effects are highly dimension-sensitive and depend on the cost–risk structure of local banking markets.

In an exploration of Sub-Saharan Africa (SSA), Yakubu & Musah (2022), analyzing the region from 2000 to 2017, applied PCA to construct an FI index and utilized GMM to address endogeneity concerns. Their findings reveal a negative relationship between FI and bank profitability, particularly in the post-global financial crisis era. This suggests that inclusive financial policies may impose cost pressures on banks, particularly in fragile financial ecosystems. In addition, Djani-Feuzeu & Nguena (2025), using Driscoll–Kraay and GMM for 46 SSA countries (2004–2021), likewise document a negative effect. In contrast, Jajah et al. (2022), studying a longer time frame (1990–2017) for SSA banks, found a positive relationship between FI and profitability using system GMM. This discrepancy can be attributed to the broader dataset and longer time horizon employed by Jajah et al. (2022), which captures a more stable period for SSA banks post-financial crisis. These divergent results imply that SSA banks' ability to translate FI into profitability depends on macro-financial stability, institutional quality, and innovation banking strategies that lower the costs of servicing new, previously excluded segments of the population.

In smaller, niche markets, such as Northern Cyprus, Erülgen et al. (2022) used dynamic panel techniques (GMM, PMG, and CS-ARDL) to demonstrate a positive relationship between FI and profitability, emphasizing deposit ratios and bank size as crucial drivers. Their study illustrates that FI can significantly enhance banking sector performance in smaller economies by encouraging deposit growth. Their policy recommendations, which advocate for relaxing

customer identification criteria to include marginalized populations, highlight the social equity dimension of FI in insular markets. Similarly, in Palestine, Shihadeh (2021) found that branch and ATM proliferation enhance bank performance, further supported by Khatib et al. (2022), whose findings from 2012 to 2020 employing GMM and linear regression techniques revealed that the accessibility and quality of financial services drive profitability.

Sedera et al. (2022) explore FI's effect on bank profitability in Indonesia from 2015 to 2020. Their panel data analysis with fixed effects reveals a positive relationship between FI and profitability across all dimensions. The study distinguishes itself by focusing on bank-level data, as opposed to national-level analyses common in existing literature. This bank-centric perspective enriches the understanding of FI's microeconomic impacts in emerging markets, particularly in the Indonesian context. It suggests that FI policies can directly enhance bank performance, offering strategic insights for policymakers and financial institutions alike. Employing linear mixed model, Obiedallah & Abdelaziz (2024) examined Egyptian banks, found that the capital adequacy ratio (CAR) moderates the relationship between FI and performance. The study indicates that high CAR strengthens the association but also suggests that FI's impact on profitability may be constrained by regulatory requirements.

Recent studies increasingly highlight the nonlinear dynamics between FI and bank performance. Bhattar et al. (2025) report a U-shaped nexus between FI and profitability in Indian banks, suggesting that initial FI expansion imposes cost and risk pressures before profitability improves beyond a critical inclusion threshold. Djani-Feuzeu & Nguena (2025), using quantile regression, find FI exerts a consistently negative effect across the profitability distribution in SSA, though the magnitude varies by quantile. Shihadeh (2020) shows that additional branches disproportionately benefit low-ROA and mid-ROE banks, implying diminishing marginal returns to FI for highly profitable institutions. Ahamed et al. (2021) report FI improves efficiency only for mid-tier banks, while Setianto et al. (2025) observe that banks with greater market power benefit more from FI expansion. Beyond bank performance, Fomum & Opperman (2023) show that FI significantly enhances MSME turnover and business progression in Eswatini, though insurance effects vary by enterprise size. Hong et al. (2025) document an inverted-U effect of financialization on performance in Chinese private firms, reinforcing broader evidence that inclusion-or financialization-related expansions often yield diminishing marginal returns after a threshold. Together, these nonlinear studies suggest that FI can be either beneficial or detrimental depending on a bank's efficiency tier, market power, and expansion stage. Ahamed et al., (2021) claims that broadening access across diverse

customer groups requires banks to offer a wider product mix, which can increase agency problems, operating costs, and organizational complexity. Thus, the empirical literature indicates that TFI produces competing effects like enhancing deposits, outreach, and intermediation efficiency at moderate levels, but raising costs and risks as scale intensifies.

Hypothesis 1: There is an inverted U-shaped nexus between TFI and bank profitability.

2.2.2. Nexus between digital FI and bank performance

Digitalisation is widely associated with improved outreach efficiency as “volume increased, scale expanded, price reduced, and risk controlled” (Zhu & Guo, 2024), yet digitalization’s profitability implications are not linear. Tong & Yang (2025) note both positive channels (product innovation, cost reduction, customer expansion) and negative channels (competition intensification, customer attrition).

The empirical evidence largely confirms these mixed effects. Zheng et al. (2023) analyzed 40 developing countries between 2011-2021, using fixed-effects, two-stage least squares (2SLS-IV), and two-step system GMM. Their study found that fintech-driven FI significantly boosts profitability, with traditional and larger banks benefiting more than smaller or Islamic banks. This highlights the transformative potential of technology in amplifying the profitability gains from FI, particularly in high-growth developing economies. The role of fintech was also explored by Aduba et al. (2023), who found that fintech significantly drives financial development and, consequently, profitability in emerging economies, where traditional banking systems are less efficient. In a broader context, Akhisar et al. (2015) demonstrated that electronic banking innovations significantly impact profitability across both developed and developing countries, though their effects vary based on levels of financial development. Similarly, studies (like Zhao et al., 2024; Guo & Ma, 2025; Aziz et al., 2024) also document strong positive associations between digital FI and profitability. Liu et al. (2024) find that FinTech improves performance by promoting better lending and liability structures, especially for national and rural banks. However, Wu & Ma (2025) find digital finance weakens profitability due to volatility, heightened competition, and regulatory uncertainty around off-balance-sheet activities. Bashiru et al. (2023) find financial development reduces profitability in SSA, while Wang et al. (2025) report fintech improves liquidity rather than immediate profitability, emphasizing lagged effects and high adjustment costs.

A recent growing branch of the literature reveals nonlinearities. Hassan et al. (2025) show that FinTech disproportionately improves performance among lower-performing banks, consistent

with technology-enabled inclusion effects. Yuan et al. (2025a) identify a critical fintech threshold (4.169), below which fintech significantly suppresses profitability due to customer diversion and cost escalation, but the negative effect weakens once maturity is reached, reflecting reduced competitive displacement and stronger complementarities. Zhu & Guo (2024) further show that while inclusive lending may initially depress profits due to cost–benefit asymmetry “doing business at a loss”, digital FI mitigates these losses by reducing information asymmetry and transaction costs. Wang et al. (2024), using a threshold panel model, find that digital finance improves efficiency only after achieving sufficient scale, with diminishing returns beyond a critical point. Yang & Masron (2023) further document profit-reducing effects of early-stage digital transformation in China due to high initial investment and operational lags. Overall, these studies converge on the view that digital FI exerts competing effects as enhancing efficiency and outreach once digital maturity or scale is achieved, but compressing margins during early-stage adoption due to technological investment, competition, and risk exposure.

Hypothesis 2: There is a U-shaped nexus between DFI and bank profitability.

Existing research on the relationship between FI and bank profitability shows varied outcomes contingent upon regional, institutional, and economic factors. In developing economies, FI can enhance profitability, especially with innovative banking practices and conducive macroeconomic conditions. However, the Ethiopian context has been largely overlooked, and many studies lack digital metrics in their analyses. This research aims to fill this gap by incorporating digital initiatives to better understand their asymmetric impact on bank profitability in Ethiopia. Additionally, much of the existing literature neglects potential endogeneity in panel datasets. To address this, this study employs the GMM approach.

3. Material and methods

3.1. Sample population

This paper employed a data set of 17 commercial banks in Ethiopia from 2015-2023, excluding recently established banks with insufficient data. The included banks approximately represent 91 percent of total assets, 98 percent of deposits, 94 percent of credit, and 76 percent of equity in the financial sector (NBE-FSR, 2024). Data was sourced from the National Bank of Ethiopia (NBE), annual reports from commercial banks (CBs), and the World Bank (WB), based on data availability.

To measure traditional and digital FI, the study employed PCA to develop composite indices. For estimation, the two-step system GMM approach was adopted, as supported by Jajah et al. (2022) and Kumar et al. (2021), to address econometric problems such as endogeneity and unobserved bank-specific effects, common in panel data settings. Detailed description of the variables and their symbols is mentioned in Table 11.

Table 11: Description of variables

Variables	Symbol	Measurement	Source
Dependent Variable			
Profitability Index	PI	Developed employing PCA combining ROA, ROE and NIM	NB
Main independent Variable			
Traditional availability dimension index	TFI	Developed employing PCA combining BRP, ATMP and PoSP	NB, WB
Traditional usage dimension index		Developed employing PCA combining DAP, CDCP, PLOAN and PDEP	NB, WB
Digital Accessibility dimension index	DFI	Developed employing PCA combining MBP, IBP, MMP and APP	NB, WB
Control Variables			
Z-score	lnZS	Return to asset + equity-to-assets ratio/ standard deviation of return on asset	NB
Scale efficiency	SE	Using DEA calculated SE based on the result of VRS/CRS	NB
Total asset	lnTA	Natural logarithm of total asset	NB
Loan to deposit ratio	LDR	Overall extended loans/total deposits	NB
Real deposit interest rate	RDIR	Deposit interest rate minus inflation rate	NB
Broad money supply	BM	Money supply/GDP	NB

Source: Prepared by authors

3.2. Variable description

3.2.1. Dependent variable

In line with the extant literature on bank performance measurement, profitability is often captured using ROA (Zheng et al., 2023; Khatib et al., 2022; Yakubu & Musah, 2022; Kumar et al., 2021; Vo & Nguyen, 2021; Jajah et al., 2022; Shihadeh et al., 2018), ROE (Zheng et al., 2023; Yakubu & Musah, 2022; Kumar et al., 2021; Jajah et al., 2022), and NIM (Zheng et al., 2023; Khatib et al., 2022; Jajah et al., 2022). Specifically, ROA reflects how effectively a bank uses its assets to generate earnings, while ROE measures the profitability relative to shareholder equity (Zheng et al., 2023; Kumar et al., 2021). In addition, NIM, provides insights into the ability with which a bank's interest-earning assets are employed to generate interest income (Khatib et al., 2022).

Different methods and combinations of variables have been proposed in the literature to construct a comprehensive measure of bank profitability. For instance, Aduba et al. (2023) developed a non-parametric approach to create a composite profitability index using ROA, ROE, and NIM as key metrics. This approach acknowledges that bank profitability is multifaceted and cannot be fully captured by any single measure. Similarly, Popa et al. (2021) employed PCA to construct a composite indicator of financial performance, which integrated both traditional accounting metrics (such as Earnings per share, ROA, ROE, Solvency) and

value-based indicators (such as Economic value-added, Market value-added, Cash flow return on investment, Cash value-added). The advantage of such an approach lies in its ability to capture the latent dimensions of profitability while reducing the dimensionality of the data, thereby minimizing potential multicollinearity among the original variables. Sha'ban et al. (2023) employed PCA to construct a banking sector performance index employing the CAMEL rating system, including banks' solvency, asset quality, efficiency, profitability and liquidity.

In this study, the study employ PCA to construct a composite index for bank profitability, drawing on the metrics of ROA, ROE, and NIM. The rationale for adopting PCA is twofold. First, PCA extracts the most significant information from a set of correlated variables, ensuring that the composite index captures the underlying structure of bank profitability. This aligns with the objectives of PCA, as outlined by Abdi & Williams (2010), which aim to reduce the attribute space from a larger set of variables to a smaller number of components that retain the highest variance. By doing so, PCA minimizes redundancy and ensures that the resulting index is both parsimonious and robust. Second, the use of PCA in the context of financial performance measurement is supported by its application in various studies. For instance, Sha'ban et al. (2023), Popa et al. (2021) and Liu et al., (2020) used PCA to combine multiple financial performance indicators into a single composite score, allowing for a more holistic assessment of a firm's financial performance. This method allows for a more accurate reflection of bank performance by aggregating the individual metrics (ROA, ROE, and NIM) into a single profitability index, which can be interpreted as a comprehensive measure of bank financial success. By capturing the common variance among these profitability metrics, the PCA-derived index provides a reliable measure that mitigates the risks of over-reliance on any single indicator, thereby offering a more nuanced understanding of bank profitability.

3.2.2. Independent variables

FI and financial exclusion (FE) are binary terms that reflect the accessibility of financial services (Koefer et al., 2024; Fernández-Olit et al., 2019). FI aims to bridge the gap of FE, particularly for disadvantaged populations, by enabling affordable access to basic financial services (Hannig & Jensen, 2010; Dabla-Norris et al., 2015). The measurement of FI, its barriers, and its relation to real sector outcomes is critical (Beck, 2016). Sarma (2016) further emphasizes that effective measurement is fundamental to comprehending the effects of FI and informing policy measures. Nguyen (2021) and Vo & Nguyen (2021) highlights comparable indices across time and space are essential for evaluating FI efforts.

In this research, FI is categorized into traditional financial inclusion (TFI) and digital financial inclusion (DFI), both of which are analyzed as separate variables. According to Ren et al. (2023) and Jain et al. (2021), TFI encompasses financial services offered by conventional financial institutions, which include traditional banking methods such as physical branches, ATMs, and point-of-sale (PoS) systems. In contrast, DFI pertains to services provided by innovative entities that leverage technological advancements, specifically through the internet, mobile networks, and digital wallets. This dual categorization aligns with the structural transition occurring in modern banking, where digital tools expand scale and convenience but traditional channels remain critical for complex services and trust formation (Keil & Ongena, 2023; Madegowda, 2025). Recent evidence shows that technological diffusion is reshaping financial systems, shifting decision-making from humans to algorithms and creating new vulnerabilities such as cyberattacks and digital-infrastructure dependence (Trotta et al., 2025; Omarova, 2020). Likewise, accelerated de-branching has produced adverse effects on firm creation, particularly when older or large-bank branches close (Cardamone & Trivieri, 2024). These findings underscore why separating TFI and DFI provides a clearer analytical lens since each dimension carries distinct operational costs, risks, and channels of profitability transmission in the banking sector. This study employs these classifications to evaluate the respective impacts of TFI and DFI on bank profitability. TFI is composed of seven indicators across two dimensions: availability and usage. Availability dimension includes: Bank branches per 100,000 adults (BRP), ATMs per 100,000 adults (ATMP), PoS terminals per 100,000 adults (PoSP). For the usage dimension, indicators include: Depositor accounts per 1,000 adults (DAP), Debit card holders per 1,000 adults (CDCP), Loan-to-GDP ratio (PLOAN), and Deposit-to-GDP ratio (PDEP). Similarly, DFI is captured through four indicators in the digital accessibility dimension: Mobile banking users per 1,000 adults (MBP), Internet banking users per 1,000 adults (IBP), Mobile wallet users per 1,000 adults (MMP), and Agents per 1,000 adults (APP).

Given the multidimensional nature of FI, this study applies PCA to construct composite indices for TFI and DFI. PCA is widely used to reduce data dimensionality while preserving the maximum amount of information (Nguyen, 2021; Vo & Nguyen, 2021). The principal component typically explains the highest variance, exceeding 60%, making it the most representative factor in the dataset (Hair et al., 2019). However, before applying PCA, as Freudenberg, (2003) and Jacobs et al., (2004) claimed, normalization is required to account for the heterogeneity of measurement units and to mitigate outliers. In the broader context of data scaling, techniques such as Min–Max scaling, mean normalization, Z-score standardization, and Gaussian-based transformations are sensitive to extreme values. Although outliers can influence range-based transformations, Min–Max normalization remains appropriate when the goal is to place all indicators on a fixed, interpretable scale. As demonstrated by Kim et al. (2024), Swift et al. (2023), and Ali (2022), constraining variables to a bounded interval enhances interpretability and provides a stable range for prediction and comparative analysis. This is particularly suitable for FI

measurement, where a 0–1 scale allows direct interpretation of inclusion intensity. For this reason, the study adopts the Min–Max approach (MMA), where 1 represents full financial inclusion (FI) and 0 denotes financial exclusion (FE). The Min–Max formula is expressed as:

$$Mean - Max = \frac{Actual\ number - Minimum\ number}{Maximum\ number - Minimum\ number}$$

After normalization, PCA is applied to calculate the eigenvalues of the variance matrix for each indicator. All sub-indices should meet standard PCA assumptions, including sufficient sampling adequacy ($KMO \geq 0.5$), significant Bartlett's test results ($p < 0.05$), and strong internal consistency (Cronbach's $\alpha \geq 0.6$), supporting the reliability and suitability of PCA for index construction. The composite indices for TFI and DFI are then constructed using the following formulas:

$$PCA_{TFI} = \sum_{n=1}^3 loading_n * TA\ Indicators_n + \sum_{n=1}^4 loading_n * TU\ Indicators_n \quad Eq\ 1$$

$$PCA_{DFI} = \sum_{n=1}^3 loading_n * DA\ Indicators_n \quad Eq\ 2$$

Where, PCA_{TFI} and PCA_{DFI} denotes the number of selected components for TFI and DFI, as well, TA stands for the traditional availability indicators, TU indicates traditional usage indicators, and DA represents digital accessibility indicators. loading, stands for the factor loadings of the corresponding indicators.

3.2.3. Control variables

This study incorporates both bank-specific and macroeconomic control variables to enhance the robustness of the analysis. Among the bank-specific variables, scale efficiency is employed to assess the efficiency ratio. Technical efficiency scores serve as a critical indicator for monitoring the operational activities of each bank (Ullah et al., 2023). To measure efficiency, this research applies the Data Envelopment Analysis (DEA) approach, employing scale efficiency (SE) based on an output-oriented approach. Following the methodology proposed by Li et al. (2013), scale efficiency is calculated using the formula,

$$SE = CRS/VRS$$

Where, SE represents the ratio of constant returns to scale (CRS) efficiency to variable returns to scale (VRS) efficiency. The Data Envelopment Analysis (DEA) model identifies inputs as salary and benefits, provisions, general expenses, and deposits, whereas outputs are characterized by net interest income and non-interest income.

Beyond scale efficiency, the study examines factors influencing banking performance, including banking stability (ZS), which reflects a bank's response to risks (Vo & Nguyen,

2021). Consistent with Yakubu & Musah (2022), stability is represented by the Z-score, calculated as:

$$Z - score_{it} = \frac{ROA_{it} + EQA_{it}}{sd(ROA)_{it}}$$

Where, **ROA** represents the return on assets, **EQA** denotes equity-to-assets ratio and **sd** stands with standard deviation.

Additionally, the loan-to-deposit ratio (LDR) assesses liquidity's effect on profitability (Kumar et al., 2021), as well, bank size (log of total asset) can be used to capture the effect of size (Vo & Nguyen, 2021). Macroeconomic control variables including the real deposit interest rate (RDIR), adjusted for inflation, which is crucial for understanding bank profitability (López-Penabad et al., 2022). Lastly, the broad money supply (BM) measures overall market liquidity's impact on profitability (Omankhanlen et al., 2021).

3.3. Model specification

Building on prior empirical studies (Yakubu & Musah, 2022; Vo & Nguyen, 2021; Zheng et al., 2023; Jajah et al., 2022; Kumar et al., 2021; Khatib et al., 2022), this study specifies its model as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$$

Where, *i* and *t*, denotes the cross-sectional and time dimensions, respectively. *Y*, indicates the dependent variable and *X*, signifies the vector of explanatory variables. The term β , signifies coefficients of these variables, while α , is the constant term. The error term is denoted by ε .

In order to tackle issues of endogeneity, heteroscedasticity, and serial correlation biases, this research employs a two-step robust system GMM estimator, as outlined by Arellano & Bover (1995) and Blundell & Bond (1998), with additional contributions from Baltagi & Baltagi (2008) and Roodman (2009). This approach addresses endogeneity and unobserved heterogeneity that remains constant over time, which are frequently encountered in panel regressions that analyze banking data (Khatib et al., 2022; Kumar et al., 2021). The GMM methodology is extensively supported in academic literature for its effectiveness in addressing endogeneity issues in various scenarios (Yakubu & Musah, 2022; Vo & Nguyen, 2021; Zheng et al., 2023; Jajah et al., 2022; Kumar et al., 2021; Khatib et al., 2022).

However, in contrast to earlier works that assume linearity, this study explicitly incorporates nonlinear dynamics to examine whether the effects of traditional and digital FI on bank

profitability vary across different stages of FI development. Following emerging nonlinear evidence (Bhatter et al., 2025; Xie & Deng, 2025; Yuan et al., 2025; Song et al., 2023), a quadratic specification is introduced to capture possible U-shaped or inverted-U patterns.

Nonlinear modeling is theoretically justified because the impact of FI is unlikely to be constant across all intensities or market conditions. As noted by Shaddady (2023), banking environments, especially in developing economies often face abrupt structural changes, making nonlinear responses more realistic. Assuming linearity when threshold effects exist can lead to biased coefficients and misleading policy implications. Accordingly, the nonlinear dynamic model is specified as:

$$\mathbf{PI}_{it} = \alpha_i + \gamma \mathbf{PI}_{i,t-1} + \beta_1 \mathbf{TFI}_{it} + \beta_2 \mathbf{TFI}_{it}^2 + \beta_3 \mathbf{DFI}_{it} + \beta_4 \mathbf{DFI}_{it}^2 + \sum_1^n \beta_{it} \mathbf{X}_{it} + \varepsilon_{it}$$

Where, $\mathbf{PI}_{it}$ denotes bank performance, $\mathbf{PI}_{i,t-1}$ is its lagged value, $\mathbf{TFI}_{it}$ and $\mathbf{DFI}_{it}$ represent traditional and digital FI scores, and their squared terms capture nonlinear effects, $\mathbf{X}_{it}$ is the vector of control variables, α_i is the individual-specific effect, γ is the coefficient for the lagged dependent variable, β_{it} , are the coefficients for the explanatory variables ε_{it} the idiosyncratic error.

To validate whether the estimated relationship truly exhibits a U-shape (or inverted U-shape) rather than a monotonic but curved form, this study employs the U-test developed by Lind and Mehlum (2010). Traditional quadratic models may incorrectly suggest a U-shape even when the true relationship is convex yet monotonic (Law et al., 2017). Hence, the U-test is applied to test the composite null hypothesis that the slope is non-increasing at the lower bound and non-decreasing at the upper bound of the FI range. Formally, the conditions are:

$$\begin{aligned} &(\beta_1 + \beta_2 \mathbf{TFI}_{\min}) \leq 0 \cup (\beta_1 + \beta_2 \mathbf{TFI}_{\max} \geq 0) \\ &(\beta_3 + \beta_4 \mathbf{DFI}_{\min}) \leq 0 \cup (\beta_3 + \beta_4 \mathbf{DFI}_{\max} \geq 0) \end{aligned}$$

The likelihood-ratio test of Lind and Mehlum (2010) is then applied to determine whether the null hypothesis of a monotonic relationship can be rejected. Rejecting the null confirms a statistically valid U-shaped or inverted U-shaped relationship, while failure to reject implies that the quadratic term does not represent a true turning point.

3.4. Index development

This research evaluated the adequacy of samples for factor analysis by employing the Kaiser-Meyer-Olkin (KMO) statistic and Bartlett's test of sphericity. A significant result from Bartlett's test ($P < 0.05$) suggests that the correlation matrix is not an identity matrix (Watkins, 2018). The KMO statistic ranges from 0 to 1, with a widely recognized minimum threshold of 0.5 (Chan & Idris, 2017; Hair et al., 2019).

Table 12: Principal component analysis result

Estimation of principal components and eigenvalues for TFI and DFI sub indices						
Component	Eigenvalue	Difference	Explained variance (EV)	Cumulative		
TFI Index (Availability Dimension)						
Comp1	2.7368	2.5655	0.9123	0.9123		
Comp2	0.1713	0.0795	0.0571	0.9694		
Comp3	0.0919		0.0306	1.0000		
TFI Index Usage Dimension)						
Comp1	3.4725	2.9920	0.8681	0.8681		
Comp2	0.4804	0.4430	0.1201	0.9882		
Comp3	0.0374	0.0278	0.0094	0.9976		
Comp4	0.0096		0.0024	1.0000		
DFI Index (Accessibility Dimension)						
Comp1	2.6249	2.3927	0.8750	0.8750		
Comp2	0.2322	0.0893	0.0774	0.9524		
Comp3	0.1429		0.0476	1.0000		
Scoring coefficients from orthogonal varimax rotation and related test outcomes						
Dimensions	Indicators	Weight (PC1)	EV	KMO	Sphericity test & Overall KMO	Cronbach alpha
TFI Index (Availability-Dimension)	BRP	0.5847	0.0644	0.7047	$\chi^2(3)=472.28$ (P=0.000), Overall-KMO=0.76	0.95
	ATMP	0.5778	0.0862	0.7560		
	PoSP	0.5694	0.1126	0.8353		
TFI Index (Usage-Dimension)	CDCP	0.4691	0.2360	0.5593	$\chi^2(6)=1111.108$ (P=0.000), Overall-KMO=0.62	0.94
	DAP	0.5195	0.0627	0.6725		
	PLOAN	0.4978	0.1396	0.5795		
	PDEP	0.5121	0.0892	0.6540		
DFI Index (Accessibility-Dimension)	MBP	0.5832	0.1072	0.7236	$\chi^2(3)=366.502$ (P=0.000), Overall-KMO=0.76	0.92
	APP	0.5665	0.1576	0.8300		
	MMP	0.5822	0.1103	0.7289		

Source: Computed from Stata 18 result. Note: internet banking indicator's KMO result was less than 0.5, thus excluded from our analysis.

Table 12 displays the PCA findings for the TFI and DFI, highlighting KMO values (≥ 0.5) and significant p-values that validate the use of PCA. The internal consistency was assessed through Cronbach's alpha, where a minimum threshold of 0.6 is deemed acceptable (Bonett & Wright, 2015). The results demonstrate robust reliability, with scores of 0.95 for traditional availability, 0.84 for traditional usage, and 0.92 for digital accessibility.

In the process, the study employed an eigenvalue threshold exceeding 1 as the basis for factor selection (Phanniphong et al., 2024; Nguyen, 2021). The eigenvalues derived from PCA estimate the latent variables: traditional availability, traditional usage, and digital accessibility,

with components that retain significant variance. An explained variance (EV) of 60% or more was regarded as acceptable (Hair et al., 2019), with the first principal component (PC1) accounting for over 91% of the variance for traditional availability, 87% for usage, and 88% for digital accessibility dimensions. The composite indices for TFI (Eq-3) and DFI (Eq-4) were formulated as follows:

$$\text{TFI}_{it} = (0.5847\text{BRP}_{it} + 0.5778\text{ATMP}_{it} + 0.5694\text{PoSP}_{it}) + (0.4691\text{CDCP}_{it} + 0.5195\text{DAP}_{it} + 0.4978\text{PLOAN}_{it} + 0.5121\text{PDEP}_{it})$$

$$\text{DFI}_{it} = 0.5832\text{MBP}_{it} + 0.5665\text{APP}_{it} + 0.5822\text{MMP}_{it}$$

For TFI, branch availability (0.5847) has the highest weight, emphasizing the continued importance of physical branches in Ethiopia, consistent with Kebede et al. (2021) findings. Within the usage dimension, deposit accounts (0.5195) rank highest, reflecting the sector's focus on customer base expansion and savings. In DFI, mobile banking holds the highest weight (0.5832), highlighting its preference over agency banking, which remains in its early stages in Ethiopia.

4. Discussion of empirical results

4.1. Descriptive analysis

Table 3 provides a descriptive analysis of both the dependent and independent variables, including standard deviation, average, minimum, and maximum points, based on 153 observations from 2015 to 2023 across 17 commercial banks. Profitability (PI) shows a mean value of 0.123, indicating that Ethiopian commercial banks, on average, generated modest returns during 2015–2023. The minimum value is slightly negative (−0.008), suggesting that some banks experienced marginal losses in certain periods, while the upper bound (0.474) reflects periods of high profitability for a few institutions. TFI and DFI mean values are 0.334 and 0.071, respectively, suggest that, compared with traditional services, the adoption of digital channels remains at an early stage. The broader range of TFI (0.008 to 2.971) indicates larger variation in traditional outreach across banks, while the narrower range of DFI (0 to 1.584) reflects more homogeneous but lower levels of digital usage. The Z-score, a proxy for bank stability, averages 3.349, implying relatively stable banking conditions during the period, though the variation (2.194 to 4.383) highlights differences in risk profiles among banks. Scale efficiency (SE) is high, with a mean of 0.974, indicating that most banks operate close to their optimal production frontier. However, the lower bound of 0.708 shows that some banks

experience operational inefficiencies. Bank size displays substantial variation (7.042 to 14.082), reflecting the wide differences between large and small commercial banks in Ethiopia. The loan-to-deposit ratio (LDR) averages 0.963, suggesting that banks deploy a significant proportion of mobilized deposits for lending, although some banks appear more conservative (0.533). The real deposit interest rate (RDIR) has a negative mean (−0.115), consistent with Ethiopia’s inflation-driven negative real returns on savings during the sample period. This may discourage deposit mobilization and influence banks’ cost structures. Broad money averages 0.518, indicating moderate liquidity in the banking system relative to total output. Its variation (0.277 to 0.890) reflects changes in monetary conditions influenced by policy adjustments and macroeconomic shocks.

Table 13: Summary analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
PI	153	0.123	0.053	(0.008)	0.474
TFI	153	0.334	0.601	0.008	2.971
DFI	153	0.071	0.204	0.000	1.584
lnZS	153	3.349	0.529	2.194	4.383
SE	153	0.974	0.049	0.708	1.000
lnTA	153	10.155	1.32	7.042	14.082
LDR	153	0.963	0.089	0.533	1.159
RDIR	153	(0.115)	0.096	(0.293)	(0.022)
BM	153	0.518	0.198	0.277	0.890

Source: Computed based Stata 18 result

4.2. Pre-estimation tests

4.2.1. Multicollinearity, autocorrelation and heteroskedasticity tests

The presence of multicollinearity, autocorrelation and heteroskedasticity pose a problem in regression analysis, potentially leading to biased results (Al-Eitan et al., 2022). Multicollinearity indicates the degree of correlation among explanatory variables that complicates the isolation of each variable's unique effect on the dependent variable (Kumar et al., 2021; Kline, 2015), while autocorrelation pertains to the correlation of residuals across different observations, which may lead to an underestimation of standard errors and inflate t-statistics (Akpan & Moffat, 2018; Gujarati et al., 2012). Heteroskedasticity arises when the variances of the error terms are not constant, leading to inefficient parameter estimates and unreliable confidence intervals (Onifade & Olanrewaju, 2020). This study uses the Wooldridge test to identify autocorrelation, the variance inflation factor (VIF) to measure multicollinearity, and the modified Wald test and the Breusch-Pagan (BP) test to evaluate heteroskedasticity. As shown in Table 14, the mean VIF is 5.91, showing a weak correlation and low multicollinearity among the independent variables. Although autocorrelation and heteroskedasticity were

detected, the study employs the GMM estimator to address these issues, as recommended by Vo & Nguyen (2021).

Table 14: Multicollinearity, heteroskedasticity and autocorrelation test

Tests	Mean VIF	Wooldridge test	Modified Wald test	BP test
Type	Multicollinearity	Serial correlation	Heteroskedasticity	Heteroskedasticity
Sig level	5.91	F(1,16)= 52.38 (p=0.0000)	$\chi^2(17)= 477.87$ (p=0.0000)	$\chi^2(1)= 118.19$ (p=0.0000)

Source: Computed based on Stata 18 result

4.2.2. Cross-sectional dependence and unitroot test

Cross-sectional dependence (CD), often referred to as common correlation, can lead to under-rejection of the null hypothesis in panel unit root tests, resulting in type II errors (Khalid & Shafiullah, 2021). Implementing CD tests is crucial for selecting appropriate unit root tests, as panel data often exhibit dependencies from shared economic influences (Chen et al., 2023; Yameogo et al., 2020; De Hoyos & Sarafidis, 2006). This CD typically arises when error terms share unobserved common factors or are affected by external shocks (Khalid & Shafiullah, 2021; Shafiullah et al., 2019; De Hoyos & Sarafidis, 2006). First-generation tests considers cross-sectional independence, whereas second-generation tests account for interdependencies (Tugcu, 2018; Barbieri, 2009). The Pesaran (2004), Frees (1995), and Friedman (1937) tests in Table 15 confirm cross-sectional independence. Furthermore, considering the heterogeneity among banks, this study employs first-generation unit root tests, including the Levin, Lin & Chu (LLC) test (2002), Harris & Tzavalis test (1999), and Augmented Dickey-Fuller (ADF) test, to avoid imposing uniform effects across different cross-sections. This approach aligns with the country-specific approach of Yameogo et al. (2020) and accommodates unit-specific characteristics. As indicated in Table 5, all variables are stationary at I(0) or I(1), confirming the model's reliability in the absence of cross-sectional dependence.

Table 15: Cross-sectional dependence and unitroot test

Variables	LLC I(0)	LLC I(1)	HT I(0)	HT I(1)	ADF I(0)	ADF I(1)
PI	-7.7799***	-6.5116***	0.3932***	-0.1551***	4.4453***	6.8781***
TFI	-3.1044***	-12.2265***	0.7814	0.2689***	1.9209*	3.8158***
DFI	13.0704	-5.2572***	1.1862	0.0628***	4.9985***	10.5007***
lnTA	-6.7186***	-5.2178***	0.9592	0.0677***	5.0190***	2.3367***
lnZS	-6.5670***	-8.8614***	0.5099***	-0.2704***	4.6292***	9.0794***
SE	-12.1552***	-39.3679***	0.3208***	-0.4831***	14.0325***	21.2525***
LDR	-3.7723***	-4.4916***	0.1663***	-0.2987***	3.7896***	7.834***
RDIR	-5.0827***	22.1295	0.0000***	-0.3577***	-4.0411	12.7806***
BM	-8.5431***	1.6763*	0.0000***	0.0000***	-3.5919	2.159*
Pesaran CD test	0.346 (P=0.1987)					
Frees CD test	0.630 (P=0.2828)					
Friedman CD test	15.843 (P= 0.464)					

Source: Computed based on Stata 18 result, Notes: H0 states that the model shows no cross-sectional dependence and should be rejected if the p-value is below 0.01

4.3. Regression analysis

Table 6 presents the results of the two-step GMM estimation, showing the effects of TFI, DFI, stability, scale efficiency, bank size, loan-to-deposit ratio, real deposit interest rate, and money supply on bank profitability.

The empirical results indicate that TFI exerts a positive and statistically significant impact on bank profitability. This finding supports the findings of previous studies, including Yakubu & Musah (2022), Vo & Nguyen (2021), Jajah et al. (2022), and Kumar et al. (2021), whom employed TFI indicators, all of which highlight the critical role of TFI in enhancing bank performance. Kumar et al. (2021) emphasize that the proliferation of bank branches leads to an increase in customer acquisition, thereby boosting deposit mobilization, loan portfolio expansion, and risk diversification. Similarly, Nguyen (2014) highlights that maintaining bank branches in underserved regions are critical for fostering compliance with know-your-customer (KYC) requirements. Such compliance mitigates credit risks and enhances loan quality, whereas the closure of bank branches, especially in regions where lending is relationship-driven and information-intensive, can adversely impacting credit availability to vulnerable sectors. In line with Hong et al. (2025), the findings also suggest that at lower levels, traditional financial inclusion improves capital access, resource allocation, and operational efficiency, thereby enhancing profitability. However, when TFI expands excessively, it may divert managerial attention and financial resources, increase operational costs, and expose banks to higher risks, ultimately weakening performance. Although the coefficients of TFI and TFI^2 point to an inverted U-shaped pattern, where profitability initially rises with TFI but eventually diminishes, the Lind and Mehlum (2010) U-test does not statistically validate this turning point. This implies that while the economic intuition for diminishing returns is plausible, the nonlinearity is not statistically confirmed in the Ethiopian banking context.

The results show that DFI exhibits a statistically significant U-shaped nonlinear relationship with bank profitability, reflected in the negative coefficient of DFI and the positive coefficient of DFI^2 . The Lind and Mehlum (2010) test in Table 7 confirms this pattern, with a significantly negative lower bound (-1.001708) and a significantly positive upper bound (0.8328111). Thus, Hypothesis 2 is supported, indicating that profitability begins to rise only after the inflection point at a DFI level of 0.865. This result aligns with recent evidence (Xie & Deng, 2025; Yuan et al., 2025; Yin et al., 2024; Song et al., 2023; Yang & Masron, 2023) showing that digitalization initially depresses profitability due to high fixed costs, technological investments, capability-building, and intensified competition. As Xie & Deng, (2025) claimed, in this early

“investment phase,” returns are limited while expenses accumulate. Once digital usage and scale increase through greater customer adoption, higher transaction volumes, and improved data capabilities, unit costs fall, operational efficiency improves, and technology spillovers dominate the competition effect, lifting profitability in the “return phase.” In Ethiopia’s context, the early-stage nature of digital finance amplifies the negative side. Digital transformation remains nascent, and banks face substantial upfront investment costs and operational risks. According to the NBE-FSR (2024), data privacy vulnerabilities and weak consumer protection further undermine trust. Moreover, digital channel expansion mainly targets existing customers and relies on regressive service pricing models, limiting outreach to underserved populations and reducing potential gains. Low digital literacy and rural infrastructure gaps and slow digital adoption, delaying the transition toward the profitability-enhancing stage of digital FI.

Despite earlier studies such as Erülgen et al. (2023), Yakubu & Musah (2022), and Vo & Nguyen (2021) reporting a positive association between Z-score and bank profitability, this study finds a negative and statistically significant effect. This result aligns with the “risk–return tradeoff” documented by Bakó & Neszveda (2024), Wang et al. (2017), Bhootra & Hur (2015), and Harvey (2001), who argue that institutions with higher stability often earn lower returns because they adopt more conservative risk exposures. Bhootra and Hur (2015) note that the negative risk–return relationship is most evident among firms with unrealized losses, while Wang et al. (2017) show that the negative pattern is particularly pronounced where capital gains overhang is low, implying that entities avoiding risk generate lower short-term returns. Within Ethiopia’s context, this negative relationship is both economically intuitive and structurally driven. Ethiopian banks rely heavily on interest income, yet recent policy measures (the recent 18% credit cap) restrict loan expansion and limit access to high-yield credit markets. As a result, banks maintain higher liquidity buffers and allocate more resources toward low-risk assets, which improves stability but suppresses returns. Additionally, persistent high inflation and macroeconomic volatility have encouraged banks to shift toward short-term, low-risk lending to protect real returns and reduce exposure to long-term credit and interest-rate risks. While these strategies strengthen banks’ solvency positions, they simultaneously depress profitability by limiting engagement in higher-yield, longer-maturity financing.

The loan-to-deposit ratio finding demonstrates a positive impact on bank profitability, aligning with the findings of (Muhammed et al., 2024; Ozili & Ndah, 2024; Jajah et al., 2022), but contrasting with Zheng et al. (2023). This finding reinforces the fractional reserve theory, as claimed by Espinosa et al. (2023),

whereby banks profit by lending a significant portion of deposits while maintaining minimal reserves. Heffernan (1996) highlights that this practice generates profit through interest rate differentials, provided intermediation costs and loan risk are managed. Supporting this, Jajah et al. (2022), this positive relationship reflects the wide gap between low deposit rates and high lending rates prevalent in Sub-Saharan Africa, which can enhance profitability. From Ethiopian context, Muhammed et al. (2024) attributes the positive effect in Ethiopian banking sector to interest revenues from loans exceeding the interest paid to depositors, demonstrating effective use of deposits in credit allocation. Similarly, Soesetio et al. (2022) argues that a high LDR enables robust credit distribution, increasing profitability despite liquidity risks.

Table 16: Empirical findings

	Main test	Robustness test
Variables	Two-step system GMM	Inclusion of ROE
I.PI	-0.0273 (-0.18)	
I.ROE		-0.043 (-0.24)
TFI	0.842* (2.08)	1.121* (1.80)
TFI²	-.125* (-1.77)	-0.147 (-1.37)
DFI	-1.002* (-2.01)	-1.446* (-1.81)
DFI²	0. .579* (2.11)	0.814* (1.83)
lnTA	-0.098 (-1.67)	-0.147* (-1.8)
SE	-0.087 (-0.4)	-0.015 (-0.05)
lnZS	-0.526*** (-3.51)	-0.749*** (-3.23)
LDR	0.601*** (3.17)	0.833** (2.87)
RDIR	-0.319** (-2.81)	-0.435** (-2.58)
BM	-0.109 (-0.58)	-0.067 (-0.24)
N	119	119
Groups	17	17
Instruments	14	14
AR(2) test	0.962 (0.05)	0.901 (0.12)
Hansen test	0.882 (0.66)	0.665 (1.58)

Source: Computed based on Stata 18 result, Notes *p< 0.1, **p< 0.05, ***p< 0.01

Real deposit interest rates negatively affect profitability, consistent with Ogunbiyi & Ihejirika (2014). Higher inflation-adjusted deposit interest rates reduce the interest spread, leading to lower profits (Ogunbiyi & Ihejirika, 2014). Banks incur higher funding costs to attract deposits while inflation diminishes the value of future income, compounding profitability challenges.

Table 17: Results of Lind and Mehlum (2010) U-test

	TFI		DFI	
	Lower bound	Upper bound	Lower bound	Upper bound
Interval	0.0077457	2.971483	0.00	1.58376
Slope	0.8395606	0.0960843	-1.001708**	0.8328111**
Extreme point		3.35		0.865**

Source: Computed based on stata 18 result, Notes *p< 0.1, **p< 0.05, ***p< 0.01

4.4. Causality test

This study undertook a causality test to investigate the relationship between traditional and digital FI in the context of bank profitability. While the findings of Dumitrescu & Hurlin (2012) suggest a unidirectional influence of TFI on bank profitability, the test by Juodis et al. (2021) indicates a bidirectional relationship, where TFI affects profitability and vice versa. This bidirectional dynamic posits that TFI not only impacts profitability but is also influenced by it. Furthermore, the Dumitrescu & Hurlin (2012) test emphasizes that bank profitability drives innovation and expansion into digital channels, reinforcing the unidirectional view that profitability catalyzes digital FI advancement. Additionally, the directional relationships of other variables with bank profitability, as analyzed through both models, are summarized in Table 18.

Table 18: Causality test

Test(Ho)	Juodis et al. (2021)		Direction	Dumitrescu & Hurlin (2012)		Direction
Direction	→	←		→	←	
PI↔DFI	-	-	PI↔DFI	-1.0383***		PI→DFI
PI↔TFI	3.5361***	4.6299***	PI↔TFI	-	-0.1773**	PI←TFI
PI↔lnZS	9.6162***	1.9227*	PI↔lnZS	-	0.4458**	PI←lnZS
PI↔LDR	5.1433***	2.6134***	PI↔LDR	-0.1081**	0.1713*	PI↔LDR
PI↔RDIR	-	2.1438**	PI↔RDIR	-	0.8380***	PI←RDIR

Source: Computed based on stata 18 result, Notes *p< 0.1, **p< 0.05, ***p< 0.01

4.5. Robustness test

The robustness of the regression model is substantiated by a series of diagnostic tests, as highlighted in pertinent literature (Aziz et al., 2024; Jajah et al., 2022; Yakubu & Musah, 2022; Kumar et al., 2021; Vo & Nguyen, 2021). These tests include the Hansen test for instrument validity and the Arellano-Bond tests for autocorrelation, both of which confirm the absence of second-order serial correlation and validate the model's specification. The results from the AR (2) and Hansen tests indicate that the conditions for GMM estimation are met. Furthermore, two approaches were employed to analyze the model's robustness. Initially, given the sensitivity of ROE to fluctuations in financial leverage, ROE (Pennacchi & Santos, 2021) was employed interchangeably with PI to evaluate the consistency of the results. The findings presented in Table 16 demonstrate that the results for each variable align with those obtained from the primary analysis, thereby reinforcing the validity of our earlier conclusions.

5. Conclusion

While the societal and economic benefits of FI are widely acknowledged, its direct implications for bank performance have received limited attention in the academic literature (Yakubu & Musah, 2022; Vo & Nguyen, 2021), particularly in the Ethiopian context. Moreover, whether FI unequivocally enhances bank profitability remains an unresolved question (Kumar et al., 2021). To that end, the present study analyzed the nonlinear impact of TFI and DFI on the profitability of 17 fully operational Ethiopian commercial banks over the period 2015–2023. Using PCA, indices for TFI and DFI were constructed from seven traditional and four digital indicators, respectively, while bank profitability index was developed using ROA, ROE, and NIM. To ensure methodological rigor, the study employed a non-linear two-step system GMM estimator and Granger causality tests to analyze the directional relationships between FI and bank profitability. Robustness checks incorporated alternative specifications, considering the inclusion of ROE as a profitability measure to account for the pandemic's disruptive effects.

The findings reveal a positive impact of TFI on bank profitability, underscoring the role of physical banking services in mobilizing deposits and generating sustainable revenue streams. However, the diminishing marginal gains observed beyond a certain expansion point suggest that excessive outreach to long-tail segments may strain operational resources and elevate risk. DFI, in contrast, follows a nonlinear trajectory as its initial phases impose financial and operational burdens, consistent with Yuan et al. (2025), who emphasize that early digital adoption is typically costly due to investment in infrastructure, cybersecurity, system integration, and talent. In Ethiopia, this adverse impact is exacerbated by regulatory constraints, limited financial literacy, and the underutilization of digital platforms for core services like lending. Yet, as digital platforms scale, interoperability improves, and banks accumulate learning effects, DFI transitions into a profitability-enhancing force. This turning point mirrors the digital transformation path documented by Yuan et al. (2025), where efficiency gains, cost compression, and data-driven lending gradually outweigh upfront expenses. In addition, Granger causality tests indicate unidirectional causality between DFI and profitability, while TFI maintains a bidirectional impact, emphasizing its foundational role in the banking sector's revenue generation strategy.

These results have several policy implications. Regulators should develop comprehensive strategies to strengthen both traditional and digital financial infrastructures. Regulators should pursue a phased digital support strategy, initially easing cost burdens through targeted incentives and regulatory sandboxes, then gradually tapering support as banks reach maturity

in digital adoption. Strengthening digital literacy, expanding infrastructure in rural areas, and incentivizing banks to diversify digital offerings will be vital for accelerating digital uptake. Relaxing stringent digital ID requirements in underserved areas, as posited by Jajah et al. (2022) and De Sousa (2015), could accelerate the inclusion process while the infrastructure for digital identification matures. Additionally, a strategic emphasis on consumer protection, data privacy, and the mitigation of cybersecurity risks is critical for sustaining trust in digital financial services.

Despite banking sector dominance as the primary source of credit, 99.8% of loans and advances are concentrated in urban areas (NBE-FSR, 2024), leaving rural populations underserved. This urban-centric focus undermines the paradigm of FI, which seeks to provide equitable financial access. Banks should adopt innovative approaches such as agent banking, partnerships with fintech firms, and a more efficient deployment of digital tools to reach underserved populations.

Finally, echoing Jajah et al. (2022), relaxing borrowing constraints and enhancing operational efficiencies can promote FI and, by extension, enhance profitability. A concerted effort from policymakers, regulators, and financial institutions is essential to align the banking sector with the broader developmental goals of FI, ensuring a sustainable and inclusive financial ecosystem.

CHAPTER FOUR: FI AND STABILITY IN ETHIOPIA USING BANK-LEVEL DATA: A TWO-STEP SYSTEM GMM ESTIMATION

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Abstract

Background

This paper examines the impact of FI on bank stability within Ethiopian context, using panel data from 17 commercial banks over the period 2015-2023. Given the scarcity of research focused on the relationship between FI and bank stability in Ethiopia, this paper seeks to address a crucial gap by analyzing both conventional and digital aspects of FI in relation with bank stability.

Methods

A two-stage principal component analysis (PCA) constructs a composite FI index, integrating 10 conventional and 5 digital indicators. A two-step system GMM approach addresses endogeneity, while Lind and Mehlum's (2010) U-test examines nonlinearities. Dumitrescu-Hurlin (2012) and Juodis et al. (2021) causality tests assess the directional relationship between FI and stability.

Results

The result reveals an inverted U-shaped relationship between FI and bank stability. FI enhances stability up to a 30.3% threshold, beyond which increased transaction costs, information asymmetries, and adverse selection risks weaken stability. Capital adequacy moderates this effect, raising the threshold to 35.1%, but its stabilizing role diminishes at higher levels. Granger causality tests confirm a bidirectional relationship. Additionally, bank efficiency and GDP growth enhance stability, while real interest rates, total assets, and income diversification exert destabilizing effects.

Conclusions

This study makes three key contributions. First, it provides the first empirical analysis of the FI-stability nexus in Ethiopia. Second: (i), it develops a multidimensional FI index; (ii), explores both linear and nonlinear relationships, and (iii) examines macroprudential regulation as a moderating factor. Third, it tests causality, offering policy insights. To enhance stability while mitigating risks, policymakers must balance FI expansion, enforce regulatory frameworks, and implement targeted capital requirements. Regulators should strengthen consumer protection and financial literacy, while banks must optimize outreach, manage credit risk, and ensure prudent asset allocation and liquidity management to sustain financial stability.

Keywords: FI; Principal Component Analysis; Bank stability; GMM; Ethiopia

1. Introduction

In contemporary financial policymaking, the pursuit of financial system stability has increasingly been viewed alongside with the promotion of FI (FI) (Antwi et al., 2024; Arora, 2020). Growing evidence suggests that the degree of FI can significantly impact the stability of financial systems (Damane & Ho, 2024; Antwi et al., 2024; Vo et al., 2020; Kim et al., 2020; Ahamed & Mallick, 2019). Historically, the dominant focus of financial authorities was primarily on preserving financial stability (Schinasi, 2005). However, over recent decades, FI has risen to prominence as a key policy goal, complementing the objectives of stability, integrity, and consumer protection, largely driven by the initiatives of global regulatory bodies and stakeholders (Hannig & Jansen, 2010). This shift prompts a critical inquiry into whether financial stability and FI function as substitutes or complements within the broader regulatory framework (Morgan & Pontines, 2017).

FI is conceptualized as encompassing the availability, access, and usage of financial products and services (Nguyen, 2021; Pesqué-Cela et al., 2021; Demirgüç-Kunt et al., 2017; Allen et al., 2016; Sarma, 2016; Babajide et al., 2015). Specifically, "availability" denotes the infrastructural capacity of financial institutions, measured by the number of bank branches, registered agents, and ATMs (Nguyen & Du, 2022; Sarma, 2016). "Access" (or penetration) reflects the extent to which financial services reach society, operationalized as the number of mobile banking, internet banking, and wallet accounts across commercial banks, microfinance institutions (Ismael & Ali, 2021; Nguyen, 2021). "Usage" captures the actual adoption of financial products, assessed by the total volume of credit and deposits relative to GDP (Nguyen & Du, 2022; Nguyen, 2021; Sarma, 2016). Conversely, bank stability, refers to the resilience of financial institutions to economic shocks, ensuring the uninterrupted mediation of savings and investments. It is characterized by the maintenance of adequate capital, effective risk management, and sustained public confidence to avert crises such as bank runs and systemic collapses (Koudalo & Toure, 2023; Oanh et al., 2023; Anatolyevna & Ramilevn, 2013; Schinasi, 2004). The determinants of bank stability can differ significantly across various contexts, requiring tailored policy responses (Ozili, 2018). Factors influencing bank stability include internal elements such as general ledger (GL) and profit-loss (PL) accounts, as well as external socio-economic and political conditions (Ha & Nguyen, 2023). A broader conceptualization of financial stability extends beyond individual banks to capture systemic resilience, market volatility, and rare financial crises (Cihak, 2020). Ha & Nguyen, (2023) and

Borio, (2003), emphasized that stability requires both microprudential measures, aimed at reducing individual bank failures, and macroprudential policies to mitigate contagion effects.

