Norwegian University of Life Sciences
School of Economic and Business

Philosophiae Doctor (PhD)
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Financial inclusion: trends, determinants, and contributions

Finansiell inkludering: trender, determinanter og bidrag

Wuddasie Dereje Bekele

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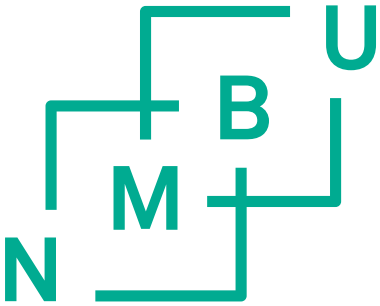

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Summary

Financial inclusion has a crucial contribution to the economy. Researchers, politicians, and other stakeholders are increasingly interested in financial inclusion, and countries have integrated it into their national strategies. This thesis contributes to the literature by analyzing different aspects of financial inclusion. The objective is to examine financial inclusion trends, determinants, and contributions. This thesis includes four independent but related research papers, focusing on identifying the underlying problems and making policy suggestions.

The first paper assesses Ethiopia's dynamic and spatial trend of financial inclusion. The level of financial inclusion is examined across time and regions to show the trend of financial inclusion and the discrepancy among the regions. Paper two investigates the determinants of and barriers to financial inclusion. It also identifies the macro and micro-level differences between Kenya and Ethiopia in their level of financial inclusion. The third paper analyzes the contribution of financial inclusion to climate resilience. Using the Sidama region of southern Ethiopia as a case study, this paper examines how financial inclusion contributes to building the climate resilience of farm households and what factors limit its contribution. Finally, paper four analyzes the role of financial inclusion in improving the Ethiopian tax administration and taxpayers' compliance and the limitations of financial services.

This thesis recommends improving the financial inclusion level as a major policy input. First, the availability of financial services should be increased at a lower cost through mobile and agent banking expansion. By reducing the transaction cost, the level of financial inclusion can be improved on both supply and demand sides. Second, financial literacy should be enhanced to increase society's awareness about the availability and use of financial services because lack of knowledge is one of the main reasons for financial exclusion. Finally, a more liberal financial system should be adopted. Increasing financial inclusion can magnify its contribution to tax administration and climate resilience. Therefore, enhancing the level of financial inclusion should be taken as a policy input to improve a country's economy.

Sammendrag

Finansiell inkludering er avgjørende for et lands økonomi. Forskere, politikere og andre interessenter har en økende interesse for finansiell inkludering, og flere land har innlemmet det i sine nasjonale strategier. Denne oppgaven bidrar til litteraturen ved å analysere ulike aspekter ved finansiell inkludering. Hovedmålet er å undersøke trender og ulike faktorers bidrag til finansiell inkludering. Denne oppgaven består av fire uavhengige, men relaterte, forskningsartikler som alle setter søkelys på å identifisere de underliggende problemene relatert til finansiell inkludering. I artiklene presenteres også forslag til politikk.

I den første artikkelen studeres trendene i finansiell inkludering i Etiopia. Både utviklingen over tid og utviklingen mellom regioner analyseres. I artikkel to studeres faktorene som påvirker finansiell inkludering. Både faktorer som påvirker positivt og negativt diskuteres. Forskjeller på så vell makro som mikronivå mellom Kenya og Etiopias grad av finansiell inkludering identifiseres og diskuteres. Den tredje artikkelen analyserer hvordan og hvorvidt finansiell inkludering bidrar til at småskala bønder står bedre rustet til å møte klimaendringer. Artikkel fire analyseres hvordan finansiell inkludering kan bidra til å forbedre skatteadministrasjonen og ikke minst bidra til at skattene faktisk blir betalt.

Et viktig resultat i oppgaven er viktigheten av finansiell inkludering på flere områder. En anbefaling er derfor at finansiell inkludering blir sentralt i politikkutforming. Tilgjengeligheten av finansielle tjenester bør økes for befolkningen generelt. En kostnadseffektiv måte å gjøre det på er gjennom utvidelse av mobil- og agentbanktjenester. Ved å redusere transaksjonskostnaden kan nivået av finansiell inkludering forbedres både på tilbuds- og etterspørselssiden. Kunnskap om bank og finans bør styrkes for å øke bevisstheten i samfunnet om tilgjengelighet og bruk av finansielle tjenester. Dette fordi mangel på kunnskap er en av hovedårsakene til økonomisk ekskludering. I tillegg bør et mer liberalt finanssystem tilpasses. Ved å øke nivået av finansiell inkludering kan småbønder stå bedre rustet til å møte klimaendringer og skatteforvaltningen vil kunne bli mye bedre. Det å øke nivået av finansiell inkludering er et viktig bidrag for å forbedre et lands økonomi.

1. Introduction

Financial inclusion is a timely topic gaining interest from researchers, politicians, policymakers, and other financial stakeholders because of its significant contribution to the economy (Hanivan & Nasrudin, 2019; Kim et al., 2018). It can be defined as the accessibility, availability, and usage of formal financial services by a country's population (Sarma, 2008). An inclusive financial system improves economic growth and reduces poverty (Churchill & Marisetty, 2020). It benefits an economy by lowering capital costs, improving finance administration, and hindering the expansion of abusive and untrustworthy informal financial activities (Sarma & Pais, 2011). Financial inclusion benefits the poor by providing investment opportunities and reducing information and transaction costs. It also permits them a safe way to keep their money, which minimizes the probability of theft (Beck et al., 2007; Wang'oo, 2013). Moreover, when vulnerable people are financially included, they can invest in assets and plan and manage future risks, contributing to a climate-resilient economy (Calderone et al., 2019; Haworth et al., 2016). Financial technology makes tax payment easier, improving a country's tax administration and taxpayers' compliance (Maino et al., 2019). Therefore, many countries have integrated financial inclusion into their national strategy (Desalegn & Yemataw, 2017).

Although financial inclusion is an important aspect, there is still a low level, particularly in developing countries like Ethiopia (Demirgüç-Kunt et al., 2018). It is, therefore, necessary to improve it. To do this, it is vital to identify the challenges associated with the provision of financial services. As a result, policy research is needed to identify the challenges and ways to enhance financial inclusion. This requires a good monitoring and measurement system (Beck et al., 2015). Financial inclusion has multi-dimensional characteristics (Chakravarty & Pal, 2013); thus, a multi-dimensional measurement is required. The multi-dimensional measurement captures financial inclusion's multifaceted property and helps track its progress. A good measure helps to study the two-way relationship between financial inclusion and economic variables. It can also serve as input for policy regarding financial inclusion (Camara & Tuesta, 2014). The index of financial inclusion (IFI) captures its multidimensionality and simplifies the study of its relationship with other variables (Sarma, 2008).

This thesis has four main research questions, all related to financial inclusion. The questions are explored in four separate essays. The first essay examines the dynamic and spatial trend of financial inclusion in Ethiopia. The trend of financial inclusion is analyzed using IFI to see the

discrepancy across time and regions. The second essay investigates the determinants of financial inclusion using a comparative analysis between Ethiopia and Kenya. The factors affecting financial inclusion and the difference between Kenya and Ethiopia are examined at macro and micro levels using IFI. The third research question is to analyze the role of financial inclusion in building farmers' resilience to climate-change-induced impacts. Using the Sidama region as a case study, the contribution of financial inclusion in building farm households' climate resilience is explored. The fourth and last research question evaluates how financial inclusion contributes to Ethiopia's tax administration and tax compliance. This study shows the role of different financial services in enhancing tax administration and increasing taxpayers' compliance. As a whole, the thesis provides policy input on how to increase the level of financial inclusion. Also, by analyzing its contribution to tax administration and a climate-resilient economy, we can identify its weaknesses. This helps to study how financial services can be shaped so that they can further contribute to the economy.

The remaining part of this chapter is organized as follows. Section 2 provides background on the financial inclusion of Ethiopia. Section 3 presents the theoretical and conceptual framework. Section 4 shows how the index of financial inclusion is estimated. Section 5 presents the data used in the thesis. The scientific contribution of the thesis is presented in section 6. Section 7 provides the policy implication of the thesis and conclusion. Finally, some limitations and suggestions for future research are presented in section 8.

2. Financial inclusion in Ethiopia

The National Bank of Ethiopia (NBE) has recognized financial inclusion's role in the economy. Some instances include its contribution to financial and monetary stability, its support to economic and social progress, its ability to bridge the gap in credit demand, and its ability to mobilize financial resources for investment. This contributes to the generation of employment opportunities, increment of income, and poverty reduction (NBE, 2017). That is why Ethiopia developed a financial inclusion strategy in 2014. However, Ethiopia still has a low financial inclusion level (Demirgüç-Kunt et al., 2018). Also, its progress in the level of financial inclusion is not as successful as its East African neighbors, such as Kenya and Rwanda (Lakew & Azadi, 2020).

Banks and microfinance institutions (MFIs) are the most crucial sectors of the Ethiopian financial system (CSA et al., 2017). The banking sector is the most dominant financial institution that works toward increasing the financial inclusion of society. MFIs also play a

vital role in reducing poverty by increasing society's financial outreach, particularly in rural areas (Kinde, 2012). The sector offers different standard financial services, such as deposit mobilization, loan disbursement, and digital financial services (NBE, 2017). Currently, there are 30 banks in the country, where 2 of them are government-owned, namely, Commercial Bank of Ethiopia (CBE) and Development Bank of Ethiopia, whereas the remaining are private. There are also 41 MFIs (NBE, 2022).

Over the years, Ethiopia adopted diverse methods of accessing financial services. One instance is the automated teller machines (ATMs), made available to society using debit cards. The objectives of installing ATMs are to reduce the number of customers at branches and provide services during the weekend and month ends (Manaye & Worku, 2018). Other outlet mechanisms of financial sectors include mobile, internet, and agent banking.

Ethiopia is one of the last two countries in Africa to launch mobile banking. In 2013, NBE issued the first regulation on mobile banking. Since then, different banks and MFIs have expanded their availability (Entele, 2019). However, mobile banking is still in its infant stage. In addition, unreliable infrastructure has been an obstacle to its expansion throughout the country (NBE, 2017).

Despite this, the introduction of mobile and internet banking has been a breakthrough for the country. This is because they reduce transaction costs, such as time and travel, and make transactions easier. Also, transactions such as paying bills, purchasing products, and checking balances can be done using mobile and internet banking without queuing in bank branches and ATMs (Baza & Rao, 2017).

In addition, most banks give legal licenses to agents to perform the essential functions of banks. Agent banks are retail outlets through which financial institutions provide financial services as part of their branchless banking. For example, a retail store acting as an agent allows customers not only to purchase goods but also to withdraw and deposit cash on behalf of banks (Mas & Siedek, 2008). Agent banking provides financial services at low cost and flexible hours, i.e., outside the usual business hours. It also helps to reach rural areas and women, who have the highest probability of being unbanked and underbanked (Desalegn & Yemataw, 2017).

Despite the expansion of financial sectors and services in Ethiopia, most of the population remains unbanked. According to the Global Findex report of 2017, only 35% of adults owned a bank account (Demirgüç-Kunt et al., 2018). Moreover, the expansion of the financial sectors is mainly restricted to urban areas (Desalegn & Yemataw, 2017; Lakew & Azadi, 2020),

whereas most of the population (78%) still lives in rural areas (World Bank, 2020). In addition, Ethiopia's use of digital payment systems is poor compared to other developing countries (Dinku, 2019).

The preference of its population toward informal financial sectors has been one of the barriers to financial inclusion (Lakew & Azadi, 2020). Furthermore, lack of money, distance to the nearest financial sector branches, lack of knowledge, and cost of opening an account are some of the main reasons for financial exclusion (Desalegn & Yemataw, 2017; Dinku, 2019; Lakew & Azadi, 2020).

Studies in Ethiopia show a positive relationship between financial inclusion and the human development index (HDI) (Alemu, 2016; Rani & Yeshaneh, 2017). However, the preference of Ethiopia's financial institutions, particularly banks, to extend credit to well-established and large businesses rather than small businesses have limited their impact on inclusive growth. Even if banks decision to lend to large businesses ensures their return, it constrains inclusive growth for the overall economy (Alemu, 2016).

3. Theoretical and conceptual framework

Financial market frictions, such as information and transaction costs, prevent the financial market from operating smoothly. It disrupts the decision-making ability of the players involved in the market (Demirgüç-Kunt & Levine, 2009). According to the transaction cost theory of financial inclusion, one of the main reasons for financial exclusion is high transaction costs (Coase, 1993). Transaction cost affects both supply and demand side financial players.

The production of financial goods, like any other product, requires labor and capital goods. In the financial market, these goods are employed in the tasks of documentation, information, and monitoring. Information costs are relatively high in the financial market because information and monitoring are very useful in producing financial products such as loans, deposits, and other financial services. However, asymmetric information and the consequence of moral hazard increase the information cost (Benston & Smith, 1976). This reduces the profit of financial sectors, which makes them refrain from expanding their services to areas where they incur a high cost (Coase, 1993).

Similarly, consumers reduce their use of financial services if transaction costs are high (Obińska-Wajda, 2016). In developing countries, low-income individuals face significant transaction costs when participating in the formal financial sector. These costs can be divided

into pecuniary and non-pecuniary costs. The pecuniary costs involve the costs associated with minimum deposit requirements, withdrawal fees, opening fees, and administrative requirements. The non-pecuniary costs include travel costs, opportunity costs concerning time and foregone wages, and administrative hassle or information gathering costs. Reducing these costs motivates consumers to participate in the formal financial sector (Karlan et al., 2013).

On the other hand, the financial literacy theory states that literacy increases people's awareness about the availability and use of financial services and allows them to make informed decisions. Financial literacy is the knowledge, skills, and attitude toward financial products and services (Kapadia, 2019). It increases people's knowledge about the availability of financial services and its contribution to their welfare. It also improves people's ability to save by helping them distinguish between their needs and wants and manage their budget efficiently (Ozili, 2020). Thus, improving financial literacy is an essential instrument of financial development that can be used in expanding financial inclusion. Especially in areas where lack of knowledge is a barrier to financial inclusion, increasing financial literacy can be used as a policy tool to enhance the financial inclusion level (Atkinson & Messy, 2013). Financial literacy is beneficial not only for the consumer but also for the financial sector. When people are aware of the availability of financial products, they will be obliged to buy them. People who previously saved at home will start saving in financial sectors after knowing about financial services. This increases the transaction level and profit of the financial sector (Bire et al., 2019). It also increases the financial inclusion level.

Figure 1 presents the conceptual framework of the thesis. It shows that IFI is used to measure financial inclusion, and the difference in transaction costs, religion, and financial literacy explains some of the variations in financial inclusion levels among the regions of Ethiopia. Gender, age, education, employment status, and ownership of mobile phones are significant determinants of financial inclusion. In contrast, lack of documentation, lack of money, lack of trust, and distance are barriers to financial inclusion. Meanwhile, differences in financial liberalization policy, GDP, percentage of the rural population, mobile money service expansion, literacy rates, and means of receiving payments explain the discrepancy in the level of financial inclusion between Ethiopia and Kenya.

Financial inclusion contributes to climate resilience by improving account ownership in financial sectors, expanding mobile money services, and enhancing access to credit. In addition, other demographic and socio-economic variables affect climate resilience. Moreover,

financial inclusion contributes to tax administration and compliance by improving taxpayers' probability of detection and registration via the credit system. It also reduces the compliance cost and improves the convenience of taxpayers and their relationship with tax officials via the bank-to-bank and E-tax payment systems.

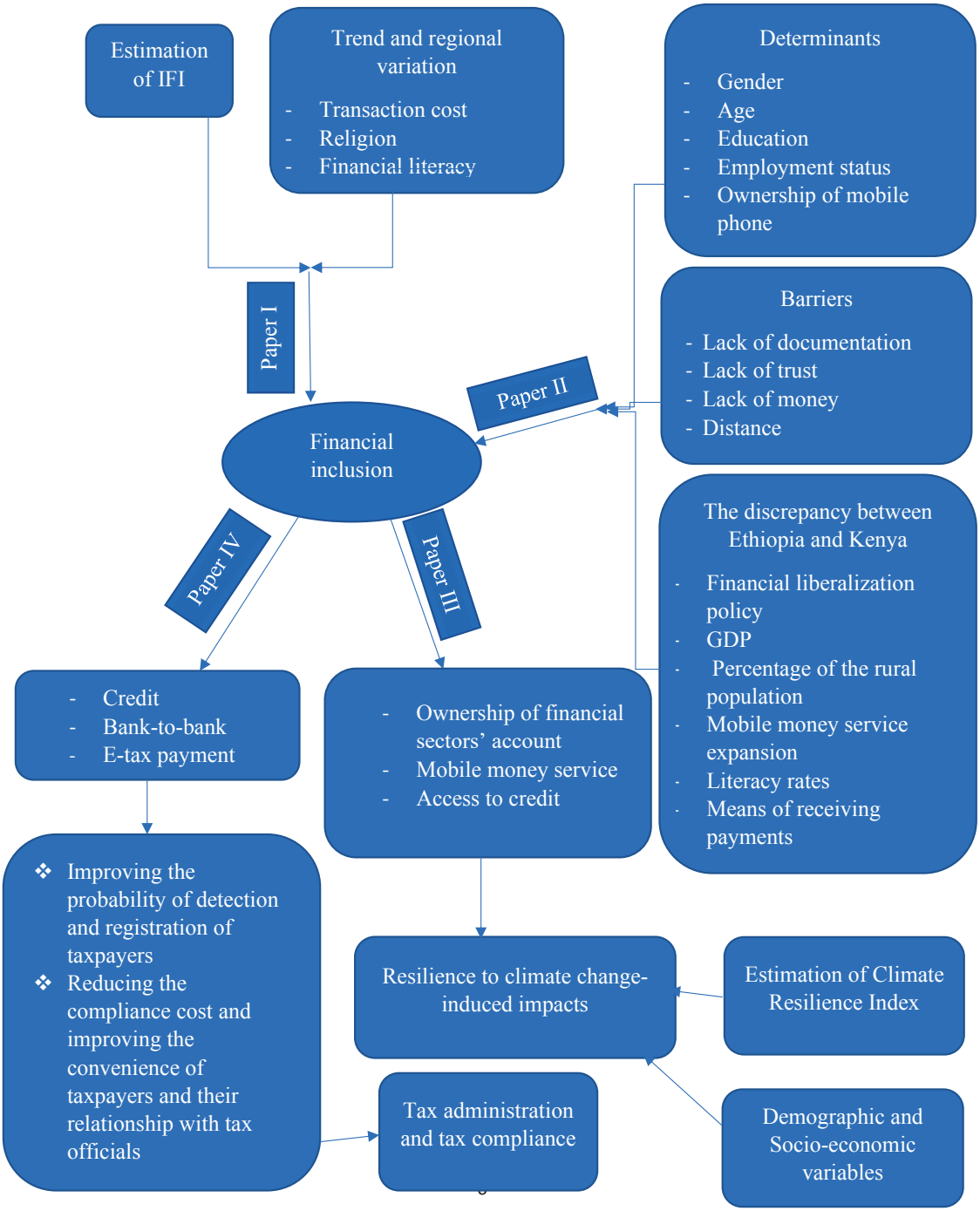

Figure 1: The trend, determinant, and contribution of financial inclusion

4. Index of financial inclusion

The IFI is a multi-dimensional index that captures information on various dimensions of financial inclusion in one single digit between zero and one. Zero denotes a complete financial exclusion, and one indicates a complete financial inclusion. An index should be easily interpretable and usable for comparing across economies and over time. To ensure this, it should have the following properties (Sarma, 2015).

I. Unit-free measure: the index should be unit free so that it can be comparable across economies.
II. Boundedness: the index should be bounded both below and above to make interpretation easy.
III. Monotonicity: the index should be an increasing function of the dimensions, i.e., a higher value of the dimension should give a higher value of the index.
IV. Homogeneity: the index should be a homogeneous function of degree zero. This means that if the dimensions are changed by a constant amount, the value of the index should remain constant.

Various studies attempt to estimate IFI using different methods. The most common is the distance-based approach IFI developed by Sarma (2008), which follows the procedure for constructing the HDI. The weights of the indicators are assigned based on the researcher's intuition regarding the importance of the indicators. Goel and Sharma (2017) follow the same steps as Sarma but allot equal weights for all dimensions. Wang and Guan (2017) follow a more indicative approach with recapitulative dimension and specific indicators. They differentially weigh the indicators and dimensions and use a formula to estimate the weights. This method avoids correlation among the dimensions.

Other methods, such as the principal component analysis (PCA), are also used to construct the index. However, the focus of PCA on the variance-covariance (second moment) makes it less useful to compute the IFI, whose primary focus is capturing the levels of achievements in various dimensions (the first moments) (Sarma, 2015).

In this thesis, the index formulated by Wang and Guan (2017) was adopted, however, with some modifications. First, the dimensions were mostly based on Sarma (2015). These dimensions were selected because they are more convenient to use, given the data availability. Second, the indicators were refined to include the main financial services provided by banks and MFIs. However, this method has its limitations. Additional indicators representing

different financial services should have been included to get a better index. But due to a lack of data, the number of indicators included in this study was limited.

The index was calculated at the macro and micro levels. Thus, the indicators should reflect this. The multi-dimensional feature of financial inclusion was captured using three dimensions. These were penetration, availability, and usage of financial services. Combining the three dimensions to get information on the financial inclusion level is vital since penetration does not imply availability, and availability does not imply the usage of financial services.

Dimension of financial inclusion

A. **Penetration**: indicates how financial sectors could penetrate society to provide services to as many users as possible. At the macro level, it was measured using the number of bank and MFI accounts per 1000 adults. At the micro-level, ownership of an account was used as a proxy.
B. **Availability**: represents the outlet mechanisms through which people use financial services. In an inclusive financial system, the services provided by financial sectors should be available to all users (Sarma, 2008). At the macro level, it was measured using the number of bank and MFI branches per 100,000 adults, number of ATMs per 100,000 adults, number of agent banks per 100,000 adults, number of internet bank users per 100,000 adults, and number of mobile bank users per 100,000 adults. At the micro-level, ownership of mobile money accounts, debit cards, and credit cards were used as proxies based on the availability of data.
C. **Usage**: Sarma explained that having an account or financial outlet mechanism does not assure that people are using the services. So, outstanding loans and deposits with banks and MFIs (as % of GDP) were used to measure the usage dimension at the macro level. Meanwhile, savings and access to credit were used as proxies at the micro level.

The IFI was calculated in three steps. In the first step, the indicators were estimated separately. This ensures that the indicators are between zero and one.

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \quad (1)$$

where,

x_{ij} is the estimated value of indicator i in the j^{th} dimension,

A_{ij} is the actual value of indicator i in the j^{th} dimension,

M_{ij} is the maximum value of indicator i in the j^{th} dimension, and

m_{ij} is the minimum value of indicator i in the j^{th} dimension.

The minimum observed value was used as the lower limit at the macro level. Using the maximum observed value for the upper limit can be problematic if there are outliers because the rest must be compared against extremely high benchmarks (Sarma, 2015). Therefore, the 90th percentile distribution of the indicators' observed value was used. If an economy had an observation higher than this, it was set equal to the upper limit. Furthermore, the indicators for the micro-level data were binary variables. They were assigned the value of one if a person's response was yes and zero otherwise. Therefore, the lower limit was zero, and the upper limit was one.

In the second step, n number of indicators were combined to estimate IFI for each dimension (IFI_j).

$$IFI_j = 1 - \frac{\sqrt{w_{1j}^2(1-x_{1j})^2 + w_{2j}^2(1-x_{2j})^2 + \ldots + w_{nj}^2(1-x_{nj})^2}}{\sqrt{w_{1j}^2 + w_{2j}^2 + \ldots + w_{nj}^2}} \quad (2)$$

w_{ij} stands for the weight of indicator i in the j^{th} dimension. The weight was computed using the coefficient of variation (CV) method. CV is used to measure the distribution of probability or frequency and is defined as the ratio of the standard deviation σ to the mean value μ (Wang & Guan, 2017). The weight of each indicator (w_{ij}) is defined as the proportion of its CV (V_{ij}) to the sum of all indicators' CV in that dimension. That is,

$$w_{ij} = \frac{V_{ij}}{\sum_i V_{ij}} \quad (3)$$

Finally, given the three dimensions, the final IFI was computed.

$$IFI = 1 - \frac{\sqrt{W_1^2(1-IFI_1)^2 + W_2^2(1-IFI_2)^2 + W_3^2(1-IFI_3)^2}}{\sqrt{W_1^2 + W_2^2 + W_3^2}} \quad (4)$$

In the above formulae, W_1, W_2, and W_3 were weights of the three dimensions, namely penetration, availability, and usage, respectively, which were calculated following the CV method.

5. Data

In this thesis, primary as well as secondary data were used. The secondary data were obtained from different sources such as the NBE, the Association of Ethiopian Microfinance institutions, the Ethiopian Ministry of Finance and Economic Development, the Ethiopian Central Statistics

Agency, the 2017 Global Findex Database, the World Bank, International Monetary Fund (IMF), the Heritage Foundation, the Global Economy database, Ethiopian Ministry of Revenue (MOR), Addis Ababa MOR, SNNPR MOR, Sidama region MOR as well as the Sidama region Bureau of Agricultural and Natural Resource Development over different periods. Moreover, the primary data was collected using semi-structured interviews and structured questionnaires. Data from business owners who paid taxes in Addis Ababa, Sidama region, and SNNP region, and farm households in Hawassa Zuria, Boricha, and Loka Abaya districts were collected using questionnaires. In addition, data from expertise in NBE, the different MORs, financial sectors, and agricultural bureaus in the Sidama region was collected using interviews. The surveys were conducted from September 2021 to December 2021, whereas the interviews were conducted over different periods between May 2021 and November 2021.

6. Scientific contributions

This thesis adds to the literature by addressing the questions on various financial inclusion issues. The main research questions this thesis addresses are 1) what is the trend of financial inclusion in Ethiopia at the national and regional levels? 2) what factors contribute to the discrepancy in the level of financial inclusion among the regions? 3) what are the determinants of and barriers to financial inclusion? 4) what factors contribute to the difference in financial inclusion between Kenya and Ethiopia? 5) What is the role of financial inclusion in building farmers' resilience to climate change-induced impacts? 6) Are there differences in climate resilience or the level of financial inclusion between the study sites? 7) What factors limit the ability of financial inclusion policies to enhance farmers' resilience to climate change-induced impacts? 8) how does financial inclusion contribute to tax administration and tax compliance? Finally, 9) what are the weaknesses of financial sectors in their contribution to tax administration and compliance? Accordingly, the following sections summarize the objectives, methods, and key findings of the four papers included in the thesis.