Empirical studies on the impact of FI on bank stability in developing countries is scarce (Chinoda & Kapingura, 2023; Koudalo & Toure, 2023; Jungo et al., 2022). Neglecting this relationship could lead to severe consequences, including costly financial crises or ongoing financial exclusion (Damane & Ho, 2024; Danisman & Tarazi, 2020; Čihák et al., 2016). Schoenmaker (1996) highlights that failures within individual financial sectors can trigger contagion effects, leading to widespread instability stemming from the collapse of financial institutions. In such scenarios, a single institution's failure can create a ripple effect, eroding investor confidence and prompting a rush to liquidate deposits (Huynh et al., 2020). Therefore, understanding contagion risk is crucial for comprehending the dynamics of the financial system and its stability (Huynh et al., 2020). Consequently, policymakers must adeptly balance the trade-offs and synergies between fostering FI and maintaining stability (Damane & Ho, 2024; Čihák et al., 2016).

While FI is widely recognized as a determinant of financial stability (Oanh et al., 2023), existing studies present divergent perspectives. A dominant strand argues that FI enhances stability by depositor base, mitigating liquidity risk and fostering economic resilience (e.g., Oanh et al., 2023; Koudalo & Toure, 2023; Malik et al., 2022; Nguyen & Du, 2022; Vo et al., 2020; Pham & Doan, 2020; Banna & Alam, 2021; Ahmed & Mallick, 2019; Le et al., 2019; Neaime & Gaysset, 2018; Morgan & Pontines, 2014), while others caution that extending credit to previously unbanked individuals may increase default rates and destabilize financial institutions (e.g., Umar & Akhtar, 2024; Antwi & Kong, 2023; Ha & Nguyen, 2023; Damrah et al., 2023; Barik & Pradhan, 2021; Feghali et al., 2020). However, three critical gaps identified from the existing literature. First, research disproportionately rely on macro-level indicators, analyzing regions such as Sub-Saharan Africa (Damane & Ho, 2024; Chinoda & Kapingura, 2023; Jima & Makoni, 2023; Anarfo et al., 2020), emerging economies (Jungo et al., 2022; Wang & Luo, 2022; Vo et al., 2020; Morgan & Pontines, 2017), ASEAN (Nguyen & Du, 2022; Sethy & Goyari, 2022), Asia (Malik et al., 2022; Pham & Doan, 2020; Vo et al., 2020; Le et al., 2019), MENA (Neaime & Gaysset, 2018), Africa (Koudalo & Toure, 2023; Kebede et al., 2021), and BRICS (Talbi & Sebai, 2025; Sebai & Talbi, 2024; Barik & Pradhan, 2021). Despite, studies examining FI's impact at the micro (bank-level) remain limited (e.g., Umar & Akhtar, 2024; Damrah et al., 2023; Anthony-Orji et al., 2022; Matsebula & Sheefeni,

2022). For instance, Ethiopia, where only 10% of households' access formal credit (Lakew & Azadi, 2020) and 99.8% of loans are concentrated in urban areas (NBE-FSR, 2024), remains conspicuously absent from empirical scrutiny. While existing studies in Ethiopia have investigated financial sector stability (Filatie & Sharma, 2024; Kebede et al., 2024; Fisseha, 2023; Yitayaw et al., 2023; Dress, 2022; Abdu, 2022; Isayas & McMillan, 2021; Aman, 2019; Meher & Getaneh, 2019; Zelig & Wassie, 2019; Meressa, 2018), the impact of FI on bank stability remains largely unexplored. Second, methodological limitations persist, including (i) prior studies have often relied solely on conventional FI indicators, ignoring its multidimensional nature (Mapurita & Mayoukou, 2024) or focused exclusively on digital aspects (e.g., Antwi & Kong, 2023; Chinoda & Kapingura, 2023; Banna & Alam, 2021). This narrow focus persists despite evidence that digital and traditional channels interact dynamically to shape stability outcomes (Anton & Nucu, 2024), resulting in an incomplete understanding of FI. (ii), corroborating Damane & Ho, (2024) claims, most previous studies ignored nonlinear dynamics, and insufficient attention moderating impact macroprudential regulation on FI-bank stability nexus (see Hua et al., 2023). Third, reliance on linear estimators and inadequate causal inference techniques obscures bidirectional relationships and endogenous feedback loops.

This study advances the FI-stability discourse through three novel contributions. First, it addresses the geographic imbalance by focusing on Ethiopia, a paradigmatic case of high financial exclusion (1% rural bank penetration) coupled with systemic concentration risks (23.5% of loans held by top borrowers). Such extremes provide a unique lens to test FI's stability implications under conditions of structural fragility. Second, this study pushes the frontier by: (i) constructing a multidimensional FI index via two-stage PCA, integrating 10 traditional and 5 digital indicators; (ii) applying a two-step system GMM estimator to mitigate endogeneity and unobserved heterogeneity; (iii) pioneering the examination of the nonlinear FI-stability relationship in Ethiopia, validated through Lind and Mehlum's (2010) U-test for greater statistical rigor; and (iv) introducing macroprudential regulation as a moderating variable, an overlooked dimension in low-income settings. Third, this study employs Dumitrescu-Hurlin (2012) and Juodis et al. (2021) causality tests to disentangle bidirectional linkages. Finally, the study offers actionable insights for policymakers, guiding strategies to enhance both FI and financial stability in Ethiopia. Finally, the study offers actionable insights for policymakers, guiding strategies to enhance both FI and financial stability in Ethiopia.

The remainder of the study is structured as: Part 2 reviews the literature; Part 3 details the data sources and econometric methods; Part 4 presents and discusses the empirical results; and Part 5 concludes with key findings and policy implications.

2. Literature review

2.1 Theoretical literature review

FI, from a macroeconomic perspective, is seen as a catalyst for “creative destruction,” promoting economic growth, reducing inequality, and enhancing financial stability. However, at the micro level, excessive FI can lead to opportunistic behaviors, such as fund misuse and deliberate payment delays, which may undermine financial stability (Hua et al., 2023). The impacts of FI are neither uniform nor static; they vary across different temporal and spatial contexts. This has led to divergent views among researchers regarding its impact on bank stability, with two divergent schools of thought emerging as the one positing a FI-stability effect and the other suggesting a FI-instability outcome (Damrah et al., 2023; Moaz, 2022). To that end, the relationship between FI and bank stability has become a central theme in both academic and policy discourse (Čihák et al., 2016). This study employs a multi-theoretical approach, drawing on asymmetric information theory, financial intermediation theory, systemic risk theory, and portfolio theory. These theoretical underpinnings collectively offer a nuanced understanding of the pathways through which FI can effect bank stability in Ethiopia.

Asymmetric information theory, highlighted by Akerlof (1970), addresses the challenges posed by uneven information distribution in financial markets. In FI, this imbalance is particularly significant as institutions serve previously unbanked populations. Difficulties in assessing creditworthiness can lead to adverse selection, hindering credit risk management and operational efficiency, which may compromise financial stability (Oanh et al., 2023; Moaz, 2022; Sethy & Goyari, 2022; Barik & Pradhan, 2021; Khan, 2011; Bofondi & Gobbi, 2003). Balancing information asymmetry within FI context can thus strengthen the financial system.

The financial intermediation theory underscores the pivotal role of banks in linking savers with borrowers (Scholtens & Wensveen, 2003; Diamond, 1984), thereby facilitating FI. By providing liquidity, managing risks, and bridging informational gaps, banks contribute to the efficient allocation of capital and the mitigation of risks, which enhances overall financial stability (Servigny & Renault, 2004). This theory emphasizes that by expanding financial access, particularly in developing economies where financial exclusion is significant, banks can improve their performance by broadening their customer base, increasing deposits, and fostering a more resilient financial system (Kim et al., 2018; Diamond, 1984). This

phenomenon lessens information asymmetry, thereby lessens market imperfections (Oanh et al., 2023).

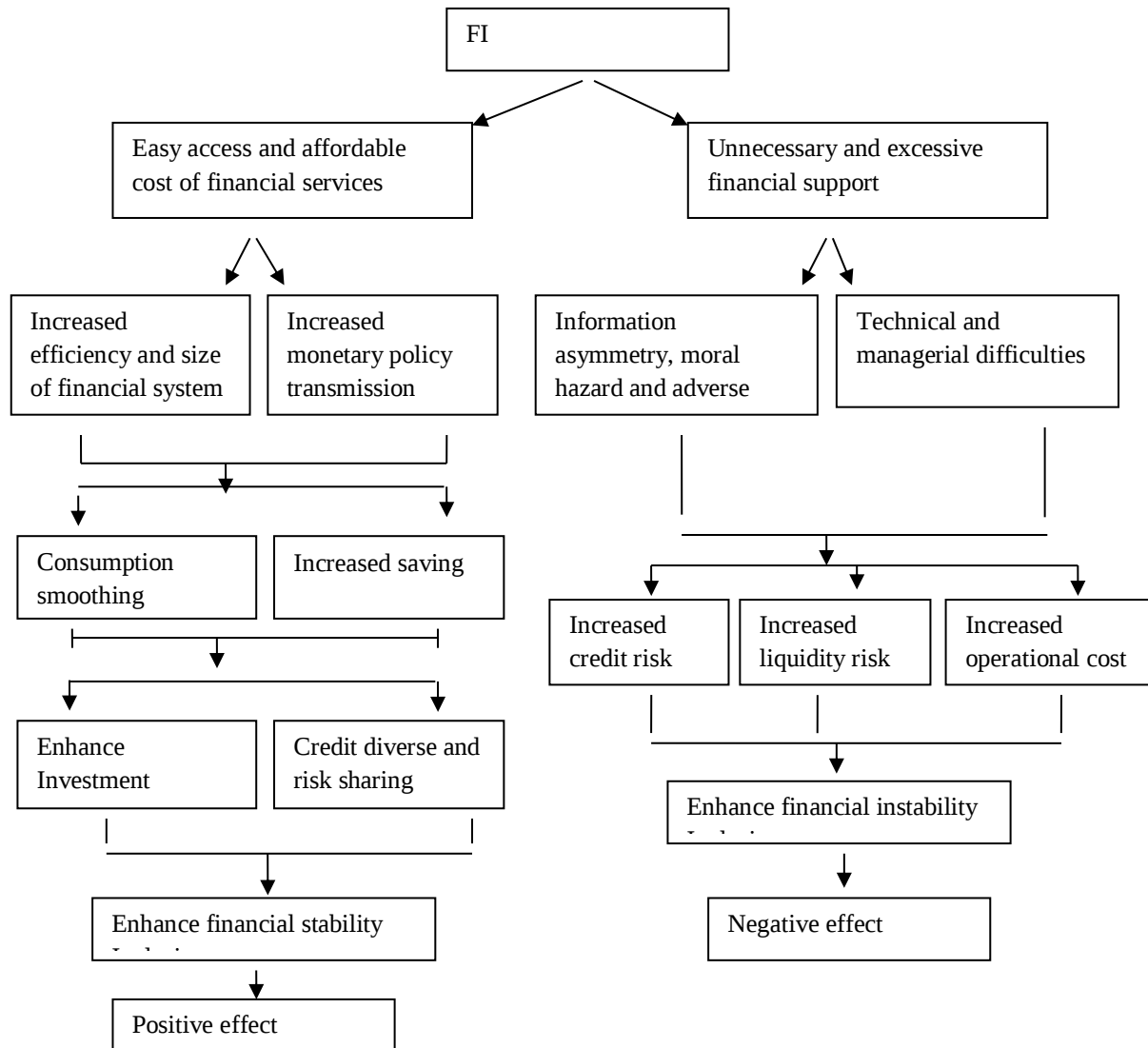
Systemic risk theory, as developed by Minsky (1982) and later refined by Borio (2011), addresses the interconnectedness of financial institutions and the amplification of shocks through mechanisms such as leverage, asset price bubbles, and procyclicality. Borio differentiates systemic risk into temporal and cross-sectional dimensions. Temporal risk involves the dynamic evolution of aggregate risk, while cross-sectional risk pertains to the distribution of risk within the financial system, influenced by common exposures and counterparty risks. Within the context of FI, Khan (2011) suggests that expanding borrower bases can lower lending standards, potentially destabilizing the financial system. Conversely, Hannig and Jansen (2010) argue that FI can enhance stability by diversifying deposit and loan bases, involving segments less susceptible to economic cycles, while Prasad (2010) highlights the positive effects of credit access on employment and economic growth.

Portfolio theory highlights the significance of diversification in mitigating risk (Markowitz, 1952). In the context of FI, a diversified loan portfolio can potentially reduce the impact of credit losses on individual banks and the overall financial system (Beck et al., 2013; Wang & Lin, 2021). Adem (2022) concurs, noting that diversification lowers bankruptcy risk for banks. Khan (2011) outlines three main ways of mitigating the FI on financial instability: diversification of bank assets through increased lending to smaller firms reduces portfolio risk; an expanded and stable deposit base lessens reliance on volatile non-core financing; and improved monetary policy transmission enhances stability. However, as Huynh & Dang (2021) argue, the effectiveness of diversification hinges on the correlation between loan segments and the portfolio's overall risk profile.

Drawing on the above theoretical foundations, this study offers a unique lens through which the impact of FI on bank stability can be comprehended. Figure 3 synthesizes these theoretical frameworks, underscoring both stabilizing and destabilizing mechanisms. On the positive side, corroborating Diamond's (1984) financial intermediation theory, Oanh (2024) assert that increased intermediation enhances the flow of funds between borrowers and savers, effectively bridging the gap between those with surplus funds and those in deficit. This formalization strengthens monetary policy transmission, optimizes resource allocation, and reduces dependence on informal financial systems (Damane & Ho, 2024; Sethy & Goyari, 2022). Additionally, FI facilitates consumption smoothing and savings mobilization, expanding

banks' deposit bases and liquidity buffers (Sethy & Goyari, 2022; Khan, 2011). In accordance with Markowitz's (1952) portfolio theory, Khan (2011) emphasizes that higher savings lead to increased investment financing and diversified credit access, mitigating loan concentration risk and enhancing risk-sharing mechanisms. Lending to small and medium-sized enterprises (SMEs) further mitigates exposure to single borrowers, lowering the likelihood of non-performing loans (NPLs) and reinforcing stability (Damane & Ho, 2024).

Figure 3: Theoretical channels of interactions between FI and bank stability



Source: Adopted from (Damane & Ho, 2024; Sethy & Goyari, 2022; Barik & Pradhan, 2021)

However, excessive FI without proper risk management can undermine financial stability (Dienillah et al., 2018). Supporting the negative implications of Akerlof's (1970) information asymmetry theory, (Damane & Ho, 2024; Sethy & Goyari, 2022), suggests that extending financial services to low-income segments increases adverse selection and moral hazard, elevating credit risk and operational inefficiencies. Specifically, rapid FI expansion often

necessitates outsourcing credit assessments and KYC functions, heightening reputational risks and weakening due diligence (Barik & Pradhan, 2021; Khan, 2011). Furthermore, aligning with Minsky's (1982) systemic risk theory, Sarmiento (2024), highlights that financial instability within non-bank financial institutions (NBFIs) can spill over into the broader financial ecosystem, amplifies systemic vulnerabilities.

2.2 Empirical review and hypothesis development

2.2.1 FI and bank stability

Empirical research regarding the impact of FI on the stability of financial systems presents varied outcomes (Damrah et al., 2023; Feghali et al., 2021; Vo et al., 2020). Despite data limitations, these studies provide perspectives on both the positive and negative effects of FI on the stability of banks.

Khan (2011) identified three key channels through which FI enhances bank stability. First, by promoting asset diversification, FI reduces the risk and cost associated with bank financing, thereby lowering custodial expenses and potential losses. Second, the inclusion of small depositors attracts retail mobilized capital, which is generally more stable than wholesale funding sources. Third, formalization of the informal segment of the population improves the monetary policy transmission, ultimately strengthening the overall stability of the banking system. Wang and Luo (2022), using data from over 1500 commercial banks across 36 emerging economies, found that FI significantly enhances bank stability by promoting operational efficiency, risk management, and funding stability. Similarly, Nguyen and Du (2022), employing System GMM for 102 banks in six ASEAN countries, concluded that FI promotes stability through increased customer deposits and reduced non-performing loans (NPLs). Their findings align with those of Morgan and Pontines (2017), who showed that lending to small and medium sized enterprises (SMEs) diversifies risk and contributes to higher Z-scores and lower NPL ratios, key indicators of bank stability. These studies collectively highlight how extending credit to SMEs serves as a buffer against financial instability by diversifying loan portfolios and reducing concentrated risk exposure.

During financial crises, resources mobilized from FI initiatives are vital for helping institutions escape crisis and enhance resilience (Ha & Nguyen, 2023; Hannig & Jansen, 2010). Vo et al. (2020) and Chinoda and Kapingura (2023) findings underscore the importance of FI in reducing systemic risks. Vo et al. (2020) highlight its role in broadening the depositor base and improving financial resilience in emerging markets, while Chinoda and Kapingura (2023) emphasize the stabilizing effects of digital FI in Sub-Saharan Africa, noting

that it significantly reduces NPLs and enhances bank stability. Another layer of analysis emerges in the work of López and Winkler (2019), who explore FI during periods of financial crises using 189 economies data for the period of 2004–2017. Their study finds that countries with higher levels of FI experience less severe disruptions in credit availability during economic downturns. Similarly, Pham and Doan (2020), examining 42 countries across Asia using Feasible Generalized Least Squares (FGLS), conclude that even a weak positive impact of FI on stability is enough to safeguard financial markets against extreme volatility, especially when FI fosters a stable retail deposit base. Jungo et al. (2022) further emphasize the importance of expanding financial access and encouraging investment in FI to maintain monetary system stability, particularly in developing countries. In general, studies like (Chinoda & Kapingura, 2023; Ha & Nguyen, 2023; Jima & Makoni, 2023; Koudalo & Toure, 2023; Nguyen & Du 2022; Wang & Luo, 2022; Pham & Doan, 2020; Vo et al., 2020; Ahamed & Mallick 2019; Le et al., 2019; Dienillah et al., 2018; Neaime & Gaysset, 2018; Morgan & Pontines, 2014; Hannig & Jansen, 2010), posits that FI contributes to bank stability by expanding the deposit base, diversifying risks, reducing income inequality, and improving regulatory efficiency through policy transmission.

On the other hand FI has an adverse impact on bank stability. Oanh et al. (2023), claims that FI brings many new, inexperienced clients into the formal financial sector, creating challenges in the credit market. Due to asymmetric information lenders struggle to assess borrowers' creditworthiness, with no credit record leads risking stability (Jima & Makoni, 2023). Damrah et al. (2023) present a nuanced view of FI's impact on bank stability in Kuwait from 2003 to 2017, illustrating how inclusion can have both positive and negative effects depending on the type of bank (Islamic vs. conventional) and external factors such as financial crises. Their Linear Mixed Model (LMM) reveals that while FI improves access to services, it also introduces inefficiencies and increased risk exposure, particularly during times of economic distress. Their findings align with those of Barik and Pradhan (2021), who, using system-GMM estimators for BRICS nations from 2005 to 2015, argue that rapid credit expansion facilitated by FI can deteriorate lending standards and escalate non-performing loans (NPLs). Employing System GMM ranging from 2011-2019, Umar and Akhtar (2024), examining Chinese banks, found that while FI generally reduces bank risk-taking, it can increase risks in unlisted and large banks, suggesting that the impact of FI varies depending on bank characteristics. Similarly, Le et al. (2019), using Feasible Generalized Least Squares (FGLS), highlight the trade-offs associated with FI, noting that while FI promotes financial sustainability, it also

negatively impacts financial efficiency due to the operational challenges of servicing previously unbanked populations. In light of the above empirical literature reviewed, this study proposes the following hypothesis:

H1: FI has a positive impact on bank stability

2.2.2. Non-linear relationship between FI and bank stability

A significant limitation of existing empirical research is its predominant focus on the mean effects of FI on financial stability, often overlooking the variation in this relationship across different levels of stability (Damane & Ho, 2024). Despite the mean impact of FI on bank stability, the findings of (Sebai et al., 2025; Hua et al., 2023; Khémiri et al., 2024; Ahamed & Mallick, 2019), reveals an inverted U-shaped relationship between FI and financial stability, demonstrating that beyond a certain threshold, further inclusion can destabilize the financial system. Chinoda and Kapingura (2024) identify an inflection point in fintech-driven FI, where early-stage adoption reduces risk-taking but excessive competition later elevates funding costs and operational risks. Contrasting perspectives, such as the U-shaped hypothesis (Talbi & Sebai, 2025; Antwi et al., 2024; Sebai & Talbi, 2024; Dang & Thi, 2022; Saha & Dutta, 2021), argue that FI's stabilizing effects resurge at higher development stages.

The above contrasting empirical evidence suggests that FI does not exert a uniform influence on financial stability (Sebai & Talbi, 2024). Instead, its effects depend on contextual factors such as market concentration, financial sector maturity and institutional quality. Kebede et al. (2021) further emphasize the intricate nature of FI in Africa, noting that its benefits may be limited by high market concentration, which can stifle competition and reduce the effectiveness of inclusion efforts. Dienillah et al. (2018), using a Tobit model for 19 countries from 2004 to 2014, revealed that FI positively impacts stability in high-income nations but shows insignificant effects in lower-income groups. This highlights the need for tailored FI strategies suited to specific economic and regulatory environments.

This view is supported by Oanh et al. (2023) and Jima and Makoni (2023), who highlight the contextual nature of FI's impact. Employing panel vector autoregression (PVAR) model for 58 countries (27 low financial development states and 31 high financial development states) from 2004 to 2020, Oanh et al. (2023) found that FI positively correlates with stability in low-financial-development countries, but this relationship turns negative in more developed financial systems, where excessive credit access may heighten systemic risks. Similarly, Jima and Makoni (2023), using ARDL cointegration and Granger causality tests from 2000 to 2019

for 26 Sub-Saharan African countries, revealed that while FI contributes to both short-term and long-term stability, the relationship is bidirectional and contingent on broader economic and institutional conditions. Ahamed and Mallick (2019) extended this argument by analyzing a global dataset of 2635 banks in 86 countries. Using two-step system GMM, they posited that FI enhances stability by increasing customer deposits and lowering marginal banking costs, with the effectiveness of these benefits being contingent on institutional quality. They highlight the role of a robust institutional framework in ensuring that FI does not devolve into unchecked risk-taking. In this context, the study implicitly warns against viewing FI initiatives in a silo, devoid of regulatory oversight or institutional support. Similarly, Hannig and Jansen (2010) emphasized the role of robust institutional frameworks in ensuring that FI initiatives do not lead to unchecked risk-taking, a finding also supported by Sethy and Goyari (2022) in their study of South Asian countries, where FI was found to be a key driver of long-term stability.

In general, based on the observed nonlinear impact of inclusive finance on financial stability (Sebai et al., 2025; Talbi & Sebai, 2025; Antwi et al., 2024; Anton & Nucu, 2024; Kebede et al., 2024; Hua et al., 2023; Khémiri et al., 2024; Sebai & Talbi, 2024), this study hypothesizes:

H2. There is an inverted U-shaped relationship between FI and bank stability

2.2.3. The moderating effects of macro-prudential regulation

Contrary to the assumptions of classical economics, market failure theory underscores the limitations of market forces in efficiently governing the real economy. Risks stemming from information asymmetries and externalities can propagate systemic vulnerabilities, disproportionately affecting traditional commercial banks (Chinoda & Kapingura, 2024; Pantelieieva et al., 2020). To mitigate such risks, financial regulation emerges as a critical safeguard, curbing excessive risk-taking by banks (Chinoda & Kapingura, 2024). Among regulatory tools, the capital adequacy ratio (CAR) is a cornerstone of prudential oversight, directly enhancing financial stability by ensuring banks maintain sufficient capital buffers (Anarfo et al., 2022). While CAR independently strengthens financial stability, its interaction with FI presents another dimension. FI, conceived as expanding access to formal financial services, promotes financial deepening and reduces reliance on informal channels (Talbi & Sebai, 2025). Yet stringent CAR requirements may inadvertently restrict banks' lending capacity, resulting in credit rationing that stifles FI (Anarfo et al., 2022; Gambacorta & Mistrulli, 2004). The stability implications of this interaction hinge on regulatory and institutional contexts. In weak regulatory environments, rapid FI expansion may incentivize reckless risk-taking, eroding the stabilizing effects of capital buffers (Beck et al., 2013).

Conversely, well-capitalized banks are better positioned to manage credit quality, thereby mitigating risks associated with financial deepening (Thakor, 2014). Robust capital frameworks, when paired with FI, can enhance stability by diversifying revenue streams and reducing dependence on volatile funding (Anarfo et al., 2022; Hua et al., 2023). However, unchecked credit growth may heighten financial fragility (Morgan & Pontines, 2014). Since existing literature has not thoroughly explored this interaction, but (Anarfo et al., 2022; Hua et al., 2023) suggest that the relationship between CAR and FI positively influences bank stability. Owing prior studies, this interaction suggests that FI, when moderated by capital adequacy, strengthens bank stability, leading to the hypothesis:

H3: The interaction between capital adequacy and FI improves bank stability.

2.3. Stylized facts about Ethiopian banking sector

The empirical literature on FI and financial stability offers a rich diverse of findings, suggesting that a recurring theme across both streams of research is the need to avoid viewing FI or stability in a silo. This concise review of the literature is crucial for our empirical analysis. This is particularly relevant for Ethiopia, where the banking sector exhibits unique structural characteristics that shape the FI-stability nexus. Ethiopian banking sector is state-dominated, with limited competition and underdeveloped capital markets (Mengesha & Berde, 2023; Worku, 2016). Government securities are absorbed by captive investors at negative real rates, and the absence of market-based debt issuance reflects systemic inefficiencies (Abdu, 2022). State-owned Commercial Bank of Ethiopia (CBE) holds 49.5% of total assets and 48.7% of deposits, while five mid-sized banks control 28.0% and 29.4%, respectively, and 24 small banks account for the rest (NBE-FSR, 2024). Financial deepening is limited, with loans and bonds at 21.4% of GDP and deposits at 24.8% in 2023. Negative real deposit interest rates, driven by high inflation (29.3%), alongside 8% savings deposit rate and a 14.25% lending rate ((NBE Annual Report, 2024), highlight persistent financial distortions. FI remains highly uneven, with less than 1% of loans disbursed to rural areas, while large borrowers (those with credit exposure above 10 million birr) constitute only 0.5% of clients but control 74.8% of total banking sector loans (NBE-FSR, 2024b).

Recent FI strategic reforms, including introduction of interest-free banking, Safaricom Ethiopia's licensing under the National Digital Payment Strategy (NDPS), and the Digital ID initiative, have expected to increase FI. Yet, whether these advances enhance stability remains uncertain. The CBE's dominance creates a bifurcated system as state banks prioritize stability via sovereign debt, while private banks, constrained by thin margins and regulatory

asymmetries, limit FI expansion. Negative real returns undermine savings mobilization, while rural exclusion and speculative urban lending lower the threshold at which FI shifts from stabilizing to destabilizing. Hence, this study employs bank-level data to offer appropriately tailored policy implication aimed at enhancing bank stability and FI in Ethiopia.

3. Methods

3.1 Source and sample of data

Commercial banking institutions in Ethiopia are the most dominant and primary point of access to essential financial services. Based on the data compiled from NBE financial stability report (2024), commercial banks hold for 91.2% of total assets, 97.8% of deposits, 93.9% of credit, and 76.1% of equity in the financial sector, as of June 30, 2023. In light of this dominance, the study focuses on commercial banks but due to data availability concern and the newness of other banks, the researchers' focuses on 17 commercial banks. Data for the study sourced from various reliable institutions, like National Bank of Ethiopia (NBE), Commercial banks (CBs) annual report, and World Bank (WB) covering the period 2015-2023.

3.2 Construction and identification of variables

3.2.1 Dependent variables

Different studies used different indicators to measure bank stability (Čihák et al., 2016; Damane & Ho, 2024). In this research, Z-score is used as a measure of bank stability, following established literature (e.g., Damrah et al., 2023; Ha & Nguyen, 2023; Koudalo & Toure, 2023; Barik & Pradhan, 2021; Sethy & Goyari, 2022; Vo et al., 2020; Ahamed & Mallick, 2019). While the Z-score may emphasize profitability, it remains a widely used proxy for bank distance-to-default due to its comprehensiveness, simplicity, and data availability (Ha & Nguyen, 2023). Due to constraints in risk-related data, this study focuses exclusively on the Z-score. Z-score is valued for its ability to indicate bank insolvency risk, measured as the inverse of the probability of insolvency, reflecting the likelihood that a bank's assets may not cover its liabilities (Ha & Nguyen, 2023; Koudalo & Toure, 2023). Higher returns on assets and greater capitalization improve stability, while lower figures suggest increased risk (Damrah et al., 2023). This score, calculated from return on assets (ROA), volatility ($sd(ROA)$), and leverage (EQA) (Damrah et al., 2023; Vo et al., 2020), is constructed in this study as follows:

$$Z - score_{it} = \frac{ROA_{it} + EQA_{it}}{sd(ROA)_{it}}$$

Where: ROA represents the return on assets, EQA denotes the ratio between bank's total equity and total assets and Sd stands with standard deviation..

3.2.2 Independent variables

Measuring FI is essential to support evidence-based policy decisions (Sarma, 2016; Nguyen, 2021). Accurate measurement reveals gaps and opportunities for expanding FI (Demirgüç-Kunt et al., 2020). However, relying on a single factor can be misleading (Sarma, 2008; Nguyen, 2021). Composite indices offer a more comprehensive view by integrating multiple dimensions, enabling better comparisons across time and regions (OECD, 2008). These indices capture the multifaceted nature of FI (Mishra, 2007). This study constructs a multidimensional FI index using two-stage PCA, combining 10 traditional indicators and 5 digital indicators (see Table 18).

Table 19: Overview of indicators and data sources used in the study

Variables	Notation	Definition	Sources	Studies
Bank Stability (Dependent Variable)				
Bank Z-Score	ZS	Computes the buffer of a state’s banking system (capitalization and returns) with the volatility of those returns.	NBE	Damrah et al., 2023; Koudalo & Toure, 2023; Barik & Pradhan, 2021; Sethy & Goyari, 2021; Vo et al., 2020; Ahamed & Mallick, 2019
FI Indicators (Independent Variable)				
Convensional Availability	BPC	Commercial bank branches (per 100,000 adults)	NBE; WB	Damrah et al., 2023; Hua et al., 2023; Gharbi & Kammoun, 2023; Jima & Makoni, 2023; Jungo et al., 2022; Barik & Pradhan, 2021; Ismail & Ali, 2021; Kebede et al., 2021; Nguyen, 2021; Sha’ban et al., 2020; Vo et al., 2020; Le et al., 2019; Ahmed & Mallick, 2019; Camara & Tuesta, 2017
Convensional Availability	BAC	Commercial bank branches (per 1000km2)	NBE; WB	
Convensional Availability	APC	Automated teller machines (ATMs) (per 100,000 adults)	NBE; WB	
Convensional Availability	AAC	Number of ATMs (per 1000km2)	NBE; WB	
Convensional Availability	PPC	Number of PoSs (per 100,000 adults)	NBE; WB	
Convensional Availability	PAC	Number of PoSs (per 1000km2)	NBE; WB	
Digital Availability	APD	Number of agents (per 1,000 adults)	NBE; WB	
Digital Availability	AAD	Number of agents (per 1,000km2)	NBE; WB	
Digital Accessibility	MPD	No of mobile active users (per 1,000 adults)	NBE; WB	
Digital Accessibility	IPD	No of internet active users (per 1,000 adults)	NBE; WB	
Digital Accessibility	WPD	No of mobile money (wallet) users (per 1,000 adults)	NBE; WB	
Convensional Usage	DPC	Depositors with commercial banks (per 1,000 adults)	CBE; WB	
Convensional Usage	APC	Number of debit cards per 1,000 adults.	NBE; WB	
Convensional Usage	LGDP	Outstanding loans and advances (% of GDP)	NBE	
Convensional Usage	DGDPC	Outstanding deposits (% of GDP)	NBE	
Control Variables				
Loan to Deposit ratio	LDR	Indicates how much of the bank's deposit base is being used for lending.	NBE	Muhammed et al., 2024; Kulu & Bondzie, 2024; Bod’a et al., 2021; Bod’a & Zimková, 2021; Hakim, 2017
Provision to Loan	PL	The loan loss provision ratio represents the funds set aside to cover expected credit losses.	NBE	Ha & Nguyen, 2023; Hua et al., 2023; Koudalo & Toure, 2023; Barik & Pradhan, 2021; Ahmed & Mallick, 2019; Chen et al., 2018; Morgan & Pontines, 2018
Natural logarithm of Total Asset	lnTA	Provides a comprehensive measure of the bank's financial strength and capacity, reflecting the aggregate value of its economic resources available for generating revenue and supporting operations.	NBE	Damrah et al., 2023; Jungo et al., 2022;; Ramzan et al., 2021; Ahmed & Mallick, 2019; Vo et al., 2020; Ali & Puah, 2018; Beck et al., 2013a; Gupta & Kashiramka, 2020
Capital adequacy ratio	CAR	Assesses a bank's ability to absorb potential losses and sustain operations during financial stress, ensuring it maintains sufficient capital to cover its risks and support continued stability	NBE	Hua et al., 2023; Jungo et al., 2022; Kebede et al., 2021; Anarfo et al., 2020; Vo et al., 2020
Income Diversification	IND	The non-interest income to total income ratio insight into the diversification of a bank's income streams beyond traditional interest-based revenue.	NBE	Ahmed & Mallick, 2019; Sanya & Wolfe, 2011; Elsas et al., 2010
Operational efficiency management	EF	It refers to the practices and strategies employed to optimize a bank’s operational processes, reduce costs, and enhance productivity.	NBE	Damrah et al., 2023; Ullah et al., 2023; Jungo et al., 2022; Ahmed & Mallick, 2019; Beck et al., 2013
Real lending interest rate	RLIR	Inflation adjusted lending interest rate, i.e., lending interest rate minus inflation rate	NBE	Koudalo & Toure, 2023; Anthony-Orji et al., 2022; Atellu & Muriu, 2022; Siddik & Kabiraj, 2018
GDP Growth Rate	GDP	Annual percentage change in gross domestic product	NBE	Damrah et al., 2023; Ha & Nguyen, 2023; Koudalo & Toure, 2023; Oanh et al., 2023; Sethy & Goyari, 2022; Vo et al., 2020; Beck et al., 2013

Source: Prepared by the author, Notes: NBE= National Bank of Ethiopia, WB= World Bank

3.2.3 Control variables

As outlined in Table 1, the study includes several bank-specific and macroeconomic control variables, including an index for operational efficiency. Non-parametric index is used to drive efficiency using an output-oriented Constant Returns to Scale (CRS) through Data Envelopment Analysis (DEA). The choice of CRS is justified by the structure of the Ethiopian banking industry. Ayalew & Xianzhi (2017) highlight that Ethiopian banks operate within a homogeneous regulatory framework with limited competition. Most banks in Ethiopia are subject to similar capital requirements, operational constraints, and government policies, which result in a uniform relationship between inputs and outputs across banks. Despite Rao & Lakew (2012) suggesting that managers in Ethiopian banks have more control over inputs than outputs, most banks prioritize maximizing profits through efficient use of inputs. Thus, assuming out-put oriented CRS provides a realistic framework for comparing efficiency, as banks are expected to scale their operations proportionally regardless of size, making it suitable for long-term efficiency assessments.

In this analysis, salary and benefits, provisions, general expenses, branches, and deposits are treated as inputs, while net interest income and non-interest income serve as outputs. Using the model by Charnes et al. (1978) under Constant Returns to Scale (CRS), the efficiency score θ is calculated as the ratio of the weighted sum of outputs to inputs.

$$Efficiency(\theta) = \frac{\sum_{r=1}^s u_r Y_{rj}}{\sum_{i=1}^m v_i X_{ij}} \leq 1, j = 1, 2, \dots, n,$$

Where (θ) = efficiency score of bank j , Y_{rj} = amount of output r produced by bank j , X_{ij} = amount of input i used by bank j , u_r = weight assigned to output r , v_i = weight assigned to input i , s = number of outputs, m = number of inputs, n = number of banks (decision-making units) being evaluated.

Additionally, the analysis includes control variables such as income diversification, capital adequacy ratio, provisions to non-performing loans, loan-to-deposit ratio, and total assets. Macroeconomic variables include the real lending interest rate and GDP growth rate.

3.3 FI composite index development strategy

PCA is employed to construct an index that effectively reduces data dimensionality while preserving much information (Tram et al., 2023; Nguyen, 2021; Hair et al., 2019; Sha'ban et al., 2020; Camara & Tuesta, 2017). It is particularly effective for large, multivariate datasets, addressing challenges like multicollinearity, computational inefficiency, and redundancy by

creating uncorrelated variables that maximize variance (Kyriazos & Poga, 2023; Mavungu, 2023; Jolliffe & Cadima, 2016). Compared to alternative methods, PCA offers several advantages. First, despite non-parametric approaches like Sarma (2008) model, which often rely assigning weights on researcher's experience (Tram et al., 2023; Camara & Tuesta, 2017), PCA adapts to changes in data structure (Decancq & Lugo, 2013), avoiding the pre-assignment of weights before data collection (Chen et al., 2019). Second, while entropy weighting is objective, studies show it is overly sensitive to minor data fluctuations than PCA (Chen et al., 2023; Wu & Wang, 2022), leading to unstable weights. Additionally, entropy weighting has limited adoption in FI empirical studies, which undermines its comparability. Third, compared to parametric methods like Confirmatory Factor Analysis (CFA), PCA enhances objectivity by not requiring subjective decisions on factor structure (Tram et al., 2023; Camara & Tuesta, 2017; Ismael & Ali, 2021; Jolliffe & Cadima, 2016; Steiger, 1979), which may differ across time and space.

Normalization is essential for comparing indicators with varying units and ranges. Common methods include ranking, z-score standardization, min-max rescaling, and logarithmic transformation (Carrino, 2015; Freudenberg, 2003; OECD, 2008). In this study, the min-max (MMY) approach is used to normalize indicators to a scale of 0 to 1, where 0 represents exclusion and 1 represents inclusion.

$$\text{MMY} = \frac{Y_i - Y_{\min}}{Y_{\max} - Y_{\min}}, \text{ Where } Y_{\min}, \text{ minimum value, } Y_{\max}, \text{ maximum value}$$

Traditional single-level multivariate analysis often fails to address nested data structures due to its assumption of independent and identically distributed (i.i.d) observations, potentially missing within group information (Yang et al., 2022). To mitigate this, a multi-level framework is employed, which addresses the hierarchical nature of the data, enhancing analytical precision (Yang et al., 2022; Hox, 2013). Additionally, single-stage PCA may disproportionately weight indicators with unequal variances. By generating sub-indices within each dimension separately before combining them, the multilevel approach provides a more balanced and accurate composite index (Ismael & Ali, 2021; Camara & Tuesta, 2017; Nagar & Basu, 2002).

3.3.1 First-stage analysis

Table 2 shows the results of the first-stage PCA. To ensure the suitability of PCA, the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity are performed. These tests confirm that the sample size is adequate and the indicators are sufficiently intercorrelated

(Ismael & Ali, 2021; Taherdoost et al., 2014). A KMO value of 0.5 or higher and a statistically significant chi-square in Bartlett's test (1950) indicate that factorization is appropriate (Hair et al., 2019). As reported in Table 19, all components meet these criteria ($KMO \geq 0.5$ and $p\text{-value} < 0.05$), supporting the use of PCA for FI index development. Additionally, internal consistency was measured using a reliability test. According to Kline (2015), a Cronbach's alpha value above 0.6 is acceptable for developing scales. The obtained Cronbach's alpha of 0.9721, as shown in Table 19, exceeds this threshold, indicating excellent internal consistency and enhancing the reliability of the data.

Table 20: First stage PCA result

Estimation of PC and eigenvalue of sub-indices of TFI and DFI							
Component	Eigenvalue	Difference	Explained variance (EV)				
Availability TFI							
Comp1	5.4682	5.1268	0.9114				
Comp2	0.3415	0.1566	0.0569				
Comp3	0.1849	0.1801	0.0308				
Comp4	0.0048	0.0043	0.0008				
Comp5	0.0004	0.0002	0.0001				
Comp6	0.0003		0				
Availability DFI							
Comp1	1.9997	1.9994	0.9999				
Comp2	0.0003		0.0001				
Accessibility DFI							
Comp1	2.0686	1.2765	0.6895				
Comp2	0.7921	0.6528	0.264				
Comp3	0.1373		0.0464				
Usage DFI							
Comp1	3.4725	2.992	0.8681				
Comp2	0.4804	0.443	0.1201				
Comp3	0.0374	0.0278	0.0094				
Comp4	0.0096		0.0024				
Scoring coefficients for orthogonal varimax rotation (weights) and test results							
Dimensions	Indicators	Comp1	Unexplained Variance	Normalized weights	KMO	Sphericity test	Cronbach alpha
Convensional Availability	BP	0.4146	0.06	0.16927	0.6974	$\chi^2(15) = 3347.798$ (P = 0.000)	0.9721
	BA	0.4105	0.0786	0.16759	0.6875		
	AP	0.4112	0.0753	0.1679	0.6929		
	AA	0.4078	0.0908	0.16649	0.6851		
	PP	0.3983	0.1324	0.16263	0.6931		
Digital Availability	PA	0.4069	0.0948	0.16612	0.7104	$\chi^2(1) = 1,119.314$ (P=0.000)	
	AP	0.7071	0.0001	0.5	0.5		
	AA	0.7071	0.0001	0.5	0.5	$\chi^2(3) = 221.805$ (P = 0.000)	
	Digital Accessibility	MP	0.6382	0.1574	0.375736		
IP		0.4067	0.6578	0.239446	0.7997		
WP		0.6536	0.1162	0.384818	0.5332	$\chi^2(6) = 1,111.108$ (P = 0.000)	
Convensional Usage	DP	0.4691	0.236	0.234706	0.5593		
	AP	0.5195	0.0627	0.259963	0.6725		
	LGDP	0.4978	0.1396	0.249065	0.5795		
	DGDP	0.5121	0.0892	0.256266	0.654		

Source: Computed based on Stata 14 result

Hair et al. (2019) deem an explained variance (EV) of 60% or higher as acceptable. Table 19 shows that PC1 captures a significant portion of the variance in the availability and usage

dimensions (91.1% and 86.8%, respectively), confirming their substantial role in FI index development. For digital inclusion, PC1 explains nearly 99.9% of the variance in availability, indicating its dominance. As well, PC1 explains 69% of the variance in accessibility, highlighting that while both dimensions are important, they contribute differently to the FI index. Based on Table 2 first-stage PCA result, the following result is built for each indicator. The dimensions of “availability”, and “usage” of the traditional sub-index is;

$$CAvailability_{it} = 0.1693BPC_{it} + 0.1676BAC_{it} + 0.1679APC_{it} + 0.1665AAC_{it} + 0.1626PPC_{it} + 0.1661PAC_{it} + v_{it}$$

$$CUsage_{it} = 0.2347DCPC_{it} + 0.26APC_{it} + 0.2491DGDPC_{it} + 0.2563LGDPC_{it} + \varepsilon_{it}$$

The analysis reveals that branch availability has the highest relative weight compared to ATMs and PoS machines in both demographic and geographic contexts, emphasizing the crucial role of physical branches in Ethiopia. This finding supports Kebede et al. (2021) and highlights the continued importance of physical branches due to factors such as lower financial literacy, which necessitates in-person interactions. Within the usage dimension, deposit accounts (0.26) hold the highest weight, followed by the deposit to GDP ratio (0.2563), loan to GDP ratio (0.2491), and debit card penetration (0.2347). This underscores the current focus on deposit mobilization in Ethiopia, which collectively emphasizes the sector's drive to encourage savings. The dimensions of “Availability”, and “Accessibility” of the digital sub-index is given as follows:

$$DAvailability_{it} = 0.5APD_{it} + 0.5AAD_{it} + \epsilon_{it}$$

$$DAccessibility_{it} = 0.3757MBPD_{it} + 0.2395IBPD_{it} + 0.3848WPD_{it} + \epsilon_{it}$$

In digital availability, agency banking indicators (APD and AAD) have equal weights of 0.5, reflecting their equal importance. For digital accessibility, mobile money wallets have the highest weight (0.3848), followed by mobile banking penetration at 0.3757 and internet banking penetration at 0.2394. This indicates that mobile money is the preferred digital financial access method for the general population, contrasting with internet banking, which is primarily used by elite customers. This finding aligns with the observation that Ethiopian banks focus internet banking services on premium clients.

3.3.2 Second-stage analysis

Table 20 confirms that the KMO measure exceeds the recommended threshold of 0.5 (Hair et al., 2019), and sphericity test is highly significant (p-value < 0.0001). The first principal component accounts for 80.07% of the total variance, indicating that only 19.97% of the

variance remains unexplained. This result confirms the adequacy of the PCA extraction, as supported by Hair et al. (2019). Among four components, only one has an eigenvalue greater than 1, which is retained for constructing the FII. The derived FII is expressed as follows:

$$IFI = 0.2625Y_i^{at} + 0.2616Y_i^{ut} + 0.2254Y_i^{ad} + 0.2505Y_i^{pd} + E_i$$

Table 21: Second-stage PCA result

Estimation of PC and eigenvalue of sub-indices of TFI and DFI					
Component	Eigenvalue	Difference	Proportion	Cumulative	
Comp1	3.20293	2.67426	0.8007	0.8007	
Comp2	0.528673	0.281266	0.1322	0.9329	
Comp3	0.247407	0.226421	0.0619	0.9948	
Comp4	0.0209866		0.0052	1	
Scoring coefficients for orthogonal varimax rotation (weights) and test results					
Indicators	Comp1	Unexplained	Normalized weights	KMO	Sphericity test
Availability	0.524	0.1205	0.2625	0.5948	$\chi^2(6) = 709.297$ (p = 0.000)
Usage	0.5223	0.1263	0.2616	0.6121	
Availability	0.45	0.3515	0.2254	0.6663	
Accessibility	0.5002	0.1987	0.2505	0.6991	

Source: Computed based Stata 14 result

This equation indicates that conventional availability (0.2625) has the highest weight, underscoring the critical role of infrastructure development in enhancing FI. This aligns with findings from Nguyen (2021) and Gharbi and Kammoun (2023), emphasizing the need for robust financial infrastructure alongside efforts in financial literacy and user adoption. Usage (0.2616) is the second most significant dimension, reflecting the importance of account usage in FI. Digital accessibility (0.2505) ranks third, highlighting the increasing impact of digital tools. Agency banking, with the lowest weight (0.2254), suggests that while digital solutions are cost-effective, more targeted interventions are required to address the needs of vulnerable populations, including women, rural residents, and those with lower literacy levels.

3.4 Model specification

This study adopts an empirical exploration, employing a panel methodology, to delve into the cross-sectional and longitudinal dynamics of evaluating the impact of FI on bank stability — within the period 2015-2023. The empirical model for examining the impact of FI on bank stability, the researchers estimated this dynamic panel model:

$$ZS_{it} = \beta_0 + \beta_1 IFI_{it} + \beta_2 LDR_{it} + \beta_3 PL_{it} + \beta_4 \ln TA_{it} + \beta_5 CAR_{it} + \beta_6 EF_{it} + \beta_7 IND_{it} + \beta_8 RLIR_{it} + \beta_9 GDP_{it} + \varepsilon_{it}$$

Where, ZS_{it} is the measure of bank stability, represented by Z-score, IFI_{it} , the index of FI extracted from two staged PCA, LDR_{it} , represents the loan to deposit ratio, PL_{it} , refers to the

provision to loan ratio, $\ln TA_{it}$, indicates the natural logarithm of total asset, CAR_{it} , represents the risk weighted capital adequacy ratio, EF_{it} , refers to the efficiency ratio extracted from DEA approach, IND_{it} , refers to non interest income to total income ratio, $RLIR_{it}$, represents inflation adjusted lending interest rate, GDP_{it} , refers to the gross domestic product growth rate, ε_{it} , refers the exogenous factors that might have effect on bank's stability, β_0 , refers to the constant term, and β_1 to β_9 , represents the slope of the independent variables. $i = 1 \dots N$ and $t = 1 \dots T$, refers to the cross-section and time span, respectively.

3.4.1 Baseline analysis applying two-step system GMM

Traditional FE and RE models, while valuable, often struggle to address endogeneity concerns stemming from omitted variables, measurement errors, reverse causality, and time-invariant unobserved heterogeneity in panel data (Hill et al., 2020; Leszczensky & Wolbring, 2022). These issues are exacerbated by the presence of lagged dependent variables and endogenous regressors, leading to biased and inconsistent estimates (Leszczensky & Wolbring, 2022; Bellemare et al., 2017). In the context of dynamic panel data, particularly “small T, large N” panels, selecting an appropriate estimation technique is critical for obtaining reliable and efficient results (Roodman, 2009).

The Arellano and Bond (1991) estimator is particularly effective in addressing dynamic dependent variables and non-strictly exogenous regressors. By differencing the regressors to eliminate fixed effects and applying GMM, it mitigates potential biases (Roodman, 2009). The system GMM estimator, introduced by Arellano & Bover (1995) and Blundell & Bond (1998), extends this by assuming the first differences of the instruments are uncorrelated with fixed effects, thus incorporating additional instruments and improving estimation efficiency (Jima & Makoni, 2023; Bun & Windmeijer, 2010). System GMM constructs a two-equation system, original levels and transformed differences, leveraging both levels and differences of the instruments (Roodman, 2009). This approach effectively addresses dynamic panel bias, which often distorts small-sample properties and yields unstable estimates when varied instrument sets are employed (Blundell & Bond, 2023; Windmeijer, 2005).

As noted by Morgan and Pontines (2017), system GMM not only addresses endogeneity bias but also remains consistent and efficient in the presence of heteroskedasticity and autocorrelation within individuals. Our results, as presented in Table 22, confirm the existence of heteroskedasticity and autocorrelation within the model. The system GMM approach is particularly effective in addressing serial correlation and unobserved heterogeneity (Vo et al.,

2020; Roodman, 2009). Therefore, employing GMM to overcome these issues aligns with previous empirical studies (Jima & Makoni, 2023; Vo et al., 2020; Ahamed & Mallick, 2019; Morgan & Pontines, 2017).

Blundell et al. (2001) and Bond et al. (2001) highlight significant improvements when dealing with models that include a lagged dependent variable along with other explanatory variables. To that end, this study refines the previous model into a dynamic form, ensuring more robust and consistent estimations. To test the first hypothesis, the specified System-GMM model is as follows:

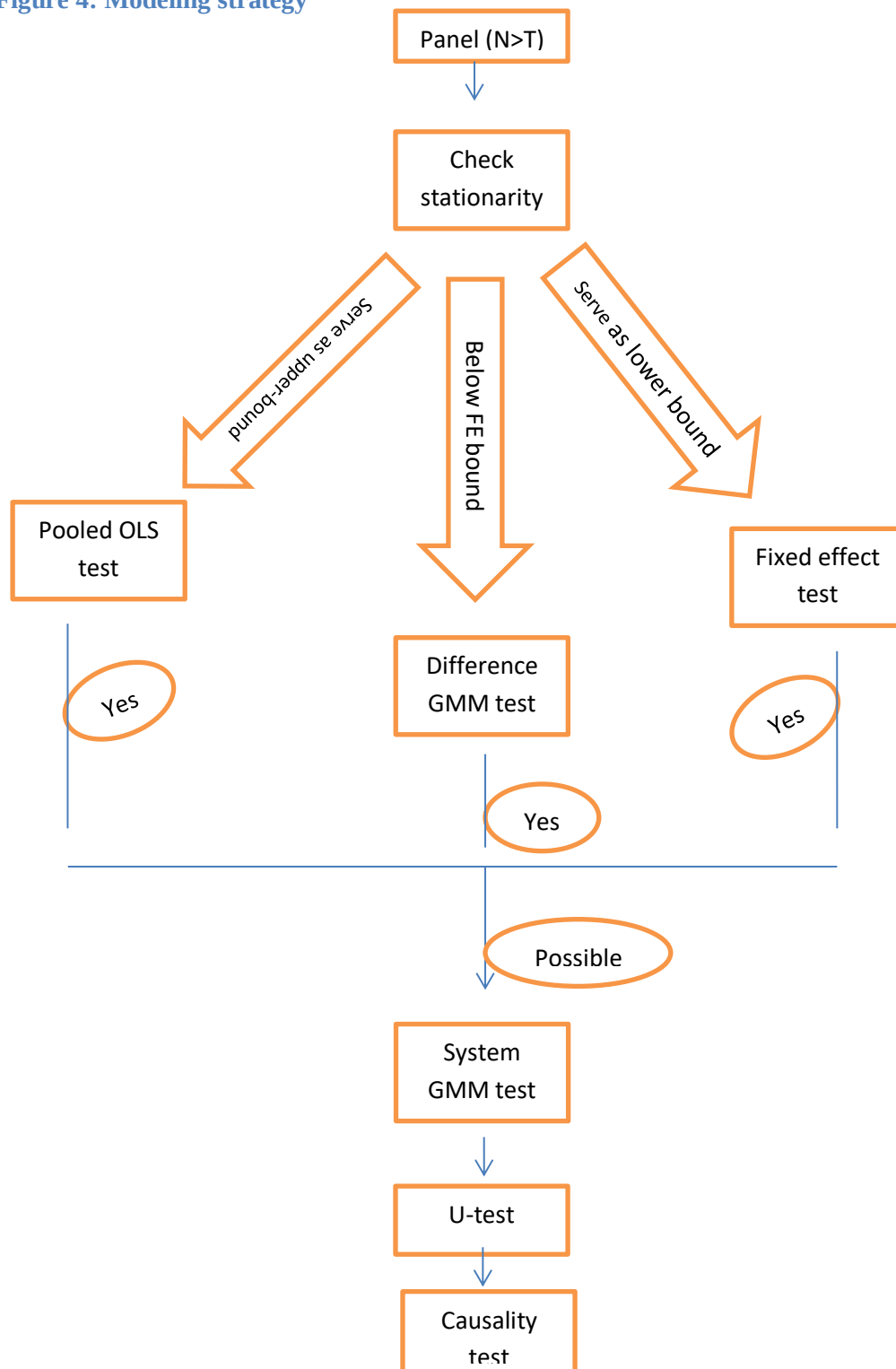
$$ZS_{it} = \alpha_i + \phi_i ZS_{i,t-1} + \sum_1^n \beta_{it} X_{it} + \epsilon_{it}$$

In this equation, ZS_{it} represents the dependent variable, α_i is the individual-specific effect, ϕ is the coefficient for the lagged dependent variable, β_{it} are the coefficients for the explanatory variables X_{it} , and ϵ_{it} is the error term.

The System GMM estimator enhances robustness and efficiency by using both difference and level moment conditions to address endogeneity and ensure reliable inference (Sebki, 2021; Soto, 2009; Presbitero, 2008). To handle heteroscedasticity and serial correlation, a two-step System GMM procedure with a consistent weighting matrix from one-step residuals was used (Davidson & MacKinnon, 2004). Although two-step GMM estimates can have downward-biased standard errors (Presbitero, 2008), the small-sample correction by Windmeijer (2005) was applied to improve efficiency, making it preferable over one-step robust GMM (Roodman, 2006). Consequently, the two-step robust System GMM estimator was thus selected for further analysis. To prevent overfitting, the maximum number of instrument lags was constrained. The AR(2) and Hansen tests were conducted to validate the absence of misspecification and the appropriateness of the instrumental variables in the GMM estimation.

The modeling strategy, illustrated in Figure 5, follows a rigorous sequential process to ensure estimator robustness. Initial pooled OLS and fixed effects (FE) estimations establish bounds for the autoregressive parameter (ϕ), with OLS serving as the upper bound and FE as the lower bound. System GMM is selected over difference GMM when Diff-GMM estimates fall near or below the FE bounds, mitigating weak instrument bias (Azimi, 2022; Bond et al. 2001; Bond, 2002; Presbitero, 2006:2008)). The two-step Sys-GMM estimator is employed with Windmeijer (2005)-corrected standard errors to address heteroskedasticity and serial correlation, enhancing efficiency over one-step alternatives (Roodman, 2009).

Figure 4: Modeling strategy



3.4.2 Non-linearity applying two-step system GMM

To derive deeper insights, this study examines the potential non-linear relationship between FI and bank stability. A growing body of literature suggests that the FI-stability nexus may exhibit an inverted U-shaped pattern, where moderate levels of FI enhance stability, but excessive inclusion may introduce risks (Sebai et al., 2025; Talbi & Sebai, 2025; Khémiri et al., 2024;

Sebai & Talbi, 2024; Hua et al., 2023). To empirically test this hypothesis, we adopt a standard quadratic specification of FI's impact on bank stability:

$$ZS_{it} = \alpha_i + \gamma_1 ZS_{i,t-1} + \beta_1 IFI_{it} + \beta_2 IFI_{it}^2 + \sum_1^n \beta_{it} X_{it} + \epsilon_{it}$$

Where, ZS_{it} , denotes bank stability for bank i at a time t , $ZS_{i,t-1}$, represents one year lag of bank stability, IFI_{it} , reveals FI score of bank i at a time t , IFI_{it}^2 , captures the non-linear (quadratic) effect of FI, X_{it} , is the vector of control variables, α_i , is the individual-specific effect, γ_1 , is the coefficient for the lagged dependent variable, β_{it} , are the coefficients for the explanatory variables ϵ_{it} , is the error term.

Building on prior research (Anarfo et al., 2022; Hua et al., 2023), this study further investigates the moderating role of capital adequacy ratio (CAR) in shaping the FI-stability relationship. A well-capitalized banking system may absorb risks associated with financial deepening, mitigating any adverse effects of excessive inclusion. To examine this interaction effect, the baseline model is extended as follows:

$$ZS_{it} = \alpha_i + \gamma_1 ZS_{i,t-1} + \beta_1 IFI_{it} + \beta_2 IFI_{it}^2 + \beta_3 IFI_{it} * CAR_{it} + \sum_1^n \beta_{it} X_{it} + \epsilon_{it}$$

Here, $(IFI_{it}^2 * CAR_{it})$, captures the interaction between the squared FI term and CAR. A significant coefficient for β_3 , would indicate that capital adequacy conditions influence the extent to which FI impacts banking stability.

3.4.2.1. Lind and Mehlum (2010) U-test for non-linearity

Traditional non-linear models validate an inverted U-shaped or U-shaped relationship by rejecting the null hypothesis when the original and squared terms exhibit opposite signs. However, this approach can be misleading if the true relationship is convex but monotonic, potentially resulting in a false quadratic interpretation (Law et al., 2017). To address this, Lind and Mehlum (2010) extend a U-test for a U-shaped pattern by evaluating whether the slope is negative at lower values and positive at higher values within the observed range. The U-test verifies these conditions:

$$\beta_1 + \beta_2 (IFI_l) < 0 < \beta_1 + \beta_2 (IFI_m)$$

Where (IFI_l) and (IFI_m) , represent the lower and upper bounds of FI within the sample. If these conditions hold, the relationship is confirmed as inverted U-shaped.

4. Results and Discussion

4.1 Results

4.1.1 Descriptive analysis

Table 21 presents the descriptive summary for the variables used to examine the impact of financial FI on bank stability. The analysis is based on a sample of 153 observations, covering 8 years (2015-2023) across 17 commercial banks (all (17) commercial banks operationalized since 2015 are taken for further analysis). The table provides key details, including the mean, standard deviation, and the minimum and maximum values for each variable.

Table 22: Summary analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
ZS	153	32.403	15.712	8.972	80.117
IFI	153	0.059	0.112	0.002	0.584
LDR	153	0.963	0.089	0.533	1.159
PL	153	0.007	0.010	-0.001	0.087
lnTA	153	10.155	1.320	7.042	14.082
CAR	153	0.188	0.089	0.084	0.958
EF	153	0.893	0.098	0.624	1.000
IND	153	0.284	0.116	0.006	0.570
RLIR	153	-0.036	0.083	-0.196	0.056
GDP	153	0.079	0.015	0.061	0.104

Source: Computed based Stata 14 result

4.1.2 Empirical analysis technique

4.1.2.1 Analysis of ordinary least-square regression (OLS)

Using fixed or random effects models in OLS regression is common for addressing unobserved heterogeneity and simultaneous causality in panel data (Kumar et al., 2022). Fixed effects handle time-invariant characteristics within firms (Schultz et al., 2010), while random effects reduce variability by pooling data and accounting for differences across firms and time (Kumar et al., 2022). The Hausman test, which checks for the correlation between unique errors and regressors, guides the choice between these models (Kumar et al., 2022; Greene, 2003). Our results indicate that the fixed-effects model is the correct choice, as shown in Table 9.

Table 23: Heteroscedasticity and autocorrelation test.

Tests	Wooldridge test	Modified Wald test	Breusch-Pagan (BP) test
Type	Serial correlation	Heteroskedasticity	Heteroskedasticity
	F-test	Chi2 test	Chi2 test
Sig level	$F(1,16)=30.970$ ($p=0.0000$)	$\chi^2(17)=112.98$ ($p=0.0000$)	$\chi^2(1)=7.54$ ($p=0.0060$)

Source: Computed based on Stata 14 result

To test for autocorrelation and heteroskedasticity, the Wooldridge, modified Wald, and Breusch-Pagan (BP) tests were employed. Results in Table 22 reveals, both problems were detected. However, the correlation matrix and Variance Inflation Factor (VIF) results in Table

23, with all VIF values less than 10, suggest that multicollinearity is not a concern. Following Vo et al. (2020) and Ahamed and Mallick (2019), robust clustered standard errors were applied to address these issues, as outlined in Table 25.

Table 24: Multicollinearity test.

Variables	VIF	1/VIF	ZS	IFI	LDR	PL	TA	CAR	EF	IND	RLIR
IFI	3.94	0.254	-0.29								
LDR	1.43	0.701	-0.02	0.423							
PL	1.12	0.894	-0.35	0.262	0.215						
lnTA	5.69	0.176	-0.16	0.718	0.364	0.220					
CAR	1.26	0.791	-0.1	0.045	-0.125	-0.007	-0.209				
EF	1.36	1.3	0.771	0.203	0.323	0.082	0.202	0.012			
IND	2.41	0.414	-0.07	-0.253	-0.282	-0.076	-0.647	0.417	-0.039		
RLIR	3.03	0.33	0.071	0.000	-0.160	-0.138	-0.462	0.255	-0.308	0.446	
GDP	2.32	0.431	0.071	0.000	-0.170	-0.112	-0.395	0.230	-0.195	0.460	0.736

Source: Computed based on Stata 14 result

4.1.3 GMM analysis

4.1.3.1 Stationary test

Conducting a unit root test is crucial to confirm stationarity of variables, thereby avoiding the risk of spurious findings (Breitung & Pesaran, 2005). Although a dynamic panel approach is typically suited for variables integrated at level or first difference, it is crucial to ensure none of the variables is integrated at a higher order, such as I(2) (Pesaran & Smith, 1995). To verify stationarity, we employed the Levin-Lin-Chu (LLC) and Harris-Tzavalis (HT) unit root tests across both I(0) and I(1) levels, as shown in Table 24. The LLC test confirms that all variables are stationary at level. Similarly, the HT test shows that only total assets achieve stationarity at first difference. Since all variables are either stationary at level or first difference, applying the GMM method is appropriately validated.

Table 25: Stationary test result: LLC and HT

	LLC		HT	
Variables	T-statistics	Order	T-statistics	Order
ZS	(7.1564)***	I(0)	0.5428*	I(0)
IFI	(6.7882)***	I(0)	(0.0528)***	I(0)
LDR	(3.7723)***	I(0)	0.1663***	I(0)
PL	(17.1597)***	I(0)	0.1221***	I(0)
lnTA	(6.7186)***	I(0)	0.0677***	I(1)
CAR	(8.2427)***	I(0)	(0.0436)***	I(0)
EF	(2.9716)**	I(0)	0.425***	I(0)
IND	(3.8704)***	I(0)	(0.2079)***	I(1)
RLIR	(8.5431)***	I(0)	(0.0852)***	I(0)
GDP	(5.8930)***	I(0)	0.2165***	I(0)

Source: Computed based on Stata 14 result, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As per the works established by Bond et al. (2001), Bond (2002), and Presbitero (2006, 2008), the System GMM estimator was selected based on a comparative analysis of autoregressive(ϕ) coefficients derived from Pooled OLS, Fixed Effects, and Difference GMM estimations. Following Bond et al.'s (2001) recommendation, the Pooled OLS coefficient served as an upper bound, while the Fixed Effects coefficient acted as a lower bound. Given that the Difference GMM coefficients (0.347 and 0.328) were significantly lower than the Fixed Effects coefficient (0.412) and well below the Pooled OLS coefficient (0.947), as presented in Table 25, the System GMM approach was deemed appropriate.

Table 26: Empirical result of the study

Variables	Robust Fixed Effect	Robust Pooled OLS	Robust One-step Difference GMM	Robust Two-step Difference GMM	Robust One-step System GMM	Robust Two-step System GMM
I.ZS	0.412*** (5.62)	0.947*** (55.49)	0.347** (2.15)	0.328 (1.15)	0.798* (2.08)	1.155*** (3.07)
IFI	-8.811 (-0.99)	-2.890 (-0.52)	-10.41 (-1.00)	-9.382 (-0.65)	49.93** (2.85)	84.07** (2.60)
LDR	10.82*** (3.43)	1.010 (0.26)	11.51*** (2.95)	9.283 (1.74)	-19.10 (-1.07)	-55.46 (-1.73)
PL	-69.73** (-2.71)	-63.76** (-2.27)	-70.40** (-2.77)	-63.67* (-1.96)	-125.7 (-0.42)	17.66 (0.07)
lnTA	-2.249** (-2.30)	0.321 (0.65)	-2.342** (-2.39)	-1.937* (-1.83)	-8.085*** (-3.04)	-10.03** (-2.66)
CAR	3.488 (0.71)	0.747 (0.45)	3.566 (0.69)	1.414 (0.18)	10.68 (0.41)	-37.80 (-0.99)
EF	13.61*** (3.56)	7.436** (2.60)	14.04*** (3.65)	13.21* (2.00)	15.35 (1.46)	26.24* (2.00)
IND	6.825* (1.80)	1.230 (0.41)	7.208* (1.80)	5.309 (1.09)	-71.81 (-1.39)	-101.7* (-1.94)
RLIR	-11.38 (-1.54)	-6.605 (-1.26)	-10.55 (-1.41)	-6.237 (-0.64)	-32.19* (-1.99)	-33.46 (-1.42)
GDP	9.593 (0.42)	29.75 (1.05)	7.668 (0.35)	4.417 (0.19)	105.3 (1.38)	229.5* (2.12)
_cons	16.42* (1.86)	-12.12 (-1.58)			99.98** (2.92)	138.4** (2.44)
N	136	136	119	119	136	136
Groups	17		17	17	17	17
Instruments	-	-	16	16	16	16
AR(2) test	-	-	-1.46 (0.144)	-1.38 (0.167)	-0.12 (0.908)	-0.71 (0.479)
Hansen test	-	-	10.55 (0.103)	10.55 (0.103)	4.12 (0.532)	1.13 (0.951)
R-Squared	0.7632	0.9665				
P-Value	F(10,16) =68.14 (p=0.000)	F(10,125) =413.07 (p=0.000)	F(10,17) =13.59 (p=0.000)	F(9,143) =8.49 (p=0.000)	F(10,16) =2104.9 (p=0.000)	F(10,16) =592.07 (p=0.000)

Source: Computed based on stata 14 result, Notes * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Beyond estimating the mean impact of FI on bank stability using two-step robust system GMM, this study investigates potential non-linearity in this relationship. To rigorously investigate the presence of a non-linear effect, the Lind and Mehlum (2010) U-test is employed, incorporating a quadratic specification to capture possible inverted U-shaped dynamics. Furthermore, the findings presented in Table 26 highlight the moderating role of CAR in the FI–bank stability

nexus. Specifically, the results illustrate the non-linearity both with and without the interaction term, providing deeper understanding of FI's conditional effects on stability.

Table 27: Non-linearity test (two step robust system GMM with and with-out interaction term)

Variables	(7) Non-linearity with interaction term	(8) Non-linearity without interaction term
l.ZS	0.212 (0.72)	0.240 (0.79)
FI	513.5*** (3.15)	417.8** (3.14)
FI^2	-731.3** (-3.20)	-688.5** (-3.01)
CAR	20.41 (1.41)	3.213 (0.32)
FI*CAR	-305.9** (-2.24)	
LDR	14.00 (0.77)	9.522 (0.53)
PL	-380.0** (-2.71)	-377.0* (-2.70)
LnTA	-12.44*** (-3.91)	-11.81** (-3.58)
EF	21.86* (1.80)	22.11 (1.84)
IND	-44.71* (-1.95)	-36.93 (-1.74)
RLIR	-30.23** (-2.29)	-30.50* (-2.31)
GDP	70.02* (2.05)	58.12 (1.73)
_cons	108.3*** (4.24)	108.3** (3.81)
N	136	136
Groups	17	17
Instruments	17	16
AR(2) test	-0.83 (p=0.405)	0.14(p=0.888)
Hansen test	1.32 (p=0.857)	1.91(p=0.752)
P-Value	F(12,16) = 2943.73 (p=0.000)	F(11,16) = 3998.22 (p=0.000)
Inverse U-test (Lind & Mehlum, 2010)		
Test components	Value	Significant
Turning point	IFI = 0.351	
Slope at lower bound	510.03	p = 0.003***
Slope at upper bound	-340.63	p = 0.003***
Overall test (t-value)	3.15	p = 0.003***

Source: Computed based on stata 14 result, Notes * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1.4 Causality test

This research examines the dynamic causal relationship between FI and bank stability within the Ethiopian banking sector. Both the Dumitrescu and Hurlin (2012) W-statistic test and the Juodis et al. (2021) Z-bar test are used to ascertain the direction of causality between FI and bank stability. Rejection of the null hypothesis indicates a causal relationship, whereas its acceptance suggests none (Antwi et al., 2024). The analysis employs a first lag, with lag

selection based on the Modified Bayesian Information Criterion (MBIC) to ensure result robustness, in line with Hussain et al. (2024) and Žiković et al. (2020) recommendations for shorter time periods.

4.2 Discussion

The findings reveal that the lagged value of bank stability positively effect current stability. Specifically, past levels of bank stability significantly impact present stability, as corroborated by the study of Yitayaw et al. (2023) within the Ethiopian context. The positive effect of lagged stability on current conditions underscores its validity as a reliable instrument for stability analysis, given that banks generally exhibit continuity in their stability across different periods, reflecting a trend of persistence over time. However, in column 7 and 8 (Table 26), where non-linear FI terms IFI_{it}^2 and interaction effects ($IFI_{it} * CAR_{it}$) are introduced, the lagged term loses significance. This suggests that stability persistence is conditional on evolving financial dynamics, as non-linearity and regulatory adjustments reshape stability paths, reducing reliance on historical trends.

Our findings confirm a significant positive relationship between FI and bank stability, supported by existing research (Koudalo & Toure, 2023; Nguyen & Du, 2022; Vo et al., 2020; Le et al., 2019; Neaime & Gaysset, 2018; Morgan & Pontines, 2014). The result clearly supports hypothesis 1. Specifically, a 1% increase in FI is associated with an 84.07 unit increase in bank stability in the short run, ceteris paribus. This outcome can be attributed to several factors. First, enhanced FI strengthens bank stability by diversifying bank assets, reducing systemic and liquidity risks, and improving monetary policy transmission (Ahamed & Mallick, 2019; Morgan & Pontines, 2014; Khan, 2011; Hannig & Jansen, 2010). Second, it also addresses information asymmetry by allowing lenders to better assess borrowers and by providing banks with critical proprietary information (Nguyen & Du, 2022), thus fostering a more resilient banking sector. Third, greater FI expands deposit bases, reducing the procyclicality risk of the banking sector (Chinoda & Kapingura, 2024; Ozili, 2018), further reinforcing financial stability.

Building on prior studies (Sebai et al., 2025; Talbi & Sebai, 2025; Antwi et al., 2024; Kebede et al., 2024; Khémiri et al., 2024; Sebai & Talbi, 2024; Hua et al., 2023; Dang & Thi, 2022; Saha & Dutta, 2021; Ahamed & Mallick, 2019), our findings in Column 8 confirm an inverted U-shaped relationship between FI and bank stability, supporting Hypothesis 2. This indicates that while FI enhances stability up to a certain threshold, beyond that point, its impact reverses.

This result aligns with studies showing a positive effect of FI on bank stability (Sebai et al., 2025; Chinoda & Kapingura, 2024; Khémiri et al., 2024; Hua et al., 2023) but contrasts with others reporting a destabilizing effect at lower FI levels (Talbi & Sebai, 2025; Antwi et al., 2024; Sebai & Talbi, 2024; Dang & Thi, 2022; Saha & Dutta, 2021). At lower bounds, FI fosters stability by mitigating asymmetric information, enabling banks to diversify their portfolios (Chinoda & Kapingura, 2024; Khémiri et al., 2024), and enhancing the quality of bank-client relationships, which reduces risk premiums and promotes financial transparency (Khémiri et al., 2024). However, at higher levels, in line with Khan (2011) and Khémiri et al., (2024), the mass participation of low-income individuals in formal banking raises transaction and information costs, increasing adverse selection and moral hazard risks. This dynamic can trigger credit contractions and asset quality deterioration, leading to financial distress (Pham & Doan, 2020). The Lind and Mehlum (2010) U-test results in Column 8 confirm this threshold effect, with the lower bound slope (414.5) exceeding the upper bound (-386.3), indicating that stability gains diminish as FI expands beyond a critical point. Specifically, incorporating a quadratic FI term (IFI^2) reveals a stability-maximizing threshold at $IFI \approx 30.3\%$ (U-test, $p = 0.006$), contrasting with Khémiri et al. (2024), who found destabilization only at much higher FI levels ($\sim 71.6\%$) in GCC economies. These findings highlight the importance of balancing FI efforts to ensure long-term banking stability, as excessive credit concentration can erode diversification benefits, necessitating prudent regulatory oversight to maintain stability beyond the optimal FI threshold.

The moderating effect of the interaction ($IFI_{it} * CAR_{it}$) shifts the inflection point from 0.30 (without interaction) to 0.35 (with interaction), confirming Hypothesis 3, that the interaction between capital adequacy and FI enhances bank stability. This indicates that stronger regulatory frameworks can improve the FI–stability relationship by mitigating financial risks and fostering transaction efficiency (Ha & Nguyen, 2023). However, beyond the threshold, stability gains diminish, and the negative FI*CAR interaction suggests that higher capital adequacy does not necessarily shield banks from excessive FI risks. This could stem from diminishing capital returns, rising regulatory costs, and increased risk exposure. In Ethiopia, where government intervention influences financial allocation (Filatie & Sharma, 2024), banks face unique stability risks as political priorities override market-driven risk management. Thus, while capital adequacy enhances stability in financially inclusive environments, its protective effects weaken when FI expands beyond sustainable levels.

Our findings indicate that control variables such as lnTA, EF, IND, RLIR and GDP growth rate significantly affect bank stability. Larger banks exhibit decreased stability, with a 10.03 unit decline per percentage increase in total assets in the short run, *ceteris paribus*. This effect is evident in both non-linear analysis (see column 7 and 8). This aligns with Mirzaei et al. (2013), who caution that excessive size amplifies systemic vulnerabilities. In Ethiopia's concentrated banking sector, state-owned CBE dominate ~50% of assets (NBE-FSR, 2024b), fostering operational rigidity and reliance on implicit government guarantees. The "too-big-to-fail" (TBTF) phenomenon fosters moral hazard, encouraging excessive risk-taking (Farhi & Tirole, 2012) and increasing instability due to complexities in governance and risk management (Shahriar et al., 2022; Vo et al., 2020). This finding aligns with Vo et al. (2020) and Mu and Lin (2016), but differing from Nguyen and Du (2022) and Ahamed and Mallick (2019).

Efficiency positively effect stability, with a 1% increase in efficiency leading to a 26.24 unit rise in stability in the short run, *ceteris paribus*. This effect is the same in both non-linear analysis (see column 7 and 8). Efficient banks optimize resource allocation, strengthen profitability, and enhance risk management (Gupta & Raman, 2020; Mohapatra & Mohanty, 2017). Empirical evidence links higher efficiency to lower non-performing loans and stronger financial resilience (Shahriar et al., 2022; Berger & DeYoung, 1997). Efficiency also bolsters market power, liquidity buffers, and long-term sustainability (Kasman & Carvallo, 2014; Fiordelisi et al., 2011). This finding consistent with Nguyen and Du (2022), and Ahamed and Mallick (2019).

Income diversification negatively impacts stability, with a 1% increase resulting in a 101.7 unit decrease in stability in the short run, *ceteris paribus*. This effect is particularly evident in model 7 but insignificant in model 8. Over-reliance on non-interest income exposes banks to systemic risks, particularly when diversification extends into unfamiliar sectors (Carlson, 2004). Excessive diversification into volatile markets such as forex trading amidst chronic dollar shortages heightens asymmetric information risks (Acharya et al., 2006). Mercieca et al. (2007) emphasize that diversification benefits depend on regulatory quality and market discipline. In the Ethiopian context, where banks are predominantly dependent on deposit revenue, an abrupt or poorly managed shift towards greater non-interest income might contribute to instability. This finding aligns with Nguyen and Du (2022) but differing from Ahamed and Mallick (2019).

GDP growth rate shows a positive effect on stability, with a 1% increase leading to a 229.5 unit rise in stability in the short run, *ceteris paribus*. This finding remains robust in non-linear

analyses with interaction terms but loses significance when interaction effects are excluded. Economic expansion enhances financial stability through multiple channels. A growing economy improves borrower creditworthiness, thereby reducing default risks and strengthening bank balance sheets (Demirgüç-Kunt & Maksimovic, 1998). Additionally, higher GDP growth fosters employment and business profitability, ensuring that debt obligations are met, thereby reducing non-performing loans and bolstering banking sector stability. Financial deepening associated with economic expansion further strengthens banks' capital positions and shock-absorbing capacity (Fosu et al., 2017). This finding consistent with Nguyen and Du (2022), Vo et al. (2020), and Ahamed and Mallick (2019).

The real lending interest rate (RLIR) exhibits a negative impact on bank stability in non-linear specifications, consistent with the findings of Anthony-Orji et al. (2022) and Atellu and Muriu (2022). Prolonged low-interest-rate environments compress net interest margins (NIMs), compelling banks to engage in riskier lending practices to sustain profitability (Rajan, 2006; Adrian & Shin, 2009). This "search-for-yield" behavior often leads to capital misallocation and elevated exposure to financial shocks. Furthermore, artificially low interest rates contribute to "money illusion," distorting risk-adjusted returns and weakening credit standards (López-Penabad et al., 2022; Dell'Ariccia et al., 2014). Simultaneously, low rates undermine banks' ability to build capital buffers through retained earnings, heightening vulnerability to liquidity constraints (Zimmermann, 2019). The destabilizing effects of low interest rates are particularly pronounced in emerging markets, where financial systems exhibit structural weaknesses and heightened interconnectedness (Beck et al., 2015; Calice et al., 2020). Interest rate repression through regulatory caps further distorts risk pricing, compelling banks to either ration credit or extend loans to subprime borrowers, thereby inflating non-performing loans (Chen et al., 2017; Beck et al., 2015). Relatedly, Apergis et al., (2022), highlight that inflationary pressures exacerbate systemic risks, further reinforcing the precarious balance between monetary policy and financial stability.

The two-step System GMM analysis, as detailed in Table 25 and Table 26, shows that the standard diagnostic tests are supportive of the model's validity. The AR(2) test indicates no evidence of second-order residual autocorrelation, with $(\text{Prob} > \chi^2 = 0.479)$ (model 6), $(\text{Prob} > \chi^2 = 0.405)$ (model 7) and $(\text{Prob} > \chi^2 = 0.888)$ (model 8), thereby validating the absence of misspecification in the dynamic panel model. Similarly, the Hansen test $(\text{Prob} > \chi^2 = 0.951)$ (model 6), $(\text{Prob} > \chi^2 = 0.857)$ (model 7) and $(\text{Prob} > \chi^2 = 0.752)$ (model 8), confirms the validity of the instruments, verifying their appropriateness. The F-test $(\text{Prob} > F = 0.000)$ for

both linear and non-linear specifications demonstrates a strong goodness of fit for the model. In addition to the two-step robust System GMM results, findings from robust FE, robust Pooled OLS, robust one-step Difference GMM, robust two-step Difference GMM, and robust one-step System GMM are largely consistent. The main variable, FI, is significant in both one-step and two-step System GMM models, while the GDP growth rate is significant in the two-step robust System GMM. Overall, these results underscore the robustness of the employed models.

In addition, based on the result revealed in Table 27, the Juodis et al. (2021) test confirms that FI significantly Granger-causes bank stability at the 5% level, a result supported by the Dumitrescu and Hurlin (2012) test, which also rejects the null hypothesis. This underscores the substantial role of FI in bolstering the resilience and stability of Ethiopia's banking sector. Additionally, reverse causality from bank stability to FI is significant at the 5% level, indicating that bank stability can predict enhancements in FI. These findings suggest that enhancing FI can improve bank stability, while a stable financial environment fosters greater FI, aligning with previous studies (Jima & Makoni, 2023; Antwi et al., 2024).

Table 28: Causality test result

Test	Z-bar	P-Value	Direction	Conclusion
ZS $\nrightarrow$ IFI	7.3252***	95.3201***	ZS $\leftrightarrow$ IFI	Reject H0
IFI $\nrightarrow$ ZS	14.3706***	4.3273**	IFI $\leftrightarrow$ ZS	Reject H0

Source: Computed based on Stata 14 result, Notes * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. Conclusion, policy implication, limitations and future research directions

5.1. Conclusion

Financial inclusiveness has increasingly become a focal point for policymakers, practitioners, and economists due to its potential to drive inclusive growth. Despite numerous efforts by policy makers and international financial institutions to bolster bank stability and inclusivity, the relationship between FI and bank stability remains contentious and inconsistent in existing literature. This study addresses this gap by examining the impact of FI on bank stability within the Ethiopian context. Using panel data from seventeen commercial banks over the period 2015-2023, the researchers employed a two-stage PCA to develop FI index based on ten conventional and five digital indicators. The effects of FI on bank stability were analyzed using a two-step robust System GMM approach while testing non-linearities via Lind and Mehlum's (2010) U-test, complemented by Granger causality tests to determine the direction of causality between FI and bank stability.

Our results from the two-stage PCA indicate that conventional availability is the most important factor in FI score, followed by conventional usage, with digital accessibility and digital availability ranking third and fourth, respectively. The System GMM analysis confirms that FI has a significant and positive effect on bank stability. However, the relationship between FI and stability is not linear. Instead, the study reveals an inverted U-shaped pattern, wherein FI contributes positively to stability up to a threshold of approximately 30.3%, beyond which its effects become destabilizing. This turning point reflects the trade-offs associated with excessive FI, as mass participation in the banking system, particularly among low-income individuals, can heighten transaction costs, exacerbate information asymmetries, and increase the likelihood of adverse selection and moral hazard. The introduction of capital adequacy as a moderating factor extends the stability-maximizing threshold to 35.1%, illustrating that stronger regulatory buffers can mitigate some of the risks associated with higher FI. However, beyond this point, capital adequacy ceases to provide stability benefits, as diminishing returns and heightened regulatory costs erode its effectiveness. Control variables such as efficiency and GDP growth rate are positively associated with bank stability, while real interest rate, total assets and income diversification exhibit negative effects. Additionally, the historical level of bank stability positively affects current stability. The Granger causality tests indicate a bi-directional relationship between FI and bank stability, suggesting that improvements in FI contribute to enhanced stability, and vice versa.

This study makes several contributions to the field. First, it is the first to empirically investigate the effect of FI on banking stability in Ethiopia, addressing a critical knowledge gap in a financial landscape where FI is still in its nascent stages. Second, unlike prior studies that have predominantly relied on either traditional or digital FI indicators in isolation, this research develops a multidimensional FI index using a two-stage PCA approach, integrating ten traditional and five digital indicators. Third, methodologically, this study applies a two-step robust system GMM estimator to address endogeneity concerns and unobserved heterogeneity, thereby enhancing the reliability of the results. Fourth, it pioneers the investigation of nonlinear FI-stability relationship in Ethiopia, testing the inverted U-shaped hypothesis. Fifth, this study introduces macroprudential regulation as a moderating factor, a dimension largely overlooked in low-income economies. The findings illustrate that while capital adequacy strengthens stability at moderate FI levels, its mitigating effects diminish beyond a certain threshold, signaling the need for more adaptive regulatory frameworks. Sixth, the research employs Lind and Mehlum's (2010) U-test, a more robust approach to validating nonlinearity than

conventional quadratic models, ensuring that the identified threshold is statistically rigorous (Law et al., 2017). Seventh, in response to concerns regarding reverse causality, the study employs Dumitrescu-Hurlin (2012) and Juodis et al. (2021) Granger causality tests, providing empirical evidence on the directional nexus between FI and stability. Finally, the study extends its impact beyond academic discourse by offering contextual actionable strategies to optimize FI expansion without compromising financial stability.

5.2. Policy implication

The policy implications are profound. To promote both FI and stability, policymakers should focus on expanding demographic and geographic outreach, enhancing both conventional and digital financial services. Ensuring that current stability supports future stability is also crucial. FI and bank stability are mutually reinforcing as efforts to enhance FI directly contribute to improved stability and vice versa. Consistent with the policy implication of Vo et al. (2020), broadening FI is essential for strengthening banking sector stability in Ethiopia.

Specifically, the findings of this study suggest several policy implications that should be considered. First, the identified inflection point of 35%, coupled with the moderating effect of capital adequacy, highlights that while policy interventions promoting FI up to this threshold will enhance stability, further expansion requires nuanced regulatory oversight. Banks must recognize that internal buffers such as capital adequacy may not act as perfect hedges against the risks associated with excessive FI. This is particularly critical in Ethiopia, where current FI levels remain low, suggesting ample room for expansion before the stability-maximizing threshold is reached. Second, expanding financial services to underserved populations not only provides banks with stable funding sources but also enhances overall sector stability and profitability. However, as financial access increases, additional risk mitigation strategies must be implemented. Echoing the recommendations of Oanh et al. (2023), governments should address financial exclusion by eliminating barriers to access, improving financial education, and developing financial infrastructure in underserved areas. Digital financial services, including mobile banking, agent banking, and fintech innovations, should be prioritized as mechanisms to expand inclusion without introducing excessive risks. Third, regulatory oversight must be adaptive to account for the evolving relationship between FI and stability. Policymakers should integrate macroprudential regulations that ensure FI initiatives are aligned with broader macroeconomic policies. Strengthening risk management frameworks, particularly for banks expanding into high-risk, financially excluded segments, will be essential. Additionally, governance mechanisms must be reinforced to prevent regulatory

capture, ensuring that FI policies remain market-driven and not subject to political distortions. Finally, the regulatory framework governing Ethiopia's financial sector must evolve to accommodate the growing role of Islamic banking. Given its potential to enhance FI while promoting ethical banking practices, Islamic finance should be supported through a dedicated regulatory framework separate from conventional banking models. Aligning Ethiopia's Islamic banking regulations with international standards set by institutions such as the Islamic Financial Services Board (IFSB) and the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) will be essential in fostering a stable and inclusive financial ecosystem.

5.3. Limitations and future research directions

This study acknowledges the following limitations. First, it does not account for regional disparities within Ethiopia, which may be shaped by the diverse economic and social landscapes across the country's regions. Future investigations should prioritize a more detailed analysis that incorporates regional policy perspectives, as this would yield richer insights and support the creation of customized interventions aimed at promoting FI both at the regional and national levels. Second, although there were attempts to include digital financial indicators, the lack of transaction data from pertinent authorities hindered the incorporation of these variables into the construction of the index. Consequently, future studies should address this gap. Third, bank stability is measured solely through the Z-score, due to data limitations. Future studies should explore alternative risk-based stability measures. Fourth, while the study employs a two-stage PCA approach, alternative methodologies such as CFA and entropy weighting could further validate the index. Fifth, reliance on commercial bank data may obscure sectoral heterogeneity. Future research should examine how development banks, microfinance institutions, and fintechs navigate the FI-stability trade-off. In particular, the role of digital FI warrants deeper exploration, given its increasing significance in emerging markets. Lastly, a longitudinal approach that tracks the stability effects of FI over an extended period could offer deeper insights into how these dynamics evolve. As regulatory frameworks adapt and financial systems mature, the optimal FI threshold may shift, necessitating ongoing research to refine FI policies accordingly.

CHAPTER FIVE: ASYMMETRIC ANALYSIS OF FI-GROWTH NEXUS: A NARDL APPROACH

Abstract

This paper examines the asymmetric impact of FI (FI) on Ethiopia's economic growth over the period 1991–2023. A composite FI index was developed using a two-stage Principal Component Analysis (PCA) that integrates six traditional and four digital financial indicators. Employing a Nonlinear Autoregressive Distributed Lag (NARDL) model, the study explores both short and long-run asymmetries in the relationship between FI and economic growth. The Toda-Yamamoto (1995) causality test further uncovers the direction between the two variables. Empirical results reveal that positive FI shocks significantly enhance long-term economic growth, whereas negative shocks reduce it, though only positive shocks significantly spur economic growth in the short run. The findings underscore a domino-effect of FI, where FI expansion generates sustained growth momentum than the adverse of impact of FI contraction. Moreover, trade openness, monetary expansion, and population growth are found to exert adverse effects on growth, while the real exchange rate contributes positively in the short run. The Toda-Yamamoto causality test finding supports both supply-leading and demand-following hypotheses, highlighting a feedback loop between FI and growth. Strengthening the regulation and functioning of domestic financial markets is critical to ensure equitable access to financial services. In parallel, investments in productive sectors, infrastructure, and public health are essential for catalyzing inclusive growth. Central banks must balance macro stability with financial deepening, while trade diversification and export-oriented strategies enhance economic resilience. The study advocates for coherent, data-informed, and regularly evaluated policy frameworks that integrate FI as a core component of long-term development agendas.

Key Words: FI; PCA, Economic Growth; Asymmetric effect; Ethiopia

JEL Classification: G2; C43; O11; C22; O55

1. Introduction

The global socioeconomic development agenda underscores the critical role of inclusive finance in reducing income inequality and poverty (Khan & Khan, 2024; Kumar & Jie, 2023; Marcelin et al., 2021). Inclusive financial systems not only empower individuals to participate in market-based economies but also drive economic expansion by mobilizing savings, enhancing investments, and channeling resources to productive uses (Ehigiamusoe & Samsurijan, 2021). Specifically, it is recognized as a driver of entrepreneurial activity (Charfeddine & Zaouali, 2022; Banerjee et al., 2017; Ayyagari et al., 2012) and a contributor to macroeconomic stability (Kebede et al., 2024; Khan & Khan, 2024; Sun & Tang, 2022). Additionally, it enhances non-monetary welfare dimensions such as healthcare, food security, and education (Adom et al., 2024; del Carmen Briano-Turrent, 2024; Swain & Nsabimana, 2024), while fostering employment opportunities (Song et al., 2024; Prasad, 2010) and sustainable economic growth (Khan & Khan, 2024; Demirguc-Kunt et al., 2018; Kim et al., 2018). Although the benefits of financial development are widely recognized, scholars continue to debate both the strength and the direction of its relationship with economic growth (Lee et al., 2021). Some researchers argue that financial development lays the foundation for economic expansion, while others, such as Robinson (1952), believe that economic growth itself drives financial sector development.

Beyond this ongoing debate over causality, recent studies have begun to question the long-held assumption that the finance-growth relationship is linear (Lee et al., 2021). Evidences suggest that the impact of financial development depends on a country's stage of economic development (Ehigiamusoe & Samsurijan, 2021; Alexiou et al., 2018; Rajan & Zingales, 1998). For example, demand for financial services tends to differ between high and low-income countries, which can result in varied growth outcomes (Ehigiamusoe & Samsurijan, 2021). This idea aligns with Huang and Lin's (2009) argument that financial intermediation influences growth in ways that are shaped by the level of economic maturity. Similarly, Beck et al. (2000) point out that financial intermediaries contribute to productivity and technological advancement by minimizing inefficiencies in capital allocation. While broader financial access is generally seen as positive, some scholars highlight potential downsides. Chen et al. (2023) and Ozili (2020) caution that it may lead to pro-cyclical financial behavior, and Karim et al. (2022) even identify critical threshold effects that can alter the finance-growth dynamic. These mixed findings underscore the importance of considering structural and institutional

differences across countries when studying the finance-growth nexus (Jima & Makoni, 2023; Persaud & Thaffe, 2023; Azimi, 2022; An et al., 2021; Alexiou et al., 2018; Sharma, 2016).

Levine (2005) emphasizes how the financial sector's participation in lowering transaction costs and information asymmetry supports the relationship between the financial system and growth. Financial institutions working under FI (FI) efforts successfully address market imperfections by providing affordable financial services and leveraging proprietary borrower information (Nguyen & Du, 2022; Oanh et al., 2023). As a result, FI has become a cornerstone of national development plans and is becoming more widely acknowledged as being essential to reaching global development goals, such as the African Union Agenda 2063 and the UN Sustainable Development Goals (Abor et al., 2020; Jima & Makoni, 2023). However, despite efforts to enhance FI, approximately 1.7 billion adults worldwide remain financially excluded (Demirguc-Kunt et al., 2018), largely due to structural and institutional barriers, including high transaction costs, stringent documentation requirements, geographical remoteness (Persaud & Thaffe, 2023; Beck et al., 2007), institutional weaknesses (Demetriades & Law, 2006; Gazdar & Cherif, 2015), limited competition (Rajan & Zingales, 2003), and high inflation (Rousseau & Wachtel, 2002; 2009).

This study advances the theoretical and empirical discourse on FI and economic growth through three novel contributions, each addressing critical gaps in the literature while introducing methodological and contextual improvements tailored to Ethiopia's evolving financial landscape. First, considering the suggestions of (Jiang & Ma, 2019; Azimi, 2022; Pal et al., 2025), the study responds to the call for contextualized investigations into the heterogeneous FI macroeconomic impacts in emerging economies with varying institutional, technological, and developmental capacities (Jiang & Ma, 2019; Azimi, 2022; Pal et al., 2025). While extant scholarship predominantly examines middle and high-income nations (Pal et al., 2025), Ethiopia presents a quintessential case of structural heterogeneities that necessitate a context specific analysis. Despite progress under the National FI Strategy (2015–2025), deep inequities persist in providing a formal financial service for the public as 48% of the population remains excluded, particularly rural and low-income cohorts. The sector is heavily state-dominated (Worku, 2016; Mengesha & Berde, 2023), capital markets are underdeveloped, and public debt is largely absorbed at negative real interest rates by captive investors (Abdu, 2022), underscoring structural rigidities and the existence of policy-induced inefficiencies in Ethiopian market. This study approach is similar to Mengesha & Berde's (2023). Mengesha &

Berde's (2023) NARDL analysis of financial development (1980–2021), conflate pre-1991 data encompassing Eritrea, a critical oversight that may have a temporal consistency issue given Eritrea's secession in 1991. By excluding pre-1991 data when Eritrea was still part of Ethiopia, this study ensures empirical precision, isolating the nation's post-reform trajectory while addressing structural breaks endogenously to align with its second FI Strategy, as (Bekaert & Harvey, 2003; Kennedy, 2008) asserted it is an essential step given the susceptibility of emerging market data to regime shifts and gradual policy transitions. Furthermore, unlike cross-sectional approaches (e.g., Hussen & Mohamed, 2023), this research employs longitudinal methodologies to disentangle dynamic macroeconomic interactions and structural realities. By anchoring the break analysis to Ethiopia's second FI strategy, the study delivers policy-relevant insights rooted in structural economic realities.

Second, this paper offers a methodologically advanced contribution by modeling the asymmetric effects of FI on economic growth using the NARDL framework. While many previous studies impose linear assumptions (Ghosh, 2011; Adu et al., 2013; Kyophilavong et al., 2016; Sharma, 2016; Ofori-Abebrese et al., 2017; Puatwoe & Piabuo, 2017; Alexiou et al., 2018; Sethi & Acharya, 2018; Le et al., 2019; Erlando et al., 2020; Marcelin et al., 2021; Ahmad et al., 2021; Shen et al., 2021; Azimi, 2022; Ugwuanyi et al., 2022; Pal & Bandyopadhyay, 2022; Du et al., 2023; Jima & Makoni, 2023; Hussain et al., 2024; Odame et al., 2024; Pal et al., 2025), this study aligns with recent scholarship that highlights the non-linear country-specific and uncertain nature of financial shocks in emerging economies, particularly in nations such as Syria (Al Khatib, 2023), Algeria (Al Khatib et al., 2023), Kenya (Chen et al., 2023), China (Azimi, 2022a), Ghana (Nsor-Ambala & Amewu, 2023) and Ethiopia (Mengesha & Berde, 2023). The NARDL approach endorsed by Shin & Greenwood-Nimmo (2014) offers four distinct advantages: (i) simultaneous modeling of short- and long-run asymmetries, (ii) accommodation of structural shifts in dynamic relationships, (iii) reveal realistic economic interpretation, and (iv) implementation simplicity (Nandelenga & Oduor, 2020). While a positive FI shock, such as a credit boom, can spur economic growth by expanding access to finance, negative shocks (bust) caused by policy reversals or macroeconomic instability may significantly hinder economic activity. These asymmetric effects are often masked in standard linear models. Asymmetric approach addresses structural non-linearities, a critical feature of emerging market data (Bekaert & Harvey, 2003; Kennedy, 2008; Nandelenga & Oduor, 2020). In addition, this model allows policymakers to better design countercyclical tools suited to Ethiopia's specific economic vulnerabilities. This study

further enhances its empirical robustness by integrating the Toda-Yamamoto causality test, ensuring causality is not misinterpreted due to cointegration constraints.

Third, this study offers the operationalization of FI by integrating both traditional and digital indicators through a two-stage PCA. There has been little focus in integrating traditional and digital indicators in FI measurement. Previous studies have primarily used traditional indicators (e.g., Ghosh, 2011; Adu et al., 2013; Sharma, 2016; Puatwoe & Piabuo, 2017; Kim et al., 2018; Sethi & Acharya, 2018; Azimi, 2022; Agya et al., 2022; Karim et al., 2022; Pal & Bandyopadhyay, 2022; Amaira, 2023; Jima & Makoni, 2023; Hussain et al., 2024; Odame et al., 2024; Boachie & Adu-Darko, 2024). Some studies have employed digital metrics (e.g., Ahmad et al., 2021; Shen et al., 2021; Demir et al., 2022; Du et al., 2023; Xi & Wang, 2023), and some have examined the ratio of broad and narrow money (Qamruzzaman & Jianguo, 2018; Nandelenga & Oduor, 2020) or liquid liabilities (Nandelenga & Oduor, 2020) to develop FI. However, such approaches often miss the multidimensional nature of FI. Building on the insights of Mao et al. (2023) and Ismael & Ali, (2021), who argue digital and traditional FI as complementary, and supporting the findings of (Ugwuanyi et al., 2022; Rapih & Wahyono, 2023; Pal et al., 2025), who have developed a composite FI index using both types of indicators, this study combines six traditional indicators with four digital measure FI.

The paper is structured as: Section 2 presents literature reviews. Section 3 outlines the methodology aspects. Section 4 present results of the study, and Section 5 outline the conclusions.

2. Literature review

2.1. Theoretical framework: the finance-growth nexus

The relationship between financial development and economic growth has long been a topic of academic debate. Early discussions often focused on whether bank-based or market-based systems are more effective in supporting economic growth (Beck & Levine, 2022; Shen et al., 2024). These debates can be traced back to the foundational work of Bagehot in the 1870s, which set the stage for a wide spectrum of views on the finance–growth relationship (Nyankomo & Stephen, 2015; Stolbov, 2013). The direction of causality in this nexus remains the heart of the debate, giving rise to four competing theoretical paradigms, such as the supply-leading hypothesis, the demand-following hypothesis, the complementarity hypothesis, and the neutrality hypothesis (Opoku et al., 2019; Bara et al., 2016).

Schumpeter (1911) was the pioneer in advancing the supply-leading paradigm. According to supply-leading view, financial development plays a key role in driving growth by improving how resources are allocated, encouraging entrepreneurship, and fostering innovation. Later contributions by Pagano (1993) and recent studies (like Ahmad et al., 2021; Jima & Makoni, 2023; Odame et al., 2024) further reinforce the idea that a well-functioning financial sector channels capital into productive activities that can boost long-term growth. This line of thinking supports the rationale for government-led efforts in many emerging markets, where expanding financial access is seen as essential for economic transformation (Karlsson et al., 2021). In this context, financial deepening marked by accessible credit, strong intermediaries, and sufficient liquidity is considered crucial for sustaining growth (Levine, 2005; Levine & Zervos, 1998; Shaw, 1973). However, when financial systems are shallow characterized by limited institutional depth, restricted credit access, and suppressed real interest rates, can reduce incentives for savings, limit investment opportunities, and ultimately hinder economic progress (Abdullah, 2022; Levine, 2005; Shaw, 1973).