Paper I: The dynamic and spatial trend of financial inclusion: a multi-dimensional measurement for Ethiopia

Ethiopia has a low financial inclusion level (Demirgüç-Kunt et al., 2018). However, given the economic benefit, the level needs to be improved. This requires studying the past trend and regional differences in the level of financial inclusion, which helps to identify the strengths and weaknesses. Thus, this paper studies the dynamic and spatial trend of financial inclusion in Ethiopia using an index to capture its multidimensionality. First, the IFI was estimated based

on the method adopted by Wang and Guan (2017). Then, the trend of financial inclusion level was analyzed at the national level for ten consecutive years and at the regional level for one year. This helps to see the progress in financial inclusion and the reasons for the discrepancy among the regions.

Ethiopia showed an increase in the level of financial inclusion over the years. However, the average level of financial inclusion was low. The availability dimension had the highest growth rate, followed by penetration and usage. The branch and ATM distribution showed growth. Despite its late introduction, agent banking showed a high growth rate, where its number surpassed the number of branches and ATMs in the latter years. The expansion of mobile banking has also been remarkable. However, the expansions of internet banking and outstanding loans (% of GDP) were poor and required improvement. This is because there was low internet availability in the country and credit distribution, especially to private and small businesses, was weak.

At the regional level, Addis Ababa had the highest level of financial inclusion and highest achievements in all indicators, whereas Somali had the lowest level of financial inclusion. The remaining regions had different performances in the indicators, i.e., better provisions for certain financial services and worse provisions for other services. Based on the value of IFI, the regions can be classified as high, upper-middle, lower-middle, and low. Accordingly, Addis Ababa, Harari, and Dire Dawa were categorized as high financial inclusion cities/regions. Tigray, Gambela, and Oromia were in the upper middle, whereas Amahara, SNNP, and Benshangul Gumuz were in the lower-middle financial inclusion categories. Afar and Somali were low financial inclusion regions. The difference between Addis Ababa and Harari was particularly notable.

Some of the reasons for this discrepancy among the regions were differences in transaction cost, religion, and literacy rate. The low financial inclusion regions had high concentrations of remote areas, discouraging financial sectors' expansion. Because of their remoteness, they had the lowest infrastructure provision, which increased the cost of setup and operation for financial sectors. As a result, the regions had low availability of financial services. Moreover, the low availability of financial services increased the transaction cost of customers, which reduced their use of financial services. This resulted in a low financial inclusion level in these regions.

In addition, the low-inclusion regions had Muslim dominance. This is a factor for financial exclusion because it prevents them from using standard financial services. Since these regions

had low availability of Sharia-compliant financial services, most of the population remained financially excluded. Furthermore, the literacy level of these regions was low compared to the high financially included areas. This is an issue because low literacy levels reduce the population's awareness about the availability and usage of financial services, contributing to a low financial inclusion level.

On the other hand, the high financial inclusion regions had large availability of infrastructure, which reduced the transaction cost. They also had a higher level of literacy. Additionally, even though they had a certain number of Muslim populations, there were enough Sharia-compliant financial products to meet their demand.

Paper II: Determinants of financial inclusion: a comparative study of Kenya and Ethiopia

The severe consequences of financial exclusion on the economy, such as worsening income inequality and increasing social instability, have motivated countries to adopt financial inclusion as a national strategy (Desalegn & Yemataw, 2017; Wang & Guan, 2017). Similarly, Ethiopia and Kenya have recognized the advantage of financial inclusion and thus have integrated it as part of their national strategy (NBE, 2017; Van Hove & Dubus, 2019). However, despite having similar economic structures, Ethiopia and Kenya have different levels of financial inclusion. According to the Global Findex report, Ethiopia has a low financial inclusion level, whereas Kenya shows better performance (Demirgüç-Kunt et al., 2018). For instance, Kenya is a leading Sub-Saharan Africa (SSA) country in terms of mobile money service expansion (Hannig, 2013). On the other hand, Ethiopia is one of the last two SSA countries to introduce mobile banking, which is still in its infant stage (NBE, 2017).

The focus of this study is to compare Ethiopia and Kenya while identifying factors affecting financial inclusion. Doing this is especially beneficial to Ethiopia because it can take lessons from Kenya, which is an important input for policy development. Therefore, this study aims to examine the determinants of and barriers to financial inclusion and investigate the macro and micro levels differences between Kenya and Ethiopia.

IFI was used to measure financial inclusion level because it captured its multidimensionality and made it easier to study its link with other economic variables. The generalized linear model was used to analyze the factors affecting financial inclusion at the micro-level. This model was preferable because of its appropriateness for variables whose value lies between zero and one, which was the case of IFI. Moreover, descriptive analysis was used to study the relationship between financial inclusion and macro-level variables.

Kenya had a higher level of financial inclusion than Ethiopia. Also, it had the highest performance in the macro and micro-level indicators. Their difference in mobile money service and agent banking was particularly noteworthy. At the micro-level, gender, age, education, employment status, and ownership of mobile phones were significant determinants of financial inclusion. Men who were older, more educated, employed, and owned mobile phones had higher financial inclusion levels than others. In addition, the gender gap was higher in Kenya than in Ethiopia. However, government transfer was only a significant determinant in Kenya.

On the other hand, lack of documentation, lack of trust, and lack of money were the main barriers to financial inclusion in both countries. In contrast, the distance to financial sectors was a barrier only in Ethiopia. Also, their influence was much smaller in Kenya than in Ethiopia. Moreover, the difference in literacy rates and means of receiving government transfers explained some of the micro-level differences between Kenya and Ethiopia.

Kenya has a liberal financial system, whereas Ethiopia follows a closed and tight financial system. Since financial freedom encourages competition among financial sectors, more financial products and services can be introduced. This contributed to a higher level of financial inclusion in Kenya. Also, higher levels of GDP are associated with higher levels of financial inclusion. Thus, since Kenya had a higher level of GDP than Ethiopia, it had the advantage of achieving a higher level of financial inclusion.

Moreover, Kenya had a lower percentage of the rural population and higher availability of mobile money services than Ethiopia. This reduced the transaction cost of expanding and using financial services, increasing financial inclusion. Therefore, the difference in the financial liberalization system, GDP, rural population percentage, and mobile money services expansion explained some macro-level differences in financial inclusion between Kenya and Ethiopia.

Paper III: Enhancing farmers' resilience to climate change-induced impacts through financial inclusion in Sidama region, southern Ethiopia

Ethiopia has had a series of climatic shocks, which increased its population's vulnerability (Haworth et al., 2016). The Sidama region, in particular, has faced drought at different times. In addition, its dependence on rain-fed agriculture has made the region vulnerable to climate shocks (UNDP-EUE, 2003). Therefore, there is a need to build climate resilience in this area. This requires integrating climate change measures into national policies and strategies (United Nations, 2015).

Since climate resilience building requires a context-specific strategy, there is a need to create products that address climate change shocks in different economies (Meirovich et al., 2013; Nicholson et al., 2018). Moreover, it is helpful to have an in-depth analysis of climate resilience at the household level because it is difficult to obtain it from nationwide data (Mekuyie et al., 2018). Therefore, this study examines how financial inclusion can be used to enhance farmers' resilience to climate-change-induced impacts in the Sidama region, southern Ethiopia.

Climate resilience is a multi-dimensional phenomenon, and there is no direct way of measuring it. Therefore, different studies used a proxy method (Mekuyie et al., 2018; Quinlan et al., 2016). Estimating Climate Resilience Index (CRI) is a proxy approach to measuring climate resilience. In this study, CRI was estimated using two-stage PCA and was used as a dependent variable. Because CRI is a continuous variable, multiple linear regression was used to analyze the contribution of financial inclusion to climate resilience. IFI and financial inclusion indicators were the main explanatory variables, and different demographic and socio-economic variables were used as covariates.

The result shows that the financial inclusion level of the study areas was low, with Hawassa Zuria having the lowest level and Boricha having the highest level. Furthermore, Hawassa Zuria had the lowest climate resilience level, while Loka Abeya had the highest level.

Financial inclusion had a significant and positive contribution to climate resilience. By helping farm households build assets and enabling them to diversify income, financial inclusion increased their climate resilience while increasing their self-sufficiency. Moreover, ownership of financial sector accounts, mobile money accounts, and access to credit played a role in building climate resilience. Ownership of the financial sector's accounts served as a channel through which farm households received safety net payments and purchased agricultural inputs. This reduced unnecessary expenditures, developed saving habits, and allowed for the immediate purchase of agricultural inputs, which supported farm households' climate-resilient activities. Mobile money accounts reduced the transaction costs of using financial services and increased financial inclusion. They also allowed for low-cost access to services like remittance and government transfer. Finally, access to credit enabled farm households to diversify their income and cover different expenses, which increased their resilience to climate change. However, ownership of debit cards and savings had insignificant roles in building climate resilience.

Despite the contribution of financial inclusion to climate resilience, the region has low availability of financial services. The lack of infrastructure, particularly in rural areas, increased the transaction cost for financial sectors. This discouraged them from expanding to these areas and reduced the availability of financial services. Moreover, lack of knowledge, the long distance to the nearest financial sectors, long queues in financial sectors, and electricity and network interruption were barriers the residents faced while opening and using the financial sector's accounts, forcing them into financial exclusion. Also, the long process it took to get credit, the low amount of credit available to the households, the lack of collateral, and the corruption in MFIs during credit extension discouraged farm households' from requesting and obtaining credit. In addition, the absence of agent banks and the shortage of mobile networks restricted the expansion of mobile money services.

Paper IV: Financial inclusion for a better tax administration and compliance: the case of Ethiopia

Taxation is required for a state building because it is an independent source of revenue (Mascagni et al., 2014). However, developing countries like Ethiopia generate low tax revenue. One of the reasons for a low level of taxation is poor tax administration, which involves a lack of qualified tax officials, lack of taxpayers' compliance, tax evasion, corruption in tax administration, and a weak control system of taxpayers (Fjeldstad & Rakner, 2003; Gupta, 2007; Ponomariov et al., 2018). Thus, countries need to improve their tax administration. This requires them to develop different strategies (Abay, 2010; Maino et al., 2019).

Financial inclusion is recognized as one of the tools that can be used to improve a country's tax administration and compliance (Capasso & Jappelli, 2013; Maino et al., 2019). Therefore, this study analyzes how financial inclusion contributes to Ethiopia's tax administration and taxpayers' compliance. This helps to identify the strengths and weaknesses of financial sectors, which can be an essential policy input. Descriptive analysis with the help of tables and figures was used to analyze the data.

The finding shows that financial inclusion contributed to the improvement of tax administration and tax compliance. The credit extension system provided opportunities for the financial sectors and tax authorities to cooperate, leading to better tax administration and compliance. To obtain credit, borrowers submitted financial statements to banks. The tax authority used this statement to verify the true worth of businesses, based on which they determined the correct tax amount. Also, borrowers submitted a clearance from tax authorities verifying that they are

registered taxpayers. This increased the probability of detection, which improved tax administration, reduced tax evasion, and increased taxpayers' compliance. However, lack of collateral, lack of interest, fear of debt, and the long process it took to obtain credit hindered businessowners from requesting credit from formal financial sectors.

Contrary to studies in other countries, the contribution of digital payment systems such as debit and credit cards to the Ethiopian tax administration and compliance could not be identified because of their limited use in transactions. Also, there was no direct cooperation between tax authorities and MFIs, which limited the contribution of financial inclusion to tax administration.

The bank-to-bank and E-tax payment system reduced the time it took to pay taxes, the queue in tax offices, and other transaction costs. They also reduced the use of cash which improved the convenience of taxpayers and reduced the probability of theft. Furthermore, they reduced the corruption in tax payments caused by frequent interaction between tax officials and taxpayers. This improved the tax administration and compliance of taxpayers. However, these systems had their weaknesses. Despite reducing the time it took to pay taxes, the bank-to-bank system suffered from overload, which caused tax payments to take longer than necessary. One of the reasons is that taxpayers waited until the end of the deadline to pay their taxes, which caused overcrowding of banks. Also, the Commercial Bank of Ethiopia (CBE) was the main bank for tax payments and other government transactions. Therefore, using CBE as the primary bank caused long queues and the system's failure due to the overload.

Moreover, the E-tax payment system suffered from frequent interruptions of the internet. Lack of knowledge on how to use the system, untimely delivery of receipts, and the availability of the system only in the capital city were other bottlenecks that hindered the fast expansion of this system, thus reducing its contribution to tax administration and compliance of taxpayers.

7. Policy implications and conclusion

Financial inclusion benefits the economy and is recognized as a policy tool that can be used to build climate resilience and improve tax administration. However, the financial inclusion level of Ethiopia is low. Therefore, Ethiopia should increase its financial inclusion level. One way to do this is by recognizing the regional differences and addressing the gap between the high financially included and low-inclusion regions. Also, increasing the regions' financial services, which are in low availability, can be a potential policy measure toward improving financial inclusion.

Because transaction cost is one of the main barriers to financial inclusion, expansion of low-cost financial services is advisable. For instance, the expansion of mobile money services and agent banking provides an opportunity to reach the financially excluded population at a reduced cost. Therefore, financial sectors should focus on expanding these services. This will be more profitable for them than opening new branches.

The study shows a positive relationship between financial inclusion and literacy rate. Thus, financial authorities should increase people's financial literacy to create awareness about the availability and use of financial services. In addition, Sharia-compliant products in Muslim-dominated regions of the country should be increased to improve the financial inclusion level. Furthermore, Ethiopia should take lessons from Kenya and liberalize its financial system. This is because the financial freedom in Kenya has contributed to the fast expansion of financial sectors in the country, which increased the availability of financial products through competition. Thus, Ethiopia should follow a more liberalized financial system.

Financial inclusion increases farm households' resilience to climate change in the Sidama region. However, the region's low financial inclusion level restricts its contribution. Therefore, financial sectors should increase the availability of their services. They should open more branches and ATMs in areas with more business transactions and infrastructures. Since the expansion of mobile money services can be done at a lower cost, they should use this service to reach areas where it is costly to open a new branch or set up ATMs. They should also launch agent banks, which can benefit the expansion of mobile money services and the availability of other financial services at a low cost. They should create awareness about the availability and use of financial services because a lack of knowledge hinders financial inclusion. Moreover, financial sectors should increase the amount of credit they extend by mobilizing more savings from farm households and reducing the corruption involved during credit extension. In addition, financial sectors should prioritize climate-resilient activities in their provision of financial services.

Financial inclusion has a positive contribution to tax administration and tax compliance. However, some factors reduce its contribution. Even though debit and credit cards can potentially improve tax administration and compliance of taxpayers, the limited use of these cards in Ethiopia prevents them from having the same role. Thus, their use in transactions should be increased. This requires the expanded availability of point-of-sale (POS) machines and increasing buyers’ and sellers’ awareness. In addition, bank-to-bank and E-tax payment

systems contribute to better tax administration and taxpayers' compliance. However, frequent interruption of the network and availability of the systems, primarily in CBE, reduces the benefit of these systems. Therefore, tax authorities and financial sectors should work together to improve the systems by delegating the responsibility of accepting tax payments without additional fees to more private sectors. Also, they need to improve the network system. Furthermore, since lack of knowledge is a bottleneck for the E-tax payment system, tax authorities should work toward increasing the awareness of taxpayers on the availability of the system and on how to use it. Tax authorities should also collaborate with other financial sectors like MFIs to increase the contribution of financial inclusion in improving tax administration and taxpayers' compliance.

In conclusion, the empirical result in this thesis indicates that financial inclusion is a crucial phenomenon in an economy. It has a positive role in building the climate resilience of farm households and improving a country's tax administration. However, Ethiopia's financial inclusion level is low and needs to be enhanced. This requires recognizing the difference among the regions and enhancing the low availability of financial services. Also, Ethiopia can take lessons from Kenya on how to improve its financial inclusion level. Doing so can significantly contribute to the economy by reducing the vulnerability of households to climate shocks and improving the tax administration and compliance of taxpayers.

8. Limitations and future research

This thesis assessed the different aspects of financial inclusion and its contribution to the economy. However, a significant limitation of this study is the lack of data. The calculation of the IFI is limited by the unavailability of data on the various financial services provided in the country. This limits the number of indicators used to develop the index. The lack of data at the regional level has also prevented us from analyzing financial inclusion trends across the regions over different periods.

Moreover, it would have been better to examine the contribution of financial inclusion to climate resilience using panel data. Nevertheless, nationwide household-level surveys, which includes relevant data, were unavailable in Ethiopia. So, we were forced to rely on cross-sectional data. In addition, the fear of generating unreliable data has confined us to rely on descriptive analysis while examining the contribution of financial inclusion to tax administration and tax compliance. Taxpayers are not truthful when answering questions about their compliance because of the current political situation in the country, their fear that the data

could be leaked to tax authorities and their desire to show that they are exemplary taxpayers. Thus, we were forced only to ask questions that would not jeopardize them and that they could answer honestly. This limited the scope of the study.

Therefore, further studies should be conducted to overcome the challenges associated with the lack of data. Future studies can calculate IFI by including more indicators to obtain information on financial inclusion. They can also assess the level of financial inclusion across time and economies. Furthermore, they can gather more data to further analyze financial inclusion's contribution to climate resilience and tax administration in depth.

This study makes a comparative analysis only between Ethiopia and Kenya. Future studies can include other countries and compare their level and determinants of financial inclusion. Finally, more studies should be conducted to see the contribution of financial inclusion to other aspects of the economy and how to use financial inclusion as a policy tool for the economy's advancement.

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Research Papers

Paper One

The dynamic and spatial trend of financial inclusion: a multi-dimensional measurement for Ethiopia

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The dynamic and spatial trend of financial inclusion: a multi-dimensional measurement for Ethiopia

Abstract

Financial inclusion is a multidimensional phenomenon that enhances a country's economy. The objective of this study is to estimate the index of financial inclusion, analyze the dynamic and spatial trends of financial inclusion in Ethiopia at the national and regional levels and examine the factors responsible for the discrepancy among the regions. The index captures the multidimensionality of financial inclusion. The finding shows that financial inclusion in the country is low despite its fast growth rate. Evaluation of the indicators shows that internet banking and credit provision are weak points for the country. In addition, the regions have different levels of financial inclusion, with Addis Ababa having the highest score and Somali having the lowest. Transaction cost, literacy rate, and religion explain some of the variations among the regions. This paper proposes reducing the discrepancy among the regions while improving the availability of internet banking and credit as possible policy targets.

Keywords: financial inclusion, index of financial inclusion, transaction cost, literacy rate, religion

1. Introduction

An inclusive financial system is advantageous to a country's economy via the comprehensive provision of financial services such as savings, credit, and payment transfer (Demirgüç-Kunt et al., 2015). In addition, studies show that having an inclusive financial system contributes to poverty reduction (Churchill & Marisetty, 2020) and benefit the poor by improving their income share and reducing income inequality (Beck et al., 2007). Also, Beck et al. (2015) argue that financial inclusion is vital to financial development, benefiting individuals and businesses substantially. This motivates countries to have a good financial inclusion policy which requires measuring and monitoring the level (Beck et al., 2015; Demirgüç-Kunt & Klapper, 2013).

A good measure of financial inclusion is needed to develop concrete policies based on evidence (Mwangi, 2019). Since financial inclusion is a multi-dimensional phenomenon, the measurement should be multi-dimensional, i.e., provide information on multiple dimensions of financial inclusion in a single number (Sarma, 2015). The multi-dimensional measurement of financial inclusion is helpful because it reflects the dynamic property of financial inclusion, shows variation across economies, and helps keep track of its progress (Chakravarty & Pal, 2013). The index of financial inclusion (IFI), which contains evidence on various dimensions of financial inclusion, allows for comparison among economies (Sarma, 2008). In addition, it can be used to explore the relationship between financial inclusion and other economic variables (Sarma, 2015). Thus, the index is important to evaluate the level of financial inclusion, which helps develop policies to improve financial services provision.

The National Bank of Ethiopia (NBE) has recognized the role financial inclusion can have on the economy, such as its ability to mobilize financial resources for investment. It also contributes to employment and income generation, thus reducing poverty (NBE, 2017). That is why Ethiopia developed a financial inclusion strategy in 2014. However, according to the Global Findex report of 2017, Ethiopia is a low financially included country. Compared to other Sub-Saharan Africa (SSA) countries such as Kenya (82%), South Africa (69%), and Uganda (59%), its rank in terms of account ownership is low. More than half of its population is unbanked, with only 35% of adults having an account. Moreover, its share in the digital payment system is lower, where only one-third of the account holders are reported to use the system (Demirgüç-Kunt et al., 2018).

Given its advantage, Ethiopia's level of financial inclusion needs to be enhanced. This requires studying the trend and recognizing the variation of financial inclusion at the regional level. In

addition, IFI should be used to measure its multidimensionality, make comparisons among regions, and study the reason behind their variation. According to Sarma (2012), constructing a more detailed country-specific index using the same methodology is possible depending on data availability. This produces a different result from a pre-existing index.

Several studies evaluate the level of financial inclusion in Ethiopia (Alemu, 2016; Baza & Rao, 2017; Desalegn & Yemataw, 2017; Dinku, 2019; Lakew & Azadi, 2020; Rani & Yeshaneh, 2017; Timbula et al., 2019). However, studies investigating the regional variation of financial inclusion in Ethiopia are missing. Moreover, the studies fail to capture its multi-dimensional characteristics. The current study contributes to the literature by estimating IFI at the national and regional levels and examining the trend and regional variation of financial inclusion in Ethiopia. A new index is estimated for Ethiopia rather than using a pre-existing index. The index is estimated based on the method used by Wang and Guan (2017), whereas the dimensions were adopted from Sarma (2015). These studies, however, focused only on the banking sector when estimating IFI. Meanwhile, both banks and microfinance institutions (MFIs) are significant parts of the Ethiopian financial sector (CSA et al., 2017; Kinde, 2012). Thus, the indicators used in the current study represent primary financial services provided by both sectors.

Hence, the objectives of this study are (1) to calculate IFI at the national and regional level, (2) to evaluate the dynamic and spatial trend of financial inclusion, and (3) to explain the discrepancy in the level of financial inclusion among the regions. This allows for tracking financial inclusion progress over time and making comparisons among regions. In addition, it will be a useful input in policy formulation.

The remaining sections of this paper are organized as follows. Section II provides the literature review. Section III presents the methodology. Section IV presents the result. Finally, section V discusses and concludes.

2. Financial system in Ethiopia

Geographically, Ethiopia is divided into nine regions[1] and two main cities: Addis Ababa (the capital city), Dire Dawa (the main city), Oromia, Amhara, Southern Nation Nationalities and People (SNNP), Afar, Benshangul Gumuz, Gambela, Somali, Harari and Tigray (NBE, 2019).

[1] Currently, the Sidama region has been added as the tenth region. However, since it is yet to be structured, there is no separate data on the region. So, the data was taken when it was still part of SNNP.

The regions are at different levels of development, and therefore, different financial inclusion levels are expected among them.

The Ethiopian financial sector has expanded substantially in recent years. It has taken measures to grow into an inclusive financial system (NBE, 2017). The major financial institutions in Ethiopia are banks and MFIs (CSA et al., 2017). As of June 2019, 18 banks were operating in Ethiopia. Two of them were state-owned, and the remaining were private banks. In the 2018/19 budget year, banks opened 807 new branches, thereby raising the total number of branches to 5564. As a result, one bank branch served around 17 thousand people (NBE, 2019). Over the past ten years, the sector grew at a high rate, with a 22% increment in profit (CRA, 2019), whereas the total capital increased by 18.4% in 2019. In the same year, there were 38 operational MFIs in the county, and their total capital and assets increased by 20.3% and 24.1%, respectively. These financial sectors provided services such as opening an account, mobile banking, ATM, internet banking, agent banking, savings, and credit. Despite the fast expansion of ATMs, mobile banking, and agent banking, most Ethiopians still transact in branches (NBE, 2019).

3. Literature review

3.1. Theories of financial inclusion

Financial inclusion is the accessibility, availability, and usage of financial services by the population of a country, whereas financial exclusion, is the inability to access the necessary financial services (Sarma, 2008). There are different theories regarding financial inclusion (exclusion). These theories explain the reasons for financial exclusion and the strategies to increase financial inclusion.

3.1.1. The transaction cost theory

A transaction cost is incurred during the collection of information, selection of a product, and execution of a contract (Eisenhardt, 1989). The transaction cost affects both the supply and demand side of financial inclusion. The provision of financial services requires labor and capital goods, both of which have costs. These goods are used in the task of documentation, information, and monitoring. In the financial market, the cost of information gathering is particularly significant. The information cost can be high because of asymmetric information, resulting in high transaction costs for the financial sectors (Benston & Smith, 1976). According to Coase (1993), financial sectors reduce the availability of their services in areas where they face high transaction costs. Moreover, customers incur transaction costs while using formal

financial services. Some of the costs include travel costs, opportunity costs, withdrawal fees, opening fees, and administrative costs. If these costs are high, it reduces their use of the service (Obińska-Wajda, 2016). Therefore, high transaction costs reduce the financial inclusion level.

3.1.2. Financial literacy theory of financial inclusion

Financial literacy is the ability to make informed decisions concerning financial services, such as accounts, savings, and loans (Kapadia, 2019). The financial literacy theory states that financial inclusion can be achieved through education. Education increases financial literacy, while financial literacy improves people's awareness and understanding of the availability and use of financial services. When people are aware of the availability of financial services and their contributions to their welfare, they are willing to participate in the formal financial sectors. Furthermore, financial literacy helps people to manage their finances by distinguishing between their wants and needs. This helps them to manage their budget and improve their ability to save (Ozili, 2020). Thus, financial literacy improves the level of financial inclusion. Especially if a lack of knowledge is the reason for exclusion, financial literacy can be used as a tool to enhance financial inclusion (Atkinson & Messy, 2013).