In contrast, the demand-following hypothesis suggests that it's the economy that leads, and finance follows. From this paradigm, financial sector growth is a consequence of rising income levels and expanding economic activity (Mlambo, 2024). This perspective, advanced by Robinson (1979), argues that as economies expand, the demand for financial services naturally increases, leading to the well-known assertion that "where enterprise leads, finance follows". Proponents argue that underdeveloped financial sectors in emerging economies stem from insufficient demand for financial services (Karlsson et al., 2021). They also contend that financial sectors evolve based on business needs, with wealthier nations better equipped to support advanced financial systems (Lee et al., 2021; Robinson, 1952). Empirical evidence suggests that as economies achieve higher income levels, their reliance on financial intermediation intensifies, reinforcing the demand-driven expansion of financial institutions (Rajan & Zingales, 1998; Mengesha & Berde, 2023). This hypothesis suggests that economic policy should focus on stimulating real-sector investment such as industrial growth and trade development so that financial sector expansion can emerge as a natural by-product of broader economic transformation (Ndlovu, 2013; Karlsson et al., 2021).

The complementarity hypothesis offers a middle ground between the supply-leading and demand-following views. It argues that the finance–growth relationship shifts depending on a country's level of development (Mlambo, 2024). Patrick's (1966) work captures this evolution suggesting that in early stages of economic development, the financial system plays a leading

role by mobilizing capital, lowering transaction costs, and facilitating investment. As development advances, however, this relationship tends to reverse financial growth becomes increasingly shaped by the evolving needs of the real economy (Mlambo, 2024; Dilek, 2019). Several empirical studies, especially in economies transitioning from low to high-income status, confirm this two-way relationship as financial institutions adapt to support more complex economic structures (Jung, 1986).

Meanwhile, the neutrality hypothesis challenges the assumption that finance and growth are causally interdependent. It argues that the nexus between them are coincidental rather than causal (Lucas, 198; Bara et al., 2016; Opoku et al., 2019). This view, grounded in the works of Solow (1956) and Lucas (1988), argues that financial development might not be a necessary driver of economic growth. Lucas (1988), in particular, was critical of the emphasis placed on financial intermediation, arguing that its role had been “overstressed” in mainstream growth theory. Some empirical studies find weak or statistically insignificant links between finance and growth, suggesting that outcomes may depend on country-specific institutional and structural factors (Opoku et al., 2019; Bara et al., 2016; Alexiou et al., 2018).

2.2. Empirical literature review and hypothesis development

Like the theoretical discourse, the empirical literature on FI has evolved in parallel with growing empirical investigations into its relationship with various socio-economic outcomes (Sharma, 2016). Research findings on the impact of FI on economic growth remains mixed, often varying across regions, income levels, and institutional settings (Sharma, 2016; Chen et al., 2023; Jima & Makoni, 2023). Understanding the direction and nature of this relationship is important for designing targeted policy interventions (Chow et al., 2019). Considering symmetric and asymmetric body of empirical literatures, this research classifies recent studies that investigate the causality between FI and economic growth from demand-following, supply-leading, complementary, and neutrality perspectives.

I. Demand-following

Several empirical studies support the demand-following hypothesis. For instance, a study by Ugwuanyi et al. (2022) panel study using feasible generalized least squares, system GMM, and VAR Granger causality tests across 29 Sub-Saharan African countries from 2012 to 2020. The authors found that while both TFI and DFI positively effects growth, causality flowed unidirectionally from economic growth to FI in middle-income economies of the sample. They argue that higher incomes drive investments in financial infrastructure which subsequently

expand service accessibility. In Malawi, Simwaka et al. (2012) employed ARDL modelling to demonstrate that financial development lagged behind economic growth over 1980–2010, with no evidence of supply-leading effects. Instead, growth-induced demand for credit and savings instruments gradually spurred banking sector expansion. Similarly, Ndlovu (2013) identified unidirectional causality from growth to financial development in Zimbabwe (1980–2006), attributing this to economic reforms that prioritized investment and trade liberalization, whose profitability later incentivized financial sector. These findings resonate with Waqabaca's (2004) analysis of Fiji (1970–2000), where cointegration tests within a bivariate VAR framework revealed that growth in the real sector preceded financial deepening. The study suggests that less advanced financial systems, such as that of Fiji, often exhibit a deficiency in depth and sophistication. Therefore, the progression of the financial system should lead to a diversification of financial instruments, ultimately resulting in increased funds available for financing economic development in Fiji. Hemrit (2021) used ARDL techniques on quarterly data from 2013–2019, found that insurance growth was largely a function of economic growth in Saudi Arabia. Using NARDL model for a data from 1980–2021, Mengesha and Berde (2023) found that economic growth is the main driver of financial sector development in Ethiopia. They argue that financial development alone does not guarantee economic growth without strong institutions and sound fiscal policies. They claim that an effective economic growth strategy is necessary to sustain financial development.

II. Supply-leading

Studies carried out by Odame et al. (2024), Ghosh (2011), and Mengesha & Berde (2023) have supported the supply-leading hypothesis, which postulates a unidirectional causation from FI to economic growth. Specifically, Abdmoulah and Jelili (2013) examined threshold effects in the finance-growth relationship by using data from 144 nations from 1985 to 2009. Their findings, which are based on GMM estimates, threshold analysis (Wald statistics), and least squares, significantly support the supply-leading hypothesis. They argue that the differences or similarities in growth rates among nations are mostly determined by access to financing. Their research highlights the importance for policymakers to prioritize financial access, particularly when bank borrowing serves as the main source of credit. Similar conclusions were drawn by Odame et al. (2024), who investigated the link between FI and economic growth in Ghana using Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) methodologies from 2005–2016. Their findings indicated a unidirectional causal relationship from financial access to GDP, despite a negative coefficient, suggesting that the nature and quality of FI are crucial for

its potential to enhance growth. Siddiki and Bala-Keffi (2024) employed Hansen's (1999) panel threshold model considering 153 countries from 2011 to 2020. Their findings indicate that FI positively affects economic growth, although the extent and direction of this impact differ across various thresholds of financial development. This highlights the necessity for policies to be customized to align with the maturity and structure of a nation's financial system.

Nizam et al. (2020), analyzing 63 nations (2014–2017), identify non-monotonic growth effects, with FI's impact magnifying at higher inclusion levels, a pattern attributed to economies of scale. Conversely, Demir et al. (2022), utilizing quantile regression across 140 countries, reveal that FI reduces inequality predominantly in high-income economies, where complementary institutions mitigate exclusionary biases. This institutional dependency resonates with Emara and El Said's (2021) GMM analysis of MENA and emerging markets (1990–2018), where FI's growth dividends materialize only under robust governance, contract enforcement, and anti-corruption regimes. Chen et al. (2023), through a quantile-on-quantile approach across the ten most financially inclusive economies (2004–2018), found that FI consistently enhances EG across quantiles, though the effects vary in magnitude, demonstrating asymmetric influence.

In a subnational analysis, Ahmad et al. (2021) examined the effect of DFI on the economic performance of China's 31 provinces from 2011 to 2018 using fixed effects, panel-corrected standard errors, Driscoll-Kraay models, and Granger causality tests. Their findings confirm a unidirectional and positive effect of DFI on economic growth, emphasizing that DFI-related policies can significantly boost growth, but the reverse causality does not hold. Ren et al. (2023) offer a nuanced perspective by analyzing both traditional and digital FI on firm-level innovation in 268 Chinese cities (2011–2018) using a two-way fixed effects model. They found that while traditional FI inhibits innovation output, DFI promotes it, especially among small and private enterprises, indicating the differentiated pathways through which various forms of FI affect growth and innovation dynamics. Similarly, Alaabed and Masih (2016), applying threshold regression to Malaysian data (1961–2011), showed that while finance initially promotes growth, excessive credit expansion beyond a certain point negatively impacts GDP, confirming non-linearity in the relationship.

Considering human capital as a mediating role, Opoku et al. (2024), examining 40 African nations (2005–2018), uncover a non-linear U-shaped relationship as an initial FI expansions yield negligible growth. They conclude that the development of human capital fully mediates the nexus between FI and economic growth in Africa, indicating that the advantages of FI are

realized through human development. This suggests FI operates not in isolation but as part of an ecosystem requiring synchronized investments in social infrastructure. Critically, Mehmood and Bilal's (2021) DCCE analysis of 10 developing economies (1991–2017) reinforces financial development's multifaceted role, deconstructing it into six indicators (e.g., broad money, domestic credit to private sector to GDP, domestic credit to private sector by banks, depth of credit information index, commercial bank branches and bank capital asset ratio). Their results support the supply-leading hypothesis, with most financial development indicators positively associated with economic growth, except for a negative effect from the capital asset ratio and an insignificant impact from commercial bank branches. Their findings advocate for enhanced financial integration, institutional strengthening, and targeted relief mechanisms to amplify the finance–growth link.

III. Complimentary

The complementary hypothesis suggests that a bidirectional, mutually reinforcing relationship between FI and economic growth, where financial access fuels growth, which in turn deepens inclusion, a virtuous cycle observed in diverse regional contexts. Jima and Makoni (2023) explored the finance-growth nexus across 26 Sub-Saharan African countries from 2000–2019, employing system GMM, ARDL cointegration, and Granger causality tests. Their results revealed a bidirectional relationship between FI and economic growth, characterized by short-run negative and long-run positive effects. Similarly, Avouba et al. (2022), using panel-corrected standard error (PCSE) estimations for WAEMU countries (2014–2018), identified a U-shaped non-linear relationship between FI and economic growth, indicating that initial increases in financial access may reduce growth until a critical threshold is reached, beyond which growth accelerates. Ugwuanyi et al. (2022) affirmed bidirectional causality between economic growth and both traditional and digital FI in low-income countries, except for digital usage, which followed a unidirectional demand-driven path. Hussain et al. (2024), using CS-ARDL and causality tests across 21 Asian countries (2004–2019), confirmed endogenous co-development of FI and economic growth, with stronger effects in developing economies. Karlsson et al. (2021) employed wavelet-based causality on 76 countries and found that finance and growth reinforce each other once a country attains at least lower-middle-income status. Le et al. (2019), using a random effects model across 20 Asian economies (2011–2016), confirmed that higher FI correlates with increased growth and reduced unemployment, underlining the role of financial literacy.

Country-specific findings further illuminate this synergy. Sharma (2016), applying VAR and Granger causality analysis to Indian data (2004–2013), confirmed a bidirectional linkage between geographic outreach and EG. Likewise, Odame et al. (2024) highlighted that the financial penetration dimension Granger-causes GDP growth and vice versa, affirming mutual causality. Adeyeye et al. (2015), investigating Nigeria’s context (1981–2013) via pairwise Granger causality, observed bi-directional causality between financial development and economic growth. However, even if supply leading hypothesis is proven their findings suggested a dominant demand-following hypothesis, attributed to weak intermediation, high government borrowing, and an underdeveloped financial sector. Kyophilavong et al. (2016), analyzing Laos through ARDL bounds testing, identified feedback effects, suggesting that both financial development and EG are mutually reinforcing. Erlando et al. (2020), applying Toda-Yamamoto causality and PVAR to data from Eastern Indonesia (2010–2016), reported that FI and EG are strongly interlinked, with FI positively influencing growth but worsening income inequality, signaling trade-offs in inclusive development outcomes.

IV. Neutrality

Contrary to the optimistic narrative, some scholars highlight neutral or insignificant effects of finance on growth. Lucas (1988) argued that finance is an “overstressed” determinant of growth, suggesting that excessive focus on financial system development could divert attention from more effective strategies such as labor productivity, export promotion, and tax reform. Using threshold regression, Deidda and Fattouh (2002) found that financial depth has a non-monotonic relationship with growth, which is statistically insignificant in low-income countries. Bloch and Tang (2003), based on a time-series analysis of 75 countries (1960–1990), claimed no significant correlation between financial sector development and growth. Andersen and Tarp (2003) further observed that financial indicators lose significance when applied to developing countries. Additionally, research by Bara et al. (2016) and Opoku et al. (2019) supports the neutrality hypothesis, indicating that financial development and economic growth tend to evolve independently across various frequency levels. Reinforcing this view, Beck et al. (2014), through GMM estimation for 132 countries (1980–2005), reported that finance positively impacts growth only up to a threshold, beyond which the effect turns insignificant. They advocated for policy interventions to curb excessive leverage and speculative finance, suggesting that measured deepening could ensure finance remains growth-enhancing.

In light of the above empirical literature reviewed, this study proposes the following hypotheses:

H1: *FI has an asymmetric impact on economic growth*, such that its effects vary across different levels of financial development and economic performance, potentially exhibiting non-linear patterns.

H2: *There exists a bidirectional causality between FI and economic growth*, indicating that while FI contributes to economic expansion, it is also endogenously shaped by the overall pace and pattern of economic development.

3. Methodology

3.1. Variable selection and source of data

This study covers the period from 1991-2023, guided by the availability and consistency of macroeconomic data in Ethiopia. As Mengesha & Berde, (2023) mentioned, the country's data management is often constrained by limited time-series depth and reliability, posing challenges for long-term analysis. Given that Ethiopia's financial system is predominantly bank-based and considering the comparatively longer availability of bank-related data, the study primarily relies on domestic financial data sources for constructing the FI index. Supplementary data were also sourced from internationally recognized institutions. Due to the underdeveloped nature of Ethiopia's capital markets, stock market related indicators (i.e., market-based measures) are excluded. Instead, the analysis adopts a bank-based perspective to examine the impact of FI on economic growth. Several studies used different proxies to measure economic activity, such as GDP per capita (Jima & Makoni, 2023; Emara & El Said, 2021; Marcelin et al., 2021; Nizam et al., 2020; Sethi & Acharya, 2018), GDP growth rate (Avouba et al., 2022; Karim et al., 2022; Erlando et al., 2020; Azimi, 2022; Kyophilavong et al., 2016) and nightlight luminosity (Singh & Ghosh, 2021). To address the objective, the study, GDP per capita is applied. Studies used macroeconomic variables like population growth rate (Azimi, 2022; Avouba et al., 2022; Karim et al., 2022; Emara & El Said, 2021; Nizam et al., 2020), trade openness (Mengesha & Berde, 2023; Azimi, 2022; Avouba et al., 2022; Karim et al., 2022; Ugwuanyi et al., 2022; Emara & El Said, 2021; Nizam et al., 2020; Sethi & Acharya, 2018), money supply (Alexiou et al., 2018; Kyophilavong et al., 2016; Adu et al., 2013), real exchange rate (Jima & Makoni, 2023; Mengesha & Berde, 2023). Institutional quality is represented by a composite average of six World Governance Indicators such as government effectiveness, regulatory quality, rule of law, control of corruption, voice and accountability, and political

stability (Jima & Makoni, 2023; Avouba et al., 2022). A detailed description of all variables and their respective sources is provided in Table 28.

3.2. Measures of FI

FI is inherently multidimensional, and relying on a single indicator may yield partial or misleading insights (Jima & Makoni, 2023; Nguyen, 2021; Sarma, 2008). A multidimensional index enhances comparability and allows for a more comprehensive evaluation of FI trends and rankings (Nizam et al., 2020). According to the Joint Research Centre (JRC, 2008), the first step in constructing a composite index is the identification of relevant indicators. Given the recent rollout of Ethiopia's digital ID initiative and the risk of double counting, several commonly used FI indicators such as the number of deposit and loan accounts, debit cards, and mobile/internet banking users, were excluded to avoid policy misinterpretation. Instead, the study uses context-specific, reliable, and consistently available data to construct the FI index. While developing a FI index, four indicators has been selected from **availability** dimension (branches/ATMs per 100,000 adults and branches/ATMs per 1000km²) and two indicators selected from **usage** dimension (deposit/loan per GDP) and four digital **accessibility** dimension (internet users (% of population), mobile phone subscription per 100 people, mobile money agents per 100,000 adults/1000km²).

The second step involves normalizing indicators to ensure comparability across different units of measurement (JRC, 2008; Nardo et al., 2005; Mukhametzyanov, 2023) and helps to eliminates extreme values or outliers from the indicators (Freudenberg, 2003). This study employs the min-max method, which scales each indicator between 0 (full exclusion) and 1 (full inclusion), using the formula:

$$\text{Mean} - \text{Max} = \frac{Y_i - Y_{min}}{Y_{max} - Y_{min}} \quad (1)$$

The third step is weight assignment, which is a critical phase in index construction (Lockwood, 2004). While non-parametric methods rely on expert judgment, this study adopts a parametric approach named PCA to derive weights based on the internal covariance of the indicators (Nizam et al., 2020; Camara & Tuesta, 2014). A two-stage PCA is applied: (i) first, to extract latent variables for each FI dimension; (ii) and second, to compute the eigenvalues and construct the overall FI Index (FII). The index is computed as:

$$FI_t = \omega_1 Y^a + \omega_2 Y^p + \omega_3 Y^u + \epsilon_i \quad (2)$$

Where FI_t is t^{th} factor of FI; ω_i , represents weights for FI dimensions; (Y^a, Y^p, Y^u) represents latent variables of FI dimensions drive from first stage PCA. e_i is variation due to error.

3.3. Model specification

This study advances the empirical investigation of FI and economic growth by adopting a NARDL framework, grounded in the theoretical foundations of endogenous growth theory (Rebelo, 1991; King & Levine, 1993) and financial intermediation models (Pagano, 1993; Beck et al., 2007; Adu et al., 2013; Kim et al., 2018; Karim et al. 2022). The baseline linear model is specified as follows:

$$lpercap_t = \alpha FI_t + \gamma X_t + \varepsilon_t \quad (3)$$

Where, $lpercap_t$ is a GDP per capita, lFI_t is the index of FI, X_t is the vector of other independent variables that affect GDP per capita, including natural logarithm of institutional quality (IIQ), natural logarithm of real exchange rate (RER), natural logarithm of trade openness (ITO), money supply (% of GDP) (MSS), and natural logarithm of population growth (IPG), ε_t is an error term, and t represents time (1, 2, ..., n).

3.3.1. Nonlinear autoregressive distributed lag (NARDL) model

While traditional linear specifications, such as the ARDL model (Pesaran et al., 2001), assume symmetric adjustments in short- and long-run dynamics, mounting empirical evidence underscores the inadequacy of such approaches in capturing the nonlinearities inherent in FI-growth nexus, particularly in emerging economies characterized by structural rigidities, institutional frictions, and macroeconomic volatility (Shin et al., 2014; Hossain et al., 2021; Udeagha & Breitenbach, 2023; Kassi et al., 2023). The NARDL framework, as proposed by Shin et al. (2014), is uniquely suited to address these complexities, offering three critical advantages over conventional methodologies: (1) mostly economic policy transmission in developing countries is often nonlinear and asymmetric (El-Shazly, 2016; Nsor-Ambala & Amewu, 2023). The positive or negative may yield distinct effects (Bahmani-Oskooee et al. 2019; Trejo-García et al., 2024), depending on institutional readiness, digital access, and economic conditions. NARDL captures these asymmetric responses by decomposing the FI index into positive and negative partial sums (Shin et al., 2014); (2) Unlike VECM or VAR models that require all variables to be integrated at the same order, NARDL accommodates a mix of $I(0)$ and $I(1)$ series (Pesaran et al., 2001), making it ideal for macroeconomic datasets from developing countries; (3) traditional linear ARDL assumes symmetric adjustment in response to shocks, ignoring how structural bottlenecks and institutional frictions shape policy

effectiveness. NARDL addresses this by estimating both short-run and long-run asymmetries; (4) as noted in Tsagkanos et al. (2019), threshold or Markov Switching models excel in nonlinear regime detection but fail to identify asymmetric long-run equilibria robustly. Furthermore, it is challenging to observe the specific impacts of asymmetric corrections from prior dynamics through past or future disequilibrium, as the probability plot alone does not adequately clarify the specific long-run shock behavior associated with the identified asymmetries (Chen et al., 2020). To capture the asymmetric impact of FI on economic growth, Shin et al. (2014) develop a cointegrating NARDL model that accommodates short- and long-run nonlinearities decomposes FI into partial positive ($FI^+ = -\beta_{2i}^+/\beta_{1i}$) and partial negative ($FI^- = -\beta_{2i}^-/\beta_{1i}$) changes. Thus, the decomposition series can be expressed as follows:

$$FI_t^+ = \sum_{i=1}^t \ln FI_t^+ = \sum_{i=1}^t \max(\Delta \ln FI_i, 0) \quad (4)$$

$$FI_t^- = \sum_{i=1}^t \ln FI_t^- = \sum_{i=1}^t \min(\Delta \ln FI_i, 0) \quad (5)$$

Incorporating these components, the asymmetric NARDL model is expressed as:

$$\begin{aligned} \Delta \ln \text{percap}_t = & \beta_0 + \sum_{i=1}^p \beta_1 \Delta \ln \text{percap}_{t-i} + \sum_{i=0}^p \beta_2^+ \Delta \ln(FI^+)_{t-i} + \sum_{i=0}^p \beta_2^- \Delta \ln(FI^-)_{t-i} \\ & + \sum_{i=0}^p \beta_3 \ln IQ + \sum_{i=0}^p \beta_4 \Delta \ln RER_{t-i} + \sum_{i=0}^p \beta_5 \Delta \ln TO_{t-i} + \sum_{i=0}^p \beta_6 \Delta \text{MSS}_{t-i} \\ & + \sum_{i=0}^p \beta_7 \Delta \ln PG_{t-i} + \lambda_1 \ln \text{percap}_{t-1} + \lambda_2^+ \ln(FI^+)_{t-1} + \lambda_2^- \ln(FI^-)_{t-1} \\ & + \lambda_3 \ln IQ_{t-1} + \lambda_4 \ln RER_{t-1} + \lambda_5 \ln TO_{t-1} + \lambda_6 \text{MSS}_{t-1} + \lambda_7 \ln PG_{t-1} \end{aligned} \quad (6)$$

Here, Δ denotes the first-difference operator, β captures the short-run dynamics, λ measures the long-run relationship, FI^+ and FI^- capture asymmetric responses of FI.

3.3.1.1. Cointegration and Bound Testing

The presence of a long-run relationship among the variables is tested using the bounds testing approach by Pesaran et al. (2001). The null hypothesis of no cointegration is:

$$\mathbf{H0}: \lambda_1 = \lambda_2^+ = \lambda_2^- = 0$$

If the F-statistic exceeds the upper bound critical value, we reject **H0**, confirming cointegration and validating long-run asymmetric relationships.

3.3.2. Toda-Yamamoto Noncauality Test

The Toda-Yamamoto (1995) Granger non-causality test is employed to investigate the directional causal relationships between (**IFI**) and economic growth (**lpercap**) in Ethiopia. This

approach circumvents pre-testing biases associated with unit root and cointegration analyses, as it remains robust to the integration order of variables (I(0), I(1), or mixed) and cointegration properties (Mengesha & Berde, 2023). The procedure for the Toda-Yamamoto Granger Causality test begins with the identification of the optimal lag length (p) through a standard lag selection process. Subsequently, the maximum order of integration ($dmax$) must be determined, as outlined in the following equations

$$lpercap_t = \phi + \sum_{i=1}^p \alpha_{1i} lpercap_{t-i} + \sum_{i=p+1}^{dmax} \alpha_{2i} lpercap_{t-i} + \sum_{i=1}^p \theta_{1i} lFI_{t-i} + \sum_{i=p+1}^{dmax} \theta_{2i} lFI_{t-i} + \varepsilon_t \quad (7)$$

$$lFI_t = \phi + \sum_{i=1}^p \beta_{1i} lFI_{t-i} + \sum_{i=p+1}^{dmax} \beta_{2i} lFI_{t-i} + \sum_{i=1}^p \gamma_{1i} lpercap_{t-i} + \sum_{i=p+1}^{dmax} \gamma_{2i} lpercap_{t-i} + \epsilon_t \quad (8)$$

From equation (7), rejection implies FI Granger-causes economic growth, if $\theta_{1i} = 0, \forall i=1, 2, \dots, p$, for equation (8) rejection implies economic growth Granger-causes FI, if $\gamma_{1i} = 0, \forall i=1, 2, \dots, p$.

4. Result

4.1. Descriptive analysis

Table 28 presents the descriptive statistics for variables central to this study, offering critical insights into their variability and distribution. The standard deviation (SD) reflects the extent to which the data deviate from the mean, serving as an indicator of dispersion (Arora, 2012). This study finding reveals that Per capita income (lpercap, Mean=8.14, SD=1.49), FI (lFI, Mean=-4.00, SD=1.60), institutional quality (IIQ, SD=0.15), real exchange rate (RER, Mean=2.49, SD = 0.79), trade openness (ITO, Mean=-1.09, SD=0.26), money supply (MSS, Mean=0.33, SD=0.06) and population growth (PG, SD=0.12) exhibit slight dispersion. Overall, the relatively low standard deviations suggest limited dispersion around the mean, and the descriptive patterns imply that the data are approximately normally distributed.

Table 29: Descriptive summary

Variable	Symbol	Description	Source	Mean	Std. Dev.	Min	Max
Per capita income	lpercap	Calculated as Nlog(GDP per capita)	WB	8.140168	1.492311	6.353607	11.12397
FI	lFI	Calculated as Nlog(FI)	NB:WB	-3.99993	1.597979	-7.3296	-1.27075
Institutional quality	IIQ	Calculated as Nlog(WB IQ index)	WB	-1.59969	0.153538	-1.922	-1.38154
Real exchange rate	RER	Calculated as Nlog(Exchange rate)	WB	2.488315	0.78514	0.727549	4.000051
Trade openness	ITO	Calculate as ((Export + imports)/GDP)	WB	-1.08704	0.258463	-1.45128	-0.69492
Money supply	MSS	Calculate as (money supply/GDP)	NB	0.335906	0.061496	0.237901	0.433383
Population growth	lPG	Calculated as Nlog(population growth rate)	WB	1.071251	0.12157	0.955511	1.458615

Source: Computed based stata 14, WB-stands for World Bank and NB-stands for National bank of Ethiopia, Nlog-stands for natural logarithm

4.2. Unitroot test

Pre-testing all-time series for unit root is undertaken to ensure a non-spurious estimation and efficient and time-invariant estimates (Jima & Makoni, 2023). Unit root analysis is essential for excluding I(2) stationary variables, which are irrelevant for the Pesaran bounds (Chen et al., 2020). This research evaluate the stationarity of variables using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, examining both the level I(0) and the first difference I(1). The results from both tests reveal that institutional quality and population growth exhibit stationarity at the level, while the ADF test indicates that the money supply is also stationary at this level. Furthermore, all variables achieve stationarity at the first difference in both the ADF and PP tests. As illustrated in Table 29, the presence of mixed orders of integration (I(0) and I(1)) justifies the use of the nonlinear ARDL approach.

Table 30: Unitroot test

Variables	PP I(0)	PP I(1)	ADF I(0)	ADF I(1)
Lpercap	-0.812	-3.514**	0.951	-1.584*
IFI	-0.365	-7.640***	0.087	-6.336***
IIQ	-3.142*	-6.229***	-1.965**	-4.270***
RER	-1.253	-3.432***	-0.542	-6.380 **
ITO	-0.880	-3.873***	-1.040	-3.054**
MSS	-1.276	-5.09***	-1.562*	-4.854***
PG	-6.501***	-4.794***	-8.49***	-6.419***

Source: Computed based on stata 14 result, Notes *p< 0.1, **p< 0.05, ***p< 0.01

4.2. Structural break analysis

The concept of structural breaks and regime shifts has gained increasing attention in financial and macroeconomic research (e.g., Stöber & Czado, 2014; Kalsie & Arora, 2019; Lovreta & López, 2020; Korley & Giouvris, 2021; Lien et al., 2022; Kirikkaleli & Alola, 2023). These breaks, which may arise from policy shifts, crises, or technological disruptions, necessitate rigorous identification to avoid spurious conclusion (Kalsie & Arora, 2019). While Nelson & Plosser (1982) argue that shocks may impart permanent effects, Plosser (1989) emphasized the importance of linking such shocks to specific economic events. Methodologically, breaks can be detected exogenously (pre-specified dates) or endogenously (data-driven identification), sparking enduring debates on their treatment (Perron, 1989; Zivot & Andrews, 2002). While endogenous approaches (e.g., Zivot & Andrews, 2002; Lumsdaine & Papell, 1997) allow break dates to emerge from the data, Lee & Strazicich (2003) and Kalsie & Arora (2019) caution against their susceptibility to size distortions under unit root null hypotheses, advocating instead for exogenous specification when theoretical priors exist. In this study, a structural break is exogenously introduced at 2021, marking the launch of Ethiopia's second national FI

strategy (NFIR). A year starting from 2021 represents a policy shift, plausibly altering the trend of economic growth through financial reforms. Accordingly, the analysis evaluates the extent to which this strategic intervention disrupted prior trends in the FI–growth nexus.

4.3. Asymmetry test for nonlinear ARDL estimates

This study employs the NARDL approach to test for asymmetric cointegration between FI and economic growth, recognizing the potential for nonlinear long-run relationships. As emphasized by Shin et al. (2014), cointegration testing is crucial to avoid spurious inferences in non-stationary time series models. Following the bounds testing methodology of Pesaran et al. (2001), the joint null hypothesis of no level relationship was tested. The results, presented in Table 30, show that both the Student (t_{BDM}) and Fisher (F_{PSS}) statistics exceed the critical thresholds, confirming the presence of cointegration. Furthermore, confirming **hypothesis 1**, the null hypothesis of symmetry is rejected ($p < 0.05$), indicating that positive and negative FI shocks have significantly different effects on growth. This evidence confirms that economic growth responds asymmetrically to FI shocks, with distinct magnitudes for positive versus negative effects. Given these findings, we conduct further analysis to examine their differential impacts on growth.

Table 31: Asymmetric test

Null hypothesis (Ho)	Short run	Long run
<i>FI has symmetric effect on economic growth</i>	8.427** (0.012)	4.857** (0.045)
Cointegration test		
$t_{BDM} = -3.4029$	$F_{PSS} = 4.7975$	

Source: Computed based stata 14 result, Notes: ** signifies the rejection of Ho of symmetry at 5% significant level.

4.4. Discussion of NARDL findings

Table 31 presents the results from the NARDL model, which investigates the asymmetric effects of FI on economic growth in Ethiopia. The model reveals strong explanatory power, with an R^2 of 0.92 and an adjusted R^2 of 0.85, indicating that 85% of the variation in economic growth is accounted for by the included predictors. To establish cointegration, the analysis checks the significance of the F-statistic and the error-correction term (ECT). Following Nandelenga and Oduor (2020), cointegration is confirmed by the ECT's negative and statistically significant coefficient (-0.86 , $p < 0.01$), which validates the existence of a stable long-run equilibrium relationship between FI and growth.

Crucially, the model reveals asymmetric effects of FI on economic growth, a feature consistent with the theoretical underpinnings of nonlinear adjustment and structural heterogeneity. In the short run, positive shocks to FI significantly stimulate economic growth ($\beta = 0.63$, $p = 0.001$),

and the lagged effect remains statistically significant ($\beta = 0.24$, $p = 0.03$), suggesting persistence in growth responses. This implies that improvements in financial access and usage have both immediate and sustained impacts on real economic activity. These findings align with the empirical evidence reported in Lenka & Sharma (2017), Agya et al. (2022), Younas et al. (2022), Musa et al. (2023), Boachie & Adu-Darko (2024), and Hussain et al. (2024), who argue that FI enhances resource allocation efficiency, fosters investment, and accelerates inclusive growth. Conversely, negative shocks to FI are statistically insignificant in the short run ($\beta = 0.02$, $p = 0.89$), with a weak and insignificant lagged effect ($\beta = -0.11$, $p = 0.36$). This suggests that short-term contractions in FI such as reduced access to financial services or disruptions in financial infrastructure do not exert immediate adverse effects on growth. One plausible explanation is the buffering role of informal financial systems in Ethiopia, which may temporarily substitute for formal financial mechanisms during short-term shocks.

The long-run coefficients reveal significant and divergent effects as a 1% positive shock to FI increases economic growth by 0.595%, whereas a 1% negative shock leads to a 0.292% decline in growth, *ceteris paribus*. These long-run asymmetries underscore the structural significance of FI in driving macroeconomic performance. The magnitude of the positive effect being nearly twice that of the negative effect further illustrates the growth-promoting potential of inclusive financial systems when scaled up sustainably. Notably, the robustness of the model is confirmed when FI strategy checks slightly alter the long-run coefficients to 0.604 (positive) and -0.282 (negative), reinforcing the validity of the baseline findings. While the structural break introduced by the FI-strategy is not statistically significant on its own, it contributes meaningfully to the adjustment dynamics. Specifically, it mitigates the negative effects of financial exclusion while amplifying the gains from enhanced inclusion. The results contrast with early studies such as (Naceur & Ghazounai, 2007; Law & Singh, 2014; Arcand et al., 2015; Nkwede, 2015; Odame et al., 2024; Yakubu et al., 2025) and supports the findings of (Ansong et al., 2011; Kyophilavong et al., 2016; Puatwoe & Piabuo, 2017; Nandelenga & Oduor, 2020; Azimi, 2022; Al Khatib, 2023; Mengesha & Berde, 2023; Hussain et al., 2024), who emphasize the critical role of FI in enhancing economic growth. Theoretically, the findings lend support to the hypothesis that FI enhances economic growth by improving the efficiency of financial intermediation, broadening access to savings and credit facilities, and facilitating the optimal allocation of capital (Chou, 2007). While Alexiou et al. (2018) caution that excessive financialization leads to "uncreative destruction", Jima and Makoni (2023) counters

argue that, FI remains a net positive driver of growth by mobilizing domestic savings, reducing information asymmetry and incentivizing productive investments.

The short-run analysis reveals a statistically significant positive relationship between real exchange rate (RER) and economic growth in Ethiopia ($\beta = 0.43$, $p = 0.009$), aligning with Rodrik's (2008) assertion that RER undervaluation stimulates growth in developing economies by enhancing export competitiveness. This finding corroborates a robust body of literature (Rodrik, 2008; Rapetti et al., 2012; Habib et al., 2017; Hatmanu et al., 2020; Rapetti, 2020; Zhu et al., 2022) positing that RER depreciation boosts growth through multiple channels: (1) improving trade balances by lowering export prices (Zhu et al., 2022), (2) incentivizing investment in tradable sectors (Aizenman & Lee 2010; Benigno et al., 2015; Aghion et al., 2011), and (3) redistributing income toward profit-driven firms with higher savings propensities (Levy-Yeyati & Sturzenegger, 2007). However, this result contrasts with studies emphasizing RER volatility's growth-suppressing effects (Ramoni-Perazzi & Romero, 2022; Mengesha & Berde, 2023), underscoring the context-dependent nature of exchange rate impacts.

Table 32: Estimation of short run and long run relationship result

Variables	NARDL	NARDL (after introducing break)
Short run asymmetric impact		
$\Delta (\ln FI^+)$	0.631*** (4.42)	0.632*** (4.27)
$\Delta (\ln FI^+ (-1))$	0.247** (2.42)	0.246** (2.33)
$\Delta (\ln FI^-)$	0.0215 (0.15)	0.00797 (0.05)
$\Delta (\ln FI^- (-1))$	-0.114 (-0.95)	-0.117 (-0.93)
$\Delta (\ln RER)$	0.430*** (3.01)	
$\Delta (\ln TO)$	-0.309** (-2.63)	-0.301** (-2.36)
$\Delta (MSS)$	-1.086* (-2.05)	-1.065* (-1.91)
$\Delta (PG)$	-3.431*** (-5.02)	-3.342** (-4.02)
$\Delta (SB)$		0.0153 (0.21)
Con	7.565*** (4.95)	
ECT	-0.859*** (-3.40)	-0.830** (-2.81)
Long run asymmetric impact		
$\ln FI^+$	0.595*** (170)	0.604*** (90.28)
$\ln FI^-$	-0.292** (6.31)	-0.282* (4.42)

Source: computed based on Stata 14 result, Notes: *, **, *** imply rejection of the null hypothesis at the 10%, 5% and 1% significance level, respectively.

The short-run asymmetric analysis reveals a statistically significant negative association between money supply (MSS) and economic growth in Ethiopia ($\beta = -1.086$, $p = 0.06$), a finding that aligns with studies in similar low-income, inflationary contexts (Adu et al., 2013; Yakubu & Abdallah, 2021; Buthelezi, 2023; Madurapperuma, 2023) but contrasts with evidence from more diversified economies (Puatwoe & Piabuo, 2017; Dinh et al., 2019; Bajrami et al., 2025). Classical and monetarist frameworks posit that money supply growth stimulates economic activity (Demeulemeester, 2024; Bajrami et al., 2025). While Keynesian models emphasize monetary expansion may only be growth-enhancing when accompanied by effective fiscal coordination, credit access, and institutional readiness (Cesaratto & Pariboni, 2022; Matamoros Romero, 2023; Bajrami et al., 2025). Ethiopia's banking sector, characterized by limited credit penetration (99% of formal access concentrated in urban area with top ten borrowers took 23% of loan and advance of the country) (NBE-FSR, 2024) and high intermediation costs, struggles to translate liquidity injections into productive investments, exacerbating inflationary pressures. The negative coefficient aligns with Madurapperuma (2023) findings in high-inflation regimes, where monetary expansion exacerbates price instability, eroding real incomes and suppressing consumption. This finding reinforces the argument that, for monetary policy to be a reliable growth instrument in transitional economies like Ethiopia and as (Bajrami et al., 2025) suggested that, it must be integrated within a broader strategy that ensures price stability, improves credit allocation, and enhances institutional quality.

The short-run analysis reveals a statistically significant negative relationship between population growth and economic growth in Ethiopia ($\beta = -3.431$, $p = 0.000$). This finding aligns with a broad strand of the literature grounded in exogenous growth theories (Solow, 1956; Ehrlich, 1968; Herzer et al., 2012), which attribute the negative association to the capital dilution effect, where a growing population reduces the amount of physical capital per worker, thereby lowering per capita output and transitional growth. Bucci (2023) refines this view by introducing the 'population-multiplicative effect', emphasizing that when population growth surpasses a critical threshold, it can undermine per capita human capital accumulation and depress long-run income growth. This finding is consistent with empirical studies that report a negative impact of population growth on growth in low-income countries, where resource constraints, capital shallowing, and weak absorptive capacity in labor markets compound the adverse effects (Afzal, 2009; Li & Zhang, 2007; Herzer et al., 2012; Prettnner, 2014; Peterson, 2017). These structural limitations are reflected in Ethiopia, where quick population growth

may surpass spending on physical capital, infrastructure, and education, putting short-term growth prospects at stake. Studies based on endogenous growth theory, on the other hand (Romer, 1986; 1990; Kremer, 1993; Jones, 1995), emphasize how population expansion may benefit society in the long run through scale effects and technological advancement. The result also diverges from empirical studies (e.g., Furuoka, 2016; Alemu, 2020; Bawazir et al., 2020; Sebikabu et al., 2020) that find either a positive effect, suggesting that the growth-population nexus is highly context-dependent. In Ethiopia's case, the short-run adverse effect of population growth is likely amplified by a high dependency ratio, limited formal employment opportunities, exacerbates land fragmentation and underdeveloped investment channels, factors that collectively hinder productivity growth and capital deepening.

The short-run asymmetric analysis reveals a statistically significant negative impact of trade openness on economic growth in Ethiopia ($\beta = -0.309$, $p = 0.02$). This finding contrasts with conventional growth theory and the empirical evidence of scholars such as (Aljadani et al., 2025; Islam et al., 2022; Jalil & Rauf, 2021; Alexiou et al., 2018; Keho, 2017; Sakyi et al., 2015), who argue that trade openness enhances productivity, allocative efficiency, and technological diffusion through globalization-induced gains and financial sector deepening. Theoretically, increased openness is expected to facilitate knowledge spillovers, managerial know-how, and competitive pressures that promote innovation (Winter, 2004; Chen et al., 2020). However, this study finding supports the works of (Hausmann et al., 2007; Kim, 2011; Ulaşan, 2015; Hye & Lau, 2015; Sakyi et al., 2015; Omoke & Opuala-Charles, 2021; Mengesha & Berde, 2023; Musila & Yiheyis, 2025). Specifically, the negative coefficient aligns with studies documenting trade's growth-suppressing effects in contexts characterized by undiversified export structures (Hausmann et al., 2007), institutional fragility (Nam et al., 2023), lacking competition (Pal et al., 2025) and limited industrial capacity (López, 2007). Ethiopia's reliance on primary export products with price and income inelasticity exposes the economy to terms-of-trade shocks, consistent with Musila & Yiheyis' (2025) observation that trade-induced openness exacerbates macroeconomic instability in low-income countries. For instance, Omoke & Opuala-Charles (2021) differentiate between the growth-enhancing effects of export trade and the contractionary effects of import dependence in Nigeria. Furthermore, tariff reductions under liberalization policies often disadvantage domestic firms, enabling multinational corporations to dominate local markets and increase income inequality (Pal et al., 2025; Newfarmer & Sztajerowska, 2012). These dynamics are especially pronounced in low-income countries lacking competitive advantage and robust regulatory capacity. Sakyi et

al. (2015) and Kim et al., (2011), further caution that while trade has significantly benefited rich economies, its advantages for low-income countries are contingent on institutional quality, policy coherence and investment effectiveness. Supporting this, Sakyi et al. (2015) found no significant link between trade openness and income growth in 30 low-income countries (including Ethiopia), reinforcing the view that trade-induced growth is not automatic but conditioned on local absorptive capacity. Ethiopia's weak regulatory frameworks, limited human capital, and underdeveloped financial systems impede its capacity to absorb foreign knowledge spillovers or channel import competition into productivity gains. As well, trade-driven deindustrialization risks, evident in job losses and wage suppression (Lechthaler & Mileva, 2024; López, 2017), are amplified in economies lacking diversified manufacturing bases.

4.5. Toda-Yamamoto causality test

Following the confirmation of a cointegration relationship and the absence of serial correlation among the variables, the Toda and Yamamoto (1995) Granger non-causality test was employed. Results revealed in Table 32 shows that FI significantly Granger-causes economic growth ($\chi^2=7.72$, $p = 0.052$), and economic growth reciprocally Granger-causes FI ($\chi^2=31.15$, $p = 0.000$). Confirming **hypothesis 2**, this finding empirically validates both the "supply-leading" hypothesis, which posits that FI leads to economic growth, and the "demand-following" hypothesis, which suggests that economic expansion stimulates FI. This result aligns with several prior studies that documented bidirectional causality between finance and growth (Adeyeye et al., 2015; Kyophilavong et al., 2016; Sethi & Acharya, 2018; Azimi, 2022; Ugwuanyi et al., 2022; Jima & Makoni, 2023; Hussain et al., 2024; Mlambo, 2024). However, it diverges from studies such as Al Khatib (2023) and Odame et al. (2024), who found a unidirectional causality from finance to growth, and from Ghosh (2011) and Mengesha & Berde (2023), who observed causality only from growth to finance. Additionally, studies such as Bara et al. (2016) and Opoku et al. (2019) reported no causality between the two. The feedback analysis reflect the impact of recent financial sector reforms aimed at enhancing efficiency, access, and the overall allocation of financial resources. These reforms likely contributed to improved financial intermediation, thereby supporting economic performance. Simultaneously, rising per capita income levels appear to stimulate demand for financial services, further expanding FI. In general, the financial sector not only facilitates resource allocation but also benefits from economic advancement.

Table 33: Toda and Yamamoto causality test

Dependent Variable	Independent Variable	X^2	P-Value	Direction
Lpercap	IFI	7.72*	0.052	IFI→lpercap
IFI	Lpercap	31.15***	0.000	lpercap→IFI

Source: Computed based on student version Eview, Notes: *, *** imply rejection of the null hypothesis at the 10% and 1% significance level, respectively.

4.5. Model diagnosis

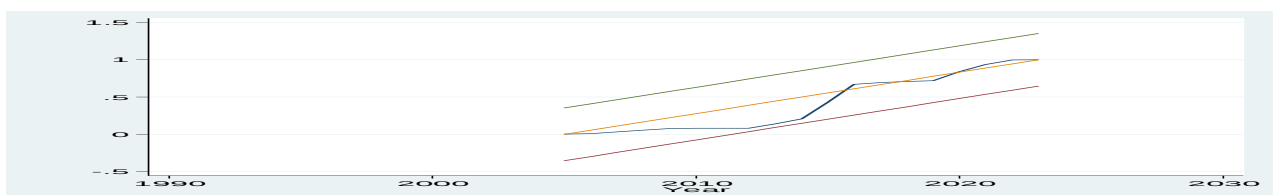
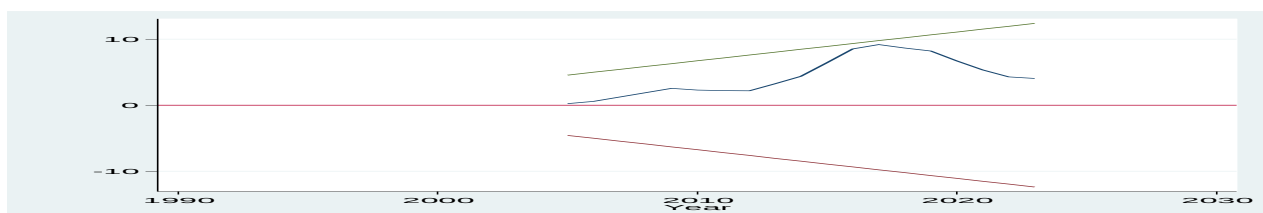
The diagnostic tests for the Nonlinear ARDL model, summarized in Table 33, confirm the robustness and reliability of the estimated parameters. The absence of **serial correlation** (Portmanteau test, $p = 0.137$), **heteroskedasticity** (Breusch-Pagan test, $p = 0.960$), and **non-normality** (Jarque-Bera test, $p = 0.992$) in the residuals validates the model's statistical integrity. Furthermore, the Ramsey RESET test ($p = 0.317$) rules out omitted variable bias or functional misspecification.

Table 34: Non-linear ARDL model test diagnosis

Test type	Statistics	P-Value
Serial correlation	$X^2 = 17.35$	0.1369
Heteroskedasticity	$X^2 = 0.0026$	0.9595
Normality	$X^2 = 0.0158$	0.9921
Functional form	$F\text{-stat} = 1.321$	0.3169

Source: Computed based on Stata 14

The stability of both short- and long-run parameters is corroborated by the CUSUM and CUSUM of squares (CUSUMSQ) tests (Figures 6 and 7), where the cumulative sum statistics remain within the 5% critical bounds. This indicates no significant parameter instability over the sample period, aligning with Hansen's (1992) emphasis on mitigating model misspecification risks.

**Figure 5: CUSUM SQUARE of stability test****Figure 6: CUSUM test of stability**

Pal et al. (2025) claims that graphical representations improve understanding of estimations by creating dynamic charts that reveal the short and long-term effects of shocks in explanatory variables on the response variable. Figure 8 presents a graph generated by employing the ‘plot’ option within a Stata command, along with a confidence interval produced through bootstrap (100) and level options, capturing the asymmetric effects of positive and negative FI shocks on per capita income over 33 years. The upper solid green line traces the impact of positive FI shocks (FI^+), while the lower dashed red line represents negative shocks (FI^-). The central dotted blue line illustrates the increasing trend of asymmetry band, with upper and lower 95% confidence bounds indicating statistical significance. This dynamic supports the long-run asymmetry reported in the model’s statistics ($F = 4.857$, $p < 0.05$), as well as a short-run asymmetry ($F = 8.427$, $p < 0.05$), highlighting the nonlinear nature of the FI–growth nexus.

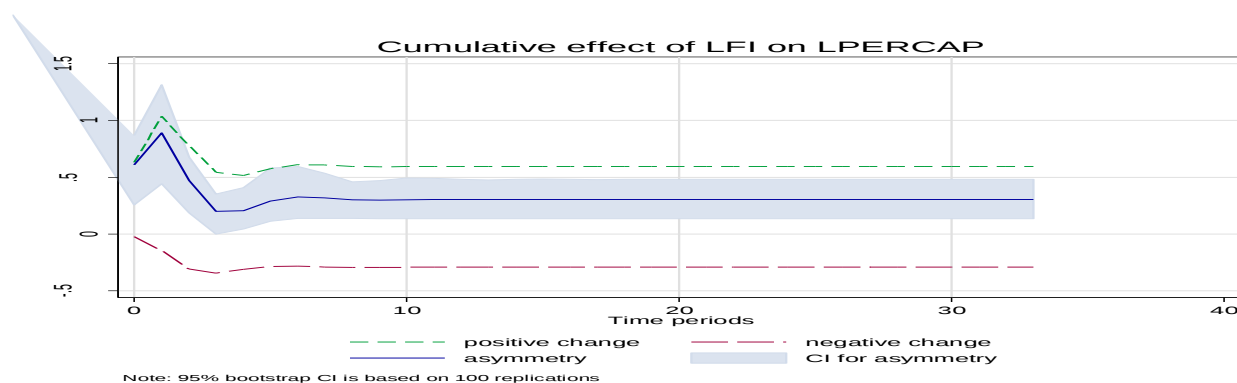


Figure 7: The cumulative dynamic multipliers

5. Conclusion

This study provides robust empirical evidence on the asymmetric relationship between FI and economic growth in Ethiopia using annual data spanning from 1991 to 2023. By constructing a composite FI index through a two-stage PCA and applying a NARDL model, the analysis captures both the long-run and short-run asymmetries inherent in the FI-growth nexus. The findings are further reinforced by the Toda-Yamamoto (1995) non-causality approach, which uncovers bidirectional causality, substantiating both the demand-following and supply-leading hypotheses.

The results clearly demonstrate the presence of long-run and short-run asymmetries like positive shocks to FI significantly promote economic growth in both short and long term, whereas negative shocks produce a statistically significant contractionary effect in the long run only. These findings signal that the positive effects of FI are not similar with its negative shocks, thereby validating the asymmetric structure of the model. The evidence also shows that macro-financial variables such as the real exchange rate positively contribute to economic

growth, while trade openness, excessive money supply, and population growth exert adverse effects. The strength and significance of asymmetry statistics highlight that positive changes tend to have more lasting and growth-promoting effects compared to the mitigating effects of negative shocks. This supports the concerns expressed by Nandelenga and Oduor (2020) regarding the potential for traditional symmetric models to overlook critical dynamics relevant to policy. In situations characterized by economic uncertainty and financial instability, these asymmetries have significant consequences.

Hence, from a policy standpoint, the study recommends a forward-looking approach to FI. Specifically, the government must foster enabling conditions that amplify positive FI shocks while mitigating the adverse effects of negative shocks, such as digital exclusion, branch closures, or liquidity constraints. Strengthening rural access, promoting low-cost digital banking solutions, and reinforcing the resilience of financial institutions are critical in this regard. The findings suggest that the second National FI Strategy (NFIS) has played a constructive role in enhancing the positive impact of FI on growth, though sustained and targeted implementation is necessary to preserve and expand its benefits. Moreover, the evidence calls for a measured and quality-focused expansion of finance. Uncontrolled financial deepening without productive absorption capacity may undermine long-term benefits. Adu et al., (2013) suggested that expansionary monetary policy that increases money supply without corresponding productivity gains could prove counterproductive. Hence, policy coordination must therefore ensure that fiscal and monetary measures are anchored to real-sector outcomes. The observed negative impact of trade openness and population growth also deserves policy attention. The government should reduce macroeconomic uncertainty, particularly inflation volatility, and shield consumers from imported inflation. Simultaneously, Ethiopia's large youth population presents a demographic dividend that can be harnessed through targeted employment generation in productive sectors.