3.2. Empirical literature

The concept of financial inclusion is concerned not only with the availability of financial services but also with their accessibility and use by a wide range of populations. As a result, studies used different indicators to measure financial inclusion. The most common ones were the number of bank accounts, number of bank branches, number of ATMs, amount of bank credits, and amount of bank deposits (Demirguc-Kunt et al., 2018). However, using individual indicators provides partial information on the inclusiveness of the financial system (Sarma 2008). Sarma (2008, 2015) and Wang and Guan (2017) developed a multidimensional measurement of financial inclusion. They used different approaches to calculate an index, which presents information on the various dimensions of financial inclusion in one single number. Such a measure can be used to compare financial inclusion across economies at a particular time.

Studies have identified financial literacy and transaction costs as significant factors affecting financial inclusion. Transaction cost is a major barrier to financial inclusion. The high cost of opening an account, the large distance to financial sectors, and the cost of accessing financial services lead to a high transaction cost, which contributes to financial exclusion (Soumare et al., 2016; Ulwodi & Muriu, 2017). On the other hand, financial literacy has a positive and

significant contribution to financial inclusion (Bire et al., 2019; Grohmann et al., 2018; Shen et al., 2018). The studies show that financial literacy provides customers with financial knowledge and skill, which helps them make informed financial decisions. By increasing their understanding, financial literacy increases their demand for financial products. Thus, financial literacy is a worthwhile policy instrument for financial inclusion.

Moreover, there is growing literature regarding the financial inclusion of Ethiopia. The studies reveal that the level of financial inclusion in Ethiopia is low. The country has a long way to go to catch up with other SSA countries (Dinku, 2019; Lakew & Azadi, 2020). Lack of sufficient resources, distance to financial sectors, and lack of money are identified as factors limiting the financial inclusion level of the country (Baza & Rao, 2017; Dinku, 2019; Lakew & Azadi, 2020; Timbula et al., 2019). In addition, there is a gap in financial inclusion levels between urban and rural dwellers and the country's Muslim and Christian populations (Desalegn & Yemataw, 2017).

Advancing the level of financial literacy is recommended as a necessity to increase the financial inclusion level (Lakew & Azadi, 2020; Timbula et al., 2019). Developing digital payment systems also contributes to increasing the level (Desalegn & Yemataw, 2017; Dinku, 2019). Furthermore, addressing the disparity in residence and religion by developing suitable products can narrow their difference and improve the overall financial inclusion level of the country (Desalegn & Yemataw, 2017).

4. Methodology

4.1. Data

The data was collected from NBE, the Association of Ethiopian Microfinance institutions, the Ethiopian Ministry of Finance and Economic Development, and the Ethiopian Central Statistics Agency. The index at the country level was estimated for ten consecutive years (2009/2010 – 2018/2019[2]). But due to a lack of data, the IFI at the regional level was computed only for the 2018/2019[3] budget year.

[2] The data covers the period from July 1, 2009, to June 30, 2019.

[3] Ethiopia's 2018/2019 budget year starts on July 1, 2018, and ends on June 30, 2019.

4.2. Measurement of financial inclusion

In this study, the index formulated by Wang and Guan (2017) was adopted with some modifications. The dimensions were adapted from Sarma (2015) because they are more fitting to the financial services provided in the study area. However, this method has its limitations. Additional indicators representing different financial services should be included to get a better index. But due to a lack of data, the number of indicators included in this study was limited. Moreover, the minimum and maximum values of the indicators used in the estimation of the index were based on the data because there were no pre-determined values. As a result, an outlier economy can have an IFI of zero or one. This does not mean that they have full financial exclusion or full financial inclusion, respectively. Rather it is a relative term stated in comparison with the other economies.

The multi-dimensional feature of financial inclusion was captured using three dimensions. These were penetration, availability, and usage of financial services. The penetration dimension was measured using the number of accounts in banks and MFIs per 1000 adults as a proxy. The availability dimension was measured using the number of bank and MFI branches per 100,000 adults, number of ATMs per 100,000 adults, number of agent banks per 100,000 adults, number of internet bank users per 100,000 adults, and number of mobile bank users per 100,000 adults as proxies. Moreover, outstanding loans and deposits with banks and MFIs (as % of GDP) were used as proxies to measure the usage dimension.

Following Wang and Guan (2017), the IFI was calculated in three steps. In the first step, the indicators were estimated separately. This ensured that the indicators were between zero and one.

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \quad (1)$$

where,

x_{ij} is the estimated value of indicator i in the j^{th} dimension,

A_{ij} is the actual value of indicator i in the j^{th} dimension,

M_{ij} is the maximum value of indicator i in the j^{th} dimension, and

m_{ij} is the minimum value of indicator i in the j^{th} dimension.

The minimum observed value was used as the lower limit. When there are outliers because the rest has to be compared against extremely high standards, using the maximum observed value for the upper limit can be challenging (Sarma, 2015). Therefore, the 90th percentile distribution

of the indicators' observed value was used. If an economy had an observation higher than this, it was set equal to the upper limit.

In the second step, n number of indicators were combined to estimate IFI for each dimension (IFI_j).

$$IFI_j = 1 - \frac{\sqrt{w_{1j}^2(1-x_{1j})^2 + w_{2j}^2(1-x_{2j})^2 + \ldots + w_{nj}^2(1-x_{nj})^2}}{\sqrt{w_{1j}^2 + w_{2j}^2 + \ldots + w_{nj}^2}} \quad (2)$$

w_{ij} stands for the weight[4] of indicator i in the j^{th} dimension. The weight was computed using the coefficient of variation (CV) method. CV is used to measure the distribution of probability or frequency and is defined as the ratio of the standard deviation σ to the mean value μ (Wang & Guan, 2017). The weight of each indicator (w_{ij}) is defined as the proportion of its CV (V_{ij}) to the sum of all indicators' CVs in that dimension. That is,

$$w_{ij} = \frac{V_{ij}}{\sum_i V_{ij}} \quad (3)$$

Finally, given the three dimensions, the final IFI was computed.

$$IFI = 1 - \frac{\sqrt{W_1^2(1-IFI_1)^2 + W_2^2(1-IFI_2)^2 + W_3^2(1-IFI_3)^2}}{\sqrt{W_1^2 + W_2^2 + W_3^2}} \quad (4)$$

In the above formulae, W_1, W_2, and W_3 were weights[5] of the three dimensions, namely penetration, availability, and usage, respectively, which were calculated using the CV method. IFI closer to one implied a higher level of financial inclusion, and an index closer to zero implied a lower level of financial inclusion.

4.3. Method of data analysis

Microsoft Excel software was used to estimate the IFI. Descriptive analysis with the help of tables and figures was used to analyze the data. In addition, a correlation matrix was used to show the statistical relationship between variables.

[4] The weights of indicators at the regional level were 1 for the number of accounts, 0.19 for the number of branches, 0.25 for the number of ATMs, 0.23 for the number of internet banking users, 0.19 for the number of mobile banking users, 0.14 for the number of agent banking, 0.54 for outstanding loans (% of GDP), and 0.46 for outstanding deposits (% of GDP). The weights of indicators at the national level were 1 for the number of accounts, 0.06 for the number of branches, 0.15 for the number of ATMs, 0.33 for the number of internet banking users, 0.21 for the number of mobile banking users, 0.25 for the number of agent banking, 0.46 for outstanding loans (% of GDP), and 0.54 for outstanding deposits (% of GDP).

[5] The weights of the dimensions for the regions were 0.22 for penetration, 0.5 for availability, and 0.28 for usage. The weights of the dimensions at the national level were 0.14 for penetration, 0.79 for availability, and 0.07 for usage.

5. Results

5.1. Dimensions and indicators of financial inclusion

On average, the usage dimension had the highest index level, whereas the availability dimension had the lowest level. However, the availability dimension showed the highest average growth rate (130.1%), followed by the penetration (67.9%) and usage (40.9%) dimensions. Over the years, the penetration dimension showed a decline in its growth rate. The growth rate of the availability dimension declined until it recovered in 2016 when it reached its highest level. The growth rate of the usage dimension fluctuated throughout the years, and its highest growth rate was recorded in 2014 (see Table 1).

Table 1: Dimensions of financial inclusion at the country level

Year	Penetration	Availability	Usage
2010	0	0	0.342792
2011	0.029839	0.00162	0.489198
2012	0.071901	0.004811	0.133909
2013	0.239926	0.012994	0.153271
2014	0.366277	0.029465	0.657713
2015	0.486066	0.062204	0.541218
2016	0.635792	0.190298	0.711516
2017	0.884882	0.340081	1
2018	0.990415	0.466913	1
2019	1	1	1
Average growth rate	67.9	130.1	40.9

As we can see from Table 2, the average growth rate in the number of accounts per 1000 adults was 23.8%. However, this figure failed to show the actual amount of account coverage because some people were without bank accounts while others had more than one account in the same bank or different banks. Meanwhile, the average growth rates in the number of branches and ATMs per 100,000 adults were 14.8% and 46.3%, respectively. Thus, there has been a fast expansion of ATMs over the years.

Agent banking had expanded progressively. It showed an average growth rate of 78.7%, with the highest growth in 2016. Despite its late introduction, the expansion was very fast as its

number surpassed the number of branches and ATMs in 2018 and 2019. In addition, since their launch, mobile and internet banking have shown accelerated growth. The data also shows that mobile bank users were much higher than internet bank users. The average number of mobile bank users per 100,000 adults was 1,519.19, whereas the average number of internet bank users per 100,000 adults was 112.28.

The average annual growth rates of outstanding loans and deposits as a percentage of GDP over the ten years were 13.5% and 21.9%, respectively. However, compared to the previous years, 2012 showed a decline in both outstanding loans and deposits (% of GDP) growth rates since their volumes grew slower than the GDP. Moreover, the level of outstanding loans (% of GDP) was lower than that of outstanding deposits (% of GDP) throughout the study period.

Table 2: Financial inclusion indicators at the country level

Year	Number of accounts per 1000 adults	Number of branches per 100,000 adults	Number of ATMs per 100,000 adults	Mobile banking users per 100,000 adults	Internet banking users per 100,000 adults	Number of agent banks per 100,000 adults	Outstanding loan (% of GDP)	Outstanding deposit (% of GDP)
2010	78.1	1.9	0.17	0.00	0.00	0.00	13.1	18.9
2011	89.4	2.3	0.18	0.00	0.00	0.00	15.0	19.8
2012	105.2	2.7	0.26	0.00	0.00	0.00	12.1	17.9
2013	168.6	3.2	0.52	9.7	0.23	0.00	11.0	19.5
2014	216.2	3.8	0.88	122.2	1.8	0.00	15.6	21.0
2015	261.3	4.3	1.2	456.2	9.8	0.01	12.1	22.2
2016	317.8	4.9	1.6	1262	36.1	2.2	12.7	23.0
2017	411.6	5.6	2.6	2284	74.3	4.4	14.1	25.2
2018	451.4	6.2	2.9	2461	110.4	8.9	14.7	25.8
2019	505.6	6.7	4.4	4039	488.7	11.5	15.0	26.1
Average growth rate	23.8	14.8	46.3	121	242	78.7	13.5	21.9

Addis Ababa had the highest level in all dimensions of financial inclusion. Meanwhile, Somali had the lowest level in the penetration and availability dimension, and Afar had the lowest level in the usage dimension. Furthermore, except for Addis Ababa, where all dimension scores were the same, the remaining regions' performance in the dimensions was inconsistent. For example, compared to the other dimensions, Harari, Dire Dawa, and Gambella had a lower level in the usage dimension, while Oromia, Somali, Amhara, and SNNP had better performance in this dimension. In addition, Dire Dawa and Tigray scored higher in all dimensions except for the availability dimension compared to Harari and Gambella, respectively (see Figure 1).

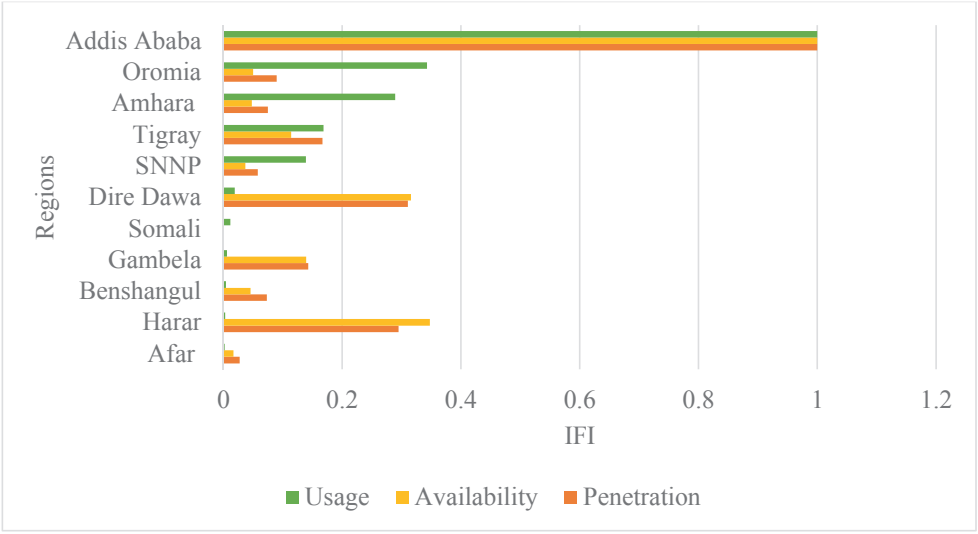

Figure 1: Dimensions of financial inclusion at the regional level

Table 3 shows the provisions of financial services by region. Addis Ababa had the highest provision of all financial services compared with the other regions and Somalia had the lowest provision except for the level of outstanding loans and deposits (% of GDP). Compared to other financial services provided in their regions, the Oromia and Amhara regions had a better performance in the outstanding loans and deposits (% of GDP), whereas Dire Dawa and Harari regions had a lower performance in these financial services. Meanwhile, Somali had a better performance in the outstanding deposits (% of GDP). Moreover, Amhara had fewer agent banks per 100,000 adults, whereas Afar had a better provision of this service.

Table 3: Indicators of financial inclusion for the regions

Name of regions/ main cities	Number of accounts per 1000 adults	Number of branches per 100,000 adults	Number of ATMs per 100,000 adults	Mobile banking users per 100,000 adults	Internet banking users per 100,000 adults	Number of agent banks per 100,000 adults	Outstanding loan (% of GDP)	Outstanding deposit (% of GDP)
Addis Ababa	3119	59.1	63.8	41986	7890	73.2	78.5	117.8
Afar	124.1	3.6	1.5	1537	53.9	8.6	0.18	1.3
Amhara	255.2	5.9	2.9	3177	293.1	7.7	16.8	39.8
Benshangul	250.1	4.9	2.4	3721	174.4	11.9	0.50	1.1
Dire Dawa	904.9	17.7	16.0	16392	1663	50.9	1.6	2.7
Gambela	442.4	7.8	4.3	5090	1713	22.9	0.94	0.70
Harari	861.9	14.0	13.6	15657	3513	47.5	0.23	1.3
Oromia	295.7	5.8	2.6	3082	231.5	13.3	21.1	44.3
SNNP	207.3	4.3	2.3	2811	305.4	7.1	9.3	16.8
Somali	48.1	1.9	0.78	1193	52.5	4.2	0.64	2.7
Tigray	508.5	12.6	5.4	5842	374.4	20.7	9.6	23.7

5.2. Financial inclusion indexes

Figure 2 presents the national-level IFI from 2010 to 2019. The average annual growth rate of financial inclusion was 105.8%, whereas the average IFI was 0.22. Thus, despite its fast growth rate, Ethiopia has a low financial inclusion level. In addition, it experienced a low growth rate in 2012 because of a decline in outstanding loans and deposits compared to the GDP. However, noticeable growth rates were recorded in 2013 and 2014 after the introduction of mobile and internet banking in 2012, in 2016 after the introduction of agent banking in 2015, and in 2019 when mobile and internet banking expanded.

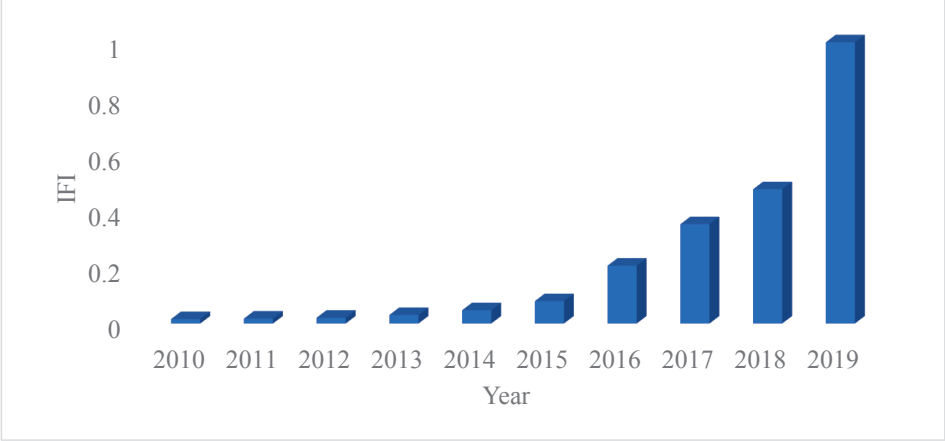

Figure 2: IFI at the country level

Figure 3 shows the IFI for the regions and main cities of Ethiopia. Addis Ababa had the highest score in IFI, whereas Somali had the lowest. The mean IFI was 0.228, and the median was 0.106. The regions/main cities could be divided into four categories[6]: highest financial inclusion achievers for those whose IFI ranged between 0.246 and 1, upper-middle financial inclusion regions when the IFI was between 0.106 and 0.246, lower-middle financial inclusion regions when the IFI was between 0.040 and 0.106, and low financial inclusion achievers for those whose IFI lied below 0.040.

Accordingly, Addis Ababa, Harari, and Dire Dawa were categorized as high financial inclusion cities/regions. Tigray, Gambela, and Oromia were in the upper-middle financial inclusion

[6] The division is made using the estimation of quantiles.

category, whereas Amahara, SNNP, and Benshangul Gumuz were in the lower middle. Afar and Somali were in the low financial inclusion category.

The gap in IFI between Addis Ababa and Harari was huge (74.1%). The next most prominent difference was between Dire Dawa and Tigray (11.5%), followed by Amhara and SNNP (3.5%). Though not as significant as these, there was a difference among the remaining regions.

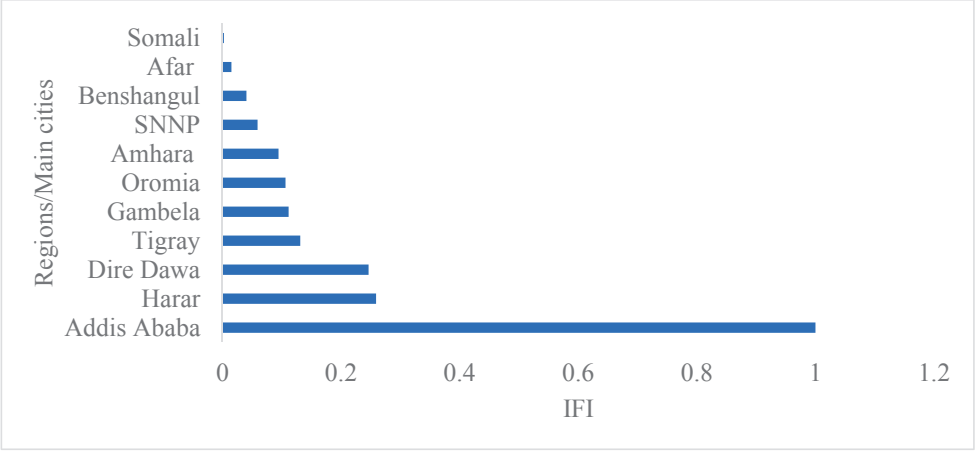

Figure 3: IFI of Regions/Main cities

6. Discussion and conclusion

This study has four significant results. First, the result shows a difference in the level of financial inclusion among the regions. Addis Ababa had the highest IFI and the maximum achievement in all financial inclusion indicators. This is consistent with Desalegn and Yemataw (2017), who found that residents in Addis Ababa have higher financial inclusion levels compared with the other regions of the country. Moreover, its difference in IFI from the other regions was huge. This is expected because Addis Ababa is the capital city of Ethiopia. Therefore, any new products introduced by financial sectors are initiated there, and there is a high concentration of financial institutions in the city. For instance, 36% and 34.35% of bank branches were located in Addis Ababa in 2016/17 and 2018/19, respectively (NBE, 2019). Thus, residents of the city have access to all available financial services.

In addition, the population density of Addis Ababa is higher than the rest of the regions. As we can see from Figure 4, there is a positive relationship between population density and financial inclusion. The correlation matrix also shows that there is a strong positive relationship between

the two, with a correlation coefficient of 0.98 (see table 4). This is because densely populated areas provide the advantage of achieving minimum viable scale. This improves the profitability of financial sectors by reducing their long-run average total cost. The reduction in transaction costs increases the expansion of financial services, contributing to a higher level of financial inclusion. A study by Allen et al. (2014) confirms that population density is an important determinant of financial inclusion in Africa.

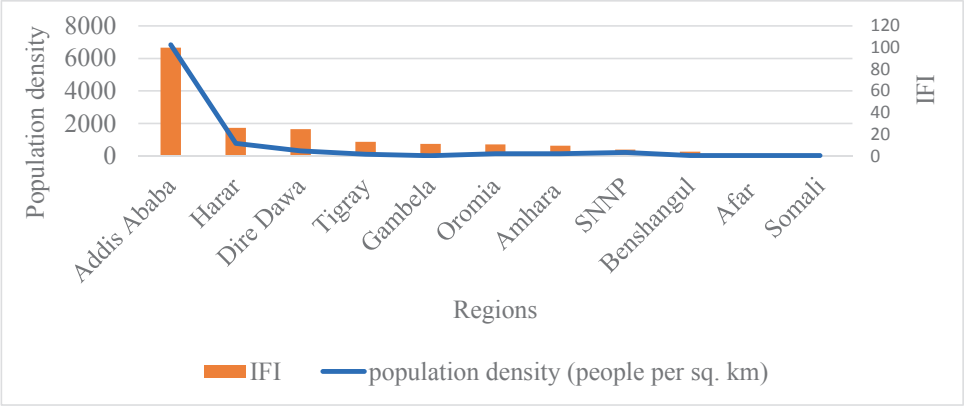

Figure 4: Relation between IFI and population density

Table 4: The correlation matrix

	IFI	Literacy rate	Rural population	Population density
IFI	1.0000			
Literacy rate	0.6624	1.0000		
Rural population	-0.9319	-0.7467	1.0000	
Population density	0.9754	0.5145	-0.8449	1.0000

The higher level of IFI in Dire Dawa, Harari, and Gambela compared to Oromia, Amhara, and SNNP, which are the most extensive regions in terms of population and land coverage, can be attributed mainly to the former regions' small populations. Even though the total numbers of branches, accounts, ATMs, agent banks, mobile bank users, and internet bank users are high in the latter regions, the proportions of the financial services compared to their population are small. That is why they have low IFI.

The majority of the population of Afar and Somali are found in remote areas. From Figure 5, we can see there is a negative relationship between remoteness (as measured by the percentage of the rural population) and financial inclusion. The correlation matrix also shows that there is a strong negative relationship between IFI and the percentage of the rural population (-0.93) (see table 4). Remote areas lack the necessary infrastructure required to expand financial services. As a result, financial sectors incur huge transaction costs during their expansion to these areas. According to the transaction cost theory, financial sectors reduce the availability of their service in areas where they face high transaction costs. Therefore, Afar and Somali are the two least financially included regions in the country. This is consistent with the findings of Demirgüç-Kunt and Klapper (2013) and Nkwede (2015), who state that remote areas have a high level of financial exclusion.

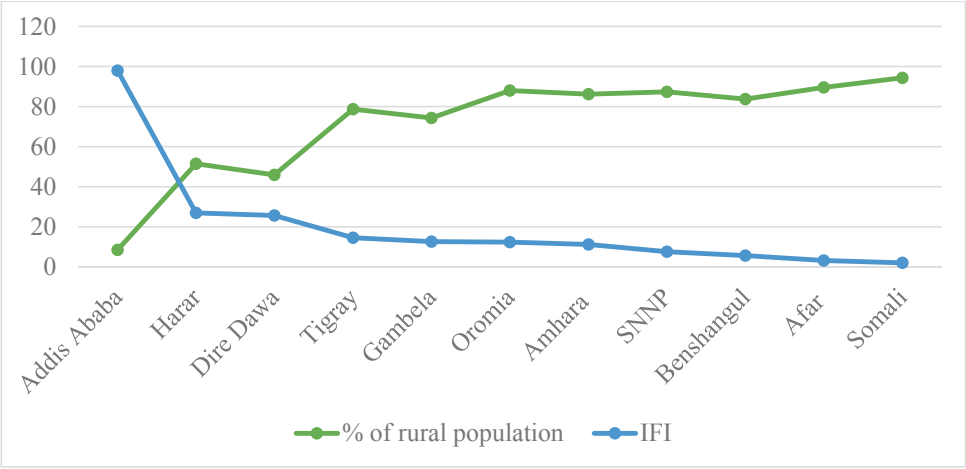

Figure 5: Correlation between IFI and percentage of the rural population of the regions

Moreover, in the low-financial inclusion regions of Ethiopia, such as Afar, Somali, and Benshangul Gumuz, the number of branches, ATMs, and agent banking per 1000 square km is very low compared to high-financial inclusion regions such as Addis Ababa, Harari, and Dire Dawa (see Figure 6). This implies that in the former regions, people must travel far to access financial services. The farther they travel, the higher their transaction cost. As the transaction cost theory states, this hinders financial inclusion because users tend to isolate themselves from using financial services when they incur high transaction costs. This is consistent with NBE (2017), which reported that one of the barriers to financial inclusion is underdeveloped infrastructure in financial sectors that result in a significant distance to and inadequate supply

of financial products (digital), services, and access points, thus resulting in high transaction cost for customers.