A key limitation of this study lies in the unavailability of disaggregated digital finance data prior to 2013, which constrained the temporal scope of digital inclusion indicators. Future research could extend the present work by applying threshold models to detect nonlinear breakpoints and identifying the critical levels of FI at which economic growth effects begin to materialize.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

1. Introduction

In recent years, FI has become a key component of sustainable economic growth, financial stability, financial performance, gender equality, poverty eradication, financial literacy, entrepreneurship, financial services innovation, and social transformation on a global scale (Mishra et al., 2024; Vo, 2025). Given Ethiopia's fast financial sector progression, it is not only relevant but also crucial for policy and practice to comprehend the multidimensional nature of FI and its wider economic implications.

This article/paper based dissertation, which was organized around four separate but related research articles, conducted a thorough empirical analysis into FI in Ethiopia. Each article focused on a different but related aspect of FI: (first) created a comprehensive index of FI; (second) studied the impact of FI on banking profitability; (third) analyzed the impact of FI on the stability of the banking sector; and (fourth) examined the asymmetric effects of FI on Ethiopia's short and long-term economic growth. The collective empirical framework that this study offers, rooted in the Ethiopian setting, both supports and contradicts widely held theoretical beliefs regarding the advantages and constraints of FI. This last chapter summarizes the study's key findings from each article, reflects on their contributions to the literature, draws broader lessons from their interaction, suggests policy implications, and discusses limitations and future research.

2. Major findings and policy implications

2.1. Summary of findings

Chapter two presented the measurement of a multidimensional FI index using two-stage PCA, integrating integrated ten traditional indicators (six for availability and four for usage) and five digital indicators (two for digital availability and three for accessibility). The results demonstrated that Ethiopia's FI score increased significantly from 10.9% in 2015 to 52.2% in 2023. However, the index also showed differences between digital and traditional dimensions. Score of digital dimensions increased quicker over time, despite starting from a low base, while the traditional availability and usage dimensions contributed more to the index. Additionally, the study showed that the Commercial Bank of Ethiopia alone accounts for 48.99% of the FI score, but the combined contributions of five medium-sized and eleven small-sized private banks were 29.26% and 21.75%, respectively.

Chapter three explores the impact of traditional and digital FI on banking financial performance, employing a non-linear two-step system GMM for 17 banks over 2015–2023. The result showed a positive and statistically significant relationship between traditional FI and bank performance. Interestingly, the study found that digital inclusion had a negative short-term association with performance until certain threshold (0.87). This likely reflects the high initial costs associated with digital transformation, existence of digital illiteracy and the behavioral inertia among users unfamiliar with or distrustful of non-branch banking. The differentiated impact of traditional and digital FI on bank profitability, as revealed in Chapter three, suggests that financial institutions should strategically optimize their service delivery models. Furthermore, Juodis et al. (2021) causality test indicated a bidirectional relationship between traditional FI-performance nexus and Dumitrescu & Hurlin (2012) causality test emphasizes that bank profitability drives the expansion into digital channels, reinforcing the unidirectional view running from performance to digital FI.

The fourth chapter shifted the focus from the impact of FI on profitability to financial stability, exploring how increasing FI influences bank risk, measured using the Z-score. In addition to using linear two-step system GMM, this study employed a quadratic equation and Lind and Mehlum's (2010) U-test to find out the nonlinearity between inclusion-stability nexus. The study discovered a nonlinear (inverted U-shaped) relationship up to a certain threshold (30.3%), FI enhances banking sector stability through deposit diversification, enhanced liquidity, and broader credit portfolios. The FI and bank stability nexus further moderated by banking regulation, which in turn raises the threshold to 35.1%. Beyond this threshold, however, risks begin to emerge particularly operational and credit risk associated with rapidly onboarding low-income. It highlights the necessity of balancing the expansion of FI with robust measures to mitigate potential risks such as increased transaction costs, information asymmetries, and adverse selection, particularly as FI levels surpass the identified threshold. The moderating role of capital adequacy further suggests implications for macro-prudential regulation, indicating the need for targeted capital requirements for banks as FI progresses. Further causality analysis (both Dumitrescu-Hurlin (2012) and Juodis et al. (2021) tests) reveals a feedback effect. This indicates that FI expansion can improve bank stability, and a stable financial environment fosters FI.

The fifth chapter analyzed the macroeconomic implications of FI, focusing on its asymmetric effects on economic growth considering the period from 1991-2023. Employing the NARDL

approach, the paper found that positive shocks to FI increases GDP per capita, with estimated long-run elasticities in the range of 0.6. Conversely, negative shocks to inclusion lead to significant but smaller contractions in economic growth. The finding that positive FI shocks have a more significant and lasting impact on economic growth compared to the effects of negative shocks underscores the need for policies that promote the continuous broadening of financial access and usage. The study further validated these findings using Toda-Yamamoto (1995) nonlinear Granger causality tests, which revealed bi-directional causality between FI and growth. This implies that the processes of FI and economic expansion are mutually supportive.

2.2. Policy implication

As demonstrated in this dissertation, FI by itself is neither a panacea nor a risk of instability. Instead, it is a strong policy tool but its results rely on how it is applied, measured, and incorporated into larger macroeconomic plans. The road to inclusive finance in Ethiopia is one of promise and concern, where access must be balanced with stability and outreach innovations must be matched by prudent execution. Hence, based on the study empirical results, the researcher provided the following recommendations:

- ❖ Economic growth, profitability, and stability are positively correlated with FI, indicating the significance of integrating inclusive finance into Ethiopia's long-term development plan. National frameworks like the HGERA, the Ten-Year Development Plan (2021–2030), and financial sector roadmaps should incorporate FI targets emphasizing urban-rural gap.
- ❖ Policies should aim to foster a virtuous cycle of financial deepening and economic expansion.
- ❖ Although FI improves stability, over expansion without proper oversight causes instability. Therefore, in line with its FI strategy, the National Bank of Ethiopia should enhance a tailored prudential regulation, especially through inspection of new entrants.
- ❖ This thesis's composite FI indicator provides a useful monitoring tool. This indicator should be institutionalized by regulators, banks, and development partners in order to monitor improvements, assess the effectiveness of inclusion programs, and direct data-driven resource distribution. In order to further improve FI, the following specific recommendations are made for government and commercial banks:

A. Government-specific recommendations

- Expand telecommunication services to rural areas to strengthen the infrastructure necessary for banking services.
- Support the ecosystem for digital tools and promote the digitalization of government payments to facilitate broader FI.
- Address regulatory barriers that exclude individuals due to personal or religious reasons. Consider recent initiatives like interest-free banking licenses but delve deeper into challenges like limited investment opportunities for such banks and the lack of Islamic financial standards.
- Foster a conducive environment for innovative players, including FinTech and big data, to introduce financial instruments tailored to local needs.
- Implement targeted financial literacy initiatives to improve financial service usage by individuals and SMEs. These programs should also emphasize trust-building, consumer protection against risks and fraud, and data privacy.
- Consider offering tax breaks or other incentives to commercial banks that actively expand their services to underserved areas or specific demographics (e.g., women entrepreneurs).
- Regular monitoring and evaluation of FI metrics are essential to track progress, identify gaps, and adopt dynamic policy adjustments effectively.
- Targeted capital requirements should be implemented as FI expands.

B. Commercial bank-specific recommendations

- Expand presence in remote areas through cost-effective approaches such as agency banking and tailored digital solutions to increase accessibility.
- Banks should strategically integrate cost-effective digital tools with traditional services to optimize profitability. For instance;
 - ✓ Employ mobile money (including agent banking model) platforms for rural saving purpose
 - ✓ Use digital credits to SMEs, diversifying loan risks to mitigate concentration risks.
- Collaborate with educational institutions to enhance financial literacy programs targeted at underserved communities.

- Invest in training and capacity building for agents involved in agency banking models. This will ensure efficient service delivery and positive customer experiences in rural areas.
- Establish clear FI performance metrics to track progress and identify areas requiring improvement. This can involve setting targets for loan disbursement to SMEs and individuals in underserved areas.

3. Contribution to knowledge

This dissertation makes contributions in two related areas. These are academic discourse and policy development. From the standpoint of academic discourse, this research challenges the existing literature on FI and its implications. Notably, there is a lack of studies focused on creating a comprehensive FI index that merges both digital and traditional financial metrics in Ethiopia. In Chapter Two, this study critiques isolated methodologies and highlights the synergistic roles of digital and traditional banking in emerging markets, referencing the limited existing works in this field (e.g., Ugwuanyi et al., 2022; Rapih & Wahyono, 2023; Pal et al., 2025). This thesis introduces a pioneering, multidimensional FI index for Ethiopia, which incorporates ten traditional indicators and five digital metrics employing a two-stage PCA. This index addresses a significant gap in the literature concerning the development of FI indices in Ethiopia. By merging traditional and digital dimensions, recognized as both complementary and distinct drivers (Mao et al., 2023; Ismael & Ali, 2021), this index offers a comprehensive assessment of Ethiopia's financial landscape, where traditional banking operates alongside emerging digital solutions. The analysis of the relationship between FI and bank profitability in Chapter three reveals that traditional FI positively influences profitability, whereas digital FI negatively impacts it due to high initial costs and limited rural adoption. This finding highlights the necessity for a phased and targeted integration of digital tools within established traditional frameworks.

Most research generally affirms a linear correlation (Nandelenga & Oduor, 2020). This particular study reveals the asymmetric and nonlinear dynamics that exist in Ethiopia, a nation marked by structural disparities, a state-dominated banking sector, and a nascent digital infrastructure. Importantly, the results presented in Chapter four demonstrate that FI increases bank stability only up to a threshold of 30.3%; beyond this limit leads to risks that outweigh the advantages, thus contributing the ongoing discourse regarding the concept of 'too much finance' (Beck et al., 2014). Furthermore, employing the NARDL model in Chapter five, this

dissertation uncovers an asymmetric relationship between FI and economic growth. Positive shocks in FI promote long-term growth, whereas negative shocks detrimentally affect it, with short-term impacts resembling a 'domino effect' where gains in FI generate more benefit than lost. The Toda-Yamamoto causality test further validates the presence of bidirectional causality, harmonizing the supply-leading (from FI to growth) and demand-following (from growth to FI) theories. This highlights the necessity for policies that align FI with investments in the productive sector and reinforces the findings regarding the asymmetric influence of FI on growth.

From an evidence-based policymaking standpoint, this study provides context-specific insights. Ethiopia's financial landscape exemplifies the balance between systemic risks and targets for inclusiveness, with 99.8% of loans concentrated in urban areas and state banks holding a dominant position (NBE-FSR, 2024). In order to address these issues, the study provides policymakers with practical insights. For example, the inverted U-shaped relationship between inclusion and stability calls for threshold-based regulation, such as the implementation of dynamic capital buffers for banks with more than 30% exposure to FI. Additionally, the evidence that suggests digital FI may jeopardize short-term profitability (due to high initial costs and low rural adoption) calls for a phased approach to integration, such as expanding credit networks for SMEs and using mobile platforms for rural savings. By highlighting the disparities in FI access between urban and rural areas, the study advocates for targeted initiatives and financial literacy programs to avert cycles of exclusion. Fostering an inclusive financial system can serve as a means to achieve inclusive economic growth, thereby contributing to the Sustainable Development Goal 10 (SDG10) of reducing inequality both within and among nations (Kebede, 2022). These findings are consistent with Ethiopia's National FI Strategy (2015–2025) and the Sustainable Development Goals, providing a framework to align FI with broader developmental objectives such as poverty alleviation and the growth of SMEs.

Beyond academia and policy, the research underscores the importance of FI as a driver of inclusive growth, linking its expansion to reductions in unemployment and poverty alleviation. It highlights financial access as a fundamental element in Ethiopia's pursuit of Sustainable Development Goals (SDGs) 1 (No Poverty) and 8 (Decent Work). However, it also presents a significant warning, as the situation in Eastern Indonesia shows, FI may inadvertently worsen inequality if there is no simultaneous investments in financial literacy and consumer protection, as evidenced by the situation in Eastern Indonesia (Erlando et al., 2020). For the 48% of

Ethiopia's population that remains excluded, the findings advocate for policies that integrate access with education, ensuring that FI serves to empower rather than marginalize individuals. Ultimately, while the study is grounded in the Ethiopian context, its implications extend to the Global South. By illustrating how macroeconomic factors influence the effects of FI, the research advises against the uncritical adoption of “best practices” without contextual adaptation.

4. Limitations and future research direction

The following limitations are acknowledged in this study. First, regional differences within Ethiopia are not taken into consideration in this study. In order to provide deeper insights and facilitate the development of tailored interventions at the regional level, future research should give priority to more thorough analysis that takes into account regional policy views. Second, although a two-stage PCA approach is used in the study, other approaches like confirmatory factor analysis and entropy weighting could be used to further validate the index. Third, examining other financial institutions' contribution in relation to FI is valuable, despite the fact that commercial banks dominate Ethiopia's financial environment. The role of development banks, microfinance organizations, fintechs and artificial intelligence with regard to FI should be the subject of future studies. Specifically, considering the growing importance of digital FI in emerging nations, further research is necessary. Lastly, prior to 2013, NBE's disaggregated digital finance data was unavailable, which limited the temporal scope of digital inclusion metrics. NBE should improve its data management strategy because raw data is the primary source of information. If not, by gathering the data required from every bank, future studies could build on the work in Chapter 5 by using threshold models to find multiple nonlinear breakpoints and pinpoint the crucial FI levels at which the consequences of economic growth start to manifest. The ideal FI threshold may change as financial systems develop and regulatory frameworks change, requiring constant research to adjust FI policies appropriately. In addition, further studies could explore the impact of specific policy interventions aimed at promoting FI in Ethiopia, such as the liberalization of the financial sector. Lastly, investigating the role of informal financial systems and their interaction with formal FI efforts in Ethiopia would also be valuable.

References

- Ali, P. J. M. (2022). Investigating the Impact of Min-Max Data Normalization on the Regression Performance of K-Nearest Neighbor with Different Similarity Measurements. *ARO-The Scientific Journal of Koya University*, 10(1), 85–91. <https://doi.org/10.14500/aro.10955>
- Allen, F., & Santomero, A. M. (1997). The theory of financial intermediation. *Journal of banking & finance*, 21(11-12), 1461-1485. [https://doi.org/10.1016/S0378-4266\(97\)00032-0](https://doi.org/10.1016/S0378-4266(97)00032-0)
- Almeshari, A., Bin Dato Haji Yahya, M. H., Bin Kamarudin, F., & Abd Hamid, S. A. (2023). Liquidity creation and economic growth: are they monotonically related? Evidence from MENA countries. *Economies*, 11(1), 24. <https://doi.org/10.3390/economies11010024>
- Ayele, A. B., Malhotra, K., & Sharma, M. (2025). Financial Inclusion and Bank Performance: Evidence from the Banking Sector in Ethiopia. *Journal of Corporate Finance Research*, 19(1), 54-69. <https://doi.org/10.17323/j.jcfr.2073-0438.19.1.2025.54-69>
- Babilla, T. U. K. (2023). Digital innovation and financial access for small and medium-sized enterprises in a currency union. *Economic Modelling*, 120, 106182. <https://doi.org/10.1016/j.econmod.2022.106182>
- Bakó, B., & Neszveda, G. (2024). An aspirational perspective on the negative risk-return relationship. *Finance Research Letters*, 61, 104977. <https://doi.org/10.1016/j.frl.2024.104977>
- Bashiru, S., Bunyaminu, A., Yakubu, I. N., Al-Faryan, M. A. S., Carthy, J. M., & Nyamekye, K. A. (2023). Quantifying the Link between Financial Development and Bank Profitability. *Theoretical Economics Letters*, 13, 284-296. <https://doi.org/10.4236/tel.2023.132018>
- Bhatter, H. K., Gupta, J., & Chhatoi, B. P. (2025). Unveiling the curvilinear dynamics: financial inclusion and bank performance in India. *Managerial Finance*, 51(11), 1742–1757. <https://doi.org/10.1108/mf-12-2024-0925>
- Bhootha, A., & Hur, J. (2015). High idiosyncratic volatility and low returns: A prospect theory explanation. *Financial Management*, 44(2), 295-322. <https://doi.org/10.1111/fima.12057>
- Cardamone, P., & Trivieri, F. (2024). Out of sight, out of mind! Bank branch closures and new firm creation in Italy. *Regional Studies, Regional Science*, 11(1), 122–152. <https://doi.org/10.1080/21681376.2024.2315187>
- Djani-Feuzeu, H.D., & Nguena, L.C. (2025). Does financial inclusion fuel bank profitability in Africa? Empirical evidence on panel data. *Finance Research Open*, 1(4). <https://doi.org/10.1016/j.finr.2025.100062>
- Fomum, A.T., & Opperman, P. (2023). Financial inclusion and performance of MSMEs in Eswatini. *International Journal of Social Economics*, 50(11), 1551-1567. <https://doi.org/10.1108/IJSE-10-2020-0689>
- Guo, R., & Ma, B. (2025). Does digital inclusive finance enhance the profitability of commercial banks? — Evidence from China. *Applied Economics Letters*, 1–7. <https://doi.org/10.1080/13504851.2025.2510576>
- Harvey, C. R. (2001). The specification of conditional expectations. *Journal of Empirical Finance*, 8(5), 573-637. [https://doi.org/10.1016/S0927-5398\(01\)00036-6](https://doi.org/10.1016/S0927-5398(01)00036-6)
- Hassan, M. I. U., Wu, M., Lu, J., Sohu, J. M., Ali, S., Anjum, H. N., & Bilal, M. (2025). Financial technology and banking performance in developing countries: evidence from an advanced quantile regression approach. *Humanities and Social Sciences Communications*, 12(1). <https://doi.org/10.1057/s41599-025-05571-8>
- Hong, H., Bao, S., & Kang, X. (2025). Inverted U-shaped impact of financialization on private enterprise business performance: Capital structure threshold effect. *International Review of Economics & Finance*, 104418. <https://doi.org/10.1016/j.iref.2025.104418>
- Jin, L., Dai, J., Jiang, W., & Cao, K. (2023). Digital finance and misallocation of resources among firms: Evidence from China. *The North American Journal of Economics and Finance*, 66, 101911. <https://doi.org/10.1016/j.najef.2023.101911>
- Keil, J., & Ongena, S. (2023). The demise of branch banking – Technology, consolidation, bank fragility. *Journal of Banking & Finance*, 158, 107038. <https://doi.org/10.1016/j.jbankfin.2023.107038>
- Kim, Y., Kim, M. K., Fu, N., Liu, J., Wang, J., & Srebric, J. (2024). Investigating the impact of data normalization methods on predicting electricity consumption in a building using different artificial neural network models. *Sustainable Cities and Society*, 118, 105570. <https://doi.org/10.1016/j.scs.2024.105570>

- Law, S. H., Lee, W. C., & Singh, N. (2018). Revisiting the finance-innovation nexus: Evidence from a non-linear approach. *Journal of Innovation & Knowledge*, 3(3), 143-153. <https://doi.org/10.1016/j.jik.2017.02.001>
- Lind, J. T., & Mehlum, H. (2010). With or without U? The appropriate test for a U-shaped relationship. *Oxford bulletin of economics and statistics*, 72(1), 109-118. <https://doi.org/10.1111/j.1468-0084.2009.00569.x>
- Liu, Z., Li, X., & Li, Z. (2024). Inclusive FinTech, open banking, and bank performance: evidence from China. *Financial Innovation*, 10(1), 149. <https://doi.org/10.1186/s40854-024-00679-3>
- Madegowda, J. (2025). The Enduring Role of Branch Banking in the Digital Era: A Perception Study. *Prajan: Journal of Banking and Financial Management*, 54(1), 22-38. <https://doi.org/10.1177/09708448251370431>
- Mao, F., Wang, Y., & Zhu, M. (2023). Digital financial inclusion, traditional finance system and household entrepreneurship. *Pacific-Basin Finance Journal*, 80, 102076. <https://doi.org/10.1016/j.pacfin.2023.102076>
- Mester, L. J. (1992). Traditional and nontraditional banking: an information-theoretic approach. *Journal of Banking & Finance*, 16(3), 545-566. [https://doi.org/10.1016/0378-4266\(92\)90044-Z](https://doi.org/10.1016/0378-4266(92)90044-Z)
- Nguyen, A.H.T., Pham, V.Q. & Phan, H.T. (2025). Applying Bayesian methods to measure the impact of financial inclusion on banking performance: An empirical analysis for selected countries in Asia. *J Econ Finan*, 49, 493–510. <https://doi.org/10.1007/s12197-025-09713-1>
- Omarova, S. T. (2020). Technology v Technocracy: Fintech as a Regulatory Challenge. *Journal of Financial Regulation*, 6(1), 75–124. <https://doi.org/10.1093/jfr/fjaa004>
- Perdana, A., Deppeler, A., Bharathi S, V., Karim, R., & Wijesooriya, C. (2025). Digital financial inclusion: Profitable models from Africa, Asia, and the Pacific. *Journal of Information Technology Teaching Cases*. 0(0),1-16. <https://doi.org/10.1177/20438869251395749>
- Putra, F. H., Suhardjanto, D., Trinugroho, I., & Arifin, T. (2024). Overcoming barriers to inclusion: The role of financial literacy and digital divide in expanding financial access in Indonesia. *Journal of Ecohumanism*, 3(8). <https://doi.org/10.62754/joe.v3i8.5608>
- Setianto, R. H., Azman-Saini, W. N. W., Law, S. H., Ahmad, A. H., & Daud, S. N. M. (2025). Does financial inclusion affect bank market power? International evidence. *Finance Research Letters*, 108302. <https://doi.org/10.1016/j.frl.2025.108302>
- Sha'ban, M., Girardone, C., Sarkisyan, A., & Arun, T. (2023). On the relationship between financial inclusion and bank performance. *Economic Notes*, 52(3), e12225. <https://doi.org/10.1111/ecno.12225>
- Shaddady, A. (2023). Unveiling the dynamics of financial institutions and markets in shaping economic prosperity in MENA. *International Journal of Financial Studies*, 11(4), 148. <https://doi.org/10.3390/ijfs11040148>
- Song, X., Yu, H., & He, Z. (2023). Heterogeneous Impact of Fintech on the Profitability of Commercial Banks: Competition and Spillover Effects. *Journal of Risk and Financial Management*, 16(11), 471. <https://doi.org/10.3390/jrfm16110471>
- Swift, D., Cresswell, K., Johnson, R., Stilianoudakis, S., & Wei, X. (2022). A review of normalization and differential abundance methods for microbiome counts data. *Wiley Interdisciplinary Reviews Computational Statistics*, 15(1). <https://doi.org/10.1002/wics.1586>
- Tong, X., & Yang, W. (2025). Empirical analysis of the impact of financial technology on the profitability of listed banks. *International Review of Economics & Finance*, 98, 103788. <https://doi.org/10.1016/j.iref.2024.103788>
- Trotta, A., Gallucci, C., Rania, F., Strano, E., & Tipaldi, R. (2025). The “black box” of digital finance: An umbrella review of the challenges and drawbacks in advancing financial inclusion. *Research in International Business and Finance*, 81, 103188. <https://doi.org/10.1016/j.ribaf.2025.103188>
- Wang, H., Yan, J., & Yu, J. (2017). Reference-dependent preferences and the risk–return trade-off. *Journal of Financial Economics*, 123(2), 395-414. <https://doi.org/10.1016/j.jfineco.2016.09.010>
- Wang, W., Xiong, D., & Li, Y. (2025). The Impact of FinTech on Financial Institution Performance and Risk: An Empirical Analysis from China. *SAGE Open*, 15(2). <https://doi.org/10.1177/21582440251344376>
- Wang, Y., Jiang, A., Zhang, S., & Chen, W. (2024). Traditional finance, digital finance, and financial efficiency: An empirical analysis based on 19 urban agglomerations in China. *International Review of Financial Analysis*, 96, 103603. <https://doi.org/10.1016/j.irfa.2024.103603>
- Wu, S., & Ma, X. (2025). Research on the Regional Impact of Digital Inclusive Finance Development on the Profitability of Commercial Banks. In 2025 3rd International Academic Conference on Management

- Innovation and Economic Development, 820-831. Atlantis Press. https://doi.org/10.2991/978-94-6463-835-6_86
- Xie, M., & Deng, H. (2025). FinTech and Traditional Banking Performance in China. Sage Open, 15(4). <https://doi.org/10.1177/21582440251387934>
- Yin, Q., Su, N., & Ding, C. (2024). The Nonlinear Effects of Digital Finance on Corporate ESG Performance: Evidence from China. Sustainability, 16(18), 8274. <https://doi.org/10.3390/su16188274>
- Yu, N., & Wang, Y. (2021). Can digital inclusive finance narrow the Chinese urban–rural income gap? The perspective of the regional urban–rural income structure. Sustainability, 13(11), 6427. <https://doi.org/10.3390/su13116427>
- Yuan, X., Puah, C.-H., & Marikan, D. A. b. A. (2025). Financial Technology and Chinese Commercial Banks' Overall Profitability: A “U-Shaped” Relationship. FinTech, 4(3), 41. <https://doi.org/10.3390/fintech4030041>
- Yuan, X., Puah, C.-H., & Marikan, D. A. b. A. (2025a). An Empirical Study on the Impact of Financial Technology on the Profitability of China's Listed Commercial Banks. Journal of Risk and Financial Management, 18(8), 440. <https://doi.org/10.3390/jrfm18080440>
- Zhao J, Wang C, Ibrahim H, Chen Y (2024). The impact of digital financial inclusion on bank performance: An exploration of mechanisms of action and heterogeneity. PLoS ONE 19(8): e0309099. <https://doi.org/10.1371/journal.pone.0309099>
- Zhu, K., & Guo, L. (2024). Financial technology, inclusive finance and bank performance. Finance Research Letters, 60, 104872. <https://doi.org/10.1016/j.frl.2023.104872>
- Weis, T., (2020). 'Ethiopia: Raising a Vegetarian Tiger?', in Emily Jones (ed.), The Political Economy of Bank Regulation in Developing Countries: Risk and Reputation. Oxford Academic. <https://doi.org/10.1093/oso/9780198841999.003.001>
- Bank, M., & Eder, B. (2021). A Review on the Probability of Default for IFRS 9. Available at SSRN 3981339. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3981339
- Kyiu, A., & Tawiah, V. (2025, January). IFRS 9 implementation and bank risk. In Accounting Forum (Vol. 49, No. 1, pp. 234-258). Routledge. <https://doi.org/10.1080/01559982.2023.2233861>
- Cohen, B. H., & Scatigna, M. (2016). Banks and capital requirements: Channels of adjustment. Journal of Banking & Finance, 69, S56–S69. <https://doi.org/10.1016/j.jbankfin.2015.09.022>
- Stern, V. (2024). Enhancing Probability of Default Prediction: Non-Linear Modeling in Turbulent Economic Times. Master's Thesis in Mathematical Sciences. <https://lup.lub.lu.se/student-papers/search/publication/9158985>
- IASB (2014). IFRS 9: Financial instruments. <https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards/english/2022/issued/part-a/ifrs-9-financial-instruments.pdf?bypass=on>
- Liang, H. (2020). Improving the predictive performance of longitudinal risk models for UK SMEs. (PhD Dissertation). <https://era.ed.ac.uk/handle/1842/37339>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Aydın Çolak, F., & Eroğlu, Ş. (2025). Evaluating metadata quality in institutional academic repositories of Turkish research universities. Online Information Review, 49(7), 1335-1350. <https://doi.org/10.1108/OIR-06-2024-0401>
- Cooper, B., Eva, N., Fazlelahi, F. Z., Newman, A., Lee, A., & Obschonka, M. (2020). Addressing common method variance and endogeneity in vocational behavior research: A review of the literature and suggestions for future research. Journal of vocational behavior, 121, 103472. <https://doi.org/10.1016/j.jvb.2020.103472>
- Federal Democratic Republic of Ethiopia (2014). Proclamation No. 847/2014: a Proclamation to Provide for Financial Reporting, Berhanena Selam, Addis Ababa.
- Federal Democratic Republic of Ethiopia (2014). Establishment and Determination of the Procedure of the Accounting and Auditing Board of Ethiopia Council of Ministers Regulation No. 332/2014, Berhanena Selam, Addis Ababa.
- Dale, A., Arber, S., & Procter, M. (1988). Doing secondary analysis. Taylor & Francis. <https://doi.org/10.4324/9781003632467>
- Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

- Boote, D. N., & Beile, P. (2005). Scholars before researchers: On the centrality of the dissertation literature review in research preparation. *Educational researcher*, 34(6), 3-15. <https://doi.org/10.3102/0013189X034006003>
- Ayalew A.A., (2022). The effect of IFRS on the financial ratios: Evidence from banking sector in the emerging economy. *Cogent Economics & Finance*, 10(1), 2113495. <https://doi.org/10.1080/23322039.2022.2113495>
- Tseganesh, T. (2019). Implementation progress of IFRS for SMEs by the SMEs in Wolaita Sodo, Southern Ethiopia: from the SMEs owner managers' perspective. *Journal of Modern Accounting and Auditing*, 15(9), 432-444. <https://doi.org/10.17265/1548-6583/2019.09.002>
- Erin, O., Olojede, P., & Ogundele, O. (2017). Value relevance of accounting data in the pre-and post-IFRS era: Evidence from Nigeria. *International Journal of Finance and Accounting*, 7(4), 1–12. <https://doi.org/10.5923/j.ijfa.20170604.01>
- Smith, A., & Bushman, R. (2001). Financial accounting information and corporate governance. *Journal of Accounting and Economics*, 32(1), 237–333. [https://doi.org/10.1016/S0165-4101\(01\)00027-1](https://doi.org/10.1016/S0165-4101(01)00027-1)
- Abuda, I. R., & Rudiawarni, F. A. (2015). The impact of IFRS adoption on financial statement quality for firms listed on the Indonesia stock exchange. *Global Journal of Business and Social Science Review*, 3(1), 255–262 <http://repository.ubaya.ac.id/id/eprint/25531>
- Emeni, F., Uwuigbe, O., Uwuigbe, U., & Erin, O. (2016). The value relevance of adopting IFRS: Evidence from the Nigerian banking sector. *Review of Economic Studies and Research*, 9(2), 49–66. <https://www.econbiz.de/Record/the-value-relevance-of-adopting-ifrs-evidence-from-the-nigerian-banking-sector-emeni-francis-kehinde/10011719946?sid=1384051934>
- Degu, C. K., Malhotra, K., & Aggarwal, M. (2024). Assessment of financial and social disclosure level of Ethiopian commercial banks. *Humanities and Social Sciences Communications*, 11(1), 1-11. <https://doi.org/10.1057/s41599-024-02804-0>
- Wagaw, Y. M., Mihret, D. G., & Obo, D. D. (2019). IFRS adoption and accounting regulation in Ethiopia. *Accounting Research Journal*, 32(4), 662-677. <https://doi.org/10.1108/ARJ-02-2017-0033>
- Getachew, S. (2021). Assessment of financial reporting qualities of Ethiopian commercial banks: a comparative study on private and public banks. *International Journal of Science, Technology and Society*, 9(2), 87-97. <https://doi.org/10.11648/j.ijsts.20211002.16>
- World Bank Group (2025). World Development Indicators. <http://datatopics.worldbank.org/world-development-indicators/> (Accessed 14 Nov 2025).
- Cabanelas, P., Cortez, R. M., Pérez-Moure, H., & Lampón, J. F. (2025). Sampling and sample size in B2B marketing: Current practices and recommendations. *Industrial Marketing Management*, 125, 71-86. <https://doi.org/10.1016/j.indmarman.2024.12.014>
- Wedel, M., & Kannan, P. K. (2016). Marketing analytics for data-rich environments. *Journal of marketing*, 80(6), 97-121. <https://doi.org/10.1509/jm.15.0413>
- Cortez, R. M., & Johnston, W. J. (2017). The future of B2B marketing theory: A historical and prospective analysis. *Industrial Marketing Management*, 66, 90-102. <https://doi.org/10.1016/j.indmarman.2017.07.017>
- Rigdon, E. E. (2023). How improper dichotomization and the misrepresentation of uncertainty undermine social science research. *Journal of Business Research*, 165, 114086. <https://doi.org/10.1016/j.jbusres.2023.114086>
- McShane, B. B., Bradlow, E. T., Lynch Jr, J. G., & Meyer, R. J. (2024). “Statistical significance” and statistical reporting: Moving beyond binary. *Journal of Marketing*, 88(3), 1-19. <https://doi.org/10.1177/00222429231216910>
- Nielsen, B.B., Eden, L., Verbeke, A. (2020). Research Methods in International Business: Challenges and Advances. In: Eden, L., Nielsen, B.B., Verbeke, A. (eds) *Research Methods in International Business*. JIBS Special Collections, Palgrave Macmillan, Cham, 3-41. https://doi.org/10.1007/978-3-030-22113-3_1
- Szabo, V., & Strang, V. R. (1997, December). Secondary analysis of qualitative data. *Advances in Nursing Science*, 20(2), 66–74. <https://doi.org/10.1097/00012272-199712000-00008>
- Hinds, P. S., Vogel, R. J., & Clarke-Steffen, L. (1997). The possibilities and pitfalls of doing a secondary analysis of a qualitative data set. *Qualitative Health Research*, 7(3), 408–424. <https://doi.org/10.1177/104973239700700306>

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation*, 1986(30), 73–84. <https://doi.org/10.1002/ev.1427>
- Dina Diatta, I., & Berchtold, A. (2023). Impact of missing information on day-to-day research based on secondary data. *International Journal of Social Research Methodology*, 26(6), 759–772. <https://doi.org/10.1080/13645579.2022.2103983>
- Laranjeiro, N., Soydemir, S. N., & Bernardino, J. (2015). A survey on data quality: Classifying poor data. In 2015 IEEE 21st pacific rim international symposium on dependable computing (prdc) (p. 179–188). <https://doi.org/10.1109/PRDC.2015.41>
- Thorne, S. (1994). Secondary analysis in qualitative research: Issues and implications. *Critical Issues in Qualitative Research Methods*, 1, 263–279.
- Heaton, J. (2008). Secondary analysis of qualitative data: An overview. *Historical Social Research*, 33, 33–45. <https://doi.org/10.12759/HSR.33.2008.3.33-45>
- Machen, R. C., Jones, M. T., Varghese, G. P., & Stark, E. L. (2021). Investigation of Data Irregularities in Doing Business 2018 and Doing Business 2020: Investigation Findings and Report to the Board of Executive Directors. <https://thedocs.worldbank.org/en/doc/84a922cc9273b7b120d49ad3b9e9d3f9-0090012021/original/DB-Investigation-Findings-and-Report-to-the-Board-of-Executive-Directors-September-15-2021.pdf>
- Wickham R. J. (2019). Secondary Analysis Research. *Journal of the advanced practitioner in oncology*, 10(4), 395–400. <https://doi.org/10.6004/jadpro.2019.10.4.7>
- Johnston, M. P. (2014). Secondary data analysis: A method of which the time has come. *Qualitative and quantitative methods in libraries*, 3(3), 619–626. <https://www.qqml-journal.net/index.php/qqml/article/view/169>
- Cowton, C.J. (1998). The Use of Secondary Data in Business Ethics Research. *Journal of Business Ethics* 17, 423–434. <https://doi.org/10.1023/A:1005730825103>
- Cheong, H. I., Lyons, A., Houghton, R., & Majumdar, A. (2023). Secondary qualitative research methodology using online data within the context of social sciences. *International Journal of Qualitative Methods*, 22. <https://doi.org/10.1177/16094069231180160>
- Aguinis, H., & Solarino, A. M. (2019). Transparency and replicability in qualitative research: The case of interviews with elite informants. *Strategic management journal*, 40(8), 1291–1315. <https://doi.org/10.1002/smj.3015>
- Sun, M., & Lipsitz, S. R. (2018). Comparative effectiveness research methodology using secondary data: A starting user's guide. In *Urologic Oncology: Seminars and Original Investigations*, 36 (4), 174–182. <http://dx.doi.org/10.1016/j.urolonc.2017.10.011>
- Emanuelson, U., & Egenvall, A. (2014). The data–Sources and validation. *Preventive veterinary medicine*, 113(3), 298–303. <https://doi.org/10.1016/j.prevetmed.2013.10.002>
- Bermeo, E. (2019). Determinants of FI: results of multilevel analyses (Doctoral dissertation, University of Bristol (United Kingdom)). <https://hdl.handle.net/1983/54782c97-e266-44ac-ab9b-0c28c4b32b5c>
- Jamila A. (2024). Essays on Digital FI and Financial Resilience for Sustainable Development in Sub-Saharan Africa. (Doctoral dissertation, Hamad Bin Khalifa University (Qatar)). <https://search.proquest.com/openview/52b2c9a4b11d152cedb925ac4831bdf6/1?pq-origsite=gscholar&cbl=2026366&diss=y>
- Peng, Y. (2021). Essays on Financial Development and FI. (Doctoral dissertation, University of Groningen (Netherlands)). <https://doi.org/10.33612/diss.181610240>
- Damane, M. G. (2023). FI and Financial Stability in Sub-Saharan Africa. (Doctoral dissertation, University of South Africa (South Africa)). <https://hdl.handle.net/10500/31345>
- Kebede, J. G. (2022). FI and Its Effects on Financial Stability, Income Inequality and Monetary Policy Effectiveness: The case of Africa. (Doctoral dissertation, Griffith University (Australia)). <http://dx.doi.org/10.25904/1912/4848>
- Allam, A. (2020). Three essays on FI. (Doctoral dissertation, Bangor University (United Kingdom)). [https://research.bangor.ac.uk/portal/en/theses/three-essays-on-financial-inclusion\(91599992-60a5-4a42-8644-3980a041740d\).html](https://research.bangor.ac.uk/portal/en/theses/three-essays-on-financial-inclusion(91599992-60a5-4a42-8644-3980a041740d).html)

- Sumanta, K. S. (2023). The Role of FI in Achieving Key Sustainable Development Goals (SDGs) in Developing Countries (Doctoral dissertation, Ritsumeikan University (Japan)). https://ritsumei.repo.nii.ac.jp/record/2000335/files/k_1704.pdf
- Jima, M. D. (2023). The Nexus Between FI, Financial Stability and Economic Growth in Sub-Saharan Africa (Doctoral dissertation, University of South Africa (South Africa)). <https://ir.unisa.ac.za/handle/10500/31756>
- Donnellan, M. Brent, and Richard E. Lucas, (2013). 'Secondary Data Analysis', in Todd D. Little (ed.), The Oxford Handbook of Quantitative Methods in Psychology, 2: Statistical Analysis. <https://doi.org/10.1093/oxfordhb/9780199934898.013.0028>
- OECD (2023). OECD/INFE 2023 International Survey of Adult Financial Literacy. OECD Business and Finance Policy Papers, No. 39, OECD Publishing, Paris, <https://doi.org/10.1787/56003a32-en>.
- Amatus, H., & Alireza, N. (2015). FI and financial stability in Sub-Saharan Africa (Ssa). International journal of social sciences, 36(1), 2305-4557. https://web.archive.org/web/20180421073637id_/http://tijoss.com/Tijoss%2036th%20Volume/5Amatus.pdf
- Saidi, H., Hakimi, A., Adili, L., & Hamdi, H. (2025). Does FI improve bank performance in the MENA region? Evidence from GCC and non-GCC countries. Cogent Business & Management, 12(1), 2547083. <https://doi.org/10.1080/23311975.2025.2547083>
- Van Wyk, B. F., & Kapingura, F. M. (2021). Understanding the nexus between savings and economic growth: A South African context. Development Southern Africa, 38(5), 828-844. <https://doi.org/10.1080/0376835X.2021.1932424>
- Seven, Ü., & Yetkiner, H. (2016). Financial intermediation and economic growth: Does income matter?. Economic Systems, 40(1), 39-58. <https://doi.org/10.1016/j.ecosys.2015.09.004>
- Nkwede, F. (2015). FI and economic growth in Africa: Insight from Nigeria. European Journal of Business and Management, 7(35), 71-80. <https://www.iiste.org/Journals/index.php/EJBM/article/view/27498>
- Odame, C., Appiah, K. O., & Gyimah, P. (2024). The FI-economic growth nexus: what is new now?. Journal of Money and Business, 4(2), 121-137. <https://doi.org/10.1108/JMB-05-2023-0026>
- Krumer-Nevo, M., Gorodzeisky, A., & Saar-Heiman, Y. (2016). Debt, poverty, and financial exclusion. Journal of Social Work, 17(5), 511-530. <https://doi.org/10.1177/1468017316649330>
- Reis, B.T. (2021). What is FI? A critical review. SOAS Department of Economics Working Paper No. 246, London: SOAS University of London. <https://www.soas.ac.uk/sites/default/files/2022-10/economics-wp246.pdf>
- Bateman, M., & Chang, H.-J. (2012). Microfinance and the Illusion of Development: From Hubris To Nemesis in Thirty Years. World Economic Review, 1, 13–36. <http://wer.worldeconomicsassociation.org/files/WER-Vol1-No1-Article2-Bateman-and-Chang-v2.pdf>
- Taylor, M. (2012). The Antinomies of 'FI': Debt, Distress and the Workings of Indian Microfinance. Journal of Agrarian Change, 12(4), 601–610. <https://doi.org/10.1111/j.1471-0366.2012.00377.x>
- Adamo, R., Federico, D., & Notte, A. (2024). FI literature review: Definition, measurement, and challenges. The role of FI for reaching sustainable development goals, 28-46. <http://dx.doi.org/10.4018/979-8-3693-0522-5.ch003>
- Zhang, Q., & Valle-Sison, J. B. (2014). FI and regulatory implications. In Global Shock, Risks, and Asian Financial Reform (pp. 600-627), Edward Elgar Publishing. <http://dx.doi.org/10.4337/9781783477944.00029>
- Mader, P. (2016). Card crusaders, cash infidels and the holy grails of digital FI. Behemoth-A Journal on Civilisation, 9(2), 59–81. <https://doi.org/10.6094/behemoth.2016.9.2.916>
- Gabor, D., & Brooks, S. (2016). The digital revolution in FI: international development in the fintech era. New Political Economy, 22(4), 423–436. <https://doi.org/10.1080/13563467.2017.1259298>
- Alliance for FI (AFI) (2013). Defining and Measuring FI. https://www.rfilc.org/wp-content/uploads/2020/08/Financial_Inclusion_in_Africa.pdf
- Mader, P. (2018). Contesting FI. Development and change, 49(2), 461-483. <https://doi.org/10.1111/dech.12368>
- World Bank (WB) (2018). FI: FI is a key enabler to reducing poverty and boosting prosperity. <https://www.worldbank.org/en/topic/financialinclusion/overview#:~:text=Financial%20inclusion%20is%20a%20catalyst,supports%20entrepreneurship%20and%20business%20growth>

- Sharma U, & Changkakati B (2022). Dimensions of global FI and their impact on the achievement of the United Nations Development Goals. *Borsa Istanbul Review*, 22(6),1238–1250. <https://doi.org/10.1016/j.bir.2022.08.010>
- Bukari, C., Koomson, I., & Annim, S. K. (2024). FI, vulnerability coping strategies and multidimensional poverty: Does conceptualisation of FI matter?. *Review of Development Economics*, 28(2), 462-498. <https://doi.org/10.1111%2Frode.13062>
- Fernández-Olit, B., Paredes-Gázquez, J. D., & de la Cuesta-González, M. (2018). Are social and financial exclusion two sides of the same coin? An analysis of the financial integration of vulnerable people. *Social Indicators Research*, 135(1), 245-268. <https://doi.org/10.1007/s11205-016-1479-y>
- Dorjnyambuu, B. (2023). The reflexive relationship between financial and social exclusion for the selected Central-Eastern European countries. *Public Finance Quarterly= Pénzügyi Szemle*, 69(4), 62-83. https://doi.org/10.35551/PFQ_2023_4_4
- Bhukta, R., Pakrashi, D., Saha, S., & Sedai, A. (2023). Does FI Mitigate Social Exclusion?. Available at SSRN. <https://ssrn.com/abstract=4686788>
- Changwony, F. K., Campbell, K., & Tabner, I. T. (2015). Social engagement and stock market participation. *Review of Finance*, 19(1), 317-366. <https://doi.org/10.1093/rof/rft059>
- Ozili, P. K. (2020). Social inclusion and FI: international evidence. *International Journal of Development Issues*, 19(2), 169-186. <https://doi.org/10.1108/IJDI-07-2019-0122>
- Stewart, R., Chowdhury, M. & Arjoon, V. (2021). Bank stability and economic growth: trade-offs or opportunities?. *Empir Econ* 61, 827–853. <https://doi.org/10.1007/s00181-020-01886-4>
- Athari, S. A., Irani, F., & Hadood, A. A. (2023). Country risk factors and banking sector stability: Do countries' income and risk-level matter? Evidence from global study. *Heliyon*, 9(10). <https://doi.org/10.1016/j.heliyon.2023.e20398>
- Tan, Y. (2014). Risk management & performance in the Chinese banking sector. *Performance, Risk & Competition in the Chinese Banking Industry*, 65-139. <https://doi.org/10.1533/9781780634463.65>
- Abate, S. G., & Adamu, A. Y. (2022). Stakeholders' participation in adult education programme development in Ethiopia. *International journal of lifelong education*, 41(3), 257-276. <https://doi.org/10.1080/02601370.2022.2052990>
- Abdi, H., & Williams, L. J. (2010). Principal component analysis. *Wiley interdisciplinary reviews: computational statistics*, 2(4), 433-459. <https://doi.org/10.1002/wics.101>
- Abdmoulah, W., & Jelili, R. B. (2013). Access to finance thresholds and the finance-growth nexus. *Economic Papers: A journal of applied economics and policy*, 32(4), 522-534. <https://doi.org/10.1111/1759-3441.12059>
- Abdu, E. (2022). Financial distress situation of financial sectors in Ethiopia: A review paper. *Cogent Economics & Finance*, 10(1), 1996020. <https://doi.org/10.1080/23322039.2021.1996020>
- Abdu, E., & Adem, M. (2021). Determinants of FI in Afar Region: Evidence from selected woredas. *Cogent Economics & Finance*, 9(1), 1920149. <https://doi.org/10.1080/23322039.2021.1920149>
- Abdullah, G. I. (2022). Analyzing the Relationship between Financial Depth and Economic Growth in Iraq during the Period (2004-2020). *Journal of Business and Management Studies*, 4(3), 146-159. <https://doi.org/10.32996/jbms.2022.4.3.13>
- Abor, J. Y., Issahaku, H., Amidu, M., & Murinde, V. (2020). FI and economic growth 1. In *Contemporary issues in development finance* (263-286). Routledge. <http://dx.doi.org/10.4324/9780429450952-10>
- Abubakar, A. M., Daneji, B. A., Muhammed, A. I., & Chekene, I. A. B. (2020). Driving faster FI in developing nations. *Technology audit and production reserves*, 2 (4 (52)), pp 35–40, <http://doi.org/10.15587/2706-5448.2020.201120>
- Acharya, V. V., Hasan, I., & Saunders, A. (2006). Should banks be diversified? Evidence from individual bank loan portfolios. *The Journal of Business*, 79(3), 1355-1412. <https://doi.org/10.1086/500679>
- Addisu, B. M., Ijara, T. M., & Ijara, T. M. (2023). Impact of working capital management on profitability of private commercial banks in Ethiopia. <https://doi.org/10.21203/rs.3.rs-2340164/v1>
- Adem, M. (2022). Impact of diversification on bank stability: evidence from emerging and developing countries. *Discrete Dynamics in Nature and Society*, 2022(1), 7200725. <https://doi.org/10.1155/2022/7200725>

- Adera, A., & Abdisa, L. T. (2023). FI and women's economic empowerment: Evidence from Ethiopia. *Cogent Economics & Finance*, 11(2). <http://dx.doi.org/10.1080/23322039.2023.2244864>
- Adeyeye, P. O., Fapetu, O., Aluko, O. A., & Migiro, S. O. (2015). Does supply-leading hypothesis hold in a developing economy? A Nigerian focus. *Procedia Economics and Finance*, 30, 30-37. [https://doi.org/10.1016/S2212-5671\(15\)01252-6](https://doi.org/10.1016/S2212-5671(15)01252-6)
- Adom, P. K., Adams, S., & Quagraine, F. A. (2024). Parental FI and child proficiency in low-income settings: Family effects. *Development and Sustainability in Economics and Finance*, 2, 100009. <https://doi.org/10.1016/j.dsef.2024.100009>
- Adrian, T., & Shin, H. S. (2009). Money, liquidity, and monetary policy. *American Economic Review*, 99(2), 600-605. <https://doi.org/10.1257/aer.99.2.600>
- Adu, G., Marbuah, G., & Mensah, J. T. (2013). Financial development and economic growth in Ghana: Does the measure of financial development matter?. *Review of Development finance*, 3(4), 192-203. <https://doi.org/10.1016/j.rdf.2013.11.001>
- Aduba, J., Asgari, B., & Izawa, H. (2023). Does FinTech penetration drive financial development? Evidence from panel analysis of emerging and developing economies. *Borsa Istanbul Review*, 23(5), 1078-1097. <https://doi.org/10.1016/j.bir.2023.06.001>
- Aduda, J., & Kalunda, E. (2012). FI and financial sector stability with reference to Kenya: A review of literature. *Journal of Applied Finance and Banking*, 2(6), 95-120.
- Afzal, M. (2009). Population growth and economic development in Pakistan. *The Open Demography Journal*, 2(1), 1-7. <https://doi.org/10.2174/1874918600902010001>
- Aghion, P., Bacchetta, P., Ranciere, R., & Rogoff, K. (2009). Exchange rate volatility and productivity growth: The role of financial development. *Journal of monetary economics*, 56(4), 494-513. <https://doi.org/10.1016/j.jmoneco.2009.03.015>
- Agya A.A., Ojiya, E.A., Ushie, E.U., (2022). FI and Economic Growth in Nigeria: Further evidence from ARDL Model. *NDIC quarterly*, 38 (1), 30-48. https://www.researchgate.net/publication/373556651_Financial_inclusion_and_Economic_Growth_in_Nigeria_Further_evidence_from_ARDL_Model
- Ahamed, M. M., & Mallick, S. K. (2019). Is FI good for bank stability? International evidence. *Journal of Economic Behavior & Organization*, 157, 403-427. <https://doi.org/10.1016/j.jebo.2017.07.027>
- Ahamed, M. M., Ho, S. J., Mallick, S. K., & Matousek, R. (2021). Inclusive banking, financial regulation and bank performance: Cross-country evidence. *Journal of Banking & Finance*, 124, 106055. <https://doi.org/10.1016/j.jbankfin.2021.106055>
- Ahmad, M., Majeed, A., Khan, M. A., Sohaib, M., & Shehzad, K. (2021). Digital FI and economic growth: Provincial data analysis of China. *China Economic Journal*, 14(3), 291-310. <https://doi.org/10.1080/17538963.2021.1882064>
- Ahmed, M. I. (2020). Islamic Banking in Ethiopia and its Legislative Challenges. *J. Int'l L. Islamic L.*, 16, 62.
- Aizenman, J., & Lee, J. (2010). Real exchange rate, mercantilism and the learning by doing externality. *Pacific Economic Review*, 15(3), 324-335. <https://doi.org/10.1111/j.1468-0106.2010.00505.x>
- Ajide, K. B. (2017). Determinants of FI in Sub-Saharan Africa countries: Does institutional infrastructure matter? *CBN Journal of Applied Statistics*, 8(2), 69-89. <https://www.cbn.gov.ng>
- Akhisar, I., Tunay, K. B., & Tunay, N. (2015). The effects of innovations on bank performance: The case of electronic banking services. *Procedia-Social and Behavioral Sciences*, 195, 369-375. <https://doi.org/10.1016/j.sbspro.2015.06.336>
- Akileng, G., Lawino, G. M., & Nzibonera, E. (2018). Evaluation of determinants of FI in Uganda. *Journal of Applied Finance and Banking*, 8(4), 47-66.
- Akpan, E. A., & Moffat, I. U. (2018). Modeling the Autocorrelated Errors in Time Series Regression: A Generalized Least Squares Approach. *Journal of Advances in Mathematics and Computer Science*. 26. 1-15. <http://dx.doi.org/10.9734/IAMCS/2018/39949>
- Al Karim, R., & Alam, T. (2013). An evaluation of financial performance of private commercial banks in Bangladesh: Ratio analysis. *Journal of Business Studies Quarterly*, 5(2), 65. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=18e31333d487e5f2933f96fa28813cb90ae27661>

- Al Khatib, A. M. G. (2023). The complexity of financial development and economic growth nexus in Syria: A nonlinear modelling approach with artificial neural networks and NARDL model. *Heliyon*, 9(10), e20265-e20265. <https://doi.org/10.1016/j.heliyon.2023.e20265>
- Al Khatib, A. M. G., Alshaib, B. M., & Kanaan, A. M. (2023). The interaction between financial development and economic growth: a novel application of transfer entropy and nonlinear approach in Algeria. *SAGE Open*, 13(4). <https://doi.org/10.1177/21582440231217871>
- Alaabed, A., & Masih, M. (2016). Finance-growth nexus: Insights from an application of threshold regression model to Malaysia's dual financial system. *Borsa Istanbul Review*, 16(2), 63-71. <http://dx.doi.org/10.1016/j.bir.2016.01.004>
- Al-Eitan, G. N., Bassam Al-Own, & Tareq Bani-Khalid (2022). FI Indicators Affect Profitability of Jordanian Commercial Banks: Panel Data Analysis. *Economies* 10: 38. <https://doi.org/10.3390/economies10020038>
- Alemu Zewdu, G. (2014). FI, regulation and inclusive growth in Ethiopia. In Working paper; Working Paper, Issue November). <https://doi.org/10.4324/9781315648668>
- Alemu, G. (2016). FI, regulation and inclusive growth in Ethiopia. Achieving Financial Stability and Growth in Africa, 137-157. <https://www.taylorfrancis.com/chapters/edit/10.4324/9781315648668-8/financial-inclusion-regulation-inclusive-growth-ethiopia-getnet-alemu>
- Alemu, K. (2020). The impact of population growth on economic growth: evidence from Ethiopia using ARDL approach. *Journal of Economics and Sustainable Development*, 11(3), 19-33. <https://doi.org/10.7176/JESD/11-3-02>
- Alexiou, C., Vogiazas, S., & Nellis, J. G. (2018). Reassessing the relationship between the financial sector and economic growth: Dynamic panel evidence. *International Journal of Finance & Economics*, 23(2), 155-173. <https://doi.org/10.1002/ijfe.1609>
- Ali, M., & Puah, C. H. (2018). Does bank size and funding risk effect banks' stability? A lesson from Pakistan. *Global Business Review*, 19(5), 1166-1186, <https://doi.org/10.1177/0972150918788745>
- Aliaga, M., & Gunderson, B. (2002). *Interactive Statistics*. Thousand Oaks, CA: Sage.
- Aljadani, A., Ibrahim, R. L., Raimi, L., Al-Mulali, U., & Al-Faryan, M. A. S. (2025). Unlocking African economic growth potentials through the lenses of trade openness and financial development shocks. *Cogent Economics & Finance*, 13(1), 2457480. <https://doi.org/10.1080/23322039.2025.2457480>
- Allen, F., Demirgüç-Kunt, A., Klapper, A. L., & Martinez-Peria, M. S. (2016). The foundations of FI: Understanding ownership and use of formal accounts. *Journal of Financial Intermediation*, 27, 1–30. <https://doi.org/10.1016/j.jfi.2015.12.003>
- Amaira, B. (2023). FI and economic growth in Tunisia: an ARDL bound test approach. *Journal of the Knowledge Economy*, 14(4), 4393-4412. <https://doi.org/10.1007/s13132-022-01040-8>
- Aman, E. E. (2019). Determinants of financial distress in Ethiopia banking sec-tor. *International Journal of Scientific and Research Publications*, 9(5).98–107. <https://doi.org/10.29322/IJSRP.9.05.2019.p8914>
- Anarfo, E. B., & Abor, J. Y. (2020). Financial regulation and FI in Sub-Saharan Africa: does financial stability play a moderating role?. *Research in International Business and Finance*, 51, 101070, <https://doi.org/10.1016/j.ribaf.2019.101070>
- Anatolyevna, M. I., & Ramilevna, S. L. (2013). Financial stability concept: Main characteristics and tools. *World Applied Sciences Journal*, 22(6), 856-858. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=e956866341dcb1ecf66123c07c83156efc0d85fa>
- Andersen, T. B., & Tarp, F. (2003). Financial liberalization, financial development and economic growth in LDCs. *Journal of International Development: The Journal of the Development Studies Association*, 15(2), 189-209. <https://doi.org/10.1002/jid.971>
- Andrianaivo, M., & Kpodar, K. (2011) "ICT, FI and growth: Evidence from African countries", IMF Working Paper 11/73, International Monetary Fund, Washington. <https://www.imf.org>
- Ansong, A., Marfo-Yiadom, E., & Ekow-Asmah, E. (2011). The effects of financial innovation on financial savings: evidence from an economy in transition. *Journal of African Business*, 12(1), 93-113. <https://doi.org/10.1080/15228916.2011.555271>
- Anthony-Orji, O.I., Orji, A., Ogbuabor, J.E., & Onwe, I. E (2022). Empirical analysis of financial development and FI nexus in Nigeria / Empiryczna ocena związku między rozwojem finansowym i

- włączeniem finansowym w Nigerii. *Economic and Regional Studies*, 15(2), 181-195.
<https://doi.org/10.2478/ers-2022-0012>
- Anton, S. G., & Afloarei Nucu, A. E. (2024). The impact of digital finance and FI on banking stability: International evidence. *Oeconomia Copernicana*, 15(2), 563– 593. <https://doi.org/10.24136/oc.3046>
- Antwi, F., & Kong, Y. (2023). Investigating the impacts of digital finance technology on financial stability of the banking sector: New insights from developing market economies. *Cogent Business & Management*, 10(3), 2284738. <https://doi.org/10.1080/23311975.2023.2284738>
- Antwi, F., Kong, Y., & Gyimah, K. N. (2024). FI, competition and financial stability: New evidence from developing economies. *Heliyon*, 10(13). <https://doi.org/10.1016/j.heliyon.2024.e33723>
- Apergis, N., Aysan, A. F., & Bakkar, Y. (2022). Borrower-and lender-based macroprudential policies: What works best against bank systemic risk?. *Journal of International Financial Markets, Institutions and Money*, 80, 101648. <https://doi.org/10.1016/j.intfin.2022.101648>
- Apeti, A. E. (2023). Household welfare in the digital age: Assessing the effect of mobile money on household consumption volatility in developing countries. *World Development*, 161, 106110.
<https://doi.org/10.1016/j.worlddev.2022.106110>
- Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance?. *Journal of economic growth*, 20, 105-148. <https://doi.org/10.1007/s10887-015-9115-2>
- Arellano, M., & O. Bover. (1995). Another look at the instrumental variable estimation of error components models. *Journal of Econometrics* 68, 29–51
- Arellano, M., & S. Bond. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies* 58: 277–297.
- Arner, D.W., Buckley, R.P., Zetzsche, D.A. et al. Sustainability, FinTech and FI. *Eur Bus Org Law Rev* 21, 7–35 (2020). <https://doi.org/10.1007/s40804-020-00183-y>
- Arora, J. S. (2012). Additional topics on optimum design. *Introduction to optimum design*, 731-784.
<https://doi.org/10.1016/B978-0-12-381375-6.00029-2>
- Arora, R. (2020). Links between FI and financial stability: A study of BRICS, in PB Anand, Shailaja Fennell, and Flavio Comim (eds), *Handbook of BRICS and Emerging Economies*, Oxford University Press.
<https://doi.org/10.1093/oso/9780198827535.003.0007>
- Arora, R. U. (2012). FI and human capital in developing Asia: The Australian connection. *Third World Quarterly*, 33(1), 177–197. <https://doi.org/10.1080/01436597.2012.627256>
- Asuming, P. O., Osei-Agyei, L. G., & Mohammed, J. I. (2018). FI in Sub-Sahara Africa: Recent trends and determinants. *Journal of African Business*, 20(1), 112–134.
<https://doi.org/10.1080/15228916.2018.1484209>
- Atellu, A. R., & Muriu, P. W. (2022). Does FI enhance financial stability? Evidence from a developing economy. *Transnational Corporations Review*, 14(3), 297-311,
<https://doi.org/10.1080/19186444.2021.2019555>
- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of international financial Markets, Institutions and Money*, 18(2), 121-136. <https://doi.org/10.1016/j.intfin.2006.07.001>
- Avouba, N. F-G., Akougbe, A. I. S., & Ndombi Ondze, C. L. I. L. (2022). Non-linearity between FI and economic growth in sub-saharan Africa: What implications for the West African Economic and Monetary Union (WAEMU)?. *Cogent Economics & Finance*, 11(1).
<https://doi.org/10.1080/23322039.2022.2158630>
- Ayalew, M. M., & Xianzhi, Z. (2017). Competitiveness Condition, Market Power and Drivers of Competition of Banks in Ethiopia. *Clear International Journal of Research in Commerce & Management*, 8(12).
- Ayalew, Z. A. (2021). Capital structure and profitability: Panel data evidence of private banks in Ethiopia. *Cogent Economics & Finance*, 9(1), 1953736. <https://doi.org/10.1080/23322039.2021.1953736>
- Aymar, G. Z. U. J., & Fabrice-Gilles, N. A. (2021). Institutional environment and FI in Sub-Saharan Africa. *Modern Economy*, 12, 477-494. <https://doi.org/10.4236/me.2021.123025>
- Ayyagari, M., Demirgüç-Kunt, A., & Maksimovic, V. (2012). Financing of firms in developing countries: lessons from research. *World Bank Policy Research Working Paper*, (6036).
<https://www.researchgate.net/publication/254073332>

- Azimi MN (2022). New insights into the impact of FI on economic growth: A global perspective. PLoS ONE 17(11): e0277730. <https://doi.org/10.1371/journal.pone.0277730>
- Azimi, M. N. (2022a). Assessing the asymmetric effects of capital and money markets on economic growth in China. Heliyon, 8 (1), e08794. <https://doi.org/10.1016/j.heliyon.2022.e08794>
- Aziz, S. A., Razak, L. A., Slesman, L. Y., & Abduh, M. (2024). The Impact of Digital FI on Bank Profitability: Evidence from Developing Countries. <https://doi.org/10.20473/jmtt.v17i2.57508>
- Babajide, A. A., Adegboye, F. B., & Omankhanlen, A. E. (2015). FI and economic growth in Nigeria. International Journal of economics and financial issues, 5(3), 629-637. <https://dergipark.org.tr/en/download/article-file/363041>
- Bahmani-Oskooee, M., Xi, D., & Bahmani, S. (2019). More evidence on the asymmetric effects of exchange rate changes on the demand for money: evidence from Asian. Applied Economics Letters, 26(6), 485-495. <https://doi.org/10.1080/13504851.2018.1486979>
- Bajrami, R., Tafa, S., Gashi, A., & Hashani, M. (2025). Analysing the impact of money supply on economic growth: A panel regression approach for Western Balkan countries (2000–2023). Regional Science Policy & Practice, 17(2), 100159. <https://doi.org/10.1016/j.rsp.2024.100159>
- Baltagi, B. H., & Baltagi, B. H. (2008). Econometric analysis of panel data. Chichester: Wiley, 4, 135-145. <https://link.springer.com/content/pdf/10.1007/978-3-030-53953-5.pdf>
- Bandyopadhyay, S., Thakur, S.S. & Mandal, J.K. (2021). Product recommendation for e-commerce business by applying principal component analysis (PCA) and K-means clustering: benefit for the society. Innovations Syst Softw Eng 17, 45–52. <https://doi.org/10.1007/s11334-020-00372-5>
- Banerjee, A. V., Breza, E., Duflo, E., & Kinnan, C. (2017). Do credit constraints limit entrepreneurship? Heterogeneity in the returns to microfinance. Heterogeneity in the Returns to Microfinance (September 1, 2017). Global Poverty Research Lab Working Paper, (17-104). <https://dx.doi.org/10.2139/ssrn.3126359>
- Banking Business Proclamation Amendment No. 1159/2019
- Banna, H., & Alam, M. R. (2021). Impact of digital FI on ASEAN banking stability: implications for the post-Covid-19 era. Studies in Economics and Finance, 38(2), 504-523. <https://doi.org/10.1108/SEF-09-2020-0388>
- Bara, A., Mugano, G., & Le Roux, P. (2016). Financial innovation and economic growth in the SADC. African Journal of Science, Technology, Innovation and Development, 8(5), 483-495. <https://doi.org/10.1080/20421338.2016.1226705>
- Barajas A, Beck T., Belhaj M., and Sami Ben Naceur (2021). FI, in Valerie Cerra, and others (eds), How to Achieve Inclusive Growth, Oxford, online edn, Oxford Academic. <https://doi.org/10.1093/oso/9780192846938.003.0004>
- Barbieri, L. (2009). Panel unit root tests under cross-sectional dependence: An overview. Journal of Statistics: Advances in Theory and Applications, 1(2), 117-158. https://www.researchgate.net/profile/Laura-Barbieri2/publication/267090484_Panel_Unit_Root_Tests_under_Crosssectional_Dependence_An_Overview/links/
- Barik, R., & Pradhan, A. K. (2021). Does FI affect financial stability: evidence from BRICS nations?. The journal of developing areas, 55(1): 341-356, <https://doi.org/10.1353/jda.2021.0023>
- Bartlett, M. S. (1950). Tests of significance in factor analysis. British Journal of Statistical Psychology, 3, 77-85. <https://doi.org/10.1111/j.2044-8317.1950.tb00285.x>
- Bartlett, M.S. and Kendall, D.G. (1946). The Statistical Analysis of Variance Heterogeneity and the Logarithmic Transformation. Supplement to the Journal of the Royal Statistical Society, 8, 128-138. <https://doi.org/10.2307/2983618>
- Bats J.V., & Houben A.C.F.J., (2020). Bank-based versus market-based financing: Implications for systemic risk. Journal of Banking & Finance, 114. <https://doi.org/10.1016/j.jbankfin.2020.105776>
- Bawazir, A.A.A., Aslam, M. and Osman, A.F.B. (2020). Demographic change and economic growth: empirical evidence from the Middle East. Economic Change and Restructuring, 53(3), 429-450. <https://doi.org/10.1007/s10644-019-09254-8>

- Bayiley, D. Y. (2013). A dynamic and multivariate analysis of treasury bill behavior in a bank asset portfolio. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2244173_code2029056.pdf?abstractid=2244173&mirid=1
- Beck, R., Georgiadis, G., & Straub, R. (2014). The finance and growth nexus revisited. *Economics Letters*, 124(3), 382-385. <http://dx.doi.org/10.1016/j.econlet.2014.06.024>
- Beck, R., Jakubik, P., & Piloju, A. (2015). Key determinants of non-performing loans: new evidence from a global sample. *Open economies review*, 26, 525-550. <https://doi.org/10.1007/s11079-015-9358-8>
- Beck, T. (2016). FI-Measuring progress and progress in measuring. <https://www.imf.org/~media/Websites/IMF/imported-events/external/np/seminars/eng/2016/statsforum/pdf/beckpaperpdf.ashx>
- Beck, T., & Levine, R. (2002). Industry growth and capital allocation: does having a market-or bank-based system matter? *Journal of financial economics*, 64(2), 147-180. [https://doi.org/10.1016/S0304-405X\(02\)00074-0](https://doi.org/10.1016/S0304-405X(02)00074-0)
- Beck, T., De Jonghe, O., & Schepens, G. (2013a). Bank competition and stability: Cross-country heterogeneity. *Journal of financial Intermediation*, 22(2), 218-244, <https://doi.org/10.1016/j.jfi.2012.07.001>
- Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. *Journal of economic growth*, 12, 27-49. <https://doi.org/10.1007/s10887-007-9010-6>
- Beck, T., Demirguc-Kunt, A., & Peria, M. S. M. (2007). Reaching out: Access to and use of banking services across countries. *Journal of financial economics*, 85(1), 234-266. <https://doi.org/10.1016/j.jfineco.2006.07.002>
- Beck, T., Levine, R., & Loayza, N. (2000). Finance and the Sources of Growth. *Journal of financial economics*, 58(1-2), 261-300. [https://doi.org/10.1016/S0304-405X\(00\)00072-6](https://doi.org/10.1016/S0304-405X(00)00072-6)
- Beck, T.; Demirgüç-Kunt, A.; Merrouche, O. (2013). Islamic vs. conventional banking: Business model, efficiency and stability. *J. Bank. Financ*, 37, 433–447, <http://doi.org/10.1016/j.jbankfin.2012.09.016>
- Beck, Thorsten, Asli Demirguc-Kunt, and Maria Soledad Martinez Peria. 2007. Reaching out: Access to and Use of Banking Services across Countries. *Journal of Financial Economics*, 85, 234–66. <https://doi.org/10.1016/j.jfineco.2006.07.002>
- Bekaert, G., & Harvey, C. R. (2003). Emerging markets finance. *Journal of empirical finance*, 10(1-2), 3-55. [https://doi.org/10.1016/S0927-5398\(02\)00054-3](https://doi.org/10.1016/S0927-5398(02)00054-3)
- Bellemare, Marc F., Thomas B. Pepinsky, & Takaaki Masaki. (2017). Lagged Explanatory Variables and the Estimation of Causal Effects. *Journal of Politics* 79(3):949-63, <https://dx.doi.org/10.2139/ssrn.2568724>
- Benigno, G., Converse, N., & Fornaro, L. (2015). Large capital inflows, sectoral allocation, and economic performance. *Journal of International Money and Finance*, 55, 60-87. <https://doi.org/10.1016/j.jimonfin.2015.02.015>
- Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking and Finance*, 21(6), 849–870. [https://doi.org/10.1016/S0378-4266\(97\)00003-4](https://doi.org/10.1016/S0378-4266(97)00003-4)
- Berhe, A. G. (2019). Investigating the determinants of commercial banks profitability in Ethiopia. *European Journal of Business and Management* 11: 37–46. <https://doi.10.7176/EJBM/11-1-05>
- Berhe, A. G. (2024). Determinants of bank profitability in Ethiopia: does political stability matter?. *Cogent Business & Management*, 11(1), 2410406. <https://doi.org/10.1080/23311975.2024.2410406>
- Bhatter, H.K., Gupta, J. and Chhatoi, B.P. (2025). Unveiling the curvilinear dynamics: FI and bank performance in India. *Managerial Finance*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/MF-12-2024-0925>
- Bikker, J. A., & Vervliet, T. M. (2018). Bank profitability and risk-taking under low interest rates. *International Journal of Finance & Economics*, 23(1), 3-18. <https://doi.org/10.1002/ijfe.1595>
- Biru, A. M. (2021). Determinants of financial performance of private commercial banks in Ethiopia. *Academy of Accounting and Financial Studies Journal*, 25, 1-17. <https://www.abacademies.org/articles/determinants-of-financial-performance-of-private-commercial-banks-in-ethiopia-12075.html>

- Bisman, J. (2010). Postpositivism and Accounting Research : A (Personal) Primer on Critical Realism. *Australasian Accounting, Business and Finance Journal*, 4(4), 3–25. <https://core.ac.uk/download/pdf/36976983.pdf>
- Biswas, S., Bhattacharya, S. N., Jin, J. Y., Bhattacharya, M., & Sadarangani, P. H. (2024). Loan loss provisions and income smoothing in banks: the role of trade openness and IFRS in BRICS. *China Accounting and Finance Review*, 26(1), 76-101. <https://doi.org/10.1108/CAFR-03-2023-0037>
- Bloch, H., & Tang, S. H. K. (2003). The role of financial development in economic growth. *Progress in Development Studies*, 3(3), 243-251. <https://doi.org/10.1191/1464993403ps063pr>
- Blundell, R., & S. Bond. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87: 115–143
- Blundell, R., Bond, S., & Windmeijer, F. (2001). Estimation in dynamic panel data models: improving on the performance of the standard GMM estimator. *Nonstationary panels, panel cointegration, and dynamic panels*, Emerald Group Publishing Limited 15: 53-91. [https://doi.org/10.1016/S0731-9053\(00\)15003-0](https://doi.org/10.1016/S0731-9053(00)15003-0)
- Blundell, R; & Bond, S; (2023). Initial conditions and Blundell–Bond estimators. *Journal of Econometrics* , 234 pp. 101-110. <https://doi.org/10.1016/j.jeconom.2023.01.020>
- Boachie, C., & Adu-Darko, E. (2024). The effect of FI on economic growth: The role of human capital development. *Cogent Social Sciences*, 10(1), 2346118. <https://doi.org/10.1080/23311886.2024.2346118>
- Bod'a, M., & Zimková, E. (2021). Overcoming the loan-to-deposit ratio by a financial intermediation measure—A perspective instrument of financial stability policy. *Journal of Policy Modeling*, 43(5), 1051-1069. <https://doi.org/10.1016/j.jpolmod.2021.03.012>
- Bofondi, M., & Gobbi, G. (2003). Bad loans and entry in local credit markets. *Bank of Italy*, 1-29. <https://www.biz.org/bcbs/events/wkshop0303/p11bofogobb.pdf>
- Bond, S. R., Hoeffler, A., & Temple, J. (2001). GMM Estimation of Empirical Growth Models. <http://www.nuff.ox.ac.uk/Economics/papers/2001/w21/bht10.pdf>
- Bond, S.R. (2002). Dynamic panel data models: a guide to micro data methods and practice. *Portuguese Economic Journal* 1, 141–162. <https://doi.org/10.1007/s10258-002-0009-9>
- Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of organizational behavior*, 36(1), 3-15. <https://doi.org/10.1002/job.1960>
- Borio, C. (2003). Towards a macroprudential framework for financial supervision and regulation? *CESifo Economic Studies*, 49(2), 181–215. <https://doi.org/10.1093/cesifo/49.2.181>
- Borio, C. (2011). Implementing a Macroprudential Framework: Blending Boldness and Realism. *Capitalism and Society*, 6(1). <https://doi.org/10.2202/1932-0213.1083>
- Brigham, E. F., & Houston, J. F. (2019). *Fundamentals of financial management*. Cengage Learning. <https://thuvienso.hoasen.edu.vn/handle/123456789/11493>
- Brink, H., Van Der Walt, C. and Van Rensburg, G. (2006) *Fundamentals of Research Methodology for Health Care Professionals*. 2nd Edition, Juta, Cape Town.
- Bruhn, M., & Love, I. (2014). The real impact of improved access to finance: Evidence from Mexico. *The Journal of Finance*, 69(3), 1347-1376. <https://doi.org/10.1111/jofi.12091>
- Bryman, A. (2001) *Social Research Methods*. Oxford University Press, Oxford.
- Bryman, A. (2012). *Social Research Methods*. Oxford: Oxford University Press.
- Bucci, A. (2023). Can a negative population growth rate sustain a positive economic growth rate in the long run?. *Mathematical Social Sciences*, 122, 17-28. <https://doi.org/10.1016/j.mathsocsci.2023.01.001>
- Buchanan, D. (1998). Beyond positivism: humanistic perspectives on theory and research in health education. *University of Massachusetts: Community Health Education*, 13(3). 439-450. <https://doi.org/10.1093/her/13.3.439>
- Bushashe, M. A. (2023). Determinants of private banks performance in Ethiopia: A partial least square structural equation model analysis (PLS-SEM). *Cogent Business & Management*, 10(1), 2174246. <https://doi.org/10.1080/23311975.2023.2174246>
- Buthelezi, E. M. (2023). Impact of money supply in different states of inflation and economic growth in South Africa. *Economies*, 11(2), 64. <https://doi.org/10.3390/economies11020064>

- Calice, P., Diaz Kalan, F., & Masetti, O. (2020). Interest rate repression around the world. <https://www.sidalc.net/search/Record/dig-okr-1098634672/Description>
- Camara, N., & D. Tuesta (2017). Measuring FI: a multidimensional index. Bank of Morocco – CEMLA – IFC Satellite Seminar at the ISI World Statistics Congress on “FI”, <https://www.bis.org/ifc/publ/ifcb47p.pdf>
- Camara, N., & Tuesta, D. (2014). Measuring FI: A multidimensional index. BBVA Research Paper, (14/26). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2634616
- Carlson, M. (2004). Are branch banks better survivors? Evidence from the depression era. *Economic Inquiry*, 42(1), 111-126. <https://doi.org/10.1093/ei/cbh048>
- Carrino, L. (2015). The weighting role of normalisation in a multidimensional analysis of Social Inclusion. University Ca'Foscari of Venice, Dept. of Economics Research Paper Series No. 32. <https://doi.org/10.2139/ssrn.2713000>
- Carrino, L. (2015). The weighting role of normalisation in a multidimensional analysis of Social Inclusion. University Ca'Foscari of Venice, Dept. of Economics Research Paper Series No. 32. <https://doi.org/10.2139/ssrn.2713000>
- Casula, M., Rangarajan, N., & Shields, P. (2020). The Potential of Working Hypotheses for Deductive Exploratory Research. *Quality & Quantity*, 55(1), 1703–1725. Springer. <https://doi.org/10.1007/s11135-020-01072-9>
- Cattell, R. B. (1966). The Scree Test for the number of factors. *Multivariate Behavioral Research*, 1, 245-276. http://dx.doi.org/10.1207/s15327906mbr0102_10
- Central Statistical Agency of Ethiopia (CSA), National Bank of Ethiopia (NBE), & World Bank (WB). (2020). Ethiopia socioeconomic survey (ESS) 2018/19, FI. https://microdata.worldbank.org/index.php/catalog/3823/datadictionary/F6?file_name=sect5a_hh_w4.dta
- Cesaratto, S., & Pariboni, R. (2022). The relation between Keynesian monetary theory and demand-led growth: a Sraffian exploration. *Review of Keynesian Economics*, 10(3), 291-315. <https://doi.org/10.4337/roke.2022.03.01>
- Chakravarty, S. R., & Pal, R. (2013). FI in India: An axiomatic approach. *Journal of Policy Modeling*, 35(5), 813-837. <https://doi.org/10.1016/j.jpolmod.2012.12.007>
- Chan, L. L., & Idris, N. (2017). Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha. *International Journal of Academic Research in Business and Social Sciences*, 7(10), 400-410. <http://dx.doi.org/10.6007/IJARBS/v7-i10/3387>
- Charfeddine, L., & Zaouali, S. (2022). The effects of FI and the business environment in spurring the creation of early-stage firms and supporting established firms. *Journal of Business Research*, 143, 1-15. <https://doi.org/10.1016/j.jbusres.2022.01.014>
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
- Chen, H., Hongo, D. O., Ssali, M. W., Nyaranga, M. S., & Nderitu, C. W. (2020). The asymmetric influence of financial development on economic growth in Kenya: evidence from NARDL. *Sage Open*, 10(1). <https://doi.org/10.1177/2158244019894071>
- Chen, L., Wang, X., Wang, Y., & Gao, P. (2023). Improved entropy weight methods and their comparisons in evaluating the high-quality development of Qinghai, China. *Open Geosciences*, 15(1), 20220570. <https://doi.org/10.1515/geo-2022-0570>
- Chen, M., Wu, J., Jeon, B. N., & Wang, R. (2017). Monetary policy and bank risk-taking: Evidence from emerging economies. *Emerging Markets Review*, 31, 116-140. <https://doi.org/10.1016/j.ememar.2017.04.001>
- Chen, P.-C., Yu, M.-M., Shih, J.-C., Chang, C.-C., & Hsu, S.-H. (2019). A reassessment of the global food security index by using a hierarchical data envelopment analysis approach. *European Journal of Operational Research*, 272(2), 687-698. <https://doi.org/10.1016/j.ejor.2018.06.045>
- Chen, Y. S., Chen, Z., Ali, S., Ullah, M. I., & Anser, M. K. (2023). Dynamic common correlated effects of FI on foreign direct investment: Evidence from East-Asia and Pacific countries. *Borsa Istanbul Review*, 23(3), 541-549. <https://doi.org/10.1016/j.bir.2022.12.002>

- Chen, Z., Ali, S., Lateef, M., Khan, A. I., & Anser, M. K. (2023). The nexus between asymmetric FI and economic growth: Evidence from the top 10 financially inclusive economies. *Borsa Istanbul Review*, 23(2), 368-377. <https://doi.org/10.1016/j.bir.2022.11.004>
- Chinoda, T., & Kapingura, F. M. (2023). The impact of digital FI and bank competition on bank stability in sub-Saharan Africa. *Economies*, 11(1), 15. <https://doi.org/10.3390/economies11010015>
- Chinoda, T., & Kapingura, F. M. (2024). Fintech-based FI and banks' risk-taking: the role of regulation in Sub-Saharan Africa. *Journal of Economic and Administrative Sciences*, <https://doi.org/10.1108/JEAS-11-2023-0304>
- Chinoda, T., Kwenda, F., & McMillan, D. (2019). Do mobile phones, economic growth, bank competition and stability matter for FI in Africa?. *Cogent Economics and Finance*, 7(1), 1–20. <https://doi.org/10.1080/23322039.2019.1622180>
- Chou, Y. K. (2007). Modeling Financial Innovation and Economic Growth: Why the Financial Sector Matters to the Real Economy. *The Journal of Economic Education*, 38(1), 78–91. <http://www.jstor.org/stable/30042753>
- Chow, S. C., Vieito, J. P., & Wong, W. K. (2019). Do both demand-following and supply-leading theories hold true in developing countries?. *Physica A: Statistical Mechanics and its Applications*, 513, 536-554. <https://doi.org/10.1016/j.physa.2018.06.060>
- Chuan Li & Joyce Wong, (2018) "Financial Development and Inclusion in the Caribbean" IMF Working Papers 2018/053, International Monetary Fund, <https://ideas.repec.org/p/imf/imfwpa/2018-053.html>
- Čihák, M., Mare, D. S., & Melecký, M. (2016). The nexus of FI and financial stability: A study of trade-offs and synergies. World Bank Policy Research Working Paper, (7722). <http://documents.worldbank.org/curated/en/138991467994676130/The-Nexus-of-financial-inclusion-and-financial-stability-a-study-of-trade-offs-and-synergies>
- Cihak, M., Mare, D. S., & Melecký, M. (2020). FI and stability: review of theoretical and empirical links. *The World Bank Research Observer*, 36(2), 197-233. <https://doi.org/10.1093/wbro/lkaa006>
- Claessens, S., Coleman, N., & Donnelly, M. (2018). Low-For-Long” interest rates and banks’ interest margins and profitability: Cross-country evidence. *Journal of Financial Intermediation*, 35, 1-16. <https://doi.org/10.1016/j.jfi.2017.05.004>
- Cleff, T. (2019). Factor analysis. In T. Cleff (Ed.), *Applied Statistics and Multivariate Data Analysis for Business and Economics*. Springer. https://doi.org/10.1007/978-3-030-17767-6_13
- Cole, S., X. Gine, and J. Vickery, (2013). How does risk management influence production decisions? Evidence from a field experiment. World Bank Policy Research Working Paper Series 6546. <https://openknowledge.worldbank.org/bitstream/handle/10986/15904/WPS6546.pdf?sequence=1&isAllowed=y>
- Collard, S. (2007). Toward FI in the UK: Progress and challenges. *Public Money and Management*, 27(1), 13-20. <https://doi.org/10.1111/j.1467-9302.2007.00550.x>
- Creswell, J. W. (2012). *Research designs: Qualitative, , quantitative, , and mixed methods approaches* (4th ed.). Thousand Oaks, CA: SAGE Publications.
- Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Los Angeles, CA: SAGE Publications.
- Creswell, J.W. (2003). *Research design: Qualitative, quantitative and mixed methods approach* (2nd ed.). Thousand Oaks, CA: Sage. https://scholar.google.com/scholar_lookup?title=Research+design%3A+Qualitative%2C+quantitative+and+mixed+methods+approach&publication_year=2003
- Cruz-García, Paula & Dircio-Palacios-Macedo, Maria & Tortosa-Ausina, Emili. (2020). FI and exclusion across Mexican municipalities. *Regional Science Policy & Practice*. 13, 1496-1526. <http://dx.doi.org/10.1111/rsp3.12388>
- Dabla-Norris, M. E., Ji, Y., Townsend, R., & Unsal, M. F. (2015). Identifying constraints to FI and their impact on GDP and inequality: A structural framework for policy. International Monetary Fund, WP/15/22, <https://www.imf.org/external/pubs/ft/wp/2015/wp1522.pdf>

- Dagnachew, T. G., & Mawugatie, T. W. (2022). The analysis of FI and its determinants in the rural area of south Wollo zone, Amhara Region, Ethiopia. *Cogent Economics & Finance*, 10(1), 2146298. <https://doi.org/10.1080/23322039.2022.2146298>
- Damane, M., & Ho, S. Y. (2024). The Impact of FI on financial Stability: review of Theories and international Evidence. *Development Studies Research*, 11(1), <https://doi.org/10.1080/21665095.2024.2373459>
- Damrah, S.; Elian, M.I.; Atyeh, M.; Shawtari, F.A. & Bani-Mustafa, A. (2023). A Linear Mixed Model Approach for Determining the Effect of FI on Bank Stability: Comparative Empirical Evidence for Islamic and Conventional Banks in Kuwait. *Mathematics*, 11, 1698. <https://doi.org/10.3390/math11071698>
- Dang, Y.H. N., & Thi, D.T. H. (2022). Impact of FI on banking stability in ASEAN countries—threshold FI. *Macroeconomics and Finance in Emerging Market Economies*, 1-18. <https://doi.org/10.1080/17520843.2022.2138488>
- Danisman, G. O., & Tarazi, A. (2020). FI and bank stability: Evidence from Europe. *The European Journal of Finance*, 26(18), 1842-1855. <https://doi.org/10.1080/1351847X.2020.1782958>
- Davidson, Russell & James G. MacKinnon. 2004. *Econometric Theory and Methods*. New York: Oxford University Press.
- De Hoyos, R. E., & Sarafidis, V. (2006). Testing for cross-sectional dependence in panel-data models. *The stata journal*, 6(4), 482-496. <https://doi.org/10.1177/1536867X0600600403>
- De Koker, L. and Jentzsch, N. (2013). FI and financial integrity: Aligned incentives? *World Development*, 44, 267-280. <https://doi.org/10.1016/j.worlddev.2012.11.002>
- Decancq, K., & Lugo, M. A. (2013). Weights in multidimensional indices of wellbeing: An overview. *Econometric Reviews*, 32(1), 7–34. <https://doi.org/10.1080/07474938.2012.690641>
- Deidda, L., & Fattouh, B. (2002). Non-linearity between finance and growth. *Economics Letters*, 74(3), 339-345. [https://doi.org/10.1016/S0165-1765\(01\)00571-7](https://doi.org/10.1016/S0165-1765(01)00571-7)
- del Carmen Briano-Turrent, G. (2024). The effect of FI on economic and social indicators in Mexico. *Latin American Journal of Central Banking*, 6(1), 100161. <https://doi.org/10.1016/j.latchb.2024.100161>
- Del Sarto, N., & Ozili, P. K. (2025). FinTech and FI in emerging markets: a bibliometric analysis and future research agenda. *International Journal of Emerging Markets*, 20(13), 270–290. <https://doi.org/10.1108/ijoem-08-2024-1428>
- Dell’Ariccia, G., Laeven, L., & Marquez, R. (2014). Real interest rates, leverage, and bank risk-taking. *Journal of Economic Theory*, 149, 65-99. <http://dx.doi.org/10.1016/j.jet.2013.06.002>
- Demetriades, P., & Hook Law, S. (2006). Finance, institutions and economic development. *International journal of finance & economics*, 11(3), 245-260. <https://doi.org/10.1002/ijfe.296>
- Demeulemeester, S. (2024). Investigating the “debt–money–prices” triangle: irving fisher’s theoretical journey toward the 100% money proposal. *Journal of the History of Economic Thought*, 46(2), 225-243. <https://doi.org/10.1017/S1053837223000196>
- Demir, A., Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2022). Fintech, FI and income inequality: a quantile regression approach. *The European Journal of Finance*, 28(1), 86-107. <https://doi.org/10.1080/1351847X.2020.1772335>
- Demirgüç-Kunt, A., & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: some international evidence. *The World Bank Economic Review*, 13(2), 379-408. <https://doi.org/10.1093/wber/13.2.379>
- Demirgüç-Kunt, A., & Levine, R. (2008). *Finance, Financial Sector Policies, and Long-Run Growth*. World Bank Policy Research Working Paper, No 11, Washington DC: World Bank.
- Demirgüç-Kunt, A., & Levine, R. (2009). Finance and inequality: Theory and evidence. *Annual Review of Financial Economics*, 1, 287-318. <http://dx.doi.org/10.1146/annurev.financial.050808.114334>
- Demirgüç-Kunt, A., & Maksimovic, V. (1998). Law, finance, and firm growth. *The journal of finance*, 53(6), 2107-2137. <https://doi.org/10.1111/0022-1082.00084>
- Demirgüç-Kunt, A., Beck, T. H. L., & Honohan, P. (2008). *Finance for all?: Policies and pitfalls in expanding access*. World bank. <https://research.tilburguniversity.edu/files/1107575/Financeforall.pdf>
- Demirgüç-Kunt, A., Klapper, L., & Singer, D. (2017). FI and inclusive growth: A review of recent empirical evidence. World Bank Policy Research Working Paper, No. 8040

- Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). The Global Findex Database 2017: Measuring FI and the fintech revolution. World Bank Publications. <http://documents1.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf>
- Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The Global Findex Database 2017: Measuring FI and opportunities to expand access to and use of financial services. The World Bank Economic Review, 34(Supplement_1), S2-S8. <https://doi.org/10.1093/wber/lhz013>
- Demirgüç-Kunt, Asli, and Leora Klapper. (2012). Measuring FI: The Global Findex Database. Washington, DC: The World Bank. <https://doi.org/10.1596/1813-9450-6025>
- Denegetu, D. H. (2024). FI of refugees in Ethiopia. Available at SSRN 4756354. <https://dx.doi.org/10.2139/ssrn.4756354>
- Denscombe, M. (1998). The good research for small –scale social research project. Philadelphia: Open University Press.
- Desalegn, G., & Yemataw, G. (2017). FI in Ethiopia: Using LSMS (Ethiopia socioeconomic survey) data. Ethiopian Journal of Economics, 26(2), 31-58. <https://www.ajol.info/index.php/eje/article/view/177737>
- Development Bank of Ethiopia (DBE) (2020). DBE Independent auditor's report and financial statements as of 30 june 2023. <https://www.dbe.com.et/BusinessPromotion/AnnualReports/AnnualReport2022.pdf>
- Diamond, D. W. (1984). Financial intermediation and delegated monitoring. The review of economic studies, 51(3), 393-414. <https://doi.org/10.2307/2297430>
- Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: Journal of the Econometric Society, 49 (4), 1057–1072. <https://doi.org/10.2307/1912517>
- Dienillah, A. A., Anggraeni, L., & Sahara, S. (2018). Impact of FI on financial stability based on income group countries. Bulletin of Monetary Economics and Banking, 20(4), 429-442. <https://doi.org/10.21098/bemp.v20i4.859>
- Dilek, Durusu-Ciftci. (2019). The Finance-Growth Nexus in the High Performance Asian Economies: A Bootstrap Panel Causality Analysis. Atatürk Üniversitesi 'İktisadi ve 'İdari Bilimler Dergisi 33: 495–514.
- Dinh, T. T. H., Vo, D. H., The Vo, A., & Nguyen, T. C. (2019). Foreign direct investment and economic growth in the short run and long run: Empirical evidence from developing countries. Journal of Risk and Financial Management, 12(4), 176. <https://doi.org/10.3390/jrfm12040176>
- Diniz, Eduardo, Rene Birochi, and Marlei Pozzebon. 2012. Triggers and Barriers to FI: The Use of ICT-Based Branchless Banking in an Amazon County. Electronic Commerce Research and Applications 11: 484–94. <https://doi.org/10.1016/j.elerap.2011.07.006>
- Doolan, D. M., & Froelicher, E. S. (2009). Using an existing data set to answer new research questions: A methodological review. Research and Theory for Nursing Practice: An International Journal, 23(3), 203–215. <http://dx.doi.org/10.1891/1541-6577.23.3.203>
- Dress, T.S. (2022). The Determinants of Financial Stability of Commercial Banks: Empirical Evidence from Ethiopia. J Acc Mark 11(389), <https://www.hilarispublisher.com/open-access/the-determinants-of-financial-stability-of-commercial-banks-empirical-evidence-from-ethiopia.pdf>
- Du, Y., Wang, Q., & Zhou, J. (2023). How does digital inclusive finance affect economic resilience: Evidence from 285 cities in China. International Review of Financial Analysis, 88, 102709. <https://doi.org/10.1016/j.irfa.2023.102709>
- Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Economic Modelling, 29(4), 1450–1460. <https://doi.org/10.1016/j.econmod.2012.02.014>
- Dunn, S. L., Arslanian-Engoren, C., DeKoekkoek, T., Jadack, R., & Scott, L. D. (2015). Secondary Data Analysis as an Efficient and Effective Approach to Nursing Research. Western Journal of Nursing Research, 37(10), 1295–1307. <https://doi.org/10.1177/0193945915570042>
- Ehigiamusoe, K. U., & Samsurijan, M. S. (2021). What matters for finance-growth nexus? A critical survey of macroeconomic stability, institutions, financial and economic development. International Journal of Finance & Economics, 26(4), 5302-5320. <https://doi.org/10.1002/ijfe.2066>
- Elliott, G., Rothenberg, T. J., & Stock, J. H. (1992). Efficient tests for an autoregressive unit root. In: National Bureau of Economic Research Cambridge. <https://www.nber.org/papers/t0130>

- Elsas, R., Hackethal, A., & Holzhäuser, M. (2010). The anatomy of bank diversification. *Journal of Banking & Finance*, 34(6), 1274–1287. <https://doi.org/10.1016/j.jbankfin.2009.11.024>
- Elsayed, A. (2020). The interrelationship between FI, financial stability, financial integrity and consumer protection (I-SIP Theory). *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3745874>
- El-Shazly, A. (2016). Structural breaks and monetary dynamics: A time series analysis. *Economic Modelling*, 53, 133-143. <http://dx.doi.org/10.1016/j.econmod.2015.11.019>
- Emara, N., & El Said, A. (2021). FI and economic growth: The role of governance in selected MENA countries. *International Review of Economics & Finance*, 75, 34-54. <https://doi.org/10.1016/j.iref.2021.03.014>
- Erlando, A., Riyanto, F. D., & Masakazu, S. (2020). FI, economic growth, and poverty alleviation: evidence from eastern Indonesia. *Heliyon*, 6(10). <https://doi.org/10.1016/j.heliyon.2020.e05235>
- Erülgen, A., Rjoub, H., Adalier, A., & Abualrub, A. (2022). FI and bank profitability: Evidence from island banking sector. *Advances in Decision Sciences*, 26(4), 78-97. <https://doi.org/10.47654/v26y2022i4p78-97>
- Espinosa, V. I., Alonso-Neira, M. A., & Huerta de Soto, J. (2023). The Ethics of Fractional-Reserve Banking System: A Private Property Rights Approach. *Economies*, 11(9), 221. <https://doi.org/10.3390/economies11090221>
- Falkena, H., Davel, G., Hawkins, P., Llewellyn, D., Luus, C., Masilela, E., and Shaw, H. (2004) “Competition in South African Banking”, Task Group Report for the National Treasury and the South African Reserve Bank.
- Farhi, E., & Tirole, J. (2012). Collective moral hazard, maturity mismatch, and systemic bailouts. *American Economic Review*, 102, 60–93. <http://dx.doi.org/10.1257/aer.102.1.60>
- Fernández-Olit, B., Martín Martín, J. M., & Porras González, E. (2019). Systematized literature review on FI and exclusion in developed countries. *International Journal of Bank Marketing*, 38(3), 600-626, <http://dx.doi.org/10.1108/IJBM-06-2019-0203>
- Fielding, D., & Regasa, D. (2024). Banking competition and FI: Evidence from Ethiopia. *World Development*, 183, 106733. <https://doi.org/10.1016/j.worlddev.2024.106733>
- Filatie, Y.S. & Sharma, D. (2024). The mediating role of intellectual capital on the nexus between diversification, financial stability and efficiency of commercial banks in Ethiopia. *Managerial Finance*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/MF-02-2024-0083>
- Fiordelisi, F., Marques-Ibanez, D., & Molyneux, P. (2011). Efficiency and risk in European banking. *Journal of banking & finance*, 35(5), 1315-1326. <https://doi.org/10.1016/j.jbankfin.2010.10.005>
- Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of monetary economics*, 32(3), 485-512. <https://doi.org/10.3386/w4565>
- Fisseha, F.L. (2023). Does financial repression inhibit or facilitate private investment? The case of Ethiopia. *Future Business Journal*, vol 9(51), pp 1-14, <https://doi.org/10.1186/s43093-023-00229-w>
- Fitri M., Anwar C.J., Herlina D., Suhendra I., & Didu S. (2025). FI in Developing Countries. *Global Economic Perspectives*, 3 (1). <https://doi.org/10.37155/2972-4813-gep0204-1%C2%A0>
- Fleetwood, S. (2005). Ontology in Organization and Management Studies: A Critical Realist Perspective. *Organization*, 12(2), 197-222. <https://doi.org/10.1177/1350508405051188>
- Folorunsho M. Ajide (2020) “Can FI reduces the presence of corruption? Evidence from selected countries in Africa”, *International Journal of Social Economics* (Emerald Publishing Limited)-Vol. 47 (11), pp 1345-1362
- Fosu, S., Ntim, C. G., Coffie, W., & Murinde, V. (2017). Bank opacity and risk-taking: Evidence from analysts’ forecasts. *Journal of Financial Stability*, 33, 81–95. <https://doi.org/10.1016/j.jfs.2017.10.009>
- Frees, E. W. (1995). Assessing cross-sectional correlation in panel data. *Journal of econometrics*, 69(2), 393-414. [https://doi.org/10.1016/0304-4076\(94\)01658-M](https://doi.org/10.1016/0304-4076(94)01658-M)
- Freudenberg, M. (2003). Composite indicators of country performance: A critical assessment. *STI Working Paper No. 16*. <https://doi.org/10.1787/405566708255>
- Friedman, M. (1937). The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *Journal of the american statistical association*, 32(200), 675-701. <https://doi.org/10.1080/01621459.1937.10503522>

- Furuoka, F. (2018). Is population beneficial to economic growth? An empirical study of China. *Quality & Quantity*, 52(1), 209-225. <https://doi.org/10.1007/s11135-016-0463-6>
- Gambacorta, L., & Mistrulli, P. E. (2004). Does bank capital affect lending behaviour? *Journal of Financial Intermediation*, 13(4), 436–457. <https://doi.org/10.1016/j.jfi.2004.06.001>
- Garry J. Schinasi. (2005). *Safeguarding Financial Stability: Theory and Practice*. <https://doi.org/10.5089/9781589064409.071>
- Gazdar, K., & Cherif, M. (2015). Institutions and the finance–growth nexus: Empirical evidence from MENA countries. *Borsa Istanbul Review*, 15(3), 137-160. <https://doi.org/10.1016/j.bir.2015.06.001>
- Gebremeskel, D. H., Ahlgren, E. O., & Beyene, G. B. (2021). Long-term evolution of energy and electricity demand forecasting: The case of Ethiopia. *Energy Strategy Reviews*, 36, 100671. <https://doi.org/10.1016/j.esr.2021.100671>
- George, A. (1970). The market for lemons: Quality uncertainty and the market mechanism. *The quarterly journal of economics* 84(3): 488-500. <https://doi.org/10.2307/1879431>
- Gharbi, I., & Kammou, A. (2023). Developing a multidimensional FI index: A comparison based on income groups. *Journal of Risk and Financial Management*, 16(6), 296. <https://doi.org/10.3390/jrfm16060296>
- Ghorbani, M., & Chong, E. K. (2020). Stock price prediction using principal components. *PloS one*, 15(3), e0230124. <https://doi.org/10.1371/journal.pone.0230124>
- Ghosh, M. M., & Ghosh, A. (2014) “FI strategies of banks: Study of Indian states”, *International Journal of Applied Financial Management Perspectives*, vol 3(2), pp 990–996.
- Ghosh, S. (2011). Does financial outreach engender economic growth? Evidence from Indian states. *Journal of Indian Business Research*, 3(2), 74-99. <https://doi.org/10.1108/17554191111132206>
- Giday, H. G. (2023). FI and its demand-side determinants: Evidence from Ethiopia. *Cogent Economics & Finance*, 11(1), 2186031. <https://doi.org/10.1080/23322039.2023.2186031>
- Grant, C. (2011) “Diversifying and transforming the doctoral studies terrain: A student’s experience of a thesis by publication”, *Alternation*, 18(2), 245–267.
- Greenacre, M., Groenen, P. J., Hastie, T., d’Enza, A. I., Markos, A., & Tuzhilina, E. (2022). Principal component analysis. *Nature Reviews Methods Primers*, 2(1), 100. <https://doi.org/10.1038/s43586-022-00184-w>
- Greene, W. H. (2003). *Econometric analysis*. Prentice Hall google schola, 3, 116-125.
- Gujarati, D. N., Porter, D. C., & Gunasekar, S. (2012). *Basic Econometrics*. Tata McGraw-Hill Education. <https://doi.org/10.1007/s10490-019-09672-2>
- Gunasekara, H. U., & Kumari, P. (2018). Factors affecting deposit mobilization in Sri Lanka. *International Review of Management and Marketing*, 8(5), 30-42. <https://www.econjournals.com/index.php/irmm/article/view/5887>
- Guo, F., & He, S. (2019). The finance-growth nexus in China: a meta-analysis. *Applied Economics Letters*, 27(13), 1071–1075. <https://doi.org/10.1080/13504851.2019.1659926>
- Gupta, J., & Kashiramka, S. (2020). Financial stability of banks in India: does liquidity creation matter?. *Pacific-Basin Finance Journal*, 64, 101439. <https://doi.org/10.1016/j.pacfin.2020.101439>
- Gupta, K., & Raman, T. V. (2020). Intellectual capital: A determinant of firms’ operational efficiency. *South Asian Journal of Business Studies*, 10(1), 49–69. <https://doi.org/10.1108/SAJBS-11-2019-0207>
- Ha, D., & Nguyen, Y. (2023). Institutional quality’s influence on FI’impact on bank stability. *Cogent Economics & Finance*, 11(1), <https://doi.org/10.1080/23322039.2023.2190212>
- Habib, M. M., Mileva, E., & Stracca, L. (2017). The real exchange rate and economic growth: Revisiting the case using external instruments. *Journal of International Money and Finance*, 73, 386-398. <https://doi.org/10.1016/j.jimonfin.2017.02.014>
- Hahn, J., & Shi, R. (2021). Breusch and Pagan’s (1980) Test Revisited (No. 202110), <https://economics.ucr.edu/repec/ucr/wpaper/202110.pdf>
- Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2019). *Multivariate Data Analysis*. 8th Edition, Cengage Learning EMEA
- Hakim, F. (2017). The Influence of Non-Performing Loan and Loan to Deposit Ratio on the Level of Conventional Bank Health in Indonesia. *Arthatama*, 1(1), 35–49, <https://journal.lifescifi.com/index.php/art/article/view/214>