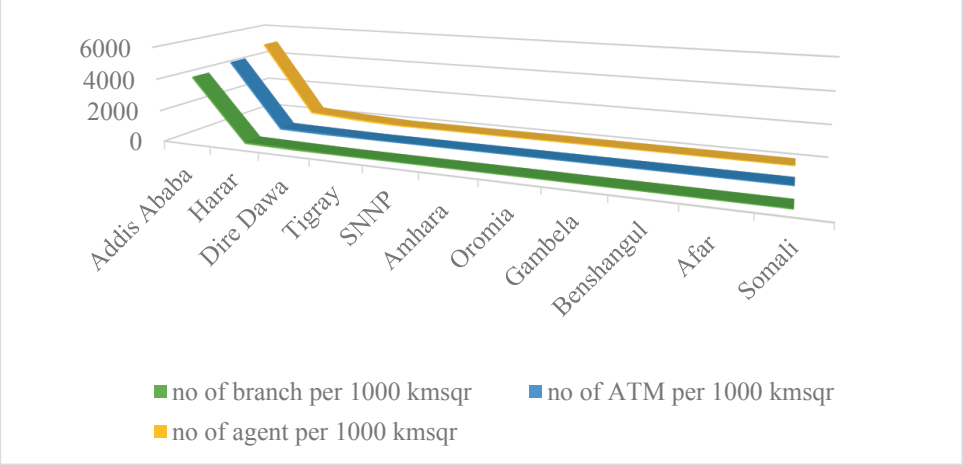

Figure 6: Availability of financial services per 1000 square km in the regions

Furthermore, there is volunteer financial exclusion in Afar and Somali regions due to religion. They are Muslim-dominated regions (95.3% in Afar and 98.4% in Somali), which prevents them from using standard financial services. Even though there are financial services compatible with these regions, such as interest-free savings and deposits (Sharia-compliant products), the supply falls short of the demand (Ahmed, 2019). Meanwhile, Addis Ababa has only a 16.2% Muslim population and has enough Sharia-compliant products to meet their demand. This result concords with Demirgüç-Kunt et al. (2018), who state that Muslim-dominated areas are the least financially included regions.

Literacy is another factor contributing to the discrepancy among the regions. As Figure 7 shows, there is a positive relationship between financial inclusion and literacy rate. The correlation matrix also shows that there is a positive relationship between the two, with a correlation coefficient of 0.66 (see table 4). In Addis Ababa, because the residents are more educated (NBE, 2019), they are aware of the services' availability and usage, resulting in a high financial inclusion level. The same goes for Harari and Dire Dawa. However, Benshangul Gumuz, Afar, and Somali have low literacy rates, contributing to their low financial inclusion level (see Figure 7). This is consistent with the financial literacy theory of financial inclusion.

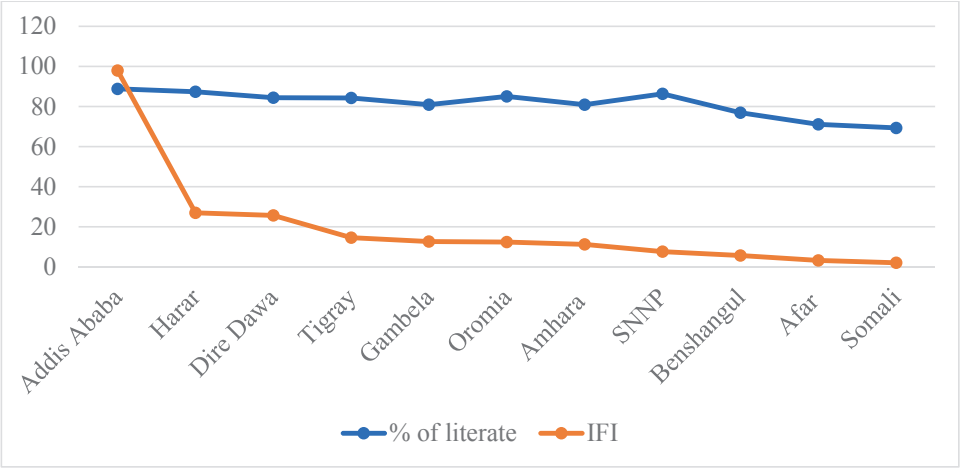

Figure 7: Relation between literacy and financial inclusion of regions

Therefore, there is a need for collaborative actions among government authorities and financial sectors to create strategies and implement policies that address the gap between the high financially included areas and low-inclusion regions. One way to do this is by targeting the most vulnerable part of society. To increase the total financial inclusion level of the country, the excluded regions' financial inclusion level should be improved. In this sense, since agent and mobile banking are expanding at an accelerated rate, rather than pinning for the traditional expansion of branches and ATMs, more focus should be placed on these financial services. However, please note that this does not mean there is no need for branches or ATMs. But the low cost and ease in the expansion of agent and mobile banking provide an opportunity to reach the financially excluded population at a reduced transaction cost. Another way is for the regions to focus on increasing their lowest financial service provisions. For instance, since Amhara has a low number of agent banks, and Harari and Dire Dawa has a low provision of outstanding loans and deposits, working to increase their expansion and improve their provision can be beneficial to enhance their level of financial inclusion.

Moreover, because religion is another factor contributing to low financial inclusion in certain regions, financial sectors should focus on the expansion of Sharia-compliant products at a faster rate to close the supply-demand gap. This will raise the overall financial inclusion level in the country and address equitability issues. In addition, the literacy rate should be increased to improve the financial inclusion level. Because financial literacy contributes to a higher level of financial inclusion, it should be used as a strategy to enhance people’s awareness about the availability and use of formal financial services.

Second, there was a fast expansion of ATMs in the country. However, it fails to fulfill the growing demand of users, as seen from the long queues around ATMs. Also, some challenges, such as network interruption and the machine's breakdown, affect its reliability. This result verifies the findings of Manaye and Worku (2018) and Teka (2017), who state that the service provided by ATM centers is not efficient and there is an excessive waste of customers' time in ATM centers. In addition, the expansion in the number of branches does not meet the demand despite its gradual growth. As a result, there are long queues of customers in financial sector branches. Thus, financial institutions should work on accelerating the expansion of branches and ATMs to meet customers' demands while improving their reliability.

Third, mobile and internet banking were expanding fast. The fast expansion can be attributed to the country's mobile and internet density advancement. In 2019, mobile and internet density increased by 41.9% and 21.8%, whereas in 2018, they increased by 39.8% and 18.5%, respectively (NBE, 2019). However, the number of mobile bank users significantly exceeded internet bank users. This is because most people have easy access to mobile phones, as we can see from the difference in their density levels. Contrary to internet banking, mobile banking services are available using any mobile phone, and there is no need for internet coverage. Meanwhile, most Ethiopian populations, especially in rural and remote areas, do not have internet access, hindering internet banking expansion. This result is consistent with the findings of Bultum (2014), who states that lack of internet access is a major hindering factor for the expansion of internet banking. Therefore, the financial and telecom sectors should improve the expansion of the internet system in the country.

Fourth, the result shows that the level of outstanding loans (% of GDP) was lower than that of outstanding deposits (% of GDP). In addition, the low growth rate of the usage dimension could be attributed to the low level of outstanding loans (% of GDP). This is because credit distribution in the country is weak, especially in the private sector. For instance, the credit extended to small and micro enterprises is very limited, failing to fulfill the demand of potential borrowers (CRA, 2019). Studies identified collateral and lack of borrowers' awareness of loan repayment as factors limiting the amount of credit extended by financial institutions (Admasu & Paul, 2010; Fanta, 2016). Thus, the government should provide federal government guarantees to reduce the collateral barrier and increase borrowers' awareness. Also, financial sectors should work to increase the amount of credit extended to different sectors.

In conclusion, financial inclusion is an important phenomenon that contributes to the economy. However, the level of financial inclusion in Ethiopia is low. Thus, it is noteworthy to study the trend of financial inclusion in the country and examine the causes of financial exclusion at the regional and national levels. Ethiopia has shown growth in all indicators of financial inclusion and IFI over the years. However, there is a shortage in the provision of certain financial services, such as internet banking and credit availability. There is also a discrepancy in the level of financial inclusion among the regions, which can be attributed to their different stages of development. Therefore, to improve the financial inclusion level, attention should be given to the low-performing financial services and their provisions in certain regions. This study provides input to a policy framework to increase the financial inclusion level of the country.

This study used descriptive analysis to analyze the data. We were not able to provide in-depth statistical evidence because there was not enough data. Therefore, future studies should collect more data and use statistical analysis to explain the trend of financial inclusion in Ethiopia and the discrepancy at the regional level.

Data availability statement

The data used in this study are available from the corresponding author upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author.

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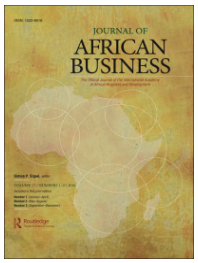
Paper Two



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Determinants of Financial Inclusion: A Comparative Study of Kenya and Ethiopia

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ABSTRACT

This study conducts a comparative analysis of the factors affecting financial inclusion in Kenya and Ethiopia at macro and micro levels. A generalized linear model is used to examine the determinants of and barriers to financial inclusion using the 2017 Global Findex Database, whereas a descriptive analysis is used to explore their macro-level differences. Kenya has a higher level of financial inclusion than Ethiopia. Differences in financial liberalization policy, gross domestic product, percentage of rural population, and mobile money service expansion are some macro-level differences that explain this variation. Differences in literacy rates and means of receiving payments such as government transfers explain some of the micro-level variations between the two countries. In addition, gender, age, employment status, and owning a mobile phone have significant and positive effects on financial inclusion. However, lack of documentation, lack of trust, and lack of money are significant barriers to financial inclusion.

KEYWORDS

Financial inclusion; index of financial inclusion; comparative study; transaction cost; mobile money; financial freedom

1. Introduction

Many countries recognize the need for the financial inclusion of their citizens and have adopted this as a national strategy (Desalegn & Yemataw, 2017). Financial exclusion creates social instability and worsens income inequality (Wang & Guan, 2017). It has also been linked to social exclusion, which signifies economic, social, and political inequality and associated e□ects on human rights (Caplan, Birkenmaier, & Bae, 2021). Meanwhile, financial inclusion can be used to enhance economic growth and reduce poverty levels (Churchill & Marisetty, 2020). Studies have stated that financial inclusion enhances investment by reducing financial frictions (Ezzahid & Elouaourti, 2021; Odugbesan, Ike, Olowu, & Adeleye, 2020). Furthermore, Sanjaya and Nursechafia (2016) show that financial inclusion is a potential policy tool to stimulate inclusive growth and development.

Ethiopia and Kenya have acknowledged the benefit they can reap from expanding their level of financial inclusion, and thus have integrated it as part of their national strategy (NBE, 2017; Van Hove & Dubus, 2019). According to the Global Findex report of 2017, Ethiopia is categorized as a low financial-inclusion country, whereas Kenya has

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a higher financial-inclusion level (Demirgüç-Kunt, Klapper, Singer, Ansar, & Hess, 2018). Kenya is recognized as a leader in mobile money service and a global player in financial inclusion in terms of sharing its success story with other countries (Hannig, 2013). Ethiopia is hence lagging behind Kenya and many people remain financially excluded (Lakew & Azadi, 2020).

Kenya and Ethiopia are neighboring countries with similar economic structures. Agriculture accounts for the largest share of employment in both countries, at 67% in Ethiopia and 56% in Kenya (World Bank, 2020). The services sector has the main share of GDP in both countries, followed by the agriculture and industry sectors (Barrientos & Soria, 2021). Given their similar economic structure, it is useful to examine why they have di erent financial inclusion levels. Furthermore, because the nature and scope of financial inclusion are a ected by di erent factors, many scholars are still trying to identify the main determinants of financial inclusion (Akileng, Lawino, & Nzibonera, 2018).

It is therefore important to compare Ethiopia and Kenya and identify the factors a ecting their financial inclusion levels and learn lessons from countries with higher levels of financial inclusion. This would be important for policy development in Ethiopia, which lags behind Kenya in terms of financial inclusion.

Financial inclusion is a multidimensional phenomenon that requires multidimensional measurement (Chakravarty & Pal, 2013). Such measurement should combine indicators that represent di erent dimensions of financial inclusion such as penetration, availability, and usage. Indexes of financial inclusion (IFI) capture its multidimensionality in a single number. This allows for comparison across economies and makes it easier to study its link with explanatory variables (Sarma, 2015). Thus, we can use IFI when comparing financial inclusion between Kenya and Ethiopia.

Studies that have assessed the factors a ecting financial inclusion in di erent countries include (Anarfo, Abor, & Ose, 2020; Asuming, Osei-Agyei, & Mohammed, 2019; Bozkurt, Karakuş, & Yildiz, 2018; Irankunda & Van Bergeijk, 2020; Sanderson, Mutandwa, & Le Roux, 2018; Soumaré, Tchana Tchana, & Kengne, 2016; Tiwari, Schaub, & Sultana, 2019; Wang & Guan, 2017). However, most studies in Sub-Saharan African (SSA) countries fail to address the multidimensionality of financial inclusion using IFI. Even though they use various indicators to measure financial inclusion, these indicators do not represent the di erent dimensions of financial inclusion, nor do they simplify comparisons across economies or identify the suitability of other explanatory variables. Moreover, those studies that used IFI as a measure of financial inclusion only estimated it at the macro level. Studies that estimated IFI at the micro level are missing. In addition, although some studies conduct a comparative analysis on financial inclusion trends (Asuming et al., 2019; Bozkurt et al., 2018; Wang & Guan, 2017), studies that explain why countries have di erent levels of financial inclusion are limited. Those studies (Soumaré et al., 2016) that explain the di erence focus only on the micro-level characteristics and ignore macro-level variables.

This paper contributes to the existing literature by analyzing the factors responsible for the di erence in the financial inclusion levels of Kenya and Ethiopia using IFI at the macro and micro levels. Specifically, it addresses questions such as how Kenya and Ethiopia di er in their level of financial inclusion, what are the determining factors of

and barriers to financial inclusion in both countries, what factors contribute to their difference at the macro and micro levels, and what can Ethiopia learn from Kenya to enhance its level of financial inclusion.

The remainder of this paper is structured as follows. Section 2 provides an empirical literature review. Section 3 presents the methodology used in the study. Section 4 presents the results and discussion. Section 5 concludes and provides policy recommendations.

2. Empirical literature review

In this section, we review the studies that examine the factors affecting financial inclusion in the SSA countries. Various indicators are used to measure financial inclusion. The most common one is account ownership at financial institutions (Asuming et al., 2019; Chikalipah, 2017; Irankunda & Van Bergeijk, 2020; Lakew & Azadi, 2020; Soumaré et al., 2016; Ulwodi & Muriu, 2017). Other measures include the number of automated teller machines (ATMs) and branches (Ajide, 2017), and saving and borrowing behavior (Asuming et al., 2019; Oyelami, Saibu, & Adekunle, 2017; Soumaré et al., 2016). Other studies use their own indicators to measure financial inclusion (Sanderson et al., 2018; Van Hove & Dubus, 2019). However, these studies use various indicators separately. It is valuable to have as many indicators as possible to measure financial inclusion, but when used separately, they provide incomplete information on the level of financial inclusion (Sarma, 2015).

At the macro level, GDP per capita is found to be a significant factor affecting financial inclusion (Asuming et al., 2019; Oyelami et al., 2017). Another important factor is literacy. Illiteracy in SSA countries has been a major factor limiting the level of financial inclusion (Chikalipah, 2017; Oyelami et al., 2017). Financial and business freedom improves a country's financial inclusion level. Meanwhile, tight regulation limits people's access to finance (Anarfo et al., 2020; Asuming et al., 2019).

Gender, age, education, and wealth are found to be significant micro-level determinants of financial inclusion. Women are less likely to be financially included than men. Furthermore, as age increases, so does adults' level of financial inclusion. Moreover, adults' likelihood of being financially included increases as their level of education and wealth increases (Asuming et al., 2019; Irankunda & Van Bergeijk, 2020; Sanderson et al., 2018). Lack of money, distance, cost, and lack of documentation are major barriers that limit adults' inclusion in financial sectors (Lakew & Azadi, 2020; Ulwodi & Muriu, 2017).

3. Methodology

3.1. Data

Cross-sectional micro-level data from the 2017 Global Findex Database are used. The database includes information on individual characteristics and financial inclusion indicators collected through nationally representative surveys. It is drawn from survey data covering almost 150,000 people in 144 countries. For this study, a sample of 2000 households from Ethiopia and Kenya (1000 per country) is used. In addition, 10-year macro-level data (from 2010 to 2019) are obtained from the National Bank of Ethiopia,

Association of Ethiopian Microfinance Institutions, World Bank, International Monetary Fund (IMF), The Heritage Foundation, and The Global Economy database to determine what macro-level variables explain the difference in financial inclusion between the two countries.

3.2. Measurement of financial inclusion

Most studies estimate IFI using macro-level data. But according to Sarma (2012), the index can be constructed at both the macro and micro levels depending on the purpose of the study. In this paper, because the objective is to analyze the macro- and micro-level differences in financial inclusion, the IFI is calculated at both levels following the method of Wang and Guan (2017) with modifications on the dimensions and indicators. The dimensions are adopted from Sarma (2015), and the indicators reflect the major services provided by banks and microfinance institutions (MFIs). However, the lack of adequate data is a limitation to this method of IFI estimation. Additional indicators that represent different financial services cannot be added because of the unavailability of data.

Three dimensions, namely penetration, availability, and usage are used to calculate the index. At the macro-level,[1] the penetration dimension is measured using the number of accounts in banks and MFIs per 1000 adults as indicators. The availability dimension is measured using the number of banks and MFI branches, ATMs, mobile bank users, and agent banks per 100,000 adults. The usage dimension is measured using outstanding loans and deposits with banks and MFIs as a percentage of GDP. At the micro level,[2] the penetration dimension is measured by ownership of accounts at financial institutions, whereas the availability dimension is measured by ownership of mobile money accounts, debit cards, and credit cards. The usage dimension is measured using savings and borrowings during the past 12 months as indicators.

The method follows three steps. The first step involves estimating the indicators separately as follows. This makes them lie between 0 and 1.

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \tag{1}$$

where,

x_{ij} is the estimated value of indicator i in the j^{th} dimension

A_{ij} is the actual value of indicator i in the j^{th} dimension

M_{ij} is the maximum value of indicator i in the j^{th} dimension

m_{ij} is the minimum value of indicator i in the j^{th} dimension

At the macro level, the minimum observed value is used as the lower limit. For the upper limit, the 90th percentile of the maximum observed value is used to avoid outliers. For those observations whose value exceeds the 90th percentile, the upper limit is used as their actual value. However, the indicators for the micro-level data are binary variables. They are assigned the value of 1 if a person's response is yes and 0, otherwise. Therefore, the lower limit is 0 and the upper limit is 1.

In the second step, the indicators are combined to calculate IFI for the dimensions (IFI_j)

$$IFI_j = 1 - \frac{\sqrt{w_{1j}^2\left(1 - x_{1j}\right)^2 + w_{2j}^2\left(1 - x_{2j}\right)^2 + .. + w_{nj}^2\left(1 - x_{nj}\right)^2}}{\sqrt{w_{1j}^2 + w_{2j}^2 + .. + w_{nj}^2}} \quad (2)$$

where w_{ij} is the weight of indicator i in the j^{th} dimension. The weight is estimated using the coe cient of variation (CV), which is the standard deviation divided by the mean. The weight of each indicator (w_{ij}) is defined as the ratio of its CV (V_{ij}) to the sum of all indicators' CV in a dimension (Wang & Guan, 2017). That is,

$$w_{ij} = \frac{V_{ij}}{\sum_i V_{ij}} \quad (3)$$

In the last step, the three dimensions are combined to estimate the IFI.

$$IFI = 1 - \frac{\sqrt{W_1^2(1 - IFI_1)^2 + W_2^2(1 - IFI_2)^2 + W_3^2(1 - IFI_3)^2}}{\sqrt{W_1^2 + W_2^2 + W_3^2}} \quad (4)$$

In the above formulas, W_1, W_2, and W_3 are the weights of the three dimensions calculated using the CV method. The IFI ranges between 0 and 1. An IFI closer to one represents a higher level of financial inclusion, whereas an IFI closer to zero represents a lower level of financial inclusion.

3.3. Method of data analysis

3.3.1. Macro-level determinants

Descriptive analysis is used to examine the relationship between the macro-level variables and financial inclusion as measured by IFI. The following variables are chosen to study the macro-level di erence in financial inclusion between Kenya and Ethiopia.

The financial freedom index (FFI) measures the level of government intervention in the financial sector. The index is comprised of five broad areas: (i) the extent of government regulation of financial services, (ii) the degree of state intervention in financial sectors, (iii) government influence on the allocation of credit, (iv) the extent of financial and capital market development, and (v) openness to foreign competition (The Heritage Foundation, 2021). Using the index makes it easier to study the relationship between financial freedom and financial inclusion.

According to institutional theory, financial freedom creates a competitive environment for financial sectors. Competitive pressures drive the financial system to focus on market competition. This creates more e cient and e ective financial products that contribute to a higher level of financial inclusion (Seman, 2016).

GDP per capita is gross domestic product divided by midyear population (The Global Economy, 2021). According to the neoclassical economic theory of poverty, financial inclusion is closely related to and moves together with GDP. There is no causality among these variables, but they are closely related and move together (Buckland, 2012). Thus, a higher level of GDP is associated with a higher level of financial inclusion.

Percentage of rural population is the proportion of people living in rural areas. Rural areas tend to have high transaction costs. According to transaction cost theory, high transaction costs discourage the expansion of the financial sector, thus lowering financial inclusion (Obińska-Wajda, 2016).

Mobile money services involve the use of mobile phones to receive and send money as well as make payments (Demirgüç-Kunt et al., 2018). It reduces transaction costs and thus increases the financial inclusion level (Van Hove & Dubus, 2019)

3.3.2. Micro-level determinants

Data on individual demographic and socioeconomic variables are used to study their effect on financial inclusion at the micro level. Two regressions are estimated. The first identifies the factors that determine financial inclusion and the second investigates the barriers. The dependent variable in both regressions is IFI.

The generalized linear model (GLM) developed by McCullagh and Nelder (1989) is adopted to analyze the determinants of and barriers to financial inclusion. Because IFI lies between 0 and 1, it is difficult to estimate an ordinary least squares (OLS) regression. If the transformed value of IFI is used, i.e. transforming it using logarithms so that it lies between $-\infty$ and ∞, using OLS can yield an inconsistent result when the log of zero values is taken. This is the case in IFI because it has several zero values. Moreover, the transformed equation can be a biased estimator of the original equation (Pena, Hoyo, & Tuesta, 2014). Thus, GLM is used.

GLM is estimated by the maximum likelihood estimation method, which makes it appropriate for variables with values between 0 and 1. GLM has two features, namely, the link function and the error structure. The link function can be log, logistic, power, negative binomial, or probit, whereas the error structure can be Gaussian, Poisson, binomial, negative binomial, or gamma (Pena et al., 2014). For this study, a binomial (Bernoulli) error structure with a logit link function is used. Its appropriateness for variables with values between 0 and 1 with most values centered around 0 makes this structure a better fit for this study because many people are financially excluded.

The basic functional form of GLM is given as $\eta = g(\mu)$, where η is the linear predictor, μ is the population average and $g(\mu)$ is the link function. Given the binomial error structure with a logit link function, the model can be defined as:

$$\eta = \ln\left(\frac{\mu}{1-\mu}\right) \tag{5}$$

η can also be defined as the linear sum of effects of the explanatory variable set X_i, thus, $\eta = \sum_{i}^{n} X_i\beta + \varepsilon$. X indicates the regressor variables, β is the parameter to be estimated from the data, and ε is the error term. The transformed variable (η) is a monotonically increasing function of IFI, and hence it preserves the same ordering as IFI (Sarma, 2008).

The following are explanatory variables for the determinants of financial inclusion.

Gender is a discrete variable with two categories, namely, men and women. Women are believed to be less financially included than men (Izquierdo & Tuesta, 2015).

Age is a continuous variable. Age is positively related to financial inclusion. However, after a certain age, the level of financial inclusion declines (Pena et al., 2014).

Education is a categorical variable with three categories: completed primary or less, secondary, and completed tertiary or more. Education is used as a proxy for literacy (Wang & Guan, 2017). According to the financial literacy theory of financial inclusion, literacy increases people's willingness to use financial services, which increases their financial inclusion level. Moreover, governments with limited ability to increase financial inclusion use literacy as a major policy tool (Atkinson & Messy, 2013).

Employment is a binary variable that is set equal to 1 if the person is employed and 0 otherwise. Employment increases the likelihood of being financially included (Llanto & Rosellon, 2017).

Government transfer is a binary variable equal to 1 if the person receives government transfers and 0 otherwise. It is assumed to have a positive effect on financial inclusion (Yangdol & Sarma, 2019).

Ownership of a mobile phone is a binary variable equal to 1 if the person owns a mobile phone and 0 otherwise. According to Demirgüç-Kunt et al. (2018), it increases the likelihood of being financially included by enabling mobile money services at a reduced cost.

The following are explanatory variables for barriers to financial inclusion. These variables are binary and equal to 1 if the response is yes and 0 otherwise.

Distance from financial institutions is an important barrier. The farther away financial sectors are located, the higher is the cost of travel and time (Demirgüç-Kunt et al., 2018). According to the transaction cost theory, this reduces the financial inclusion level (Obińska-Wajda, 2016).

Cost of opening an account is reported as a barrier to financial inclusion. The probability of opening an account is lower in areas where the cost is high (Allen, Demirgüç-Kunt, Klapper, & Peria, 2016).

Lack of documentation hinders account ownership. Documentation, particularly local documentation, can be difficult to obtain, thus restricting people from opening an account (Demirgüç-Kunt et al., 2018).

Lack of trust in financial institutions is a barrier that is difficult to overcome. Lack of information triggers a lack of trust, which hinders people from using formal financial services (Kumar, 2011).

Religion is a voluntary reason for financial exclusion. It instigates people's choice not to own an account or use other financial services (Allen et al., 2016).

Lack of money is the most cited reason for financial exclusion. According to the neoclassical economic theory of poverty, the poor have less ability to save and are more likely to be without a bank account. They also face discrimination in financial markets (Davis & Sanchez-Martinez, 2014). These factors contribute to their financial exclusion.

Moreover, the variables are interacted with a residence variable that equals 1 if the person is Kenyan and 0 if the person is Ethiopian. The interaction term is useful to investigate how each variable varies between the two countries and allows a comparative analysis.

4. Results and discussion

4.1. Descriptive analysis

In Table 1, the macro-level indicators of financial inclusion for Kenya and Ethiopia from 2010 to 2019 are presented. Kenya outperforms Ethiopia in all indicators of financial inclusion. The difference between the two countries is large for mobile money accounts and agent banking. The average mobile money account per 100,000 adults is 65,825 in Kenya, whereas it is 1,063 in Ethiopia. Similarly, the average number of agents per 100,000 adults is 462 in Kenya and three in Ethiopia. In contrast, their difference in the number of branches and outstanding deposits (% of GDP) is small.

The result also clearly shows that Kenya has a higher level of financial inclusion than Ethiopia. At the macro-level, Kenya's IFI is 64.7 percentage points higher than Ethiopia's, i.e. the average IFI in Kenya is 0.691, whereas it is 0.044 in Ethiopia. The maximum IFI in Ethiopia is 0.119, whereas in Kenya it is 0.941 which is close to full financial inclusion. Moreover, the minimum IFI is 0.0012 in Ethiopia and 0.379 in Kenya. However, Ethiopia's financial inclusion level rises consistently throughout the study period with an average growth rate of 80.4%. Meanwhile, Kenya's financial inclusion average growth rate is only 10.8% and declines in 2019 (see Figure 1).

At the micro-level, Kenya outperforms Ethiopia in all indicators except for the savings indicator. The difference in mobile money accounts is particularly prominent. In both countries, the share of adults with accounts in financial institutions is high, whereas the share of adults with credit cards is low. This is consistent with the findings of Demirgüç-Kunt et al. (2018).

The average micro-level IFI is 0.073 and 0.133 for Ethiopia and Kenya, respectively. The highest IFI in Ethiopia is 0.749 and the lowest is 0. In Kenya, the maximum IFI is 1 and the minimum is 0. The IFI can be divided[3] into low (<0.065), medium (between

Table 1. Indicators of Financial Inclusion.

Country	Year	No. of accounts per 1000 adults	No. of branches per 100,000 adults	No. of ATMs per 100,000 adults	No. of mobile users per 100,000 adults	No. of agent banks per 100,000 adults	Outstanding loans (% of GDP)	Outstanding deposits (% of GDP)
Ethiopia	2010	78.12	1.96	0.17	0	0	13.13	18.93
	2011	89.37	2.34	0.18	0	0	15.04	19.79
	2012	105.2	2.71	0.26	0	0	12.13	17.94
	2013	168.6	3.22	0.52	9.68	0	11.01	19.51
	2014	216.2	3.77	0.88	122.2	0	15.57	21.02
	2015	261.3	4.31	1.22	456.2	0.002	12.06	22.15
	2016	317.8	4.95	1.63	1262.1	2.15	12.71	23.03
	2017	411.6	5.61	2.58	2284.5	4.35	14.11	25.19
	2018	451.4	6.15	2.87	2460.9	8.92	14.68	25.79
	2019	505.6	6.72	4.37	4038.6	11.48	15.03	26.13
Kenya	2010	547.7	4.76	8.76	39,019.8	165.9	24.87	29.95
	2011	705.8	5.06	8.96	44,465.03	205.8	27.78	31.10
	2012	756.8	5.36	9.39	47,586.8	303.5	27.25	31.81
	2013	1001.1	5.48	9.49	55,579.9	431.5	32.97	32.25
	2014	1267.2	5.69	9.64	53,961.5	456.2	36.34	42.43
	2015	1531.6	5.82	9.69	65,998.3	513.4	37.04	39.56
	2016	1740.9	5.59	9.16	71,355.8	572.3	35.11	36.74
	2017	1868.9	5.44	9.35	74,472.3	609.1	31.48	37.06
	2018	2063.6	5.21	9.15	92,819.6	664.8	35.19	36.66
	2019	2226.3	4.89	7.69	112,992.2	701.0	27.79	36.95

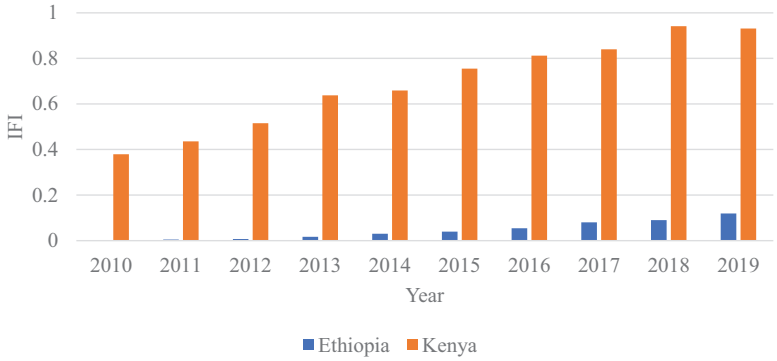

Figure 1. IFI in Ethiopia and Kenya.

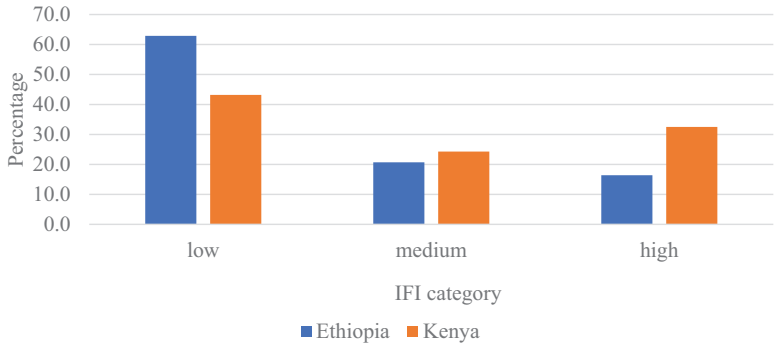

Figure 2. IFI Categories in Ethiopia and Kenya.

0.065 and 0.142), and high (>0.142) categories. As we can see from Figure 2, the highest proportion of adults with low IFI is found in Ethiopia (62.9%), rather than Kenya (43.2%). The majority of adults in Kenya have high and medium IFI (32.5% and 24.3%, respectively), which contrasts with Ethiopian adults where 16.4% have high IFI and 20.7% have medium IFI. In addition, 53.5% of Ethiopian adults are financially excluded, but this figure is much lower in Kenya (14.5%).

4.2. Factors affecting financial inclusion

Table 2 presents the regression result of the determinants of financial inclusion. It shows that gender is a statistically significant determinant of financial inclusion in both countries. Because of their low economic status, women are less likely to be financially included than men. This result is consistent with the findings of Asuming et al. (2019). The gender gap is higher in Kenya than in Ethiopia because being a man in Kenya increases financial inclusion by 37.9%, whereas in Ethiopia, this figure is 17.6%.

Age has a positive e□ect on financial inclusion, whereas the coe□ cient of age-squared is negative implying the existence of a threshold e□ect. To see the overall e□ect of age on financial inclusion, net e□ects are estimated following Asongu and Odhiambo (2020a,

Table 2. Determinants of Financial Inclusion.

Explanatory variables	Ethiopia	Kenya
Gender	0.1762*	0.3794***
	(0.0906)	(0.0949)
Age	0.1113***	0.0929***
	(0.0243)	(0.0235)
Age2	–0.0013***	–0.0011***
	(0.0003)	(0.0003)
Secondary education	0.4675***	0.8183***
	(0.1024)	(0.1248)
Tertiary or more education	-	1.5625***
		(0.1913)
Employed	0.3353**	0.4724***
	(0.1466)	(0.1494)
Received government transfers	0.0753	0.2989**
	(0.1697)	(0.1345)
Owns mobile phone	0.6072***	1.1319***
	(0.1251)	(0.2047)
Residence	-	–0.4499
		(0.6169)
Net effects of age	0.0256	0.0247
Threshold for age (years)	43	42
Number of observations	1000	1000

Note ***, **, * denote significance at 1%, 5%, and 10%, respectively.

2020b). Accordingly, the net effect is 0.0256 in Ethiopia and 0.0247 in Kenya, which shows that their level of financial inclusion increases with age. The effect of age is zero at an age of 43 years for Ethiopia and 42 years for Kenya. Above this age group, its increment reduces financial inclusion.

Education[4] has a positive effect on financial inclusion. Compared with completing primary education or less, secondary education increases financial inclusion by 46.8% and 81.8% in Ethiopia and Kenya, respectively, whereas completing tertiary education or more increases financial inclusion by 156.3% in Kenya. Thus, more educated people have a higher financial inclusion level than less educated people and the effect is higher in Kenya than in Ethiopia. This is consistent with financial literacy theory.

Those who are employed have a higher level of financial inclusion than the unemployed. Employment entails receipt of income and most likely they receive it via financial institutions. Thus, employed people are 33.5% in Ethiopia and 47.2% in Kenya more financially included than unemployed people. This is consistent with the findings of Llanto and Rosellon (2017).

Receiving government transfers has no effect on financial inclusion in Ethiopia, whereas it has a significant and positive effect in Kenya. When the government uses the financial sector to make payments, people are forced to open accounts to receive them. Most Kenyans receive government transfers via accounts, which increases their financial inclusion level by 29.9%. This result is consistent with Yangdol and Sarma (2019).

Owning a mobile phone increases financial inclusion in both countries. Its effect is higher in Kenya than in Ethiopia by 52.5%, which is a notable difference. It enables the use of mobile money services and reduces the transaction cost of using financial services. This result is consistent with the findings of Bongomin, Ntayi, Munene, and Malinga

(2018). Finally, the fact that a person is merely a Kenyan or Ethiopian does not have an effect on financial inclusion. The difference between the two countries arises when other variables are involved.

4.3. Barriers to financial inclusion

Table 3 shows the main barriers responsible for financial inclusion. Distance is one of the barriers to financial inclusion in Ethiopia. However, it is not a significant factor in Kenya. This is mainly attributed to the advancement of mobile money services in Kenya, which reduces the use of financial sector branches. Meanwhile, the comparatively low availability of mobile money services in Ethiopia has forced people to use branches whose transaction cost increases with distance, thus reducing the financial inclusion level.

The cost of opening an account is found to be an insignificant factor in both countries. Because the financial sector encourages people to open an account free of charge, the cost is not a barrier. This is consistent with the findings of Lakew and Azadi (2020).

Lack of documentation reduces financial inclusion in both countries. This result corroborates the findings of Demirgüç-Kunt et al. (2018), which show that the number of people with government-issued identification is lower in SSA countries (56%) such as Ethiopia and Kenya than in developing economies in general (85%). This produces a challenge in providing documentation. Furthermore, having national identification is not always sufficient to open an account because financial sectors require local identification. This makes lack of documentation a barrier to financial inclusion.

Lack of trust in financial institutions significantly reduces financial inclusion in both countries. This result verifies the findings of previous studies, which explains how people find it difficult to entrust their money to financial institutions because they lack full information on their activities and/or are unfamiliar with new financial products (Demirgüç-Kunt et al., 2018; Tiwari et al., 2019). Therefore, a lack of trust in financial sectors and their products causes financial exclusion.

In both countries, religion has no effect on financial inclusion. In general, religion is a significant barrier in a Muslim-dominated areas (Demirgüç-Kunt et al., 2018). However, in Kenya, only 7% of the population is Muslim. In Ethiopia, 33.8% of the

Table 3. Barriers to Financial Inclusion.

Explanatory variables	Ethiopia	Kenya
Distance	−1.9359***	−0.2239
	(0.4265)	(0.2789)
Cost of opening account	0.1104	−0.2538
	(0.8849)	(0.2243)
Lack of documentation	−3.7976***	−1.0377***
	(0.9709)	(0.2311)
Lack of trust	−1.5046***	−0.6628***
	(0.4572)	(0.2472)
Religion	−0.6669	−0.8342
	(1.1841)	(0.6036)
Lack of money	−2.4733***	−1.8986***
	(0.1849)	(0.1397)
Number of observations	1000	1000

Note ***, **, * denote significance at 1%, 5%, and 10%, respectively.

population is Muslim (PRC, 2011). However, the availability of sharia-compliant financial products as well as Islamic banking offsets the impact of religion on financial inclusion (Hailu & Yatoo, 2021) making it an insignificant factor.

Lack of money is a significant barrier to financial inclusion in both countries. This result concords to the findings of Demirgüç-Kunt et al. (2018), where lack of money is found to be a major barrier to financial inclusion globally. Furthermore, it is consistent with the neoclassical theory of poverty, which states that people with limited money are unable to open an account or save, thus forcing them into financial exclusion.

Therefore, lack of documentation, lack of trust, and lack of money are the major barriers to financial inclusion in both countries, whereas distance is a barrier only in Ethiopia. Their effect is much smaller in Kenya than in Ethiopia, i.e. by 275.99% for lack of documentation, 84.18% for lack of trust, and 57.5% for lack of money.

4.4. The difference in financial inclusion between Kenya and Ethiopia

One of the main findings of this study is that there is a significant difference in financial inclusion levels between Kenya and Ethiopia, with Kenya having a higher value. Different macro- and micro-level reasons contribute to this difference.

4.4.1. Macro-level differences in financial inclusion

Kenya has a more liberalized financial system and more foreign financial companies. Ethiopia has a regulated financial system that is closed to foreign companies. Thus, Kenya has a higher level of FFI than Ethiopia. A higher FFI indicates higher levels of freedom from government interference and efficiencies of financial sectors. This creates a competitive environment for financial sectors encouraging them to develop different financial products for the society, which increases financial inclusion by increasing the availability of financial services. This is consistent with institutional theory. However, tight financial regulation, which results in low FFI, reduces financial inclusion. As we can see from Figure 3, there is a positive relation between IFI and FFI, and Kenya has a higher value for both.

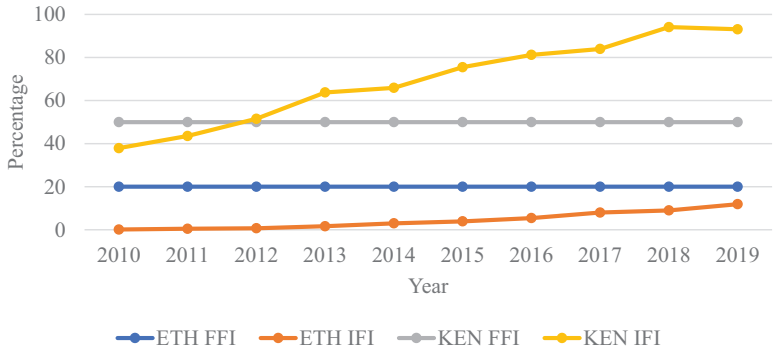

Figure 3. Correlation between IFI and FFI in Both Ethiopia (ETH) and Kenya (KEN).

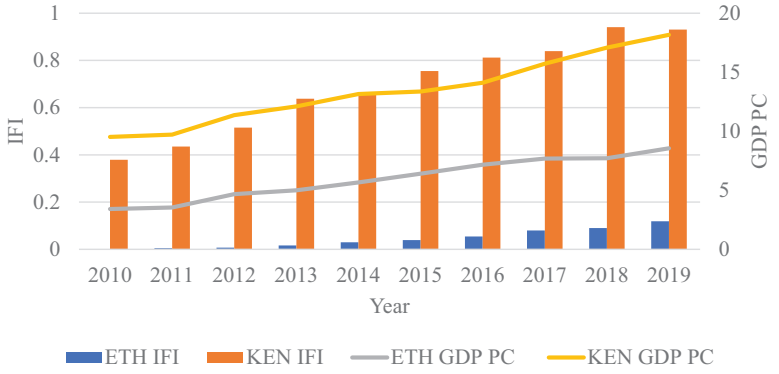

Figure 4. Relation between IFI and GDP per Capita.

Ethiopia is a low-income country and Kenya is a lower-middle-income country (Demirgüç-Kunt et al., 2018). From Figure 4, we can see that there is a positive relationship between GDP per capita and IFI, with Kenya having the highest score for both. This is because high-income countries tend to have high financial inclusion levels (Sarma, 2015). Thus, Kenya has a higher financial inclusion level than Ethiopia. This is consistent with the neoclassical economic theory of poverty, which states that there is a positive relationship between financial inclusion and GDP.

Figure 5 shows that the percentage of the rural population in Kenya is low compared with Ethiopia. Rural areas lack the necessary infrastructure required for financial sectors. Thus, opening a formal financial sector results in a high operating cost (Yangdol & Sarma, 2019). According to transaction cost theory, a high transaction cost restricts the expansion of financial sectors. As we can see from the figure, this gives Kenya an advantage in having a higher level of financial inclusion, whereas Ethiopia has a lower level.

In addition, mobile money services are more widely available in Kenya than in Ethiopia. Kenya was the first SSA country to launch mobile money in 2007. It has the highest share of adults with mobile money accounts in the world. In 2017, the percentage

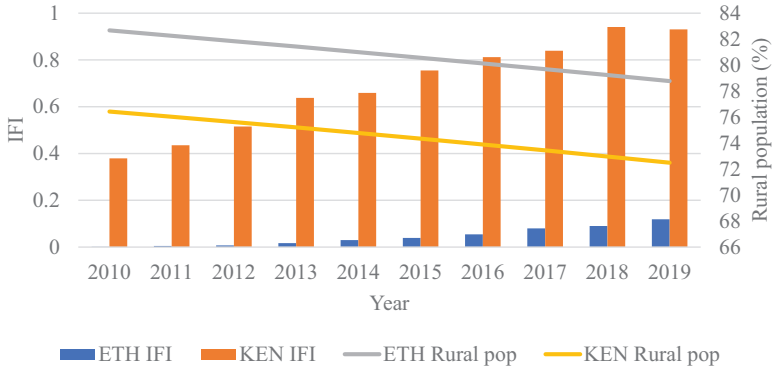

Figure 5. IFI and Rural Population of Ethiopia and Kenya.

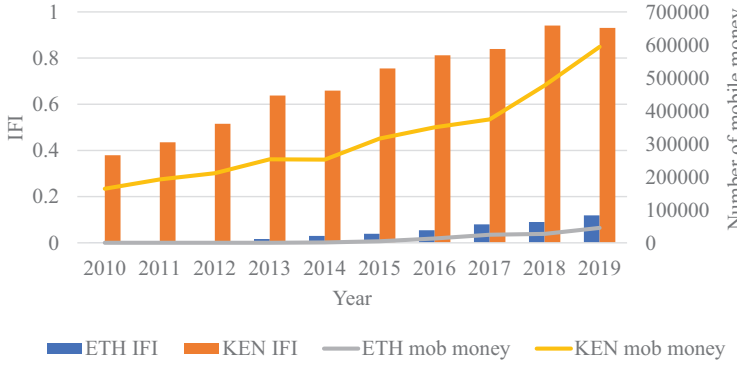

Figure 6. Relation between IFI and Number of Mobile Money Accounts.

of adults with mobile money accounts in Kenya was 76.9%, whereas it was only 0.8% in Ethiopia. Moreover, telecoms in Kenya are allowed to provide mobile money services (Klein & Mayer, 2011). However, until May 2021, Ethiopian Telecom was prohibited from participating in financial markets unless it is in cooperation with a financial institution. Only banks and MFIs had the authority to launch mobile money services in the country (Asfaw, 2015). In addition, there are di□erent telecom service providers in Kenya, whereas Ethiopian Telecom is a monopoly. The absence of a monopoly in Kenya creates competition among telecoms to introduce new and convenient mobile money services. All these factors contribute to the di□erence in the expansion of mobile money services between the two countries. As we can see from Figure 6, there is a positive relationship between the number of mobile money accounts and financial inclusion. This gives Kenya the advantage of having a higher level of financial inclusion.

Recently, the situation in Ethiopia has been changing as it opens its telecom sector to private investors. Ethio Telecom also started a mobile money service called Tele Birr in May 2021. However, the e□ect of these changes on the country's financial inclusion level remains to be seen.

4.4.2. Micro-level differences in financial inclusion

Ethiopia and Kenya also di□er at the micro level. Literacy creates the awareness and ability to choose wisely and use financial services (Bongomin, Ntayi, Munene, & Nabeta, 2016). Thus, countries with higher education levels have the advantage of enhancing their level of financial inclusion. According to the Global Findex Database, the percentage of adults with primary education or less is 71.5% in Ethiopia, whereas it is 29.7% in Kenya. However, the percentage of adults with secondary education is 28.7% in Ethiopia and 64.2% in Kenya. Meanwhile, the proportion of adults with tertiary education is 6.1% in Kenya. In accordance with financial literacy theory, the educational gap, which stimulates financial literacy in favor of Kenya, is one of the reasons why there is a notable di□erence in the level of financial inclusion between the two countries.

Moreover, the di□erence in the method of receiving payments augments the divergence in financial inclusion between the two countries. One instance is government transfers. According to Demirgüç-Kunt et al. (2018), despite the availability of

financial services in Ethiopia, government transfers are usually made in cash. But in Kenya, this kind of payment is mostly done using financial services. Thus, the effect of government transfers on financial inclusion is more pronounced in Kenya than in Ethiopia (see Table 2), creating a difference in their level of financial inclusion.

5. Conclusion and policy recommendations

Although financial inclusion plays an important role in an economy, it is affected by different economic and individual characteristics. Thus, it is crucial to determine how these factors affect the level of financial inclusion in Kenya and Ethiopia and identify the reasons for their difference. To investigate this, it is helpful to use an index that captures the multidimensionality of financial inclusion and allows for comparison. Therefore, the objectives of this study are to investigate the determinants of and barriers to financial inclusion in Kenya and Ethiopia and analyze their differences at the macro and micro levels.

Kenya has a higher level of financial inclusion than Ethiopia. The difference in financial liberalization policy, economic growth, proportion of the rural population, and expanded availability of mobile money services because of developed telecoms are some of the macro-level variables contributing to this variation. At the micro level, a higher literacy rate and receipt of payments such as government transfers via financial institutions give Kenya an advantage in achieving higher levels of financial inclusion. Meanwhile, Ethiopians incur a higher cost because they depend primarily on traditional banking services such as branches, making transaction costs a cause for financial exclusion. Furthermore, cash transactions are used widely for transfer payments, thus reducing the use of financial services. These factors contribute to the difference in financial inclusion between the two countries.

Different recommendations can be deduced from the findings. There is a positive relationship between education and financial inclusion. This effect is more prominent in Kenya than in Ethiopia, which gives it an advantage in terms of having higher awareness for the use of different financial services, especially digital banking. Thus, in accordance with financial literacy theory, Ethiopia should increase its literacy rate as a policy measure to boost its financial inclusion level.

However, the gender gap is higher in Kenya than in Ethiopia. To reduce this, Kenya should work toward increasing women's financial inclusion level. One way is to increase the literacy level of women because literacy contributes to an increased level of financial inclusion.

The use of cash in transactions such as government transfers is noticeable in Ethiopia. Therefore, as in Kenya, more government transfers in Ethiopia should be made using financial services. When the government frequently makes any kind of payment via the financial sector, people's awareness and habits in the use of financial services can be induced and financial inclusion can be enhanced.

Another finding is that high transaction costs reduce financial inclusion. However, the expansion of mobile money services reduces the transaction costs of using financial services. For instance, distance is one of the major causes of financial exclusion in Ethiopia, but it is not a barrier in Kenya because of the expanded availability of mobile money services. Therefore, the financial and telecom sectors in Ethiopia should learn from Kenya and further expand the availability of mobile money services, and increase people's awareness of their use through different promotional activities.

In addition, Ethiopia should liberalize its financial system. The presence of foreign financial companies in Kenya seems to improve its financial inclusion level, especially in the expansion of mobile money services. Furthermore, as we can see from Kenya, having more telecom companies (foreign and domestic) and allowing for more mobile operators provides the opportunity for mobile money services expansion. Therefore, Ethiopia can learn from Kenya and follow a more liberalized approach to enhancing its financial inclusion level.

Finally, even though Kenya has a higher financial inclusion level than Ethiopia, there is still a large percentage of financially excluded adults. Thus, Kenya should further improve its financial inclusion level by reducing barriers such as lack of documentation and lack of trust by simplifying the documentation challenge and creating awareness to develop trust.

Notes

1. The weights of the indicators are 1 for number of accounts, 0.08 for number of branches, 0.23 for number of ATMs, 0.34 for number of mobile bank users, 0.35 for number of agent banks, 0.62 for outstanding loans (% of GDP), and 0.38 for outstanding deposits (% of GDP). The weights of the dimensions are 0.22 for penetration, 0.69 for availability, and 0.09 for usage.
2. The weights of the indicators are 1 for account ownership, 0.22 for debit card ownership, 0.15 for mobile money account ownership, 0.63 for credit card ownership, 0.37 for savings, and 0.63 for borrowings. The weights of the dimensions are 0.21 for penetration, 0.38 for availability, and 0.41 for usage.
3. The division is made based on the data using quartiles.
4. The e□ect of tertiary education on IFI is only relevant for Kenya because there are no tertiary education graduates in Ethiopia in the 2017 Global Findex database.

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Data availability statement

The data used in this study are available from the Global Findex Database (https://microdata.worldbank.org/index.php/catalog/global-findex), IMF Database (https://data.imf.org), The Heritage Foundation (https://www.heritage.org/), The Global Economy (https://www.theglobaleconomy.com/), and from the corresponding author upon reasonable request.

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Paper Three

Enhancing farmers' resilience to climate change-induced impacts through financial inclusion in Sidama region, southern Ethiopia

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Enhancing farmers' resilience to climate change-induced impacts through financial inclusion in Sidama region, southern Ethiopia

Abstract

Building climate resilience is vital owing to the potentially severe effect of climate change. However, there is limited empirical evidence on the contribution of financial inclusion to climate resilience using household-level data. This paper adds to the literature by examining the potential role of financial inclusion in building farm households' climate resilience. The study uses semi-structured interviews and structured questionnaires to collect relevant data from the Sidama region in southern Ethiopia. The principal component analysis is used to estimate the climate resilience index, and multiple linear regression is used to identify the contribution of financial inclusion to climate resilience. The results show that financial inclusion has a significant and positive contribution to households' climate resilience by increasing their asset ownership and diversification of income. Ownership of bank and microfinance institution accounts, mobile money services, and access to credit are the major financial services that contribute to climate resilience. However, there are certain factors limiting farm households' level of financial inclusion. Thus, if the full potential of financial inclusion in building climate resilience is to be achieved, different strategies should be devised to increase its level and outreach.

Keywords: financial inclusion, climate resilience, mobile money services, account ownership, access to credit

1. Introduction

Climate change refers to changes in temperature and weather patterns over time. Global climate change affects people through diverse changes in local climates. It brings intense rainfall, causing flooding in some regions but causing severe drought in others. Such severe effects ruin people's livelihoods and destroy animals' habitats (Intergovernmental Panel on Climate Change [IPCC], 2022). Thus, it is necessary to integrate climate resilience into policy frameworks to address this serious issue and achieve sustainable development (Singh et al., 2019). Climate resilience can be defined as the capacity to anticipate, evade, plan for, cope with and adapt to climatic shocks (Bahadur et al., 2015).