- Hamdy, A., & Hussein, W. B. (2016). Credit risk assessment model based using principal component analysis and artificial neural network. In MATEC Web of Conferences (Vol. 76, p. 02039). EDP Sciences. <https://doi.org/10.1051/mateconf/20167602039>
- Hanivan, H., & Nasrudin, M. (2019). A FI index for Indonesia. *Bulletin of Monetary Economics and Banking*, 22(3), 1-16. <https://doi.org/10.21098/bemp.v22i3.1056>
- Hannig, A., & Jansen, S. (2010). FI and financial stability: Current policy issues. ADBI Working Paper No. 259, <https://dx.doi.org/10.2139/ssrn.1729122>
- Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica* 50: 1029–1054.
- Harris, R. D., & Tzavalis, E. (1999). Inference for unit roots in dynamic panels where the time dimension is fixed. *Journal of econometrics*, 91(2), 201-226. [https://doi.org/10.1016/S0304-4076\(98\)00076-1](https://doi.org/10.1016/S0304-4076(98)00076-1)
- Hartmann, Philipp; Heider, Florian; Papaioannou, Elias; Lo Duca, Marco (2007) "The role of financial markets and innovation in productivity and growth in Europe"
- Hassan, A., (2024). Mobile Financial Services and the Shadow Economy in Southern African Countries: Does Regulatory Quality Matter? *International Journal of Financial Studies* 12: 115. <https://doi.org/10.3390/ijfs12040115>
- Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of economics and finance*, 51(1), 88-104. <https://doi.org/10.1016/j.qref.2010.09.001>
- Hatmanu, M., Cautisanu, C., & Ifrim, M. (2020). The impact of interest rate, exchange rate and European business climate on economic growth in Romania: An ARDL approach with structural breaks. *Sustainability*, 12(7), 2798. <https://doi.org/10.3390/su12072798>
- Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, 12, 1–25. <https://doi.org/10.1007/s10887-006-9009-4>
- Heffernan, S. A. (1996). *Modern banking in theory and practice*. Chichester: John Wiley and Sons. <https://lccn.loc.gov/95044830>
- Hemrit, W. (2021). Does insurance demand react to economic policy uncertainty and geopolitical risk? Evidence from Saudi Arabia. *The Geneva papers on risk and insurance. Issues and practice*, 47(2), 460. <https://doi.org/10.1057/s41288-021-00229-3>
- Hendriks, S. (2019) "The role of FI in driving women's economic empowerment", *Development in Practice*, vol 29(8), pp 1029–1038, <https://doi.org/10.1080/09614524.2019.1660308>
- Herzer, D., Strulik, H., & Vollmer, S. (2012). The long-run determinants of fertility: one century of demographic change 1900–1999. *Journal of Economic Growth*, 17, 357-385. <https://doi.org/10.1007/s10887-012-9085-6>
- Hill, T. D., Davis, A. P., Roos, J. M., & French, M. T. (2020). Limitations of Fixed-Effects Models for Panel Data. *Sociological Perspectives*, 63(3), 357-369. <https://doi.org/10.1177/0731121419863785>
- Hossain, M. A., Acet, H., Ahmed, Z., & Majumder, A. (2021). Revisiting inflation and growth nexus in Bangladesh: an asymmetric cointegration based on non-linear ARDL approach. *Revista Finanzas y Política Económica*, 13(2), 371-402. <https://doi.org/10.14718/revfinanzpolitecon.v13.n2.2021.5>
- Hotelling H. (1933). Analysis of a complex of statistical variables into principal components. *Journal of Educational Psychology* 24(6):417–441. <https://psycnet.apa.org/doi/10.1037/h0071325>
- Hox, J. J. (2013). Multilevel regression and multilevel structural equation modeling. In T. D. Little (Ed.), *The Oxford handbook of quantitative methods in psychology: Statistical analysis* (Vol. 2, pp. 491-516). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199934898.013.0014>
- Hua, X., Bi, J., & Shi, H. (2023). The appropriate level of FI: The perspective of financial stability. *China Economic Quarterly International*, 3(3), 167-178, <https://doi.org/10.1016/j.ceqi.2023.08.001>
- Huang, H. C., & Lin, S. C. (2009). Non-linear finance–growth nexus: A threshold with instrumental variable approach 1. *Economics of Transition*, 17(3), 439-466. <https://doi.org/10.1111/j.1468-0351.2009.00360.x>
- Huang, Y., & Zhang, Y. (2019). FI and urban-rural income inequality: Long-run and short-run relationships. *Emerging Markets Finance and Trade*, 56(2), 1-15. <https://doi.org/10.1080/1540496x.2018.156>

- Humphrey, T. M. (1986). The theory of multiple expansion of deposits: what it is and whence it came. <https://fraser.stlouisfed.org/title/economic-quarterly-federal-reserve-bank-richmond-960/march-april-1987-477341/theory-multiple-expansion-deposits-501743>
- Hundie, S. K., & Tulu, D. T. (2023). Determinants of FI gender gap in Ethiopia: Evidence from decomposition analysis. *Cogent Business & Management*, 10(2), 2238124. <https://doi.org/10.21203/rs.3.rs-746583/v1>
- Huong, N. T. T. (2018). The Impact of FI on Monetary Policy: A Case Study in Vietnam. *Journal of Economics and Development* 20 (2): 5–22. <https://doi.org/10.33301/JED-P-2018-20-02-01>
- Hussain, S., Rehman, A. ur, Ullah, S., Waheed, A., & Hassan, S. (2024). FI and Economic Growth: Comparative Panel Evidence from Developed and Developing Asian Countries. *Sage Open*, 14(1). <https://doi.org/10.1177/21582440241232585>
- Hussen, M. S., & Mohamed, M. A. (2023). Impact of FI on household welfare in Ethiopia. *Future Business Journal*, 9(1), 67. <https://doi.org/10.1186/s43093-023-00243-y>
- Huynh, J., & Dang, V. D. (2021). Loan portfolio diversification and bank returns: Do business models and market power matter?. *Cogent Economics & Finance*, 9(1), 1891709. <https://doi.org/10.1080/23322039.2021.1891709>
- Huynh, T. L. D., Nasir, M. A., Nguyen, S. P., & Duong, D. (2020). An assessment of contagion risks in the banking system using non-parametric and Copula approaches. *Economic Analysis and Policy*, 65, 105-116. <https://doi.org/10.1016/j.eap.2019.11.007>
- Hye, Q. M. A. (2012). Long term effect of trade openness on economic growth in case of Pakistan, *Quality & Quantity* 46(4): 1137–1149. <http://dx.doi.org/10.1007/s11135-011-9612-0>
- Hye, Q. M. A., & Lau, W. Y. (2015). Trade openness and economic growth: empirical evidence from India. *Journal of Business Economics and Management*, 16(1), 188-205. <https://doi.org/10.3846/16111699.2012.720587>
- Ibrahim & Alagidede (2017). Financial sector development, economic volatility and shocks in sub-saharan Africa.
- Ifediora, C., Kenekchukwu Onochie Offor, Eze Festus Eze, Samuel Manyo Takon, Anthony Eboselume Ageme, Godwin Imo Ibe & Josaphat U. J. Onwumere (2022). FI and its impact on economic growth: Empirical evidence from sub-Saharan Africa, *Cogent Economics & Finance*, 10:1, 2060551. <https://doi.org/10.1080/23322039.2022.2060551>
- Ingrassia, S., Costanzo, G.D. (2005). Functional Principal Component Analysis of Financial Time Series. In: Bock, HH., et al. *New Developments in Classification and Data Analysis*. Studies in Classification, Data Analysis, and Knowledge Organization. Springer, Berlin, Heidelberg. https://doi.org/10.1007/3-540-27373-5_42
- Inoue, T., & Hamori, S. (2012). How has financial deepening affected poverty reduction in India? Empirical analysis using state-level panel data. *Applied Financial Economics*, 22(5), 395-408. <https://doi.org/10.1080/09603107.2011.613764>
- International Monetary Fund (2020) “Technical assistance report—financial soundness indicators mission”, Country Report No. 20/323, accessed 24 February 2024 from <https://www.imf.org/-/media/Files/Publications/CR/2020/English/1ETHEA2020003.ashx>
- International Monetary Fund (IMF) (2020). Technical assistance report—financial soundness indicators mission. Country Report No. 20/323. <https://www.imf.org/-/media/Files/Publications/CR/2020/English/1ETHEA2020003.ashx>
- Iryna Didenko, Tetiana Vasilyeva, Olga Osadcha, Kateryna Shymanska (2022) “The influence of the FI of the population on the level of illegally income in countries with different levels of economic development”, *Fінансово-кредитна діал'ніст': проблеми теорії та практики*, Vol. 6 (41), pp 268-276, <https://doi.org/10.18371/fcaptp.v6i41.251452>
- Isayas, Y. N. (2022). Determinants of banks' profitability: Empirical evidence from banks in Ethiopia. *Cogent economics & finance*, 10(1), 2031433. <https://doi.org/10.1080/23322039.2022.2031433>
- Isayas, Y. N., & McMillan, D. (2021). Financial distress and its determinants: Evi-dence from insurance companies in Ethiopia. *Cogent Business & Manage-ment*, 8(1). <https://doi.org/10.1080/23311975.2021.1951110>

- Islam, M. S., Alsaif, S. S., & Alsaif, T. (2022). Trade Openness, Government Consumption, and Economic Growth Nexus in Saudi Arabia: ARDL Cointegration Approach. *SAGE Open*, 12(2), 21582440221096661. <https://doi.org/10.1177/21582440221096661>
- Ismael, D. M., & Ali, S. S. (2021). Measuring digital and traditional FI in Egypt: A new index. *International Journal of Applied Research in Management and Economics*, 4(2), 13-34. <https://doi.org/10.33422/ijarme.v4i2.629>
- Issaka, J. Y., Anarfo, E. B., & Aveh, F. K. (2020). FI and bank profitability in Sub-Saharan Africa. *International Journal of Finance & Economics*, 27, 32-44. <https://doi.org/10.1002/ijfe.2135>
- Izaguirre, Juan Carlos. (2020). Making Consumer Protection Regulation More Customer Centric. Washington, DC: CGAP. Washington, DC: World Bank.
- Jacobs, R., Smith, P., & Goddard, M. (2004). Measuring performance: an examination of composite performance indicators. *CHE Technical Paper Series* 29, <https://pure.york.ac.uk/portal/en/publications/measuring-performance-an-examination-of-composite-performance-ind>
- Jain, P., Upadhyay, D., & Purswani, G. (2021). Digital FI: Strategic issues and imperatives. *FI in Emerging Markets: A Road Map for Sustainable Growth*, 297-309. https://doi.org/10.1007/978-981-16-2652-4_15
- Jajah I.Y., Anarfo EB, & Aveh FK (2022). FI and bank profitability in Sub-Saharan Africa. *Int J Fin Econ*. 27: 32–44. <https://doi.org/10.1002/ijfe.2135>
- Jakab, Z., & Kumhof, M. (2014). Models of banking: loanable funds or loans that create funds?. Available at SSRN 2474759. <https://dx.doi.org/10.2139/ssrn.2474759>
- Jalil, A., & Rauf, A. (2021). Revisiting the link between trade openness and economic growth using panel methods. *The Journal of International Trade & Economic Development*, 30(8), 1168–1187. <https://doi.org/10.1080/09638199.2021.1938638>
- Janićijević, S., Mizdraković, V., & Kljajić, M. (2022). Principal Component Analysis in Financial Data Science. *IntechOpen*. <http://dx.doi.org/10.5772/intechopen.102928>
- Jiang, C., & Ma, X. (2019). The impact of financial development on carbon emissions: A Global Perspective. *Sustainability*, 11(19), 5241. <https://doi.org/10.3390/su11195241>
- Jima, M. D., & Makoni, P. L. (2023). Determinants of Sustainable FI in Sub-Saharan Africa: A System GMM Approach. *Prague Economic Papers*, 32(6). <https://doi.org/10.18267/j.pep.845>
- Jima, M. D., & Makoni, P. L. (2023). FI and Economic Growth in Sub-Saharan Africa—A Panel ARDL and Granger Non-Causality Approach. *Journal of Risk and Financial Management*, 16(6), 299. <https://doi.org/10.3390/jrfm16060299>
- Jima, M.D.; Makoni, P.L. 2023. Causality between FI, Financial Stability and Economic Growth in Sub-Saharan Africa. *Sustainability*, 15, 1152. <https://doi.org/10.3390/su15021152>
- Johnson, B. & Christensen, L. (2012). Educational Research, Qualitative, Quantitative and Mixed Approach. 4th Ed. California: SAGE Publication.
- Joint Research Centre (JRC) (2008). Handbook on constructing composite indicators: Methodology and user guide. OECD publishing. <https://doi.org/10.1787/9789264043466-en>
- Jolliffe, I. T., & Cadima, J. (2016). Principal component analysis: A review and recent developments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2065). <https://doi.org/10.1098/rsta.2015.0202>
- Jones, C. I. (1999). Growth: With or without scale effects? *American Economic Review*, 89(2), 139-144. <https://doi.org/10.1257/aer.89.2.139>
- Joseph, M. T., Edson, G., Manuere, F., Clifford, M., Michael, K., & Kamoyo, M. (2012). Non-performing loans in commercial banks: a case of CBZ Bank Limited in Zimbabwe. *Interdisciplinary Journal of Contemporary Research in Business*, 4(7), 467-488. https://www.academia.edu/97059900/Non_Performing_loans_in_Commercial_Banks_A_case_of_CBZ_Bank_Limited_In_Zimbabwe?auto=download
- Jung, W. S. (1986). Financial development and economic growth: international evidence. *Economic Development and cultural change*, 34(2), 333-346. <https://doi.org/10.1086/451531>

- Jungo, J., Madaleno, M., & Botelho, A. (2022). The effect of FI and competitiveness on financial stability: why financial regulation matters in developing countries?. *Journal of Risk and Financial Management*, 15(3), 122. <https://doi.org/10.3390/jrfm15030122>
- Juodis, A., Karavias, Y. & Sarafidis, V. (2021). A homogeneous approach to testing for Granger non-causality in heterogeneous panels. *Empir Econ* 60, 93–112 (2021). <https://doi.org/10.1007/s00181-020-01970-9>
- Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement*, 20, 141-151. <https://doi.org/10.1177/001316446002000116>
- Kalsie, A., & Arora, A. (2019). Structural break, US financial crisis and macroeconomic time series: Evidence from BRICS economies. *Transnational Corporations Review*, 11(3), 250-264. <https://doi.org/10.1080/19186444.2018.1475087>
- Kanungo, R. P., & Gupta, S. (2021). FI through digitalisation of services for well-being. *Technological Forecasting and Social Change*, 167, 120721. <https://doi.org/10.1016/j.techfore.2021.120721>
- Kappeler, A., Ashiagbor, D., Minsat, A., Deiana, R., & Nguyen Quoc, T. (2018). Banking in Africa: Delivering on FI, Supporting Financial Stability 2018 (European Investment Bank), https://www.eib.org/attachments/efs/economic_report_banking_africa_2018_en.pdf
- Kar, M., Nazhoğlu, Ş., & Ağır, H. (2011). Financial development and economic growth nexus in the MENA countries: Bootstrap panel granger causality analysis. *Economic modelling*, 28(1-2), 685-693. <https://doi.org/10.1016/j.econmod.2010.05.015>
- Karim, Z. A., Nizam, R., Law, S. H., & Hassan, M. K. (2022). Does financial inclusiveness affect economic growth? New evidence using a dynamic panel threshold regression. *Finance Research Letters*, 46, 102364. <https://doi.org/10.1016/j.frl.2021.102364>
- Karlan, D., Kendall, J., Mann, R., Pande, R., Suri, T., & Zinman, J. (2016). Research and impacts of digital financial services. NBER Working Paper 22633, National Bureau of Economic Research, Cambridge., <http://www.nber.org/papers/w22633>
- Karlsson, H. K., Månsson, K., & Hacker, S. (2021). Revisiting the nexus of the financial development and economic development: new international evidence using a wavelet approach. *Empirical Economics*, 60, 2323-2350. <https://doi.org/10.1007/s00181-020-01885-5>
- Kasman, A., & Carvalho, O. (2014). Financial stability, competition and efficiency in Latin American and Caribbean banking. *Journal of Applied Economics*, 17(2), 301–324. [https://doi.org/10.1016/S1514-0326\(14\)60014-3](https://doi.org/10.1016/S1514-0326(14)60014-3)
- Kassi, D. F., Li, Y., Ngangoin, Y. T., N'Drin, M. G.-R., Gnahe, F. E., & Edjoukou, A. J. R. (2023). Investigating the Finance-Energy-Growth Trilogy in Sub-Saharan Africa: Evidence from the NARDL Framework. *SAGE Open*, 13(1), 21582440221149714. <https://doi.org/10.1177/2158244022114971>
- Kebede, J. G., Selvanathan, S., & Naranpanawa, A. (2024). Financial stability and FI: a non-linear nexus. *Journal of Economic Studies*. <https://doi.org/10.1108/JES-09-2023-0488>
- Kebede, J., Naranpanawa, A., & Selvanathan, S. (2021). FI: Measures and applications to Africa. *Economic Analysis and Policy*, 70, 365-379. <https://doi.org/10.1016/j.eap.2021.03.008>
- Kebede, T.N., Erana, O.T., & Tesfaye, G.D. (2024). Determinants of financial distress: evidence from insurance companies in Ethiopia. *Journal of Innovation and Entrepreneurship*, 13(17), 1-23, <https://doi.org/10.1186/s13731-024-00369-5>
- Keho, Y. (2017). The impact of trade openness on economic growth: The case of Cote d'Ivoire. *Cogent Economics & Finance*, 5(1), 1332820. <https://doi.org/10.1080/23322039.2017.1332820>
- Kempson, E., Atkinson, A., & Pilley, O. (2004). Policy level response to financial exclusion in developed economies: Lessons for developing countries. Report of Personal Finance Research Centre, University of Bristol.
- Kennedy, P. (2008). *A Guide to Econometrics*. Wiley-Blackwell Publishing, Malden, MA.
- Khalid, U., & Shafiullah, M. (2021). Financial development and governance: A panel data analysis incorporating cross-sectional dependence. *Economic Systems*, 45(2), 100855. <https://doi.org/10.1016/j.ecosys.2021.100855>
- Khan, H. R. (2011). FI and financial stability: are they two sides of the same coin. Address by Shri HR Khan, Deputy Governor of the Reserve Bank of India, at BANCON, 1-12. <https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/06SPBUL120312.pdf>

- Khan, I., & Khan, I. (2024). FI matter for poverty, income inequality and financial stability in developing countries: new evidence from public good theory. *International Journal of Emerging Markets*, 19(11), 3561-3580. <https://doi.org/10.1108/IJOEM-10-2021-1627>
- Khatib, S. F., Hendrawaty, E., Bazhair, A. H., Rahma, I. A. A., & Al Amosh, H. (2022). FI and the performance of banking sector in Palestine. *Economies*, 10(10), 247. <https://doi.org/10.3390/economies10100247>
- Khémiri, W., Chafai, A., Attia, E. F., Tobar, R., & Farid Fouad, H. (2024). Trade-off between FI and Islamic bank stability in five GCC countries: the moderating effect of CSR. *Cogent Business & Management*, 11(1), 2300524. <https://doi.org/10.1080/23311975.2023.2300524>
- Kim, D. H. (2011). Trade, growth and income. *The Journal of International Trade & Economic Development*, 20(5), 677-709. <https://doi.org/10.1080/09638199.2011.538966>
- Kim, D. H., Lin, S. C., & Suen, Y. B. (2011). Nonlinearity between trade openness and economic development. *Review of Development Economics*, 15(2), 279-292. <https://doi.org/10.1111/j.1467-9361.2011.00608.x>
- Kim, D. W., Yu, J. S., & Hassan, M. K. (2018). FI and economic growth in OIC countries. *Research in International Business and Finance*, 43, 1-14. <https://doi.org/10.1016/j.ribaf.2017.07.178>
- Kim, H., Batten, J. A., & Ryu, D. (2020). Financial crisis, bank diversification, and financial stability: OECD countries. *International Review of Economics & Finance*, 65, 94-104. <https://doi.org/10.1016/j.iref.2019.08.009>
- King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *The quarterly journal of economics*, 108(3), 717-737. <https://doi.org/10.2307/2118406>
- Kirikkaleli, D., & Alola, A. A. (2023). The regime switching evidence of financial-economic-political risk in Turkey. *Quality & Quantity*, 57(4), 3747-3762. <https://doi.org/10.1007/s11135-022-01529-z>
- Kirkley, J., Squires, D., & Strand, I. E. (1998). Characterizing managerial skill and technical efficiency in a fishery. *Journal of Productivity Analysis*, 9(2), 145-160. <https://doi.org/10.1023/a:1018308617630>
- Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). Guilford publications.
- Koefer, F., Bokkens, A., Preziuso, M., & Ehrenhard, M. (2024). Addressing financial and digital literacy challenges for inclusive finance: Insights from microfinance institutions and fintech organisations. *EIF Working Paper* No 2024/97. https://www.eif.org/news_centre/publications/EIF_Working_Paper_2024_97.htm
- Koh, F., Phoon, K. F., and Ha, C. D., (2018) "Chapter 15 - Digital FI in South East Asia," in D. L. K. Chuen and R. Deng (Eds.), *Handbook of Blockchain, Digital Finance, and Inclusion*, Volume 2, Academic Press, pp. 387-403. ISBN 9780128122822. Available at: <https://doi.org/10.1016/B978-0-12-812282-2.00015-2>
- Koker, L. D., & Jentzsch, N. (2013). FI and financial integrity: Aligned incentives? *World Development*. 44, 267-280. <https://doi.org/10.1016/j.worlddev.2012.11.002>
- Koomson, I., Villano, R. A., & Hadley, D. (2020). Effect of FI on poverty and vulnerability to poverty: Evidence using a multidimensional measure of FI. *Social Indicators Research*, 149(2), 613-639. <https://doi.org/10.1007/s11205-019-02263-0>
- Korley, M., & Giouvris, E. (2021). The regime-switching behaviour of exchange rates and frontier stock market prices in Sub-Saharan Africa. *Journal of Risk and Financial Management*, 14(3), 122. <https://doi.org/10.3390/jrfm14030122>
- Kothari, C.R. (2004) *Research Methodology: Methods and Techniques*. 2nd Edition, New Age International Publishers, New Delhi.
- Koudalo, Y. M., & Toure, M. (2023). Does FI promote financial stability? Evidence from Africa. *Cogent Economics & Finance*, 11(2), <https://doi.org/10.1080/23322039.2023.2225327>
- Kremer, M. (1993). Population growth and technological change: One million BC to 1990. *The quarterly journal of economics*, 108(3), 681-716. <https://doi.org/10.2307/2118405>
- Kulu E., & Bondzie, E.A., 2024. Mobile money, credit to deposit ratio and mone-tary policy: Empirics from Ghana, 16(3), 1-12, <https://doi.org/10.1016/j.tncr.2024.200060>
- Kumar, R., (2014). Chapter 3 - Risks Inherent in Financial Institutions, Editor(s): Rajesh Kumar, *Strategies of Banks and Other Financial Institutions*, Academic Press. <https://doi.org/10.1016/B978-0-12-416997-5.00003-8>

- Kumar, R., (2016). Perspectives on value and valuation. <https://doi.org/10.1016/B978-0-12-802303-7.00001-2>
- Kumar, S. S., & Jie, Q. (2023). Exploring the role of FI in poverty reduction: An empirical study. *World Development Sustainability*, 3, 100103. <https://doi.org/10.1016/j.wds.2023.100103>
- Kumar, V., Thrikawala, S., & Acharya, S. (2021). FI and bank profitability: Evidence from a developed market. *Global Finance Journal*, 53, 100609. <https://doi.org/10.1016/j.gfj.2021.100609>
- Kumar, V., Thrikawala, S., & Acharya, S. (2022). FI and bank profitability: Evidence from a developed market. *Global Finance Journal*, 53, 100609. <https://doi.org/10.1016/j.gfj.2021.100609>
- Kurita, T. (2019). Principal component analysis (PCA). *Computer vision: a reference guide*, 1-4. https://doi.org/10.1007/978-3-030-03243-2_649-1
- Kyophilavong, P., Uddin, G. S., & Shahbaz, M. (2016). The nexus between financial development and economic growth in Lao PDR. *Global Business Review*, 17(2), 303-317. <https://doi.org/10.1177/0972150915619809>
- Kyriazos, T., & Poga, M. (2023). Dealing with multicollinearity in factor analysis: the problem, detections, and solutions. *Open Journal of Statistics*, 13(3), 404-424. <https://doi.org/10.4236/ojs.2023.133020>
- Lakew, B. T., & Azadi, H. (2020). FI in Ethiopia: is it on the right track?. *International journal of financial studies*, 8(2), 28. <https://doi.org/10.3390/ijfs8020028>
- Lal, T. (2018). Impact of FI on poverty alleviation through cooperative banks. *International Journal of Social Economics*, 45(5), 808–828. <https://doi.org/10.1108/IJSE-05-2017-0194>
- Laura Cabeza-Garcia, Esther B. Del Brio, and Mery Luz Oscanoa-Victorio (2019) “Female FI and its impacts on inclusive economic development”, *Women's Studies International Forum*, Volume 77, 102300, ISSN 0277-5395, <https://doi.org/10.1016/j.wsif.2019.102300>
- Law, S. H., & Singh, N. (2014). Does too much finance harm economic growth?. *Journal of Banking & Finance*, 41, 36-44. <https://doi.org/10.1016/j.jbankfin.2013.12.020>
- Law, S. H., Lee, W. C., & Singh, N. (2018). Revisiting the finance-innovation nexus: Evidence from a non-linear approach. *Journal of Innovation & Knowledge*, 3(3), 143-153. <https://doi.org/10.1016/j.jik.2017.02.001>
- Law, S. W. (2021). FI and Virtual Bank in the Era of Digitalisation: A Regulatory Case Study in Hong Kong. *SocioEconomic Challenges*, 5(3), 81-91. [https://doi.org/10.21272/sec.5\(3\).81-91.2021](https://doi.org/10.21272/sec.5(3).81-91.2021)
- Le Q. H., Ho H. L., and Mai N. C., (2019). The impact of FI on income inequality in transition economies. *Manag. Sci. Lett.*, 9(5), 661–672. <https://doi.org/10.5267/j.msl.2019.2.005>
- Le, T. H., Chuc, A. T., & Taghizadeh-Hesary, F. (2019). FI and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review*, 19(4), 310-322. <https://doi.org/10.1016/j.bir.2019.07.002>
- Le, T.-H., Chuc, A. T., & Taghizadeh-Hesary, F. (2019). FI and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review*, 19(4), 310-322. <https://doi.org/10.1016/j.bir.2019.07.002>
- Lechthaler, W., & Mileva, M. (2024). Trade liberalization, wage inequality, and monetary policy. *Journal of International Money and Finance*, 143, 103065. <https://doi.org/10.1016/j.jimonfin.2024.103065>
- Lee, C. C., Olasehinde-Williams, G., & Olanipekun, I. (2021). Financial systems, regulatory quality, and economic growth. *The Journal of International Trade & Economic Development*, 30(2), 246-274. <https://doi.org/10.1080/09638199.2020.1847172>
- Lee, J. and Strazicich, M.C. (2003) Minimum LM Unit Root Test with Two Structural Breaks. *Review of Economics and Statistics*, 85, 1082-1089. <http://dx.doi.org/10.1162/003465303772815961>
- Leedy, P., & Ormrod, J. (2001). *Practical Research: Planning and Design* (7th ed.). Upper Saddle River, NJ: Merrill Prentice Hall.
- Lenka S. K. and Sharma R., (2017). Does FI Spur Economic Growth in India?. *J. Dev. Areas*, 51(1), 15–228,. <https://doi.org/10.1353/jda.2017.0069>
- Lenka, S. K. (2021). Relationship between FI and financial development in India: Is there any link?, *Journal of Public Affairs*, e2722. <https://doi.org/10.1002/pa.2722>
- Lenka, S. K., & Barik, R. (2018). Has expansion of mobile phone and internet use spurred FI in the SAARC countries? *Financial Innovation*, 4(5). <https://doi.org/10.1186/s40854-018-0089-x>

- Leszczensky, L., & Wolbring, T. (2022). How to Deal With Reverse Causality Using Panel Data? Recommendations for Researchers Based on a Simulation Study. *Sociological Methods & Research*, 51(2), 837-865. <https://doi.org/10.1177/0049124119882473>
- Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, 108(1), 1-24. [https://doi.org/10.1016/S0304-4076\(01\)00098-7](https://doi.org/10.1016/S0304-4076(01)00098-7)
- Levine, R. (1997). Financial development and economic growth: views and agenda. *Journal of economic literature*, 35(2), 688-726. <https://www.jstor.org/stable/2729790>
- Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth*, 1(A), 865–934. Elsevier. [https://doi.org/10.1016/S1574-0684\(05\)01012-9](https://doi.org/10.1016/S1574-0684(05)01012-9)
- Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion, & S. N. Durlauf (Eds.), *Handbook of economic growth*. Amsterdam: Elsevier. [https://doi.org/10.1016/S1574-0684\(05\)01012-9](https://doi.org/10.1016/S1574-0684(05)01012-9)
- Levine, R., & Zervos, S. (1998). Stock markets, banks, and economic growth. *American Economic Review*, 88, 537–558. <https://www.jstor.org/stable/116848>
- Levy-Yeyati, E., Sturzenegger, F., & Gluzmann, P. A. (2013). Fear of appreciation. *Journal of Development Economics*, 101, 233-247. <https://doi.org/10.1016/j.jdeveco.2012.11.008>
- Li, H., & Zhang, J. (2007). Do high birth rates hamper economic growth?. *The Review of Economics and Statistics*, 89(1), 110-117. <https://doi.org/10.1162/rest.89.1.110>
- Li, L., Li, M., & Wu, C. (2013). Production efficiency evaluation of energy companies based on the improved super-efficiency data envelopment analysis considering undesirable outputs. *Mathematical and Computer Modelling*, 58(5-6), 1057-1067. <https://doi.org/10.1016/j.mcm.2012.07.001>
- Li, Y., & Zhang, Q. (2011). The application of principal component analysis on financial analysis in real estate listed company. *Procedia Engineering*, 15, 4499-4503. <https://doi.org/10.1016/j.proeng.2011.08.845>
- Licensing and Authorization of Payment Instrument Issuers Directive No. ONPS/01/2020 and ONPS/09/2023
- Lichtman M. (2013). *Qualitative research in education: A user's guide* (3rd ed.). Thousand Oaks, CA: Sage. https://scholar.google.com/scholar_lookup?title=Qualitative+research+in+education%3A+A+user%27s+guide&publication_year=2013
- Lien, D., Zhang, J., & Yu, X. (2022). Effects of economic policy uncertainty: A regime switching connectedness approach. *Economic Modelling*, 113, 105879. <https://doi.org/10.1016/j.econmod.2022.105879>
- Lim, W. M. (2023). Philosophy of science and research paradigm for business research in the transformative age of automation, digitalization, hyperconnectivity, obligations, globalization and sustainability. *Journal of Trade Science*, 11(2/3), 3–30. Emerald. <https://doi.org/10.1108/jts-07-2023-0015>
- Limits on Birr and foreign currency holding in the territory of Ethiopia, Directive No. FXD/49/2017 and FXD/81/2022
- Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences, revisited. *The Sage handbook of qualitative research*, 4, 97-128.
- Lind, J. T., & Mehlum, H. (2010). With or without U? The appropriate test for a U-shaped relationship. *Oxford bulletin of economics and statistics*, 72(1), 109-118. <https://doi.org/10.1111/j.1468-0084.2009.00569.x>
- Lisa Chauvet & Luc Jacolin, (2015) "FI and Firms performance", <https://ideas.repec.org/p/hal/journal/hal-01516871.html>
- Liu, Y. D., Wu, Q. L., & Yuan, F. (2020). Financial Performance Evaluation of Listed Companies in Anhui Province Based on Principal Component Analysis. *Open Journal of Social Sciences*, 8, 293-303. <https://doi.org/10.4236/jss.2020.85021>
- Lockwood, B. (2004). How robust is the foreign policy/Kearney globalization index? *The World Economy*, 27(4), 507–523. <https://doi.org/10.1111/j.0378-5920.2004.00611.x>
- López, H.M. (2017). Trade liberalization and premature deindustrialization in Colombia. *Journal of Economic Structures*, 6(1), 30. <https://doi.org/10.1186/s40008-017-0095-6>
- López, T., & Winkler, A. (2019). Does FI mitigate credit boom-bust cycles?. *Journal of Financial Stability*, 43, 116-129. <https://doi.org/10.1016/j.jfs.2019.06.001>

- López-Penabad, M. C., Iglesias-Casal, A., & Neto, J. F. S. (2022). Effects of a negative interest rate policy in bank profitability and risk taking: Evidence from European banks. *Research in International Business and Finance*, 60, 101597. <https://doi.org/10.1016/j.ribaf.2021.101597>
- Louis de Koker and Nicola Jentzsch (2013). FI and Financial Integrity: Aligned Incentives?. *World Development* (Elsevier), 44, 267-280. <https://doi.org/10.1016/j.worlddev.2012.11.002>
- Lovreta, L., & López P.J. (2020). Structural breaks in the interaction between bank and sovereign default risk. *SERIEs*, 11(4), 531-559. <https://doi.org/10.1007/s13209-020-00219-z>
- Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, 22(1), 3-42. [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)
- Lumsdaine, R.L., & Papell, D.H. (1997). Multiple trend breaks and the unit root hypothesis'. *Review of Economics and Statistics*, 79, 212–218. <https://doi.org/10.1162/003465397556791>
- Maćkiewicz, A., & Ratajczak, W. (1993). Principal components analysis (PCA). *Computers & Geosciences*, 19(3), 303-342. [https://doi.org/10.1016/0098-3004\(93\)90090-R](https://doi.org/10.1016/0098-3004(93)90090-R)
- Madurapperuma, W. (2023). Money supply, inflation and economic growth of Sri Lanka: co-integration and causality analysis. *Journal of Money and Business*, 3(2), 227-236. <https://doi.org/10.1108/JMB-08-2022-0039>
- Maity, S. (2023). FI also leads to social inclusion—myth or reality? Evidences from self-help groups led microfinance of Assam. *J Innov Entrep* 12, 42. <https://doi.org/10.1186/s13731-023-00307-x>
- Maity, S., & Sahu, T. N. (2020). Role of public sector banks towards financial inclusion during pre and post introduction of PMJDY : A study on efficiency review. *Rajagiri Management Journal*, 14(2), 95–105. <https://doi.org/10.1108/RAMJ-03-2020-0009>
- Maksimović, Jelena & Evtimov, Jelena (2023). Positivism and post-positivism as the basis of quantitative research in pedagogy. *Research in Pedagogy*, 13, 208-218. <https://doi.10.5937/IstrPed2301208M>
- Malik, A. H., bin Md Isa, A. H., bin Jais, M., Rehman, A. U., & Khan, M. A. (2022). Financial stability of Asian Nations: Governance quality and FI. *Borsa Istanbul Review*, 22(2), 377-387. <https://doi.org/10.1016/j.bir.2021.05.005>
- Mani, P., Nyamute, W., & Ondigo, H. (2024). FI and Human Development: Evidence from African Countries. *European Journal of Business and Management Research*, 9(3), 80–85. <https://doi.org/10.24018/ejbmr.2024.9.3.2274>
- Mao, F., Wang, Y., & Zhu, M. (2023). Digital FI, traditional finance system and household entrepreneurship. *Pacific-Basin Finance Journal* 80(C), 102076. <https://doi.org/10.1016/j.pacfin.2023.102076>
- Mapurita, C. K., & Mayoukou, C. (2024). Contribution to the measurement of digital FI in Sub-Saharan Africa. *Borsa Istanbul Review*, 24(6), 1227-1247. <https://doi.org/10.1016/j.bir.2024.07.007>
- Marcelin, I., Egbendewe, A. Y., Oloufadi, D. K., & Sun, W. (2021). FI, bank ownership, and economy performance: Evidence from developing countries. *Finance Research Letters*, 46, 102322. <https://doi.org/10.1016/j.frl.2021.102322>
- Markowitz, H., (1952). Portfolio selection. *Journal of Finance* 7: 77-91. <https://doi.org/10.1111/j.1540-6261.1952.tb01525.x>
- Matamoros Romero, G. R. (2023). Essays on Monetary Policy, Inflation, and Income Distribution (Doctoral dissertation, Université d'Ottawa/University of Ottawa). <https://ruor.uottawa.ca/server/api/core/bitstreams/03935468-a91e-442c-8098-29c68dc5fef5/content>
- Matsebula, V. & Sheefeni, J. P. S. (2022). An Analysis of the Relationship Between FI and Financial Stability in South Africa. *Global Journal of Economics and Business*, 12 (5), 637-648, <https://doi.org/10.31559/GJEB2022.12.5.8>
- Mavungu, M. (2023). Computation of financial risk using principal component analysis. *Algorithmic Finance*, 10(1-2), 1-20. <https://doi.org/10.3233/AF-220339>
- May, T., & Williams, M. (2016). *Knowing the social world*. Philadelphia: Open University Press.. <https://philpapers.org/rec/MAYKTS>
- Meher, K., & Getaneh, H. (2019). Impact of determinants of financial distress on financial sustainability of Ethiopian commercial banks. *Banks and Bank Systems*, 14(3), 187–201. [https://doi.org/10.21511/bbs.14\(3\).2019.16](https://doi.org/10.21511/bbs.14(3).2019.16)
- Mehmood, S., & Bilal, A. R. (2024). Investigation for finance–growth nexus: A dynamic common correlated estimator approach. *Global Business Review*, 25(6), 1525-1539. <https://doi.org/10.1177/09721509211016250>

- Mehrotra, A. N., & Yetman, J. (2015). FI-issues for central banks. BIS Quarterly Review. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580310
- Mendoza, E. G., Quadrini, V., & Rios-Rull, J. V. (2009). Financial integration, financial development, and global imbalances. *Journal of Political Economy*, 117(3), 371e416.
- Mengesha, S. T., & Berde, E. (2023). Financial development and economic growth in Ethiopia: Is there a causal link?. *Cogent Economics & Finance*, 11(2), 2245309. <https://doi.org/10.1080/23322039.2023.2245309>
- Mengesha, S. T., & Berde, E. (2023). Financial development and economic growth in Ethiopia: Is there a causal link?. *Cogent Economics & Finance*, 11(2), 2245309. <https://doi.org/10.1080/23322039.2023.2245309>
- Mengstie, B., Mosisa, T., & Mosisa, T. (2024). Impact of working capital management on profitability of private commercial banks in Ethiopia. *Journal of Innovation and Entrepreneurship*, 13(1), 23. <https://doi.org/10.1186/s13731-024-00379-3>
- Menza, M., Jerene, W., & Oumer, M. (2024). The effect of financial technology on FI in Ethiopia during the digital economy era. *Cogent Social Sciences*, 10(1), 2309000. <https://doi.org/10.1080/23311886.2024.2309000>
- Mercieca, S., Schaeck, K., & Wolfe, S. (2007). Small European banks: Benefits from diversification?. *Journal of Banking & Finance*, 31(7), 1975-1998. <https://doi.org/10.1016/j.jbankfin.2007.01.004>
- Meressa, H. A. (2018). Evaluating financial distress condition of micro finance institutions in Ethiopia. *International Journal of Accounting Research*, 3(4), 35–42. <https://doi.org/10.12816/0044418>
- Merin, M. A. (2016). Determinants of bank profitability in Ethiopia: A case study of private commercial banks. *Research Journal of Finance and Accounting*, 7(7), 28-43. <https://core.ac.uk/download/pdf/234631402.pdf>
- Mhlanga, D. (2020). Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital FI, *International Journal of Financial Studies* 8(3), 1-14. <https://doi.org/10.3390/ijfs8030045>
- Mialou, A., Amidzic, G., & Massara, A. (2017). Assessing countries' FI standing—A new composite index. *Journal of Banking and Financial Economics*, 2(8), 105-126. <https://doi.org/10.7172/2353-6845.jbfe.2017.2.5>
- Michael Freudenberg (2003). Composite Indicators of Country Performance: A Critical Assessment. STI Working Paper 16, <https://doi.org/10.1787/405566708255>
- Minsky, H. P. (1982). Can “it” happen again? A reprise. *Challenge*, 25(3), 5-13. <https://doi.org/10.1080/05775132.1982.11470774>
- Mirzaei, A., Moore, T., & Liu, G. (2013). Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies. *Journal of Banking and Finance*, 37, 2920–2937. <http://dx.doi.org/10.1016/j.jbankfin.2013.04.031>
- Mishra, D., Kandpal, V., Agarwal, N., and Barun Srivastava (2024). FI and Its Ripple Effects on Socio-Economic Development: A Comprehensive Review. *Journal of Risk and Financial Management* 17: 105. <https://doi.org/10.3390/jrfm17030105>
- Mishra, S. K. (2007). A comparative study of various inclusive indices and the index constructed by the principal components analysis. Available at SSRN 990831. <https://doi.org/10.2139/ssrn.990831>
- Mishra, S., Sarkar, U., Taraphder, S., Datta, S., Swain, D., & Saikhom, R. et al. (2017). Multivariate Statistical Data Analysis- Principal Component Analysis (PCA). *International Journal of Livestock Research*, 7(5), 60-78. <http://dx.doi.org/10.5455/ijlr.20170415115235>
- Mlambo, C., (2024). Financial Development and Economic Growth: Evidence from Low-Income Nations in the SADC Region. *International Journal of Financial Studies* 12: 62. <https://doi.org/10.3390/ijfs12030062>
- Moaz Safwat Muhammad Siddiq (2022). The Effect of FI on Banking Performance. *Journal of Financial and Commercial Studies*, PHD Thesis 32: 554-578, <http://dx.doi.org/10.21608/mosj.2022.273397>
- Mohammed, H. (2023). Modeling Determinants of Private Banks Profitability in Ethiopia. University Library of Munich, Germany. <https://econpapers.repec.org/paper/pramprapa/116817.htm>

- Mohapatra, S., & Mohanty, S. (2017). Improving operational efficiency in utility sector through technology intervention. *International Journal of Enterprise Network Management*, 8(4), 291.
<https://doi.org/10.1504/IJENM.2017.088863>
- Morgan, P., & Pontines, V. (2014). Financial stability and FI. Asian Development Bank Institute ADBI Working Paper 488
- Morgan, P.J., & Pontines, V. (2017). Financial Stability and FI: The Case of SME Lending. *The Singapore Economic Review*, 63 (1): 111-124, <https://doi.org/10.1142/S0217590818410035>
- Mossie, W. A. (2022). Understanding FI in Ethiopia. *Cogent Economics & Finance*, 10(1), 2071385.
<https://doi.org/10.1080/23322039.2022.2071385>
- Moyo, C., & Phiri, A. (2024). The effects of interest rates on bank risk-taking in South Africa: Do cyclical and location asymmetries matter? *International Journal of Financial Studies*, 12(49), 1–16.
<https://doi.org/10.3390/ijfs12020049>
- Mu, Y., & Lin, J. (2016). FI and stability in Africa's middle-income countries. In Leigh & Mansoor (Ed) *Africa on the move: unlocking the potential of small middle-income states*, 107-129, International Monetary Fund. <https://doi.org/10.5089/9781513588605.071>
- Mudessir, A. H., Kedir, A. M., & Kassie, A. (2024). The Influence of Digital and Financial Literacy on Interest-Free Banking FIs: Insight from Ethiopia's Country-Specific Socioeconomic Survey 2018–19. *Ethiopian Journal of Business and Economics*, 14(1), 94-140.
<https://www.ajol.info/index.php/ejbe/article/view/277300>
- Muhammed, Seid, Goshu Desalegn, & Prihoda Emese. 2024. Effect of Capital Structure on the Financial Performance of Ethiopian Commercial Banks. *Risks* 12: 69. <https://doi.org/10.3390/risks12040069>
- Muijs, D. (2004). *Doing Qualitative Research in Education with SPSS*. London: SAGE Publication.
- Mukhametzyanov, I. Z. (2023). Normalization of Multidimensional Data for Multi-Criteria Decision Making Problems: Inversion, Displacement, Asymmetry. *Springer Nature*. 348. https://doi.org/10.1007/978-3-031-33837-3_1
- Musa, I., Magaji, S., & Salisu, A. (2023). Relationship Between FI and Economic Growth:: Evidence From Ardl Modelling. *International Journal of Indonesian Business Review*, 2(2), 117-127.
<https://doi.org/10.54099/ijibr.v2i2.377>
- Musau, S., Muathe, S., & Mwangi, L. (2018). FI, bank competitiveness and credit risk of commercial banks in Kenya. *International Journal of Financial Research*, 9(1), 203-218.
<https://doi.org/10.5430/ijfr.v9n1p203>
- Mushtaq, A., & Shah, M. A. (2020). Empirical study on FI: A structural equation modeling approach. *International Journal of Microgravity Science and Application*, 4(20), 373-383
- Musila, J.W., & Yiheyis, Z., (2015). The impact of trade openness on growth: the case of Kenya. *J. Policy Model*. 37 (2015), 342–354. <https://doi.org/10.1016/j.jpolmod.2014.12.001>
- Naceur, S. B., & Ghazouani, S. (2007). Stock markets, banks, and economic growth: Empirical evidence from the MENA region. *Research in international business and finance*, 21(2), 297-315.
<https://doi.org/10.1016/j.ribaf.2006.05.002>
- Nagar , A. L., & Basu, S. R. (2002). Weighting socioeconomic indicators of human development: A latent variable approach. In A. Ullah et al. (Eds.), *Handbook of Applied Econometrics and Statistical Inference*. Marcel Dekker.
- Nair, A., & Von Pischke, J. D. (2007). Commercial banks and financial access. In Barr et al., (Eds.). (2007), *Building Inclusive Financial Systems: A Framework for Financial Access*. Washington: Brookings, 89-116.
<https://www.drnishikantjha.com/booksCollection/Building%20Inclusive%20Financial%20Systems%20A%20Framework%20for%20Financial%20Access%20.pdf>
- Nam, H. J., Bang, J., & Ryu, D. (2023). Do financial and governmental institutions play a mediating role in the spillover effects of FDI?. *Journal of Multinational Financial Management*, 69, 100809.
<https://doi.org/10.1016/j.mulfin.2023.100809>
- Namaz, M., & Salehi, M. (2010). The role of inflation in financial repression: Evidence from Iran. *World Applied Sciences Journal*, 11(6), 653–661.