Studies have identified climate resilience as a solution to different economic stresses (Hussain et al., 2020; Keshavarz & Moqadas, 2021). Accordingly, strengthening resilience to climate change has become an integral part of the United Nation's sustainable development goals (United Nations [UN], 2020), which call for the need to invest in a climate-resilient economy (Hussain et al., 2020). Countries should have well-developed insurance systems that not only mitigate but also build the resilience of individual households over time (Meirovich et al., 2013).

Financial inclusion, which involves the provision of savings, credit, mobile banking, and other innovative products, is recognised as a tool to build climate resilience (Haworth et al., 2016; Singh et al., 2019; Hussain et al., 2020). It contributes to climate resilience by enabling people to plan, mitigate and manage future risks (Haworth et al., 2016). It also empowers the poor to invest in assets, education, and businesses, which reduces their vulnerability (Calderone et al., 2019). Microfinance institutions (MFIs) can assist the poor to build their climate resilience in a more sustainable way than other climate finances, such as carbon credits (Chirambo, 2016a). However, financial inaccessibility decreases the ability of individuals to cope with future shocks, which reduces their self-sufficiency while increasing their dependence on external assistance (Nicholson et al., 2018). Thus, there is a need for investment in the financial sector to increase financial inclusion, which can then be used to improve climate resilience (Chirambo, 2016b).

Ethiopia is facing serious consequences of climate change (Conway et al., 2011). Its frequent poverty, topography, and dependence on rain-fed agriculture make it highly vulnerable to climate change (Haworth et al., 2016). From 2015 to 2016, the country faced drought episodes that caused 50-90% of harvests to fail, affecting more than 10.2 million

people. Meanwhile, the absence of formal insurance schemes and the ineffectiveness of informal risk-sharing mechanisms in the face of covariate shocks have reduced the coping capacity of the people. Thus, the country's vulnerability to adverse climate shocks increases the urgency to build a climate-resilient economy, which requires concrete policies and actions (Bekele et al., 2020b).

A limited number of studies explore the role of financial inclusion on climate resilience (Haworth et al., 2016; Chirambo, 2017; Diallo et al., 2017; Hussain et al., 2020). They concur that financial inclusion is crucial to increase climate resilience. It provides basic services to the vulnerable population, which allows them to adapt to climate disasters. Thus, it should be incorporated into climate change policies. However, these studies lack in-depth analyses and relevant outcomes based on micro-level data. This is important because it is difficult to assess resilience at the household level based on nationwide studies (Mekuyie et al., 2018).

In addition, studies of climate resilience should be context specific. Studies examining different aspects of climate change in the Sidama region (Hameso, 2014; Bekele et al., 2020a; Matewos, 2020) show that there is a risk of drought in the area and that the local adaptive capacity of the rural community is fragile. Therefore, further intervention activities are required for a sustainable solution. However, the studies do not consider financial inclusion as a possible solution.

This study adds to the existing literature by analysing how financial inclusion contributes to building household-level climate resilience using the case study of the Sidama region, Ethiopia. It addresses three basic questions: (1) What is the role of financial inclusion in building farmers' resilience to climate change-induced impacts? (2) Are there differences in climate resilience or the level of financial inclusion between the study sites? and (3) What factors limit the ability of financial inclusion policies to enhance farmers' resilience to climate change-induced impacts? This study serves as an input to policy formulation in building a climate-resilient economy.

2. Conceptual framework

From Figure 1 we can see that climate resilience index (CRI) is compiled from six components: asset, adaptive capacity, social safety net, access to basic services, income and food access, and stability (Food and Agriculture Organisation [FAO], 2012; Tambo, 2016; Mekuyie et al., 2018). Households that have large numbers of assets, can build adaptive capacity, can improve

their stability, can strengthen their social safety net, and have better access to income and food, and basic services are more resilient to climate change (Asmamaw et al., 2019).

Inclusive financial services enable farm households to purchase livestock, land, house, and other resources, which increases their asset. It also allows them to diversify their income and increase their expenditure, which improves their adaptive capacity, their access to income and food, and their access to basic services. Moreover, they can plan, manage risk, and absorb shocks, which improves their stability. Access to a digital payment system makes it easy to receive remittances and aid from the government, which strengthens their social safety net (Haworth et al., 2016; Hussain et al., 2020). Therefore, financial inclusion contributes to building the climate resilience of farm households.

In addition, demographic characteristics and socio-economic variables affect the climate resilience of households. Some of these variables also affect the financial inclusion level of farm households. These variables are thus used as a control variable.

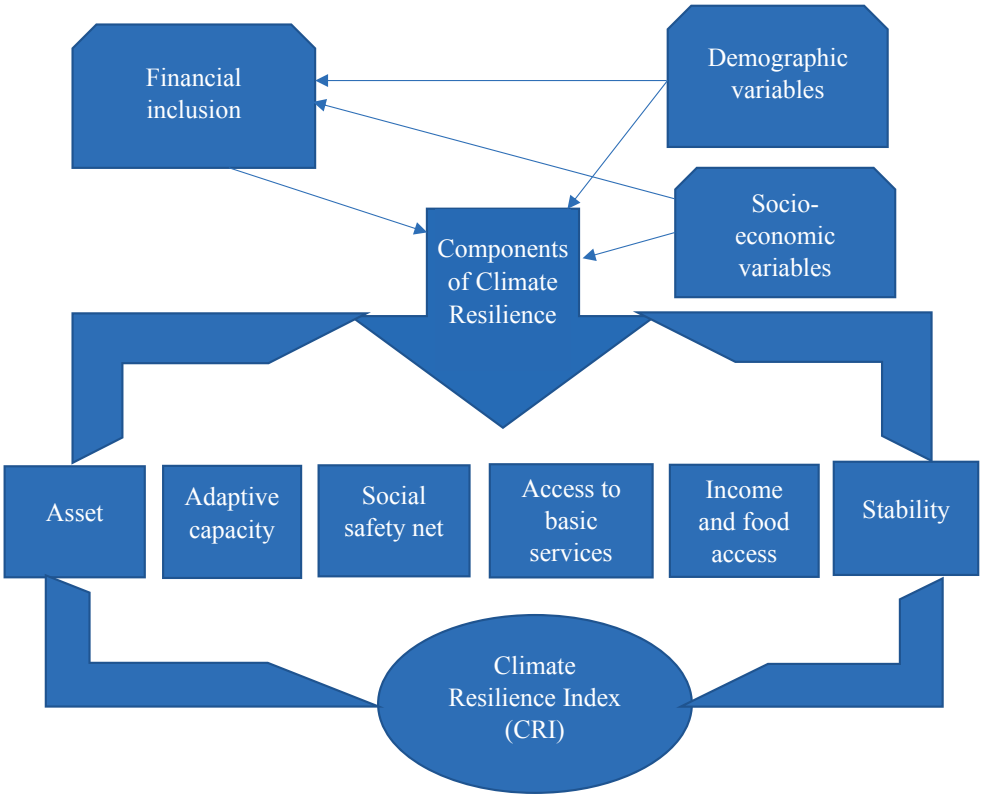

Figure 1: The relationship between financial inclusion and climate resilience

3. Materials and methods

3.1. Study area

Sidama region is one of 10 regions in Ethiopia, located in the southern part of the country, and its main city is Hawassa. Sidama region's geographic coordinates are latitude 6º 10' and 7º 05' North, and longitude 38º 21' and 39º 11' East. It covers a total area of 6,981.9 km2. The region is bordered by the Oromia region in the north, east, and southeast, by Gedeo zone in the south, and by Bilate river in the west (see Figure 2) (SZBoFED, 2007). The region has a total population of 2,954,136, of which 5.51 % are urban inhabitants and 0.18 % are pastoralists (Central Statistical Authority [CSA], 2007). The Sidama region is a leading coffee-growing region in Ethiopia and supplies over 40% of washed coffee to the market. Its economy is dominated by rain-fed and subsistence agriculture. The long-term dependence on subsistence agriculture has increased the vulnerability of the population and their reliance on food aid programs. It has experienced degradation of its natural resources, pastureland is shrinking and most of the abundant water resources are now polluted (Wolassa, 2016). Among the 20 districts of the Sidama region, Hawassa Zuria, Boricha and Loka Abaya in particular have high rainfall variability and high temperatures. They are known to be drought-prone districts (Matewos, 2020).

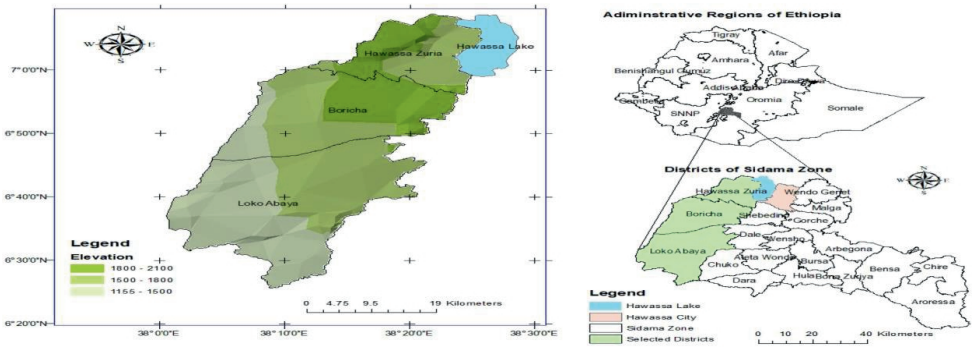

Figure 2: Map of Sidama region (Source: Matewos (2020) https://creativecommons.org/licenses/by-nc-nd/4.0/)

3.2. Sampling and data collection

In this study, a cross-sectional research design in three districts of the Sidama region was used to explore the contribution of financial inclusion in building climate resilience. Following the works of Opiyo et al. (2016), a two-stage sampling method was used to select the sample farm households. In the first stage, purposive sampling techniques were used to select three drought-

prone districts of the Sidama region, namely Loka Abaya, Boricha, and Hawassa Zuria. Then, two kebeles (administrative districts) were selected from Loka Abaya, two from Boricha, and four from Hawassa Zuria. In the second stage, a sample of 400 farm households was purposely selected based on their availability on their farm or home at the time of the data collection.

The sample size was estimated using the formula of Yamane (1967). Yamane's sample size determination formula is given as follows:

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

where n is the sample size, N is the population size of the study area, which in this case is the number of farm households, e is the desired level of precision (in this case, e = 5%) with the same unit of measure as the variance and e^2 is the variance of an attribute in the population. Thus, the sample size was calculated as follows:

$$n = \frac{95{,}861}{1+95{,}861\ (0.05)^2} = 398.337 \quad (2)$$

This sample size approximated to 400 farm households. A probability proportional to size sampling method was then employed to determine the sample size from each district (see Table 1).

Table 1: Population distribution and sample size determination

Districts	Number of farm households	Sample size
Loka Abaya	24,729	104
Boricha	24,535	104
Hawassa Zuria	46,598	192
Total	95,861	400

Source: Author analysis based on the data from Sidama region's Bureau of Agricultural and Natural Resource Development.

Both primary and secondary data were used. Primary data were collected using pretested structured questionnaires and semi-structured interviews. The questionnaires were completed by 400 farm household heads, and administered by enumerators under the supervision of the researcher during the period from October 5 to November 16, 2021. The questionnaire included 98 questions on the indicators of financial inclusion and climate resilience, as well as questions on the demographic and socio-economic characteristics of farm households. Each questionnaire took approximately 25 minutes to administer, with the enumerators asking the questions face-to-face and writing the answers given by the household heads. Enumerators

were chosen from each kebele based on their experience in data collection and their familiarity with the subject matter. They were trained for two days to minimise errors during data collection. Moreover, 13 semi-structured interviews with the experts in the agricultural bureau and financial sectors were conducted personally by the researcher at various times between September 20, 2021, and November 4, 2021. A single interview took 30 minutes on average and was used to comprehend the agricultural and financial activities of the study areas. Meanwhile, data on the number of households in the districts were collected from the Sidama region's Bureau of Agricultural and Natural Resource Development.

3.3. Measurement of financial inclusion

The index of financial inclusion (IFI) was estimated using the method adopted by Wang and Guan (2017) with modifications. Three dimensions (penetration, availability, and usage) were used to calculate the index. The penetration dimension was measured using account ownership at financial institutions. The availability dimension was measured by ownership of mobile money accounts and debit cards as indicators. These two indicators were selected because internet banking and agent banking services were not available in the study areas. Finally, the usage dimension was measured using savings and access to credit in the past 12 months as indicators. However, this method of estimating financial inclusion was limited by a lack of data, which restricted the use of more indicators.

The method involved three steps. The first step involved estimating the indicators separately as follows, such that they lay in an interval between 0 and 1:

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \quad (3)$$

where:

x_{ij} is the estimated value of indicator i in the j^{th} dimension,

A_{ij} is the actual value of indicator i in the j^{th} dimension,

M_{ij} is the maximum value of indicator i in the j^{th} dimension and

m_{ij} is the minimum value of indicator i in the j^{th} dimension.

The indicators are binary variables. They were assigned a value of one if a person's response was yes, and zero otherwise. Therefore, the minimum value was zero and the maximum value was one.

In the second step, the indicators were combined to calculate IFI for the dimensions (IFI_j):

$$IFI_j = 1 - \frac{\sqrt{w_{1j}^2(1-x_{1j})^2 + w_{2j}^2(1-x_{2j})^2 + ..+ w_{nj}^2(1-x_{nj})^2}}{\sqrt{w_{1j}^2 + w_{2j}^2 + ..+ w_{nj}^2}} \quad (4)$$

where w_{ij} denotes the weight of indicator i in the j^{th} dimension. The weight[1] was estimated using the coefficient of variation (CV), which is the standard deviation divided by the mean. The weight of each indicator (w_{ij}) is defined as the ratio of its CV (V_{ij}) to the sum of all indicators' CV within a dimension (Wang & Guan, 2017). That is,

$$w_{ij} = \frac{V_{ij}}{\sum_i V_{ij}} \quad (5)$$

In the last step, the three dimensions were combined to estimate the IFI:

$$IFI = 1 - \frac{\sqrt{W_1^2(1-IFI_1)^2 + W_2^2(1-IFI_2)^2 + W_3^2(1-IFI_3)^2}}{\sqrt{W_1^2 + W_2^2 + W_3^2}} \quad (6)$$

In the above-mentioned formulae, W_1, W_2 and W_3 were weights of the three dimensions[2] calculated using the CV method. The IFI ranged between zero and one, where zero indicated total financial exclusion and one indicated full financial inclusion.

3.4. Climate resilience measurement

Resilience is a dynamic phenomenon that must be measured by considering different indicators (Quinlan et al., 2016). Because there is no direct way of measuring climate resilience, many studies adopt the use of various quantifiable indicators (Jones & Tanner, 2015; Mekuyie et al., 2018). They use a proxy variable approach as it is a more straightforward option for measuring climate resilience. Therefore, estimating the CRI involves a proxy method that captures its multidimensionality.

The CRI for a given household i was defined as a composition of different dimensions. As Table 2 indicates, the dimensions were measured using six components, which in turn were based on 27 indicators (Food and Agriculture Organisation [FAO], 2012; Tambo, 2016; Mekuyie et al., 2018). The indicators in this study were modified to fit the study area's climate shocks and adaptation practices:

[1] The weights of the indicators were 1 for account ownership, 0.46 for debit card ownership, 0.54 for mobile money account ownership, 0.32 for savings, and 0.68 for access to credit.
[2] The weights of the dimensions were 0.17 for penetration, 0.54 for availability, and 0.29 for usage.

$$CRI_i = f(A_i, AC_i, SSN_i, ABS_i, S_i, IFA_i) \quad (7)$$

where:

CRI_i = climate resilience index of individual i,

A_i = assets of individual i,

AC_i = adaptive capacity of individual i,

SSN_i = social safety nets of individual i,

ABS_i = access to basic services of individual i,

S_i = stability of individual i and

IFA_i = income and food access of individual i.

Table 2: Components and indicators of climate resilience

Component	Indicators	Units	Source
Asset	Livestock owned	Tropical livestock unit	Mekuyie et al., 2018
	Farmland owned	Hectare	Mekuyie et al., 2018
	Housing owned	Dummy	Food and Agriculture Organisation [FAO], 2012
	Adult labour	Count	Mekuyie et al., 2018
	Access to irrigation water	Dummy	Mekuyie et al., 2018
	Access to improved seed	Dummy	Mekuyie et al., 2018
Adaptive capacity	Diversity of income source	Count	Mekuyie et al., 2018
	Number of coping mechanisms	Count	Food and Agriculture Organisation [FAO], 2012
	Food consumption ratio (Share of food expenditure divided by total expenditure)	Proportion	Food and Agriculture

			Organisation [FAO], 2012
	Awareness of climate change and its impacts	Dummy	Tambo, 2016
Social safety nets	Aid from government or safety net	Dummy	Mekuyie et al., 2018
	Remittance	Dummy	Mekuyie et al., 2018
	Cash for work	Dummy	Mekuyie et al., 2018
Access to basic services	Travel time to nearest water service	Minutes	Tambo, 2016
	Travel time to nearest health centre	Minutes	Mekuyie et al., 2018
	Travel time to nearest school	Minutes	Mekuyie et al., 2018
	Travel time to nearest market	Minutes	Mekuyie et al., 2018
	Travel time to nearest veterinary clinic	Minutes	Mekuyie et al., 2018
	Access to electricity	Dummy	Tambo, 2016
	Access to mobile phone	Dummy	Tambo, 2016
Income and food access	Average annual income from all income sources	Local currency	Mekuyie et al., 2018
	Average annual expenditure	Local currency	Mekuyie et al., 2018
Stability	Livestock loss	Count	Mekuyie et al., 2018
	Crop loss	Count	Mekuyie et al., 2018
	Illness and death of family member	Count	Mekuyie et al., 2018
	Income change	Ordinal	Food and Agriculture Organisation [FAO], 2012
	Expenditure change	Ordinal	Food and Agriculture Organisation [FAO], 2012

The CRI was estimated using a two-stage principal component analysis (PCA) (Camara & Tuesta, 2017; Mekuyie et al., 2018). PCA is mostly used to estimate indices that have no well-defined weights (Boka, 2017). Because the indicators of the CRI did not have predefined

weights, this made the PCA a suitable choice. Assigning weights to the indicators or dimensions was important to obtain optimal information from the dataset. A good index should be well-balanced and not have biased information from a single or a couple of indicators. Thus, the two-stage PCA was used to estimate the best-weighted combination of indicators to produce an index (Camara & Tuesta, 2017).

The first stage involved the identification and measurement of indicators to estimate the dimensions, i.e., the six components of climate resilience. The formula is given as follows:

$$d_i^c = \beta_n \sum_{n=1}^{N} z_n + \nu_i \quad (8)$$

where d_i^c captures the c dimensions (components) of climate resilience for individual i, z represents the indicators, β denotes the parameters to be estimated, ν_i is the error term and n is the number of indicators in a dimension. The components are unobserved and must be estimated together with the parameters.

The six components are indices that are estimated using the principal component as linear functions of the indicators. Given that λ_i is the eigen value and P_{ki}^I is the kth principal component of indicator (I) for individual i, the weighted average of each component could be estimated following equation (9). Only principal components with eigenvalues greater than one were selected to estimate the indices:

$$d_i^c = \frac{\sum_{i,k}^{p} \lambda_i^I P_{ki}^I}{\sum_{i=1}^{p} \lambda_i^I} \quad (9)$$

In the second stage, the overall CRI was estimated following similar procedures to those of the first stage. Using the components indices, the general formula for the CRI is given as follows:

$$CRI_i = \frac{\sum_{i,k}^{p} \lambda_i^c P_{ki}^c}{\sum_{i=1}^{p} \lambda_i^c} \quad (10)$$

The principal component can be written as the linear combination of the resilience components and the eigenvectors of the respective correlation matrices represented by φ.

$$P_{ki}^c = \sum \varphi_{ki} \, d_i^c \quad (11)$$

3.5. Method of data analysis

The collected quantitative data were analysed using STATA (version 17.0) and Microsoft Excel software. The IFI was estimated using Excel, whereas the CRI was estimated using

STATA. Descriptive analysis was used to examine the demographic and socio-economic characteristics of the respondents as well as the qualitative data obtained from the semi-structured interview. Finally, multiple linear regression (MLR) was used to analyse the contribution of financial inclusion to climate resilience.

The CRI was the dependent variable. Because its values ranged from positive to negative, it was made a continuous variable. Therefore, MLR was used to estimate its determinants following Boka (2017). The variable of interest is financial inclusion, which was measured using IFI and different indicators. The MLR model was specified as follows:

$$CRI_i = \alpha + \beta FI_i + \lambda X_i + \varepsilon_i \quad (12)$$

where CRI_i denotes the climate resilience index of individual i, FI_i denotes the measures of financial inclusion and X_i represents the vector of covariates, which includes demographic and socio-economic variables (see Table 3). α, β and λ are parameters and ε_i is the error term.

Table 3: Explanatory variables

Explanatory variable	Description	Expected sign	Source
Index of financial inclusion	An index that ranges between 0 and 1	Positive	Haworth et al., 2016
Account ownership	Dummy (1 if yes, 0 otherwise)	Positive	Haworth et al., 2016
Mobile money account ownership	Dummy (1 if yes, 0 otherwise)	Positive	Haworth et al., 2016
Debit card ownership	Dummy (1 if yes, 0 otherwise)	Positive	–
Savings	Dummy (1 if yes, 0 otherwise)	Positive	Haworth et al., 2016
Access to credit	Dummy (1 if yes, 0 otherwise)	Positive	Asmamaw et al., 2019
Gender	Dummy (0 female, 1 male)	Positive	Tambo, 2016
Age	Continuous	Positive	Awazi et al., 2019
Education level	Categories (1 if illiterate, 2 if can read	Positive	Opiyo et al., 2016

	and write, 3 if primary education, 4 if secondary education, 5 if tertiary education and above		
Household size	Continuous	Negative	Asmamaw et al., 2019
Dependency ratio	Continuous	Negative	Boka, 2017
Farm experience	Continuous	Positive	Awazi et al., 2019
Membership of a group	Dummy (1 if yes, 0 otherwise)	Positive	Awazi et al., 2019 Asmamaw et al., 2019
Access to extension service	Dummy (1 if yes, 0 otherwise)	Positive	Tambo, 2016 Awazi et al., 2019
Access to sufficient water	Dummy (1 if yes, 0 otherwise)	Positive	Asmamaw et al., 2019
Location	Categorical (1 if Boricha, 2 if Hawassa Zuria, 3 if Loka Abaya)	–	–

3.6. Specification test

MLR is subject to potential problems of endogeneity and heteroskedasticity. Endogeneity occurs when an explanatory variable is correlated with the error term, whereas heteroskedasticity is a situation where the variance of the residual is not constant (Wooldridge, 2012).

Because endogeneity in particular is a major problem, it needs to be addressed carefully. In this study, the Hausman–Wu test was used to check for endogeneity. This required performing a two-stage least squares (2SLS) regression using an instrumental variable (IV). In this case, financial inclusion was potentially an endogenous variable due to simultaneity. Thus, following

Dogan et al. (2021), distance to the nearest financial sector branch was used as an IV. The IV had a very strong relationship with financial inclusion, as indicated by the F-statistic of 10.16, which was greater than 10, with a p-value of 0.0016. Then, the 2SLS regression was performed, followed by the endogeneity test. The test showed that there was no endogeneity problem because it failed to reject the null hypothesis that the variable is exogenous (see Table 4).

Table 4: Test for endogeneity

Ho: Variables are exogenous

Durbin (score) chi2_ (1) = 1.87121 (p = 0.1713)

Wu–Hausman F (1,383) = 1.80011 (p = 0.1805)

White's test was used to check for heteroscedasticity. The test revealed that there was a heteroscedasticity problem, and MLR with robust standard errors was used to resolve this.

4. Results and discussion

4.1. Characteristics of the respondents

Table 5 presents the demographic and socio-economic characteristics of the respondents. Among the respondent households, 84.5% were male-headed and 15.5% were female-headed households. The age of the household heads ranged from 18 years to 85 years, with an average age of 43 years. The average household size was 5.6 persons, which is close to the average household size of rural Ethiopia (5.1) (Central Statistical Agency [CSA] & The World Bank [WB], 2013). On average, the dependency ratio was 0.62, and more than 85% of the household members were below 14 years old. Moreover, most of the respondents had primary education, whereas those who could read and write and had secondary education constituted the second and third largest proportions of the respondents, respectively. Those with tertiary education made up the lowest percentage of the respondents. The farm households had an average of 26 years of farming experience. Moreover, 98% had access to agricultural extension services, and 91% had access to sufficient water. In addition, 42.8% of the farm households were members of a group.

Table 5: Characteristics of the respondents

Variables		Percentage	Minimum	Maximum	Mean	Standard deviation
Gender	Male	84.5	–	–	–	–

	Female	15.5	–	–	–	–
Age		–	18	85	43	11.2
Education	Illiterate	18	–	–	–	–
	Can read and write	25	–	–	–	–
	Primary education	29.25	–	–	–	–
	Secondary education	19.75	–	–	–	–
	Tertiary education	8	–	–	–	–
Household size		–	0	13	5.6	1.75
Dependency ratio		–	0	3	0.62	0.51
Farm experience		–	0	61	25.6	10.6
Access to extension service	Yes	98	–	–	–	–
	No	2	–	–	–	–
Members of group	Yes	42.8	–	–	–	–
	No	57.2	–	–	–	–
Access to sufficient water	Yes	91	–	–	–	–
	No	9	–	–	–	–

4.2. Financial inclusion level in the study area

The major financial sectors in these three study districts were banks and MFIs. The Commercial Bank of Ethiopia (CBE) was the only bank in the districts, with only one branch located in each district's main city except in the Boricha district, where one private bank had recently opened a branch. Moreover, Omo and Sidama were the only two MFIs in the districts, and like the CBE, they each had one branch in each district's main city. There were no insurance companies in the districts.

About 64% of the farm households owned an account in a bank and/or MFI. The majority (83.6%) of those with an account used it to save, whereas 44.1% used it to receive payments such as salaries or remittances, and 12.7% used it to receive assistance. Only 20.25% of the farm households had received credit from the financial sectors. MFIs were the main financial sector that provided different types of credit, and the most common one was joint credit. Because most farm households lacked the collateral to borrow from MFIs, they formed a group

and borrowed money using each other as sureties. This created an opportunity for those who previously were unable to obtain a loan. Furthermore, 13% of the sample households used mobile money services, whereas 17% owned a debit card.

The average IFI was 0.136 with a minimum of zero and a maximum of one. The IFI could be divided into three categories[3]: low (< 0.057), medium (0.057–0.157), and high (0.157–1). The largest percentage of the respondents had low IFI (65.75%) followed by high IFI (22%) and medium IFI (12.25%). Thus, the level of financial inclusion was low. Most of the low IFI population was found in Hawassa Zuria (72.9%). Loka Abaya and Boricha had the largest percentage of adults with high IFI (25% each), whereas Boricha had the lowest percentage of low IFI adults and the highest percentage of medium IFI adults followed by Loka Abaya (see Figure 3). Despite its proximity to Hawassa city, Hawassa Zuria lacked basic infrastructure and had poor transport methods (Hameso, 2015). In addition, the interviews with financial sectors revealed that most of the government employees, who were frequent users of financial services, lived in Hawassa city and travelled to the district every day for work. They mainly used Hawassa city's financial sectors. This reduced the financial sector's number of customers and the use of financial services in the district, which reduced their profit. Therefore, combined with the lack of infrastructure, financial sectors found it profitable to only open a single branch in the district. However, this limited the availability and accessibility of financial services for the farm households, resulting in low IFI. Conversely, Boricha had a greater number of banks and a better infrastructure, contributing to its higher financial inclusion level.

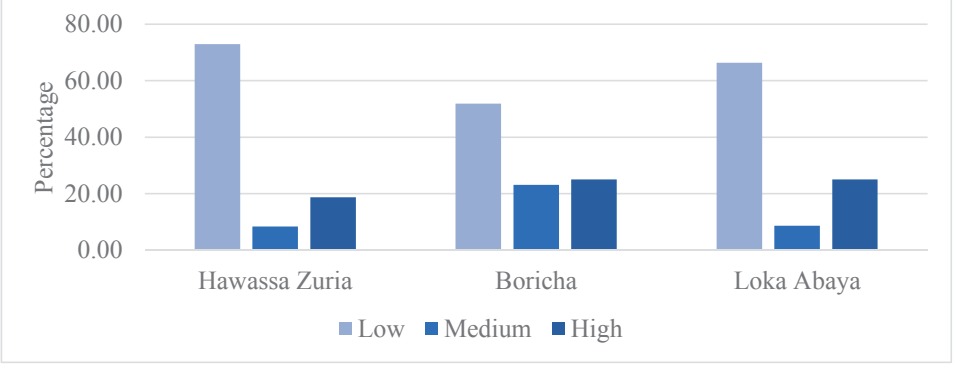

Figure 3: Categories of IFI of the districts

[3] The division was made based on the data using quartiles.

4.3. Level of climate resilience in the study area

Using PCA, indices for the six components were generated from the indicators (see equations 8 and 9). Then, the indices were used to estimate the CRI (see equations 10 and 11). Since only principal components whose eigenvalue is greater than one was considered, components 1 and 2 were included. Once the two principal components were generated, each component was multiplied by its proportion of variance to estimate the CRI.

$$CRI = (0.2771/0.5309) * \text{Component 1} + (0.2537/0.5309) * \text{Component 2} \quad (13)$$

As we can see from Figure 4, stability followed by adaptive capacity and assets were the most important components of the CRI, whereas social safety net was the least important. Moreover, Hawassa Zuria had the lowest values for adaptive capacity, social safety net, and stability, while it had the highest values for assets, access to basic services, and income and food access. Boricha had the lowest values for assets, access to basic services, and income and food access components. Loka Abaya had the highest values for adaptive capacity, social safety net, and stability components (see Figure 5).

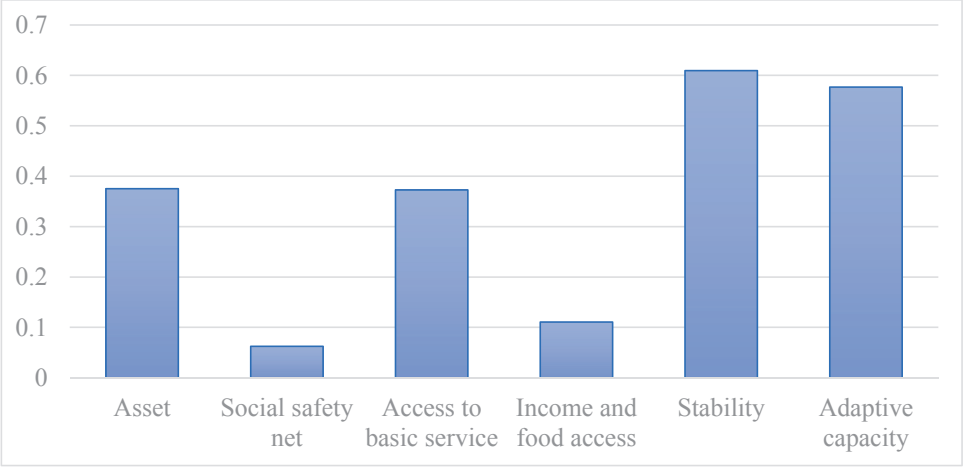

Figure 4: Resilience components by their principal component

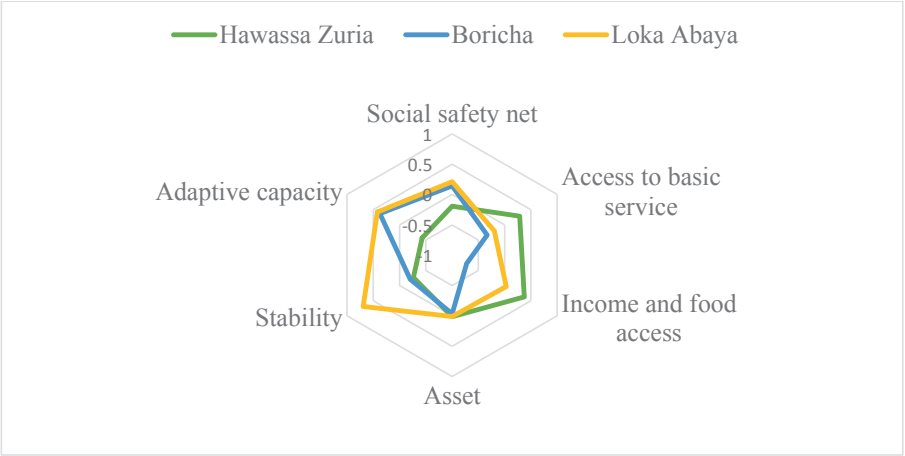

Figure 5: Resilience components by districts

The maximum CRI was 3.10 and the minimum was –2.55. On average, Hawassa Zuria had the lowest CRI and Loka Abaya had the highest CRI (see Figure 6). This contrasts with Quinlan et al. (2015), who reported that farms in Hawassa Zuria were more resilient than those in Loka Abaya and Boricha. However, their result shows that over the years the resilience level in Loka Abaya grew faster, whereas the resilience level in Hawassa Zuria became stagnant. Moreover, Hameso (2015) stated that Hawassa Zuria had the least average land available for crops and grazing compared with the other districts because its proximity to Hawassa city had reduced farming land as the city expanded. Even though its proximity has advantages, such as market access, climate change had been so fierce over the years that it reduced the crops and animal productivity, reducing their marketability (Lomiso, 2020). Moreover, the poor road infrastructure of the district reduced market accessibility. In addition, higher levels of temperature were recorded in the district, resulting in frequent droughts and reduction of livestock productivity. Meanwhile, there was large-scale soil erosion, which reduced the farm productivity of the district. Hence, the decline in animal and farm productivity combined with the decline in market accessibility reduced the income and asset of the farm households, increasing their vulnerability and reducing their resilience to climate change (Hameso, 2015; Lomiso 2020).

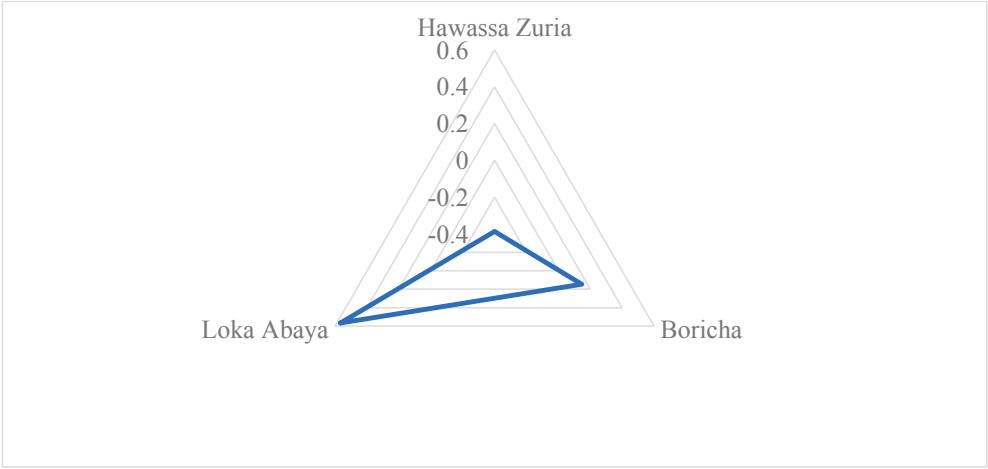

Figure 6: CRI of the districts

4.4. Contribution of financial inclusion to climate resilience

Table 6 presents the regression results. Column 1 shows the result when IFI is used as a measure of financial inclusion. Columns 2, 3, and 4 use the ownership of financial sector accounts, mobile money accounts, and debit cards, whereas columns 5 and 6 use savings and access to credit as measures of financial inclusion, respectively. According to the multiple regression result, financial inclusion was found to be statistically significant at 5% with a regression coefficient of 0.397. Thus, the more financially included the farm households, the higher their resilience to climate change. Financial inclusion enabled farm households to diversify their livelihoods and accumulate assets, which helped them to build resilience more independently and sustainably. In addition, access to financial services allowed them to improve their resilience by enabling them to invest in physical assets. Studies in South Asian countries, Mali and Myanmar confirm that inclusion in financial services increases the resilience against severe consequences of climate change (Haworth et al., 2016; Hussain et al., 2020). The reason was that financial inclusion enabled them to accumulate assets and reduced their vulnerability, which increased their climate resilience.

Moreover, farm households who owned an account were 20.6% more resilient than other households. This study shows that financial sector accounts served as a channel through which safety net programmes paid their beneficiaries and farmers purchased agricultural inputs. This reduced unnecessary expenditures, developed saving habits, and allowed for fast purchase of

agricultural inputs, which supported their climate-resilient activities. Thus, access to accounts allows low-income households to improve their resilience (Calderone et al., 2019).

In addition, those who owned mobile money accounts were 23.4% more resilient than those without one. Mobile money accounts reduced the transaction cost of receiving remittances and government transfers. They also allowed for easy and cheaper access to other financial services. Haworth et al. (2016) found that mobile money had the potential to build climate resilience in Mali by increasing the level of inclusion and allowing for a secure way to receive remittances in the face of climate change. However, the finding in Myanmar revealed that it did not have any impact on climate resilience due to underdeveloped infrastructure.

Furthermore, access to credit increased climate resilience by 23.7%. The result shows that 75.3% of the farm households used the credit to start their own business, which involved fattening and selling livestock. This was particularly common among those who received joint credit from MFIs. Engaging in this business increased their income level by enabling them to diversify their income sources, which lowered their vulnerability to climate change. Moreover, this motivated them to be self-sufficient in building their climate resilience, which was a more sustainable solution to climate change. In addition, 69% of the farm households claimed that the loan they received helped them during drought seasons by covering their expenses. This increased their ability to be resilient to climate change. Similarly, studies in Cameroon and the central highlands of Ethiopia show that access to credit had a significantly positive effect on resilience by enabling households to develop their assets and increase their income (Asmamaw et al., 2019; Awazi et al., 2019).

Ownership of debit cards and savings were found to be insignificant factors. Farm households' lack of knowledge and low amount of debit card ownership restricted the benefits. In addition, lack of money limited their ability to save. These factors reduced the role of debit cards and savings on climate resilience. By contrast, other studies show that savings increased resilience by helping people to plan and adapt to changes (Haworth et al., 2016; Chirambo, 2017).

The regression also provides information on other determinants of climate resilience. Contrary to the findings of other studies, gender and age were not significant determinants of climate resilience. Similarly, education and the dependency ratio were not significant factors. However, household size was a positive and significant determinant of climate resilience. Moreover, access to extension services, farm experience, membership of groups, and access to

sufficient water were significant determinants of climate resilience. Compared to residents of the Boricha district, residents of Loka Abaya were more resilient to climate change, and residents of Hawassa Zuria were less resilient.

Table 6: Determinants of climate resilience

Explanatory variables	Dependent variable: CRI					
	(1)	(2)	(3)	(4)	(5)	(6)
IFI	0.397**					
	(0.185)					
Account ownership		0.206**				
		(0.079)				
Mobile money ownership			0.234**			
			(0.118)			
Debit card ownership				–0.043		
				(0.104)		
Savings					0.072	
					(0.072)	
Access to credit						0.237***
						(0.088)
Gender	–0.153	–0.187*	–0.149	–0.149	–0.163	–0.146
	(0.108)	(0.107)	(0.108)	(0.108)	(0.107)	(0.104)
Age	–0.010	–0.009	–0.009	–0.010	–0.010	–0.009
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Can read and write	0.043	0.012	0.064	0.062	0.046	0.006
	(0.118)	(0.120)	(0.118)	(0.118)	(0.121)	(0.118)
Primary education	0.127	0.126	0.131	0.144	0.135	0.134
	(0.124)	(0.124)	(0.123)	(0.12)	(0.125)	(0.123)
Secondary education	0.054	0.034	0.087	0.106	0.079	0.052
	(0.138)	(0.142)	(0.137)	(0.137)	(0.139)	(0.137)
Tertiary education	0.223	0.322*	0.269	0.441**	0.379**	0.354**
	(0.183)	(0.174)	(0.174)	(0.179)	(0.172)	(0.169)

Household size	0.168***	0.167***	0.169***	0.170***	0.168***	0.172***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Dependency ratio	0.059	0.059	0.057	0.056	0.059	0.067
	(0.064)	(0.063)	(0.064)	(0.064)	(0.064)	(0.063)
Farm experience	0.015**	0.015**	0.014**	0.014**	0.014**	0.014**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Access to extension service	1.019**	1.075**	1.025**	1.067**	1.059**	1.064**
	(0.436)	(0.458)	(0.435)	(0.445)	(0.447)	(0.440)
Access to sufficient water	0.613***	0.616***	0.587***	0.576***	0.592***	0.594***
	(0.126)	(0.616)	(0.125)	(0.125)	(0.124)	(0.125)
Membership of a group	0.432***	0.407***	0.450***	0.473***	0.446***	0.432***
	(0.089)	(0.091)	(0.088)	(0.089)	(0.091)	(0.088)
Hawassa	–0.261***	–0.314***	–0.242***	–0.261***	–0.292***	–0.240***
Zuria	(0.089)	(0.093)	(0.090)	(0.092)	(0.092)	(0.091)
Loka Abaya	0.489***	0.496***	0.495***	0.495***	0.486***	0.523***
	(0.096)	(0.095)	(0.096)	(0.099)	(0.096)	(0.098)
N	400	400	400	400	400	400
R-squared	0.474	0.477	0.474	0.468	0.469	0.477

Note: The symbols ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

4.5. Factors limiting the contribution of financial inclusion to climate resilience

The previous section explains the contribution of farm households' financial inclusion in building climate resilience. However, it was found that this contribution was limited due to the low level of financial inclusion in the region. From the questionnaire and interview responses, the following factors were identified as the challenges hindering the financial inclusion level.

The main challenge that financial sectors faced in these areas was the lack of infrastructure. To open more branches, financial sectors require a building, an internet system, and other infrastructure. However, the lack of such infrastructure in the rural kebeles of the districts prevented them from opening branches. Therefore, they based their branches in the main city of the districts, then occasionally sent out their employees to the rural areas to open accounts

and gather savings. However, this limited farm households' access to financial services, especially saving, because they found it difficult to travel to the main city every time they wanted to make a small deposit. This reduced their level of savings. Therefore, the lack of infrastructure is a challenge for the expansion of financial sectors that needs to be overcomed (Haworth et al., 2016; Hussain et al., 2020).

Ownership of an account had a positive contribution to climate resilience. However, there were challenges to the opening and use of an account. The main reasons for not owning an account were lack of knowledge and long distances to banks/MFIs. These factors resulted in household financial exclusion because account ownership is a gateway for financial inclusion. Meanwhile, because of the existence of only one bank branch and MFI branch per district, long queues in a branch restricted access to accounts. Network and electricity interruptions were also obstacles that farm households faced while using their account. These factors reduced the accessibility of accounts and discouraged households from using them.

Moreover, despite credit's contribution to building a climate-resilient economy, the long process required to obtain credit has been a hindering factor. Financial sectors took a long time to give credit because of administrative problems, such as a shortage of human resources and negligence. This discouraged people from asking for a loan or following through with their request afterward. Another administration problem in these sectors was corruption. During the credit extension process, the district MFIs favoured people they knew, which excluded those farmers who did not have the required social connections.

The sample households lacked the collateral acceptable to financial sectors to obtain credit. Similarly, Schuetz and Venkatesh (2020) report that the inability to meet the formal guarantee requirements inhibited rural area residents from receiving credit. That is why MFIs encouraged the joint credit system. However, this system had its limitations because the households found it difficult to form a group. In addition, the maximum credit limit provided by MFIs was lower than the demand, which limited the group's ability to expand their businesses.

Furthermore, the expansion of mobile money services was restricted by the low availability of mobile networks. Farm households' lack of knowledge about the existence or the use of this service hindered its expansion and forced the exclusion of households. In addition, the fact that households were required to travel to the main town of the district to withdraw cash from their mobile money account restricted the benefits that the residents could obtain from this service. This is because there were no agent banks in the kebeles. Agent banking is a useful and cheaper

financial outlet mechanism, enabling distant financial sector branches to easily reach farm households. However, the long list of requirements for agents, which included total capital, education level, ownership of a taxpayer tin, and licence for trade, made it difficult to find agents in rural kebeles. This limited its expansion and contribution to the expansion of mobile money services.

5. Conclusion and recommendation

This study examines the contribution of financial inclusion to farm households' climate resilience using micro-level data for the Sidama region, Ethiopia. The results suggest that financial inclusion had a positive and significant role in building climate resilience. The provision of financial services at a reduced cost provided farm households with the opportunity to build their resilience to climate shocks in a sustainable and self-sufficient way. Thus, it should be considered a policy framework to increase the climate resilience of farm households. Financial sectors should also adjust their services by giving priority to climate-resilient activities. However, various factors limited the financial inclusion level, which restricted its contribution to climate resilience. Thus, given the potential benefit in terms of building a more resilient economy, improving the current performance of financial services is crucial.

The study shows that the lack of infrastructure and the associated high cost hindered the opening of new branches. Thus, it is advisable to expand mobile money services, which can be operated at a lower cost. Moreover, financial sectors should open new branches and set up ATMs in certain kebeles with more business transactions and relatively better infrastructure. This minimises the cost of opening a branch while increasing the number of branches, and it will also improve the accessibility of accounts. Furthermore, because the use of accounts was restricted by electricity and network interruptions, financial sector players should work toward reducing this problem.

Financial institutions should also develop their credit extension system by reducing the time taken to provide credit. They should increase the amount of credit they extend to meet the demands of borrowers. One way to do this is by mobilising more savings from farm households. In addition, financial institutions should make it easier for low-income households to save by introducing financial products that do not require frequent visits to branches.

Moreover, the use of mobile money services was restricted due to the lack of infrastructure and farm households' lack of knowledge. Thus, financial institutions should increase their awareness and expand the availability of mobile networks in collaboration with Ethio telecom.

In addition, agent banking should be expanded because it is restricting the benefits of mobile money services. One of the reasons why there were no agents was the failure to find people who met all the specified criteria. However, financial sectors should choose people who own businesses and train them in agent banking. Thus, rather than dismissing the idea of selecting agents because they could not find people who meet all their criteria, they should find potential agents who meet some of the criteria and train them to be agents. By increasing the availability and accessibility of financial services to a larger percentage of the population at a lower cost, financial inclusion can further contribute to building a more resilient economy.

Data availability statement

The data used in this study are available from the corresponding author upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics declaration

The author(s) has obtained ethics approval from the Norwegian Agency for Shared Services in Education and Research (NSD) under reference number 921873. The author(s) has also obtained informed consent from the respondents using a format provided by NSD.

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Paper Four

Financial inclusion for a better tax administration and compliance: the case of Ethiopia

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Financial inclusion for a better tax administration and compliance: the case of Ethiopia

Abstract

This study analyzes how financial inclusion contributes to tax administration and compliance. Primary and secondary data are collected, and descriptive analysis is used. Financial services such as credit, bank-to-bank, and E-tax payment systems improve tax administration and compliance by reducing the compliance cost of tax payment and the probability of tax evasion while enhancing taxpayers' convenience. However, the contribution of digital payment systems such as debit and credit cards cannot be identified because of their limited use in transactions. Increasing financial inclusion thus should be a policy input in improving tax administration and compliance.

KEYWORDS: financial inclusion, tax compliance, tax administration, bank-to-bank payment, E-tax payment system, credit

1. Introduction

All countries depend on taxation for governance and state-building (Mascagni et al., 2014). This is especially true for developing countries whose domestic mobilization of resources is essential to strengthening their weak economic development (African Union Commission [AUC], 2019). However, the tax level of these countries is usually low. While tax revenue for upper-income countries is 30% of GDP on average, for developing countries, it is 15% of their GDP. This means that there is far less money to spend on public goods for development, which keeps them in a vicious cycle, i.e., they are poor because they lack the revenue to invest in public goods (Bachas et al., 2021).

Many of the challenges low-income countries face regarding tax revenue mobilization are associated with tax administration (International Center for Tax and Development [ICTD], 2021). Specifically, the tax administration problem is related to fiscal corruption, a shortage of tax experts in the treasury and planning department, and taxpayers' lack of compliance (Fjeldstad & Rakner, 2003; Gupta, 2007). Corruption in tax administration proves to be a burden, which affects the overall perception of corruption (Ponomariov et al., 2018). In addition, tax administrative challenges such as tax evasion, avoidance, and compliance costs alter the effectiveness of the tax system (Bird, 2015). However, if a better tax administration is employed, the tax revenue of these countries can be improved.

Ethiopia is not an exception. While Ethiopia's scarcity of material and financial resources raises the need to mobilize domestic revenue (Ayenew, 2016), there is a noticeable fiscal gap because of low tax revenue. Between 2012 and 2020, the tax revenue (% of GDP) in Ethiopia declined by 32%, where it was only 6.2% in 2020 (World Bank [WB], 2021). This is well below what developing countries' tax-to-GDP ratio should be to achieve sustainable growth, i.e., at least 15% (Dahal, 2020). In Kenya, for instance, the tax revenue (% of GDP) in 2020 was 14.3%, which is closer to the benchmark (World Bank [WB], 2021).

There are several reasons for this low level, with poor tax administration as the prominent one. Unethical practices of tax officials, non-compliance behavior of taxpayers, their lack of awareness, the weak control system of both registered and unregistered taxpayers, and tax avoidance are some of the significant challenges related to tax administration (Asmare & Asaye, 2020; Tumoro, 2020). However, this can be remedied if the tax administration is improved and different instruments to advance the tax collection system are developed (Ayenew, 2016; Tumoro, 2020).

Financial inclusion, which involves providing financial services such as savings, credit, and payment transfer (Sarma, 2015), is an instrument to increase a country's tax revenue. A higher level of financial inclusion is associated with higher tax revenue. When a person is financially included, their income increases, contributing to the tax they pay (Al-Own & Bani-Khalid, 2021; Compaore, 2022; Oz-Yalaman, 2019). Financial inclusion via digital payment systems significantly affects tax revenue, which allows governments to improve their economy (Maherali, 2017). The use of payment systems such as debit and credit cards pull people into the formal economy, increasing tax revenue (Mitchell & Scott III, 2019). Financial inclusion motivates businesses to disclose their true worth by providing a reduced cost of credit, reducing the shadow economy and tax evasion (Capasso & Jappelli, 2013). When the government uses digital financial services such as e-tax payments to transact its finance with customers and businesses, it reduces corruption and improves administrative efficiency (Stijns & Borysko, 2017).

Some studies analyzed the effect of financial inclusion on tax revenue in different countries (Al-Own & Bani-Khalid, 2021; Compaore, 2022; Maherali, 2017; Mitchell & Scott III, 2019; Oz-Yalaman, 2019). However, studies examining the role of financial inclusion on tax administration and tax compliance are missing. Moreover, different researchers have studied the determinants of Ethiopia's tax administration and compliance (Tehulu & Dinberu, 2014; Tilahun, 2019; Tumoro, 2020; Yesegat, 2008). However, they do not consider financial inclusion as a determining factor. Therefore, exploring how financial inclusion can contribute to tax administration and taxpayers' compliance in Ethiopia is beneficial.

This study adds to the existing literature by examining the contribution of financial inclusion to tax administration and tax compliance using the case study of Ethiopia. The study attempts to answer the following questions, "how does financial inclusion contribute to tax administration and compliance of taxpayers?" and "what are the weaknesses of financial inclusion in its contribution to tax administration and compliance?". Studying this can help identify the strengths and shortcomings of financial sectors in their role to tax administration and compliance to refine them for a better result.

The remainder of the paper is structured as follows. Section 2 provides the literature review. Section 3 presents the methodology used in this study. Section 4 presents the result and discussion part. Finally, section 5 concludes and provides policy recommendations.

2. Literature review

2.1. Tax administration and compliance

Tax administration can be defined as determining, valuing, or collecting tax liability and enforcing tax laws (Law insider, 2022). The role of tax administration is to collect all taxes fairly as decided by the government with as low a cost as possible for taxpayers. In addition, it needs to ensure that taxpayers comply with the tax rules and that adequate resources are available (European Commission [EC], 2022). Therefore, a better tax administration is employed if it is convenient to taxpayers, results in a minimum compliance cost, and is fair. Furthermore, digitalizing the tax payment system using computer technology improves tax administration (Usman & Abubakar, 2021).