- Nandelenga, M. W., & Oduor, J. (2020). Asymmetric analysis of finance-Inequality nexus: Evidence from sub-Saharan Africa. *The Journal of Economic Asymmetries*, 22, e00184. <https://doi.org/10.1016/j.jeca.2020.e00184>
- Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., and Giovannini, E. (2005). Handbook on constructing composite indicators. OECD publishing. https://www.oecd-ilibrary.org/handbook-on-constructing-composite-indicators_5lgmz9dkcdg4.pdf
- National Bank of Ethiopia (NBE) annual report, (2024). <https://nbe.gov.et/files/annual-report-2022-2023-2/>
- National Bank of Ethiopia Annual Bulletin (2022) “Annual Report 2020-2021”, <https://nbe.gov.et/files/annual-report-2021-2022/>
- National Bank of Ethiopia. (2021). National FI Strategy-II (2021-2025). <https://nbe.gov.et/wp-content/uploads/2023/12/National-Financial-Inclusion-Stratgy-II-2021-2025.pdf>
- National Bank of Ethiopia’s (NBE-FSR) (2024b): Financial Stability Report. https://nbe.gov.et/wp-content/uploads/2024/11/Financial-Stability-Report_NOV2024.pdf
- National Bank of Ethiopia’s (NBE-FSR). (2024). Financial Stability Report. <https://nbe.gov.et/fsr/>
- Nazlioglu, S., Altuntas, M., Kilic, E., & Kucukkkaplan, I. (2022). Purchasing power parity in GIIPS countries: evidence from unit root tests with breaks and non-linearity. *Applied Economic Analysis*, 30(90), 176-195. <https://doi.org/10.1108/AEA-10-2020-0146>
- Ndlovu, G. (2013). Financial sector development and economic growth: Evidence from Zimbabwe. *International Journal of Economics and Financial Issues*, 3(2), 435-446. <https://dergipark.org.tr/en/pub/ijefi/issue/31957/351919>
- Neaime, S., & Gaysset, I. (2018). FI and stability in MENA: Evidence from poverty and inequality. *Finance Research Letters*, 24, 230-237. <http://dx.doi.org/10.1016/j.frl.2017.09.007>
- Nelson, C.R., & Plosser, C.R. (1982). Trends and random walks in macroeconomic time series: Some evidence and implications'. *Journal of Monetary Economics*, 10, 139–162. [https://doi.org/10.1016/0304-3932\(82\)90012-5](https://doi.org/10.1016/0304-3932(82)90012-5)
- Nene, S. T., Ilesanmi, K. D., & Sekome, M. (2022). The effect of inflation targeting (IT) policy on the inflation uncertainty and economic growth in selected African and European countries. *Economies*, 10(2), 37. <https://doi.org/10.3390/economies10020037>
- Nesru, K.B, & Mekonnen, K.Y (2022). Deposit mobilization and its determinants: Evidence from commercial banks in Ethiopia. *Future Business Journal*, 8(32). <https://doi.org/10.1186/s43093-022-00144-6>
- Newfarmer, R., & Sztajerowska, M. (2012). Trade and employment in a fast-changing world. Policy priorities for international trade and jobs, 7. [http://refhub.elsevier.com/S2772-655X\(25\)00001-1/sbref0078](http://refhub.elsevier.com/S2772-655X(25)00001-1/sbref0078)
- Nguyen, H.Q. (2014). Do Bank Branches Still Matter? The Effect of Closings on Local Economic Outcomes. https://reinvestmentpartners.org/file_download/inline/b3a90d2a-c243-4c1d-a81c-63996ae9875c#:~:text=First%2C%20closings%20are%20associated%20with,competitive%20effects%20of%20the%20merger
- Nguyen, Q. K., & Dang, V. C. (2022). The impact of risk governance structure on bank risk management effectiveness: evidence from ASEAN countries. *Heliyon*, 8 (10), e11192. <https://doi.org/10.1016/j.heliyon.2022.e11192>
- Nguyen, T. D., & Du, Q. L. T. (2022). The effect of FI on bank stability: Evidence from ASEAN. *Cogent Economics & Finance*, 10(1), 2040126. <https://doi.org/10.1080/23322039.2022.2040126>
- Nguyen, T. T. T. (2021). Measuring FI: A composite FI index for developing countries. *Journal of Economics and Development*, 23(1), 77–99. <https://doi:10.1108/jed-03-2020-0027>
- Niaz, M. U. (2022). Socio-economic development and sustainable development goals: A roadmap from vulnerability to sustainability through FI. *Economic Research-Ekonomska Istraživanja*, 35(1), 3243–3275. <https://doi.org/10.1080/1331677X.2021.1989319>
- Nizam, R., Karim, Z. A., Rahman, A. A., & Sarmidi, T. (2020). Financial inclusiveness and economic growth: New evidence using a threshold regression analysis. *Economic Research-Ekonomska Istraživanja*, 33(1), 1465–1484. <https://doi.org/10.1080/1331677X.2020.1748508>

- Nizam, R., Karim, Z. A., Rahman, A. A., & Sarmidi, T. (2020). Financial inclusiveness and economic growth: New evidence using a threshold regression analysis. *Economic research-Ekonomska istraživanja*, 33(1), 1465-1484. <https://doi.org/10.1080/1331677X.2020.1748508>
- Nkwede, F. (2015). FI and economic growth in Africa: Insight from Nigeria. *European Journal of Business and Management*, 7(35), 71-80. <https://www.iiste.org/Journals/index.php/EJBM/article/view/27498/28213>
- Nsor-Ambala, R., & Amewu, G. (2023). Linear and non-linear ARDL estimation of financial innovation and economic growth in Ghana. *Journal of Business and Socio-economic Development*, 3(1), 36-49. <https://doi.org/10.1108/JBSED-09-2021-0128>
- Nuzzo, G., & Piermattei, S. (2020). Discussing measures of FI for the main Euro area countries. *Social Indicators Research*, 148(3), 765–786. <https://doi.org/10.1007/s11205-019-02223-8>
- Nyankomo, M., & Stephen, Z. (2015). A review of finance-growth nexus theories: How does development finance fits in?. *Studies in Business & Economics*, 10(1). <https://doi.org/10.1515/sbe-2015-0007>
- Oanh, T. T. K. (2024). Digital FI in the context of financial development: Environmental destruction or the driving force for technological advancement. *Borsa Istanbul Review*, 24(2), 292-303. <https://doi.org/10.1016/j.bir.2024.01.003>
- Oanh, T. T. K., Van, L. T. T., & Dinh, L. Q. (2023). Relationship between FI, monetary policy and financial stability: An analysis in high financial development and low financial development countries. *Heliyon*, 9(6), e16647. <https://doi.org/10.1016/j.heliyon.2023.e16647>
- Obiedallah, Y. R., & Abdelaziz, A. H. (2024). FI and Financial Performance: The interplay role of capital adequacy requirements in Egyptian Banks. *Future Business Journal*, 10(1), 96. <https://doi.org/10.1186/s43093-024-00383-9>
- Odame, C., Appiah, K. O., & Gyimah, P. (2024). The FI–economic growth nexus: what is new now?. *Journal of Money and Business*, 4(2), 121-137. <https://doi.org/10.1108/JMB-05-2023-0026>
- OECD (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD Publishing, Paris, <https://doi.org/10.1787/9789264043466-en>
- Ofori-Abebrese, G., Pickson, R.B. and Diabah, B.T. (2017) Financial Development and Economic Growth: Additional Evidence from Ghana. *Modern Economy*, 8, 282-297. <https://doi.org/10.4236/me.2017.82020>
- Ogunbiyi, S. S., & Ihejirika, P. O. (2014). Interest rates and deposit money banks' profitability nexus: The Nigerian experience. *Oman Chapter of Arabian Journal of Business and Management Review*, 34(2350), 1-16. <https://doi.org/10.12816/0016525>
- Ohiomu, S., & Ogbeide-Osaretin, E. N. (2019). FI and gender inequality reduction: Evidence from sub-Saharan Africa. *The Indian Economic Journal*, 67(3-4), 367–372. <https://doi.org/10.1177/0019466220946411>
- Oman Khanlen, A. E., Ilori, N., Isibor, A., & Okoye, L. U. (2021). Monetary policies and the achievement of bank profit objective. *Journal of Central Banking Theory and Practice*, 10(2), 201-220. <https://doi.org/10.2478/jcbtp-2021-0020%0A>
- Omar, M. A., & Inaba, K. (2020). Does FI reduce poverty and income inequality in developing countries? A panel data analysis. *Journal of Economic Structures*, 9(1), 1–25. <https://doi.org/10.1186/s40008-020-00214-4>
- Omoke, P. C., & Opuala–Charles, S. (2021). Trade openness and economic growth nexus: Exploring the role of institutional quality in Nigeria. *Cogent Economics & Finance*, 9(1), 1868686. <https://doi.org/10.1080/23322039.2020.1868686>
- Onifade, O. C., & Olanrewaju, S. O. (2020) Investigating Performances of Some Statistical Tests for Heteroscedasticity Assumption in Generalized Linear Model: A Monte Carlo Simulations Study. *Open Journal of Statistics*, 10, 453-493. <https://doi.org/10.4236/ojs.2020.103029>
- Opoku, E. E. O., Ibrahim, M., & Sare, Y. A. (2019). The causal relationship between financial development and economic growth in Africa. *International Review of Applied Economics*, 33(6), 789-812. <https://doi.org/10.1080/02692171.2019.1607264>
- Opoku, E., Poku, K., & Domeher, D. (2024). FI, Human Capital Development and Economic Growth in Africa: An Examination of the Transmission Channel. *SAGE Open*, 14(3). <https://doi.org/10.1177/21582440241271285>

- Osawaru, M., Ogwu, M., & Imarhiagbe, O. (2015). Principal component analysis (PCA) as an ideal tool for analysing on-farm research data. *Biological and Environmental Sciences Journal for the Tropics*, 12, 514–522.
- Oshora, B., Desalegn, G., Gorgenyi-Hegyes, E., Fekete-Farkas, M., & Zeman, Z. (2021). Determinants of FI in small and medium enterprises: Evidence from Ethiopia. *Journal of Risk and Financial Management*, 14(7), 286. <https://doi.org/10.3390/jrfm14070286>
- Osuma, G. (2024). The impact of FI on poverty reduction and economic growth in Sub-Saharan Africa: A comparative study of digital financial services. *Social Sciences & Humanities Open*, 11, 101263–101263. <https://doi.org/10.1016/j.ssaho.2024.101263>
- Ozili, P. K. (2021a). Has FI made the financial sector riskier? *Journal of Financial Regulation and Compliance*, 29(3), 1–24. <https://doi.org/10.1108/JFRC-08-2020-0074>
- Ozili, P. K. (2021b). Digital finance, green finance, and social finance: Is there a link? *Financial Internet Quarterly*, 17(1), 1–7. <https://doi.org/10.2478/fiqf-2021-0001>
- Ozili, P. K., & Ndah, H. (2024). Impact of financial development on bank profitability. *Journal of Economic and Administrative Sciences*, 40(2), 238–262.
- Ozili, P. K., (2020b). Contesting digital finance for the poor. *Digital Policy, Regulation and Governance*, Volume 21
- Ozili, P. K., (2020c). Theories of FI. Munich: MPRA Paper No. 101810: Munich Personal RePEc Archive Available Online at <https://mpra.ub.unimuenchen.de/101810/>
- Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4): 329–340, <https://doi.org/10.1016/j.bir.2017.12.003>
- Ozili, P.K., (2020). FI research around the world: A review. *Forum for Social Economics* 1–23. <https://doi.org/10.1080/07360932.2020.1715238>
- Pagano, M., (1993). Financial markets and growth: an overview. *European Economic Review*, 37, 613–622. [https://doi.org/10.1016/0014-2921\(93\)90051-B](https://doi.org/10.1016/0014-2921(93)90051-B)
- Pal, S., & Bandyopadhyay, I. (2022). Impact of FI on economic growth, financial development, financial efficiency, financial stability, and profitability: an international evidence. *SN Business & Economics*, 2(9), 139. <https://doi.org/10.1007/s43546-022-00313-3>
- Pantelieieva, N., Khutorna, M., Lytvynenko, O., & Potapenko, L. (2020). FinTech, RegTech and traditional financial intermediation: Trends and threats for financial stability. In *Data-Centric Business and Applications: Evolvments in Business Information Processing and Management*, 3, 1–21. https://doi.org/10.1007/978-3-030-35649-1_1
- Paolucci, E.M.G., (2016). The determinants of bank profitability: empirical evidence from European banking sector. *Journal of Financial Reporting and Accounting*, 14(1). <http://dx.doi.org/10.1108/JFRA-05-2015-0060>
- Papathoma-Kohle, M., Cristofari, G., Wenk, M., & Fuchs, S. (2019). The importance of indicator weights for vulnerability indices and implications for decision making in disaster management. *International Journal of Disaster Risk Reduction*, 36, 101103. <https://doi.org/10.1016/j.ijdrr.2019.101103>
- Park, C. Y., & Mercado, R. V. (2021). FI: New measurement and cross-country impact assessment. In *FI in Asia and beyond: Measurement, Development Gaps, and Economic Consequences*, 98–128. Routledge. <https://doi.org/10.4324/9781003035916>
- Patrick, H. T. (1966). Financial development and economic growth in underdeveloped countries. *Economic Development and Cultural Change*, 14(2), 174–189. <https://doi.org/10.1086/450153>
- Pazarbasioglu, C., Mora, A. G., Uttamchandani, M., Natarajan, H., Feyen, E., & Saal, M. (2020) “Digital Financial Services. World Bank Group”, <https://www.worldbank.org>
- Pearce, D. (2011). FI in the Middle East and North Africa: Analysis and roadmap recommendations. World Bank policy research working paper, (5610). <https://ssrn.com/abstract=1794915>
- Pearson K. (1901). On lines and planes of closest fit to systems of points in space. *Philosophical Magazine* 2(11):559–572. <https://doi.org/10.1080/14786440109462720>

- Pennacchi, G. G., & Santos, J. A. (2021). Why do banks target ROE?. *Journal of Financial Stability*, 54, 100856. <https://doi.org/10.1016/j.jfs.2021.100856>
- Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: journal of the Econometric Society*, 57, 1361-1401. <https://doi.org/10.2307/1913712>
- Persaud, A., & Thaffe, W. (2023). The state of FI research on developing countries. *Transnational Corporations Review*, 15(4), 22-34. <https://doi.org/10.1016/j.tncr.2023.08.002>
- Pesaran MH, Shin Y, Smith RJ (2001). Bounds testing approaches to the analysis of level relationships. *J Appl Econom* 16(3), 289–326. <https://doi.org/10.1002/jae.616>
- Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. *Cambridge Discussion Paper* 1240, 1-39. <https://ftp.iza.org/dp1240.pdf>
- Pesaran, M. H. (2007). A Simple Panel Unit Root Test in the Presence of Cross Section Dependence. *Journal of Applied Econometrics*, 22, 265–312. <https://doi.org/10.1002/jae.951>
- Pesqué-Cela, V., Tian, L., Luo, D., Tobin, D., & Kling, G. (2021). Defining and measuring FI: A systematic review and confirmatory factor analysis. *Journal of International Development*, 33(2), 316-341. <http://dx.doi.org/10.1002/jid.3524>
- Peterson, E. W. F. (2017). The role of population in economic growth. *Sage Open*, 7(4), 2158244017736094. <https://doi.org/10.1177/2158244017736094>
- Pham, M. H., & Doan, T. P. L. (2020). The impact of FI on financial stability in Asian countries. *The Journal of Asian Finance, Economics and Business*, 7(6), 47-59. <https://10.13106/jafeb.2020.vol7.no6.047>
- Phan, H. T., Hoang, T. N., Dinh, L. V., and Hoang, D. N. (2020). The Determinants of Listed Commercial Banks' Profitability in Vietnam. *Journal of Asian Finance, Economics and Business*, 7(11), 219-229, <https://doi.org/10.13106/jafeb.2020.vol7.no11.219>
- Phanniphong, K., Niangchaem, L., Na-Nan, K., & Arunyaphum, A. (2024). Unraveling the complexity of cyberbullying: Development and validation of a comprehensive questionnaire. *Transnational Corporations Review*, 16(3). <https://doi.org/10.1016/j.tncr.2024.200073>
- Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *biometrika*, 75(2), 335-346. <https://doi.org/10.1093/biomet/75.2.335>
- Pilloff, S. J. (1996). Performance changes and shareholder wealth creation associated with mergers of publicly traded banking institutions. *Journal of Money, Credit and Banking*, 28(3), 294-310. <https://doi.org/10.2307/2077976>
- Plosser, C.R. (1989). Understanding real business cycles. *The Journal of Economic Perspectives*, 3, 51–78. <https://doi.org/10.1257/jep.3.3.51>
- Ponterotto, J.G. (2005). Qualitative research in counseling psychology: a primer on research paradigms and philosophy of science. *Journal of Counseling Psychology*, 52 (2), 126-136. <https://doi.org/10.1037/0022-0167.52.2.126>
- Popa, D. C. S., Popa, D. N., Bogdan, V., & Simut, R. (2021). Composite financial performance index prediction—a neural networks approach. *Journal of Business Economics and Management*, 22(2), 277-296. <https://doi.org/10.3846/jbem.2021.14000>
- Popper, K. R. (1963). Science as falsification. *Conjectures and refutations*, 1, 33-39.
- Popper, K.R. (1972) *Objective Knowledge: An Evolutionary Approach*. Revised Edition, Oxford University Press, Oxford.
- Poutanen, P., Soliman, W., & Ståhle, P. (2016). The complexity of innovation: an assessment and review of the complexity perspective. *European Journal of Innovation Management*, 19(2), 189-213. <https://doi.org/10.1108/EJIM-03-2014-0036>
- Prasad, E. S. (2010). Financial sector regulation and reforms in emerging markets: An overview. <https://doi.org/10.3386/w16428>
- Presbitero, A. F., (2008). The Debt-Growth Nexus in Poor Countries: A Reassessment. *Economics*, 2. <https://doi.org/10.5018/economics-ejournal.ja.2008-30>
- Presbitero, Andrea F. (2006) The Debt-Growth Nexus: a Dynamic Panel Data Estimation. *Rivista Italiana degli Economisti* 3(4):417–462
- Prettner, K. (2014). The non-monotonous impact of population growth on economic prosperity. *Economics Letters*, 124(1), 93-95. <http://dx.doi.org/10.1016/j.econlet.2014.04.031>

- Puatwoe, J. T., & Piabuo, S. M. (2017). Financial sector development and economic growth: evidence from Cameroon. *Financial Innovation*, 3(1), 25. <https://doi.org/10.1186/s40854-017-0073-x>
- Qamruzzaman, M. D., Jianguo, W., & Jianguo, W. (2018). Investigation of the asymmetric relationship between financial innovation, banking sector development, and economic growth. *Quantitative finance and economics*, 2(4), 952-980. <https://doi.org/10.3934/QFE.2018.4.952>
- Rajan, R. G. (2006). Has finance made the world riskier?. *European financial management*, 12(4), 499-533. <http://dx.doi.org/10.3386/w11728>
- Rajan, R. G., & Zingales, L. (2003). The great reversals: the politics of financial development in the twentieth century. *Journal of financial economics*, 69(1), 5-50. [https://doi.org/10.1016/S0304-405X\(03\)00125-9](https://doi.org/10.1016/S0304-405X(03)00125-9)
- Rajan, R., & Zingales, L. (1998). Financial development and growth. *American economic review*, 88(3), 559-586. <https://www.nber.org/papers/w5758>
- Ramoni-Perazzi, J., & Romero, H. (2022). Exchange rate volatility, corruption, and economic growth. *Heliyon*, 8(12). <https://doi.org/10.1016/j.heliyon.2022.e12328>
- Ramzan, M., Amin, M., & Abbas, M. (2021). How does corporate social responsibility affect financial performance, financial stability, and FI in the banking sector? Evidence from Pakistan. *Research in International Business and Finance*, 55, 101314. <https://doi.org/10.1016/j.ribaf.2020.101314>
- Rao, K. R. M., & Lakew, T. B. (2012). Cost Efficiency and Ownership Structure of Commercial Banks in Ethiopia: An application of non-parametric approach. *European Journal of Business & Management*, 4(10), 36-47.
- Rao, K. S., & Baza, A. U. (2017). Barriers to access to and usage of financial services in Ethiopia. *Business and Economic Research*, 7(1), 139-149.
- Rapetti, M. (2020). The real exchange rate and economic growth: A survey. *Journal of Globalization and Development*, 11(2), 20190024. <https://doi.org/10.1515/jgd-2019-0024>
- Rapetti, M., Skott, P., & Razmi, A. (2012). The real exchange rate and economic growth: are developing countries different?. *International Review of Applied Economics*, 26(6), 735-753. <https://doi.org/10.1080/02692171.2012.686483>
- Rapih, S., & Wahyono, B. (2023). The relative impact of traditional and digital FI on economic growth: a threshold regression-based comparative analysis. *International Review of Applied Economics*, 37(6), 781-803. <https://doi.org/10.1080/02692171.2023.2281460>
- Rebelo, S.T., (1991). Long-run policy analysis and long-run growth. *Journal of Political Economy*, 3, 500–521. <https://doi.org/10.1086/261764>
- Ren, K., Wang, Y., & Liu, L. (2023). Impact of traditional and digital FI on enterprise innovation: Evidence from China. *Sage Open*, 13(1). <https://doi.org/10.1177/21582440221148097>
- Rewilak J. 2013. Finance is good for the poor but it depends where you live. *Journal of Banking & Finance* 37: 1451–1459. <http://dx.doi.org/10.1016/j.jbankfin.2012.04.022>
- Robinson, J. (1952). The generalization of the general theory. In *The rate of interest and other essays*. 2nd edn. London: Macmillan
- Robinson, J. (1979). The Rate of Interest. In: *The Generalisation of the General Theory and other Essays*. Palgrave Macmillan, London. https://doi.org/10.1007/978-1-349-16188-1_4
- Robu, I. B., & Istrate, C. (2015). The analysis of the principal components of the financial reporting in the case of Romanian listed companies. *Procedia Economics and Finance*, 20, 553-561. [https://doi.org/10.1016/S2212-5671\(15\)00108-2](https://doi.org/10.1016/S2212-5671(15)00108-2)
- Rodrik, D. (2008). The real exchange rate and economic growth. *Brookings papers on economic activity*, 2008(2), 365-412. <https://doi.org/10.1353/eca.0.0020>
- Romer, P. M. (1986). Increasing Returns and Long-Run Growth. *Journal of Political Economy*, 94(5), 1002–1037. <http://www.jstor.org/stable/1833190>
- Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*, 98(5), S71–S102. <http://www.jstor.org/stable/2937632>
- Roodman, D. (2009). How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal*, 9(1), 86-136. <https://doi.org/10.1177/1536867X0900900106>
- Roodman, David. (2006). How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. Working Papers 103 Center for Global Development
- Rousseau, P. L., & Wachtel, P. (2002). Inflation thresholds and the finance–growth nexus. *Journal of international money and finance*, 21(6), 777-793. [https://doi.org/10.1016/S0261-5606\(02\)00022-0](https://doi.org/10.1016/S0261-5606(02)00022-0)

- Rousseau, P. L., & Yilmazkuday, H. (2009). Inflation, financial development, and growth: A trilateral analysis. *Economic Systems*, 33(4), 310-324. <https://doi.org/10.1016/j.ecosys.2009.06.002>
- Ruey, C. J. (2024). Factors That Affect Rural FI: A Case of Gambella Town, Gambell Peoples National Regional State, Ethiopia. *KnE Social Sciences*, 760-786. <https://doi.org/10.18502/kss.v9i14.16143>
- Saha, M., & Dutta, K. D. (2021). Nexus of FI, competition, concentration and financial stability: Cross-country empirical evidence. *Competitiveness Review: An International Business Journal*, 31(4), 669-692. <https://doi.org/10.1108/CR-12-2019-0136>
- Sahay, M. R., Cihak, M., N'Diaye, M. P., Barajas, M. A., Mitra, M. S., Kyobe, M. A., ... & Yousefi, M. R. (2015). FI: can it meet multiple macroeconomic goals?. International Monetary Fund. <https://www.elibrary.imf.org/view/journals/006/2015/017/article-A001-en.xml>
- Sakyi, D., Villaverde, J., & Maza, A. (2015). Trade openness, income levels, and economic growth: The case of developing countries, 1970–2009. *The Journal of International Trade & Economic Development*, 24(6), 860-882. <https://doi.org/10.1080/09638199.2014.971422>
- Sanderson, A., Mutandwa, L., & Le Roux, P. (2018) “A review of determinants of FI”, *International Journal of Economics and Financial Issues*, vol 8(3), <https://www.proquest.com/openview/14ab3dad2a8024c379011eae0d0bf8aa/1?pq-origsite=gscholar&cbl=816338>
- Sanya, S., & Wolfe, S. (2011). Can banks in emerging economies benefit from revenue diversification? *Journal of Financial Services Research*, 40(1), 79–101. <https://doi.org/10.1007/s10693-010-0098-z>
- Sapriza, H., & Temesvary, J. (2024). Economic activity and the bank credit channel. *Journal of Banking & Finance*, 164, 107216. <https://doi.org/10.1016/j.jbankfin.2024.107216>
- Sarma, M. (2008). Index of FI. Working Paper 215, Indian Council for Research on International Economic Relations, New Delhi <https://www.econstor.eu/handle/10419/176233>
- Sarma, M. (2016). Measuring FI for Asian Economies. In Gopalan, S., & Kikuchi, T. (eds) *FI in Asia*. Palgrave Studies in Impact Finance. Palgrave Macmillan. https://doi.org/10.1057/978-1-137-58337-6_1
- Sarma, M. (2016). Measuring FI for Asian Economies. In: Gopalan, S., Kikuchi, T. (eds) *FI in Asia*. Palgrave Studies in Impact Finance. Palgrave Macmillan, 3-34. https://doi.org/10.1057/978-1-137-58337-6_1
- Sarma, M., & Pais, J. (2011). FI and development. *Journal of International Development*, 23(5), 613–628. <https://doi.org/10.1002/jid.1698>
- Sarmiento, M. (2024). The transmission of non-banking liquidity shocks to the banking sector. *Latin American Journal of Central Banking*, 100139. <https://doi.org/10.1016/j.lacsb.2024.100139>
- Saunders, M. N., Saunders, M., Lewis, P., & Thornhill, A. (2011). *Research methods for business students*, 5/e. Pearson Education India.
- Saunders, M., Lewis, P. and Thornhill, A. (2016) *Research Methods for Business Students*. 7th Edition, Pearson, Harlow.
- Schinasi, G. J. (2004). Defining financial stability. <https://doi.org/10.5089/9781451859546.001>
- Schneider, M. (2020). Gamification: The effects of the game element countdown-timer on the engagement of European students. Copenhagen Business School, (Master’s Thesis). https://researchapi.cbs.dk/ws/portalfiles/portal/62179332/867975_Master_Thesis_Markus_Schneider_No17237_May142020.pdf
- Schoenmaker, D. (1996). Contagion risk in banking. LSE Financial Markets Group, pp. 86-104
- Scholtens, B., & Van Wensveen, D. (2003). The theory of financial intermediation: an essay on what it does (not) explain. *SUERF Studies* 2003/1. <https://www.econstor.eu/handle/10419/163455>
- Schularick, M., & Taylor, A.M., (2012). Credit booms gone bust: monetary policy, leverage cycles, and financial crises, 1870-2008. *Am. Econ. Rev.* 102 (2), 1029–1061. <https://doi.org/10.1257/aer.102.2.1029>
- Schultz, E. L., Tan, D. T., & Walsh, K. D. (2010). Endogeneity and the corporate governance - performance relation. *Australian Journal of Management*, 35(2), 145-163. <https://doi.org/10.1177/0312896210370079>
- Schumpeter, J.A. (1911). *The Theory of Economic Development*. Harvard University Press, Cambridge.
- Sebai, M., & Talbi, O. (2024). Threshold effects of FI on financial stability: Evidence from BRICS nations. *Journal of Infrastructure, Policy and Development*, 8(11). <https://dx.doi.org/10.24294/jipd.v8i11.8363>

- Sebai, M., Talbi, O., & Guerchi-Mehri, H. (2025). Optimal FI for financial stability: Empirical insight from developing countries. *Finance Research Letters*, 71, 106467. <https://doi.org/10.1016/j.frl.2024.106467>
- Sebikabu, D. R., Ruvuna, E., & Ruzima, M. (2020). Population growth's effect on economic development in Rwanda. *Rwandan Economy at the Crossroads of Development: Key Macroeconomic and Microeconomic Perspectives*, 73-95. https://doi.org/10.1007/978-981-15-5046-1_5
- Sebki, W. (2021). Education and economic growth in developing countries: empirical evidence from GMM estimators for dynamic panel data. *Economics and Business*, 35(1), 14-29, <https://doi.org/10.2478/eb-2021-0002>
- Sedera, R. M. H., Risfandy, T., & Futri, I. N. (2022). FI and bank profitability: Evidence from Indonesia. *Journal of Accounting and Investment*, 23(3), 398-412. <https://doi.org/10.18196/jai.v23i3.14721>
- Seman A. J., (2016). FI: the role of financial system and other determinants. (PhD dissertation). <https://salford-repository.worktribe.com/preview/1492768/Final%20PhD%20Thesis-%20JUNAIDAH%20ABU%20SEMAN.pdf>
- Senou, M. M., Ouattara, W., & Houensou, D. A. (2019). FI dynamics in WAEMU: Was digital technology the missing piece? *Cogent Economics & Finance*, 7(1), 1–16. <https://doi.org/10.1080/23322039.2019.1665432>
- Servigny, A.D., & Renault, O. (2004). Measuring and Managing Credit Risk.
- Sethi, D., & Acharya, D. (2018). FI and economic growth linkage: Some cross country evidence. *Journal of Financial Economic Policy*, 10(3), 369-385. <https://doi.org/10.1108/JFEP-11-2016-0073>
- Sethy, S. K., & P. Goyari. (2022) FI and Financial Stability Nexus Revisited in South Asian Countries: Evidence from a new Multidimensional FI Index. *Journal of Financial Economic Policy* 14 (5): 674–693. <https://doi.org/10.1108/JFEP-07-2021-0195>
- Sha'ban, M., Girardone, C., & Sarkisyan, A. (2020). Cross-Country Variation in Fi-nancial Inclusion: A Global Perspective *European Journal of Finance* 26: 319-340. <https://doi.org/10.1080/1351847X.2019.1686709>
- Shafiullah, M., Okafor, L. E., & Khalid, U. (2019). Determinants of international tourism demand: Evidence from Australian states and territories. *Tourism Economics*, 25(2), 274-296. <https://doi.org/10.1177/1354816618800642>
- Shahriar, A., Mehzabin, S., Ahmed, Z., Döngül, E. S., & Azad, M. A. K. (2022). Bank stability, performance and efficiency: an experience from West Asian countries. *IIM Ranchi journal of management studies*, 2(1), 31-47. <https://doi.org/10.1108/IRJMS-02-2022-0017>
- Sharma, D. (2016). Nexus between FI and economic growth: Evidence from the emerging Indian economy. *Journal of financial economic policy*, 8(1), 13-36. <https://doi.org/10.1108/JFEP-01-2015-0004>
- Shaw, E. S. (1973). *Financial deepening in economic development*. New York, N.Y. (USA) Oxford Univ. Press. <https://agris.fao.org/search/en/providers/122621/records/647396913ed73003714cd005>
- Shehu, A.Y. Promoting FI for effective anti-money laundering and counter financing of terrorism (AML/CFT). *Crime Law Soc Change* 57, 305–323 (2012). <https://doi.org/10.1007/s10611-011-9351-0>
- Shen, X., Huang, Q., Nazar, R., & Chin, L. (2024). Unlocking growth: Investigating asymmetry in the FI-growth nexus in financially inclusive middle east economies. *Heliyon*, 10(18). <https://doi.org/10.1016/j.heliyon.2024.e37785>
- Shen, Y., Hu, W., & Hueng, C. J. (2021). Digital FI and economic growth: a cross-country study. *Procedia computer science*, 187, 218-223. <https://doi.org/10.1016/j.procs.2021.04.054>
- Shifa, M. A., Debela, K. L., & Tarfa, E. G. (2019). Determinants of the profitability of commercial banks in Ethiopia. *Copernican Journal of Finance & Accounting*, 8(4), 185-201. <https://apcz.umk.pl/CJFA/article/view/30371>
- Shihadeh, F. (2020). The influence of FI on banks' performance and risk: new evidence from MENAP. *Banks and Bank Systems*, 15(1), 59-71. [https://doi:10.21511/bbs.15\(1\).2020.07](https://doi:10.21511/bbs.15(1).2020.07)
- Shihadeh, F. (2021). FI and banks' performance: Evidence from Palestine. *Investment Management and Financial Innovations*, 18(1), 126- 138. [http://dx.doi.org/10.21511/imfi.18\(1\).2021.11](http://dx.doi.org/10.21511/imfi.18(1).2021.11)
- Shihadeh, F. H., Azzam, H., Hannon, J., Guan, J., Haq, I. u., & Wang, X. (2018). Does FI improve the banks' performance? Evidence from Jordan. In Kensinger, J.W. (Ed) *Global Tensions in Financial Markets*, Emerald Publishing Limited, 3, 117-138. <https://doi.org/10.1108/S0196-382120170000034005>

- Shihadeh, F., Gamage, S. K. N., & Hannon, A. (2019). The Causal Relationship Between SME Sustainability and Banks' Risk. *Economic Research-Ekonomska Istraživanja*, 32(1), 2743-2760. <https://doi.org/10.1080/1331677X.2019.1655465>
- Shin, Y.Y. B., and Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) *Festschrift in Honor of Peter Schmidt*. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9
- Siddik, M. N. A. (2017). Does FI promote women empowerment? Evidence from Bangladesh. *Applied Economics and Finance*, vol 4(4), pp 169–177, <https://doi.org/10.11114/aef.v4i4.2514>
- Siddik, M. N. A., Ahsan, T., & Kabirag, S. (2019). Does financial permeation promote economic growth? Some econometric evidence from Asian countries. *Sage Open*, 9(3), 1–13, <https://doi.org/10.1177/2158244019865811>
- Siddik, N. A. & Kabiraj, S. (2018). Does FI Induce Financial Stability? Evidence from Cross-country Analysis, *Australasian Accounting, Business and Finance Journal*, 12(1): 2018, 34-46, <https://doi.org/10.14453/aabfj.v12i1.3>
- Siddiki, J., & Bala-Keffi, L. R. (2024). Revisiting the relation between FI and economic growth: a global analysis using panel threshold regression. *Economic Modelling*, 135, 106707. <https://doi.org/10.1016/j.econmod.2024.106707>
- Silverman, D. (2013). *Doing Qualitative Research: A Practical Handbook*. Sage Publications.
- Simwaka, K., Munthali, T., Chiumia, A., & Kabango, G. (2012). Financial development and economic growth in Malawi: an empirical analysis. *Banks and Bank Systems*, 7(3), 85-96. https://www.businessperspectives.org/images/pdf/applications/publishing/templates/article/assets/4872/BBS_en_2012_3_Simwaka.pdf
- Singh, V. K., & Ghosh, S. (2021). FI and economic growth in India amid demonetization: A case study based on panel cointegration and causality. *Economic Analysis and Policy*, 71, 674-693. <https://doi.org/10.1016/j.eap.2021.07.005>
- Smith, R., Staikouras, C., & Wood, G. (2003). Non-interest income and total income stability. Bank of England Working Paper No. 198, Cass Business School Research Paper. <https://dx.doi.org/10.2139/ssrn.530687>
- Soesetio, Y., Waffiudin, W., Rudiningtyas, D. A., & Siswanto, E. (2022). Determinants of Profitability on Indonesian's Small Commercial Banking. *Jurnal Dinamika Akuntansi*, 14(1), 1-16. <https://dx.doi.org/10.15294/jda.v14i1.33532>
- Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65–94. <https://doi.org/10.2307/1884513>
- Song, X., Li, J., & Wu, X. (2024). FI, education, and employment: empirical evidence from 101 countries. *Humanities and Social Sciences Communications*, 11(1), 1-11. <https://doi.org/10.1057/s41599-024-02630-4>
- Soto, M. (2009). System GMM estimation with a small sample. <https://ddd.uab.cat/record/69615>
- Soumare, I., Tchana Tchana, F., & Kengne, T. M. (2016) "Analysis of the determinants of FI in Central and West Africa", *Transnational Corporations Review*, vol 8(4), pp 231–249, <https://doi.org/10.1080/19186444.2016.1265763>
- Staveren, I. V. (2001). Gender biases in finance. *Gender & Development*, 9(1), 9–17. <https://doi.org/10.1080/13552070127734>
- Steiger, J. H. (1979). Factor indeterminacy in the 1930s and the 1970s: Some interesting parallels. *Psychometrika*, 44(2), 157–167. <https://doi.org/10.1007/BF02296409>
- Stöber, J., & Czado, C. (2014). Regime switches in the dependence structure of multidimensional financial data. *Computational Statistics & Data Analysis*, 76, 672-686. <https://doi.org/10.1016/j.csda.2013.04.002>
- Stolbov, M. (2013). The finance-growth nexus revisited: From origins to a modern theoretical landscape. *Economics*, 7(1), 20130002. <https://doi.org/10.5018/economics-ejournal.ja.2013-2>
- Subbarao, D. (2009). FI: Challenges and opportunities. *Reserve Bank of India Bulletin*, 9, 1–16. <https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/1FISCB080110.pdf>

- Sun, Y., & Tang, X. (2022). The impact of digital inclusive finance on sustainable economic growth in China. *Finance Research Letters*, 50, 103234.
- Sutherland, D., & Hoeller, P., (2012). Debt and Macroeconomic Stability: an Overview of the Literature and Some Empirics. OECD Economics Department Working. Paper No. 1006, <https://doi.org/10.2139/ssrn.2188941>
- Swain, B. R., & Nsabimana, A. (2024). FI and nutrition among rural households in Rwanda. *European Review of Agricultural Economics*, 51(2), 506-532. <https://doi.org/10.1093/erae/jbae007>
- Swan, T.W., (1956). Economic growth and capital accumulation. *Economic Record*, 32(2), 334–61.
- Talbi, O., & Sebai, M. (2025). Exploring the relationship between FI and financial stability in BRICS countries: A panel smooth transition regression analysis. *Development and Sustainability in Economics and Finance*, 6, 100042. <https://doi.org/10.1016/j.dsef.2025.100042>
- Tan Y., (2014). 4 - Risk management and performance in the Chinese banking sector, Editor(s): Yong Tan, In *Chandos Asian Studies Series, Performance, Risk and Competition in the Chinese Banking Industry*. Chandos Publishing, 65-139. <https://doi.org/10.1533/9781780634463.65>
- Taylor, C.P.S., & Medina, M. (2013). Educational research paradigms: From positivism to multiparadigmatic. <https://doi.org/10.13140/2.1.3542.0805>
- Teka, B., Nahusenay, S., & Asmare, T. (2020). Determinants of FI in East Gojjam, Ethiopia. *Journal of Applied Finance & Banking*, 10(4), 69-88. https://www.scienpress.com/Upload/JAFB/Vol%2010_4_4.pdf
- Teshome, E., Debela, K., & Sultan, M. (2018). Determinant of financial performance of commercial banks in Ethiopia: Special emphasis on private commercial banks. *African Journal of Business Management*, 12(1), 1-10. <https://doi.org/10.5897/AJBM2017.8470>
- Thakor, A. V. (2014). Bank capital and financial stability: An economic trade-off or a Faustian bargain? *Annual Review of Financial Economics*, 6(1), 185–223. <https://doi.org/10.1146/annurev-financial-110613-034531>
- Thathsarani, U. S., Wei, J., & Samaraweera, G. R. S. R. C. (2021) “FI’s role in economic growth and human capital in South Asia: An econometric approach”, *Sustainability*, vol 13(8), p 4303. <https://doi.org/10.3390/su13084303>
- The NBE Directive No SBB/69/2018 “Asset classification and provisioning (5th replacement)”
- Third Amendment of Branch Opening Directive No. SBB/66/2018
- Tibebe, A. N. (2020). Determinants of financial performance of private commercial banks in Ethiopia: Camel approach. *International Journal of Research in Business Studies and Management*, 7(4), 25-34. <http://www.ijrbmsm.ijrsset.org/papers/v7-i4/3.pdf>
- Tibebe, A. N., & Gujral, T. M. S. (2022). Determinants of profitability of commercial banks in Ethiopia: A study on internal factors. *Journal of Positive School Psychology*, 6(8), 1219-1238. <https://journalppw.com/index.php/jpsp/article/view/9888>
- Timbula, M. A., Mengesha, T., Mekonnen, Y., & Kebede, M. (2019). FI and its determinants among households in Jimma Zone of Oromia Regional State, Ethiopia. *International journal of Commerce and Finance*, 5(2), 106-119. <http://ijcf.ticaret.edu.tr/index.php/ijcf/article/view/124>
- Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(1), 225–250. [https://doi.org/10.1016/0304-4076\(94\)01616-8](https://doi.org/10.1016/0304-4076(94)01616-8)
- Tram, T.X.H., Lai, T.D., & Nguyen, T.T.H. (2023). Constructing a composite financial inclusion index for developing economies. *The Quarterly Review of Economics and Finance*, <https://doi.org/10.1016/j.qref.2021.01.003>
- Tran, H. T. T., & Le, H. T. T. (2021). The impact of FI on poverty reduction. *Asian Journal of Law and Economics*, 12(1), 95–119. <https://doi.org/10.1515/ajle-2020-0055>
- Tran, S., Nguyen, D., & Nguyen, L. (2022). Concentration, capital, and bank stability in emerging and developing countries. *Borsa Istanbul Review*, 22(6), 1251-1259. <https://doi.org/10.1016/j.bir.2022.08.012>
- Trejo-García, J. C., Valencia-Romero, R., Soto-Rosales, M. D. L., & Venegas-Martínez, F. (2024). On the asymmetric relation between inflation and growth in Mexico: A NARDL approach. *Economies*, 12(1), 21. <https://doi.org/10.3390/economies12010021>

- Tsagkanos, A., Siriopoulos, C., & Vartholommatou, K. (2019). Foreign direct investment and stock market development: Evidence from a new emerging market. *Journal of Economic Studies*, 46(1), 55–70. <http://dx.doi.org/10.1108/JES-06-2017-0154>
- Tugcu, C. T. (2018). Panel data analysis in the energy-growth nexus (EGN). In *The economics and econometrics of the energy-growth nexus* (pp. 255-271). Academic Press. <http://dx.doi.org/10.1016/B978-0-12-812746-9.00008-0>
- Tun, N. N. (2019). An empirical analysis of macroeconomic factors affecting deposit mobilization of private commercial banks in Myanmar. *International Journal of Research in Business and Technology*, 3(2). <https://ejournal.lucp.net/index.php/ijrbt/article/view/10/528>
- Tura, B. D. (2023). Banking sector performance evaluation in Ethiopia for the period of growth and transformation plan (GTP-II): private vs public commercial banks. *Journal of Banking Regulation*, 24(4), 484-494. <https://doi.org/10.1057/s41261-022-00209-0>
- Uddin, A., Chowdhury, M. A. F., & Islam, M. N. (2017). Determinants of FI in Bangladesh: Dynamic GMM & quantile regression approach. *The Journal of Developing Areas*, 51, 221–237. <https://doi.org/10.1353/jda.2017.0041>
- Udeagha, M. C., & Breitenbach, M. C. (2023). On the asymmetric effects of trade openness on CO2 emissions in SADC with a nonlinear ARDL approach. *Discover Sustainability*, 4(1). <https://doi.org/10.1007/s43621-022-00117-3>
- Ugwuanyi, U., Ugwuoke, R., Onyeonu, E., Festus Eze, E., Isahaku Prince, A., Anago, J., & Ibe, G. I. (2022). FI-economic growth nexus: traditional finance versus digital finance in Sub-Saharan Africa. *Cogent Economics & Finance*, 10(1), 2133356. <https://doi.org/10.1080/23322039.2022.2133356>
- Ulaşan, B., 2015. Trade openness and economic growth: panel evidence. *Appl. Econ. Lett.* 22 (2), 163–167. <https://doi.org/10.1080/13504851.2014.931914>
- Ullah, S., Majeed, A., & Popp, J. (2023). Determinants of bank's efficiency in an emerging economy: A data envelopment analysis approach. *PloS one*, 18(3), e0281663. <https://doi.org/10.1371/journal.pone.0281663>
- Umar, M. & Akhtar, M. (2024). FI and bank risk-taking nexus: evidence from China. *China Finance Review International*, Vol. 14 No. 2, pp. 352-362. <https://doi.org/10.1108/CFRI-08-2021-0174>
- Urgaia, W. R. (2016). The Contribution of Financial Sector Development for Economic Growth in East Africa. *Applied Economics and Finance*, 3(2), 201-214. <https://doi.org/https://doi.org/10.11114/aef.v3i2.1251>
- Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with indirect influence on reliability estimators. *Procedia Economics and Finance*, 20, 679-686. [https://doi.org/10.1016/S2212-5671\(15\)00123-9](https://doi.org/10.1016/S2212-5671(15)00123-9)
- Use of Agents Directive No. FIS/02/2020
- Van, L. T. H., Nguyen, N. T., Nguyen, H. L. P., & Vo, D. H. (2022). The asymmetric effects of institutional quality on FI in the Asia-Pacific re-gion. *Heliyon*, 8(12), <https://doi.org/10.1016/j.heliyon.2022.e12016>
- Van, L. T. H., Vo, A. T., Nguyen, N. T., & Vo, D. H. (2021). FI and economic growth: An international evidence. *Emerging Markets Finance and Trade*, 57(1), 239–263. <https://doi.org/10.1080/1540496X.2019.1697672>
- Viswanadham, P., Yirgalem, T., & Medanit, B. (2015). The effect of location and information technology on banks deposit mobilization status in Ethiopia: Empirical evidence on private commercial banks in Adama Town. *International Journal of Science and Research*, 6–14.
- Vo, D. H., & Nguyen, N. T. (2021). Does FI improve bank performance in the Asian region?. *Asian-Pacific Economic Literature*, 35(2), 123-135. <https://doi:10.1111/apel.12330>
- Vo, D. H., Nguyen, N. T., & Van, L. T. H. (2021). FI and stability in the Asian region using bank-level data. *Borsa Istanbul Review*, 21(1), 36-43. <https://doi.org/10.1016/j.bir.2020.06.003>
- Vo, D.H. (2025). Long-term effects of institutional quality on FI in Asia–Pacific countries. *Financ Innov* 11, 59. <https://doi.org/10.1186/s40854-024-00727-y>

- Wang, C., & Lin, Y. (2021). Income diversification and bank risk in Asia Pacific. *The North American Journal of Economics and Finance*, 57, 101448. <https://doi.org/10.1016/j.najef.2021.101448>
- Wang, R., & Luo, H. R. (2022). How does FI affect bank stability in emerging economies?. *Emerging Markets Review*, 51, 100876. <https://doi.org/10.1016/j.ememar.2021.100876>
- Wang, X., & Guan, J. (2017). FI: Measurement, spatial effects, and influencing factors. *Applied Economics*, 49(18), 1751–1762. <https://doi.org/10.1080/00036846.2016.1276413>
- Waqabaca, C. (2004). Financial development and economic growth in Fiji. Economics, Department, Reserve Bank of Fiji, Working Papers, 03. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=224aeff17c2e82ceb2c3f49042b399f8bc6143cf>
- Watkins, M. W. (2018). Exploratory Factor Analysis: A Guide to Best Practice. *Journal of Black Psychology*, 44(3), 219-246. <https://doi.org/10.1177/0095798418771807>
- Wen J., Khalid S., Mahmood H., & Zakaria M. (2021). Symmetric and asymmetric impact of economic policy uncertainty on food prices in China: A new evidence. *Resources Policy*, 74. <https://doi.org/10.1016/j.resourpol.2021.102247>
- Werner, R. A. (2014). Can banks individually create money out of nothing?—The theories and the empirical evidence. *International Review of Financial Analysis*, 36, 1-19. <https://doi.org/10.1016/j.irfa.2014.07.015>
- Werner, R. A. (2016). A lost century in economics: Three theories of banking and the conclusive evidence. *International Review of Financial Analysis*, 46, 361-379. <https://doi.org/10.1016/j.irfa.2015.08.014>
- Williams, C. (2011). Research Methods. *Journal of Business and Economics Research*, 5. <https://doi.org/10.19030/jber.v5i3.2532>
- Windmeijer, Frank. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics* 126(1):25–51. <https://doi.org/10.1016/j.jeconom.2004.02.005>
- Winters, L. A. (2004). Trade liberalisation and economic performance: an overview. *The economic journal*, 114(493), F4-F21. <https://doi.org/10.1111/j.0013-0133.2004.00185.x>
- Wu, R. M. & Wang, Y. (2022). Which objective weight method is better: PCA or entropy?. *Scientific Journal of Research & Reviews*. <http://dx.doi.org/10.33552/SJRR.2022.03.000558>
- Wuhan, L. S., & Khurshid, A. (2015). The effect of interest rate on investment: Empirical evidence of Jiangsu Province, China. *Journal of International Studies*, 8(1), 81–90. <https://doi.org/10.14254/2071-8330.2015/8-1/7>
- Xi, W., & Wang, Y. (2023). Digital FI and quality of economic growth. *Heliyon*, 9(9). <https://doi.org/10.1016/j.heliyon.2023.e19731>
- Xin'e, Z., Ting, W., & Yuan, Z. (2012) “Economic Value Added for Performance Evaluation: A Financial Engineering. *Systems Engineering Procedia*”
- Yakubu, I. N., & Abdallah, I. (2021). Modelling the financial intermediation function of banks and economic growth in sub-Saharan Africa. *Journal of Money and Business*, 1(1), 1-7. <https://doi.org/10.1108/JMB-04-2021-0005>
- Yakubu, I. N., & Musah, A. (2022). The nexus between FI and bank profitability: A dynamic panel approach. *Journal of Sustainable Finance & Investment*, 14(2), 430-443. <https://doi.org/10.1080/20430795.2022.2105792>
- Yakubu, I.N., Yussif, A.R., Abdul-Rahaman, M. (2025). The Impact of FI on Economic Growth: Does Institutional Quality Matter?. In: Yakubu, I.N. (eds) *Strategic Approaches to Banking Business and Sustainable Development Goals*. Sustainable Development Goals Series. Springer, Cham. https://doi.org/10.1007/978-3-031-80744-2_7
- Yameogo, C. E., Omojolaibi, J. A., & Dauda, R. O. (2020). Economic globalisation, institutions and environmental quality in Sub-Saharan Africa. *Research in Globalization*, 3, 100035. <https://doi.org/10.1016/j.resglo.2020.100035>
- Yang, F., & Masron, T. A. (2023). Does FI moderate the effect of digital transformation on banks' performance in China?. *Cogent Economics & Finance*, 11(2), 2267270. <https://doi.org/10.1080/23322039.2023.2267270>

- Yang, Y., Su, M., & Liu, R. (2022). Concepts and applications of multivariate multilevel (MVML) analysis and multilevel structural equation modeling (MLSEM). In M. S. Khine (Ed.), *Methodology for Multilevel Modeling in Educational Research*, 55–88. Springer. https://doi.org/10.1007/978-981-16-9142-3_4
- Yitayaw, M. K., Mogess, Y. K., Feyisa, H. L., Mamo, W. B., & Abdulahi, S. M. (2022). Determinants of bank stability in Ethiopia: A two-step system GMM estimation. *Cogent Economics & Finance*, 11(1). <https://doi.org/10.1080/23322039.2022.2161771>
- Yonis M.B., Alemayehu A.A., Di Salvo F. & Rawlins M.R. (2025). The Dynamics of FI in Ethiopia: Diversifying Delivery Channels, Expanding Digital Technology, and Enhancing Financial Knowledge for Greater FI. Washington, D.C.: World Bank Group. <http://documents.worldbank.org/curated/en/099222204152534475>
- Younas, Z. I., Qureshi, A., & Al-Faryan, M. A. S. (2022). FI, the shadow economy and economic growth in developing economies. *Structural Change and Economic Dynamics*, 62, 613-621. <https://doi.org/10.1016/j.strueco.2022.03.011>
- Yüksel, S., Mukhtarov, S., Mammadov, E., & Özşarı, M. (2018). Determinants of Profitability in the Banking Sector: An Analysis of Post-Soviet Countries. *Economies*, 6(3), 41. <https://doi.org/10.3390/economies6030041>
- Yusuf, J. M., & Shikur, A. A. (2023). Bank Regulations and Firm Performance: In the Case of Ethiopian Commercial Banks. *International Journal of Finance and Banking Research*, 9(4), 58-67. <https://doi:10.11648/j.ijfbr.20230904.11>
- Z'ikovic', S., Z'ikovic', I. T., & Lenz, N. V. (2020). A disaggregated approach to energy-growth nexus: Micro-regional view. *Energy Strategy Reviews*, 28, 100467. <https://doi.org/10.1016/j.esr.2020.100467>
- Zelie, E. M., & Wassie, F. A. (2019). Examining the financial distress condition and its determinant factors: A study on selected insurance companies in Ethiopia. *World Journal of Education and Humanities*, 1(1), 64. <https://doi.org/10.22158/wjeh.v1n1p64>
- Zhang, Z., Song, J., Shu, T., & Zhao, T. (2024). Changes in rural financial exclusion's supply and demand factors from the perspective of digital inclusive financial policies. *Cogent Economics & Finance*, 12(1). <https://doi.org/10.1080/23322039.2024.2305480>
- Zheng, C., Rahman, M. A., Hossain, S., & Moudud-Ul-Huq, S. (2023). Does Fintech-Driven Inclusive Finance Induce Bank Profitability? Empirical Evidence from Developing Countries. *Journal of Risk and Financial Management*, 16(10), 457. <https://doi.org/10.3390/jrfm16100457>
- Zhu, W., Ahmad, F., Draz, M. U., Ozturk, I., & Rehman, A. (2022). Revisiting the nexus between exchange rate, exports and economic growth: further evidence from Asia. *Economic research-Ekonomska istraživanja*, 35(1), 7128-7146. <https://doi.org/10.1080/1331677X.2022.2059692>
- Zhuang, J., Gunatilake H., Niimi Y., Khan E.M., Jiang Y., Hasan R., Khor N., Lagman-Martin S.A., Bracey P., Huang B. (2009). Financial Sector Development, Economic Growth, and Poverty Reduction: A Literature Review. ADB Economics Working Paper Series 173, Asian Development Bank. <https://hdl.handle.net/10419/109358>
- Zimmermann, K. (2019). Monetary policy and bank profitability, 1870–2015. <https://doi.org/10.2139/ssrn.3322331>
- Zivot, E., & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of business & economic statistics*, 20(1), 25-44. <https://doi.org/10.1198/073500102753410372>
- Zulfiqar, Kalsoom, Muhammad Aslam Chaudhary, and Aribah Aslam. (2016). FI and Its Implications for Inclusive Growth in Pakistan. *Pakistan Economic and Social Review* 54: 297–325. <https://pesr.econpu.edu.pk/website/journal/article/6073d8f4eedd6/page>