Tax compliance can be defined as the act of tax payment by taxpayers, and it can be either voluntary or enforced (Randlane, 2016). Different researchers identified various determinants of tax compliance. They can generally be classified as economic and non-economic factors. The economic determining factors include the probability of tax audits, penalties, and compliance costs. The non-economic factors include trust in government, the tax system's fairness, the relationship between taxpayers and tax officials, and other individual characteristics (Okpeyo et al., 2019; Randlane, 2016).

There are different theories on tax compliance. The compliance cost of tax administration is a theory that depicts how tax administration affects the compliance cost of paying tax, which in turn impacts tax evasion. Compliance cost involves costs incurred during tax payments, such as lost time, trips to the tax office, and payments to tax accountants and lawyers. It is closely related to tax administration and the behavior of tax evasion. In some countries, this cost can be high if taxpayers wait hours to pay their taxes or if the tax administration is flawed. This prompts them to evade tax. Therefore, the higher the compliance cost, the more likely people will evade tax. Tax evasion can be reduced by improving tax administration and lowering compliance costs (Tanzi & Shome, 1993).

The Allingham and Sandmo model stipulates that the behavior of taxpayers is affected by the tax rate, penalty rate, and probability of detection (Allingham & Sandmo, 1972). Taxpayers weigh the cost and benefit of evading tax. If the benefit is significant, they evade tax. However, evasion will decline if the cost of evading tax is higher due to a high penalty rate or higher probability of detection (Walsh, 2012).

2.2. Financial inclusion in Ethiopia

Financial inclusion can be defined as the access and use of financial services by all individuals and businesses and their awareness and ability to use them (Bozkurt et al., 2018). An inclusive financial system can be measured using different financial services such as an account, branches, debit cards, credit cards, mobile banking, internet banking, agent banking, credit, deposit, and other indicators of financial inclusion (Bekele, 2022).

In Ethiopia, different financial services have the potential to contribute to better tax administration. Some examples include credit, bank-to-bank, and E-tax payment systems. Credit can be defined as the total amount of money that firms or individuals can borrow from financial sectors (Twin, 2020). A bank-to-bank system is a system where taxpayers pay their taxes via banks. Moreover, Ethiopia has recently initiated E-tax systems such as E-filing, E-tax payment, and E-clearance. E-filing system refers to filing or declaring tax amounts using the internet. E-tax payment involves the use of internet banking to pay taxes. Finally, the E-clearance system uses the internet to request clearance from tax authorities (Ministry of Revenue [MOR], 2020).

However, Ethiopia has a shortage of financial services available at its citizens' disposal. Compared with its neighboring countries like Kenya, the financial inclusion level of Ethiopia is low (Bekele, 2022). This hinders the contribution of financial inclusion to the economy.

2.3. Empirical literature

Different factors affect tax administration and tax compliance in Ethiopia. According to Yesegat (2008), the significant challenges to tax administration in Ethiopia are an insufficient number of skilled personnel, lack of awareness, lack of trust between taxpayers and tax officials, problems with taxpayers' identification and registration, and other administrative gaps. On the other hand, tax administration can be improved through the availability of sufficient administration resources, decentralization of tax administration, increasing taxpayers' awareness, using advanced technology to collect tax, and revising tax policy (Tumoro, 2020; Yesegat, 2008). In addition, the perception of government spending, equity and fairness of the tax system, penalties, probability of detection, tax rate, tax system fairness, and financial constraint have significant effects on tax compliance (Tehulu & Dinberu, 2014; Tilahun, 2019).

2.4. Conceptual framework

Figure 1 presents the conceptual framework of this study. It shows how financial inclusion contributes to tax administration and compliance. Three significant aspects of financial inclusion, namely credit, bank-to-bank system, and E-tax payment system, and their contribution to tax administration and compliance are identified. Financial inclusion via credit and payment systems creates a minimal compliance cost, improves the convenience of taxpayers, improves the relationship between taxpayers and tax officials, increases the registration of taxpayers, and increases the probability of detection. This improves the tax administration and compliance of taxpayers.

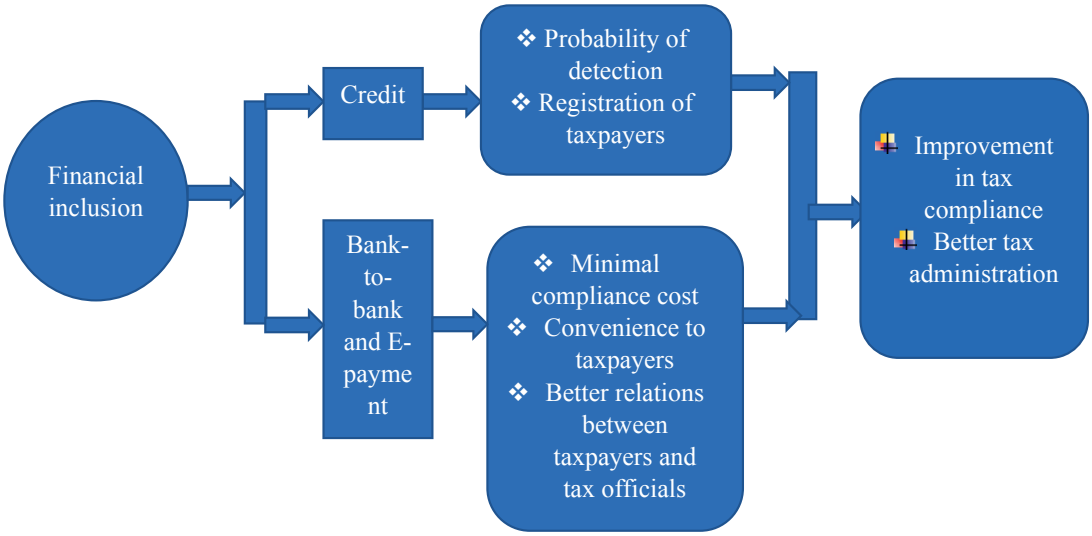

Figure 1: Conceptual framework for financial inclusion and tax administration

3. Methodology

3.1. Data

We collected data from three regions in Ethiopia, namely Addis Ababa, Sidama region[1], and Southern Nation, Nationalities and People Region (SNNPR). Addis Ababa was selected because it is the country's capital city where major business activities are conducted, and payment systems like bank-to-bank and E-payment systems were first initiated. Sidama region and SNNPR were selected because they are composed of people with different economic and ethnic backgrounds. Also, these study areas were safe to travel to compared to the rest of the

[1] Sidama region was part of the SNNPR until it was declared a separate region in June 2020.

country, where there is political instability. In addition, data from the Ethiopian Ministry of Revenue (MOR) was collected to get information about the whole country. Ideally, we should have collected data for the whole country, but that was not attainable due to the current instability in the country, as well as the COVID pandemic.

From the three study areas, 150 sample business owners who pay value-added tax (VAT) and turnover tax (TOT) were selected. Given that this study adopted descriptive analysis, this sample size was found to be sufficient. Thus, 60 taxpayers were selected from Addis Ababa, 45 from the Sidama region, and 45 from SNNPR. The sample taxpayers were chosen purposively based on their availability at the time of the data collection and their willingness to participate.

Both primary and secondary data were collected. Primary data was collected using semi-structured interviews and structured questionnaires. The researcher administered the structured questionnaires to collect data from the sample taxpayers (business owners) between November 22 and December 23, 2021. A total of 150 questionnaires were administered. Each copy contained 71 open and close-ended questions on the level of financial inclusion, tax administration, tax compliance, and the taxpayers' demographic characteristics and tax categories. The questions were framed to allow the respondents to share their ideas on how to improve the current situation. A single questionnaire took approximately 20 minutes to administer, with the researcher asking some taxpayers face-to-face and leaving others to fill it themselves. One hundred and forty-two questionnaires were successfully administered, whereas eight failed to respond.

Furthermore, data from tax officials in the Ethiopian MOR, Addis Ababa MOR, SNNPR MOR, and Sidama region MOR, as well as from expertise in the National Bank of Ethiopia (NBE), was collected using semi-structured interviews. The researcher conducted the interviews personally at different times between May 10, 2021, and November 15, 2021. A single interview took an average of 25 minutes to complete. It was used to understand the level of financial inclusion and characteristics of the tax administration of the study areas. In addition, secondary data was collected from NBE and the different MORs.

3.2. Method of data analysis

The descriptive analysis method was used to analyze the collected data. The quantitative data from the questionnaires were analyzed using Microsoft Excel software. The responses from the interview questions and questionnaires were analyzed with the help of tables and figures. This

helps explain financial inclusion's contribution to tax administration and compliance and the associated challenges.

Using an econometric model would have been a better choice to show the role of financial inclusion on tax compliance. However, the attempt to measure tax compliance was not successful. The pre-test showed that most respondents are not responsive to questions about their tax compliance because of the political situation in the country. Moreover, they tend to portray themselves as an exemplary taxpayer and hide their true behavior. Therefore, we were unable to get reliable data. That is why we used descriptive analysis to show the contribution of financial inclusion on tax administration and compliance of taxpayers.

4. Results and Discussion

4.1. Descriptive statistics

Table 1 presents the descriptive statistics of the sample respondents. More than half of the respondents were men, and the remaining were women. They owned various businesses such as boutiques, electronics, general trading, supermarket, stationery, computer accessory, and cosmetics. Most of them paid VAT, whereas the remaining paid TOT. Among them, 52.3% paid their taxes themselves, and the rest hired accountants to pay for them. Those who paid their taxes via banks constituted the highest proportion of the respondents, followed by those who paid via E-tax and tax office payment systems.

Table 1: Summary of descriptive statistics

Variables		Percentage
Gender	Male	54.9
	Female	45.1
Tax type	VAT	54.9
	TOT	45.1
Status of payer	Owner	52.3
	Accountant	47.7
Place of payment	Bank	60.6
	E-tax payment	23.2
	Tax office	16.2

4.2. The contribution of credit to tax administration and compliance

In Ethiopia, credit extended by formal financial sectors has a vital role in the country's tax system. The data shows that 52.1% of the respondents had received credit from formal financial sectors. Among them, 78.4% claimed that the credit they received helped them expand their business, which raised their income and increased the tax they paid. The remaining 21.6% argued that the credit they received did not influence their tax payment. They cited the high-interest rate, the small amount of credit that restricted their business expansion, the short repayment period, the reduction in transactions due to the slow economy, and the use of credit for personal expenses as explanations (see Figure 2).

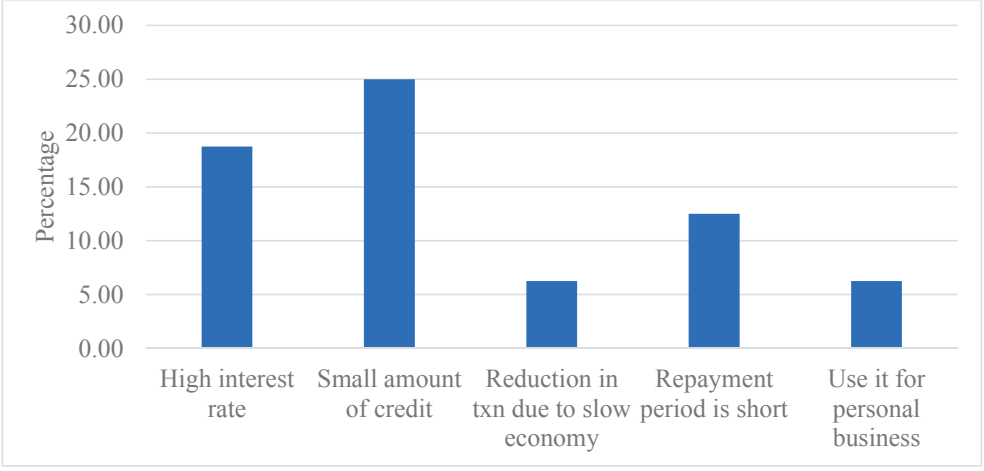

Figure 2: Reasons why receiving credit did not increase tax payment

Taxpayers submit financial statement to tax authorities, which is then used to determine the tax amount paid by the taxpayers. They also submit the statement when they request for credit from banks. In this process, the taxpayers tend to overstate banks' financial statements, whereas they understate the ones submitted to tax authorities. However, through the collaboration between banks and tax authorities during the credit extension process, the latter started using the financial statement submitted to banks to verify the tax amount. This increased the probability of detection, forcing the taxpayers to show their actual financial statements. This made the tax administration easier and improved taxpayers' compliance. This is consistent with the Allingham and Sandmo Model.

All business owners who received credit from financial sectors submitted a clearance from tax authorities verifying that they are taxpayers and do not have residual tax claims. To have this,

they were required to be registered by the tax authority as taxpayers, which reduced their involvement in the informal sectors. Thus, financial inclusion pulls people from the informal economy to the formal economy. Because tax offices register businesses in the formal sector, it reduces the opportunity to evade tax, which would have been easy in the informal market. This enhanced the tax administration and compliance of taxpayers. This result is consistent with Capasso and Jappelli (2013), which state that inclusion in financial sectors minimizes the expansion of the informal sector and tax evasion.

Therefore, the credit extension system reduces the probability of tax evasion and improves tax administration. However, lack of collateral, lack of interest, fear of debt, preference to obtain credit from informal sectors, and the long process it takes to get credit due to negligence and shortage of human resources hindered the respondents from requesting credit from formal financial sectors (see Figure 3).

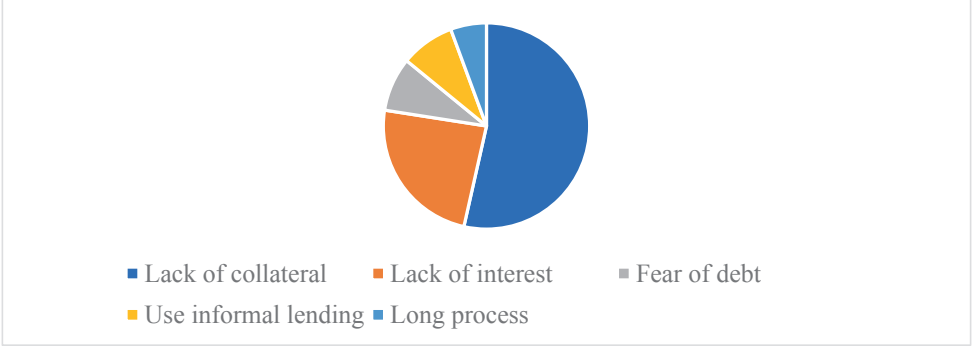

Figure 3: Reasons for not requesting credit

4.3. The contribution of digital financial services to tax administration and compliance

Digital payment systems such as credit and debit cards can improve a country's tax system by relocating consumption expenditure from the informal economy into the formal economy (Mitchell & Scott III, 2019). However, in Ethiopia, the ownership of debit and credit cards was very low, which limited their contribution. For example, in 2021, the percentage of people with debit cards was 17.98%. Meanwhile, the ownership of credit cards was almost non-existent. Moreover, the figure was lower for people who use the cards for transaction purposes.

Our data shows that only 8.5% of business owners accepted payment using debit cards. Even then, the proportion of customers who paid using the card was smaller. The reasons were customers' preference to use cash for transaction purposes and buyers' lack of knowledge.

Business owners also cited the lack of point of sale (POS) machines and their lack of knowledge as reasons for not accepting payments using debit cards (see Figure 4). Moreover, none of them accepted credit cards for payment. Due to this, the contribution of these digital payment systems to tax administration and compliance could not be identified.

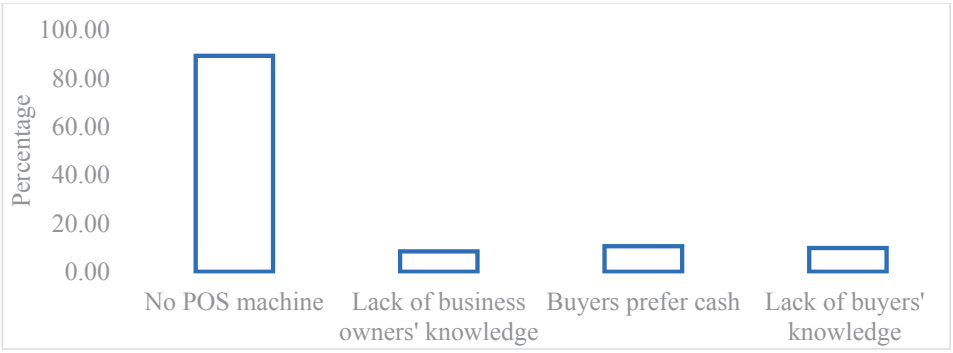

Figure 4: Factors that limit the use of debit card

Digital financial services such as internet banking influenced tax administration by facilitating payment services. The use of the E-tax payment system depends on internet banking. The more expanded internet banking was, the easier it was to apply an E-tax payment system. This is consistent with the works of Kitsing (2017).

4.4. Bank-to-Bank and E-tax payment system

Financial inclusion has the advantage of improving tax administration and compliance by expanding the service financial sectors provide and making it easier and accessible for taxpayers to pay their taxes. For example, using banking and internet financial services to pay tax was possible only to the financially included people.

4.4.1. Bank-to-bank system

This system started in Ethiopia in the 2017/18 budget year, and people have been using it to facilitate the payment of all tax types. Taxpayers could pay their taxes via banks by transferring the tax amount from their bank account to the tax authority's account. The primary account of the tax authority was found in the Commercial Bank of Ethiopia (CBE). Paying in private banks was possible only in Addis Ababa, requiring taxpayers to pay an additional service fee. The system in other regions allowed taxpayers to pay only in CBE. On the other hand, there was no direct collaboration between microfinance institutions (MFIs) and tax authorities in the tax payment system.

More than 82% of the taxpayers claimed that the bank-to-bank system eased tax payment. As shown in Figure 5, one of the ways it eased taxpayment was by reducing the time it took to pay taxes. The duration to pay tax was reduced by more than half. The declaration of the tax amount took the same time for both bank-to-bank and tax office payment systems. However, when paying in a tax office, handling the money transaction alone took 2 hours on average, whereas it took no more than 30 minutes to pay in banks. Even if the bank-to-bank system required taxpayers to travel between tax offices and banks, the overall amount of time it took to pay tax via banks was significantly lower than paying in a tax office. Also, since banks had branches within walking distance of tax offices, the travel cost was minimized. In addition, there were banks in Addis Ababa that facilitated the tax payment system by sending their cashiers to the tax office, eliminating the travel cost for taxpayers. Thus, the bank-to-bank system reduced the time and financial cost spent on paying taxes and made it more convenient to pay.

Moreover, this system reduced the long queues in tax offices, which was a waste of taxpayers' and tax officials' time. The tax authority had an office shortage which limited its ability to deal with many customers simultaneously. This resulted in long queues and long waiting times. However, paying taxes in banks reduced this problem. This system also reduced the workload of tax officials, allowing the use of the labor force to improve the efficiency of the tax office rather than doing manual tax file shuffling. Therefore, by improving the tax administration, the bank-to-bank system reduced the compliance cost of taxpayers and the probability of tax evasion. This is in accordance with the compliance cost theory.

The survey result also shows that 60.5% of the taxpayers claimed that this system reduced the use of cash. No cash transaction was required when transferring money from the taxpayers' account to the tax authority's account. This reduced the time spent paying tax by reducing the time taken to count cash. It also reduced the probability of theft because taxpayers no longer carry cash around. In addition, this improved the efficiency of using the tax revenue for developmental purposes. Tax payments in tax offices were reported at the end of the month, which means that the tax money could be transferred to the country's treasury account at the end of the month. However, because banks could not hold the money for longer than six hours, the bank-to-bank system allowed immediate money transfers to the treasury account. This allowed the Ministry of Finance to use the tax money conveniently for the intended purpose. This is consistent with the findings of Ozgen and Turan (2007).

Furthermore, this system reduced face-to-face transactions with tax officials, which could be a source of corruption. When taxpayers pay their taxes in tax office branches, there is an interaction between tax officials and taxpayers, which opens an opportunity for negotiation to lower the tax amount. This is consistent with the findings of Ponomariov et al. (2018), who state that frequent interaction can be linked with corruption in tax administration. Tax officials also tend to use the tax money for their personal affairs during the month, believing they would return it at the end of the month. This is illegal and immoral, and sometimes they cannot pay for it. However, the bank-to-bank system reduced this practice by serving as an interface between the two parties. Since tax officials no longer received the payment, it eliminated the chance of using the money for personal business, which translates to a better tax administration. However, the problem still exists to a certain degree, as there are interactions between the two parties during the tax declaration.

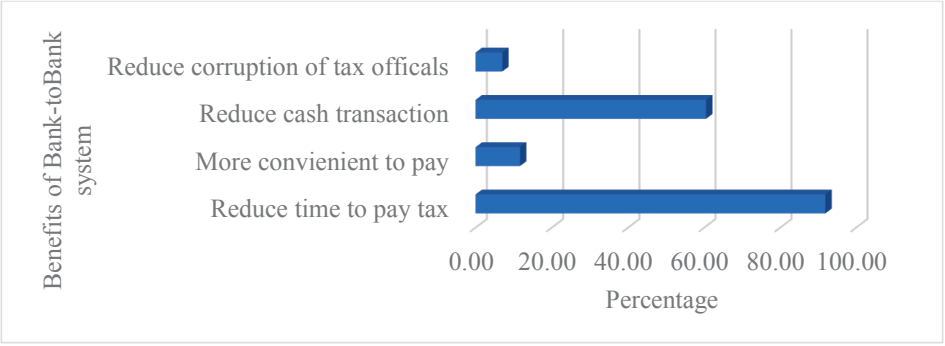

Figure 5: Benefits of the Bank-to-Bank system

This system is not without its weaknesses. Despite reducing the time taken to pay tax compared to the payment in the tax office, 70.9% of the taxpayers claimed that paying tax in banks still took longer than necessary. This is because most of the taxpayers paid in CBE. When taxpayers use only CBE, it contradicts the aim of using bank-to-bank service, i.e., there will be long queues and an increase in the workload of bank officials in CBE. However, if taxpayers could also pay in private banks, it would benefit them because most of them (94%) were customers of different private banks and preferred to pay their taxes in these banks. As shown in Figure 6, taxpayers favored private banks for tax payments because private banks reduced the long queue in CBE and provided better services. Paying in private banks also reduced cash transfers from private banks to CBE during tax payments for those taxpayers whose main account was in private banks.

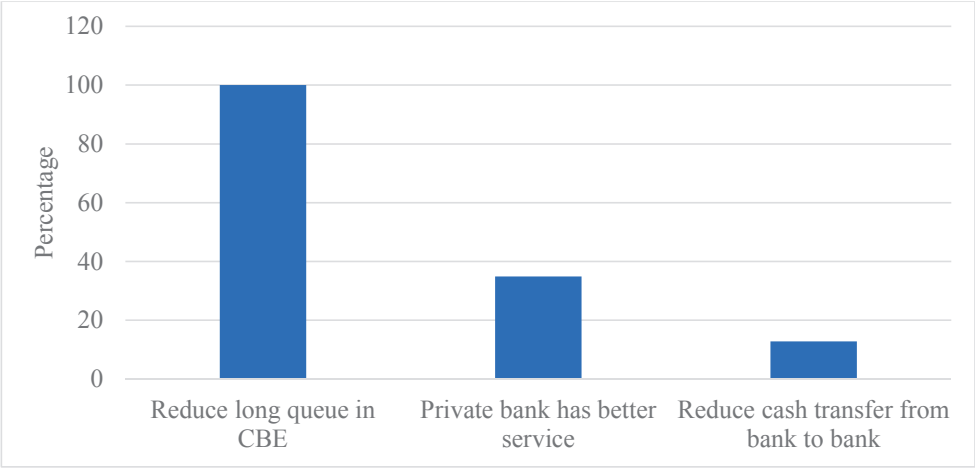

Figure 6: Taxpayers' preference for private banks

Another hindering factor in using the bank-to-bank system was the unstable network system in the country. Especially during the end of the deadline, which was a typical time for tax payment, there was an overload in the bank system, which resulted in its failure. Most respondents (48.8%) believed the overload was caused because taxpayers were waiting till the end of the deadline to pay their taxes rather than paying them beforehand. This allowed them to use the money for their business transactions, but it caused overcrowding of banks. Also, 27.9% of the taxpayers cited that the overload was caused because CBE was the center for all government transactions, such as salary and bill payments. As a result, the overload caused the bank system to crash, which resulted in taxpayers' inconvenience and inability to pay their taxes on time. Moreover, not having enough cashiers and bank branches and CBE's poor service were reasons why taxpayers found it challenging to pay their taxes via the bank-to-bank system (see Figure 7).

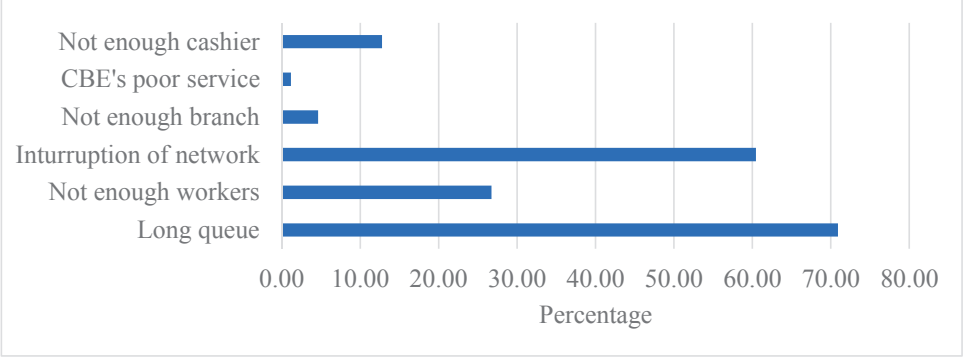

Figure 7: Challenges of the Bank-to-Bank system

Furthermore, there were circumstances where banks mixed accounts. Tax authorities had different accounts for different tax categories. Sometimes, banks mix up the account and charge the wrong tax category to the wrong account. Nevertheless, despite its challenges, the advantages of the bank-to-bank system outweighed its disadvantages, and it surpassed the benefit of paying taxes in tax office branches.

4.4.2. E-tax payment system

The E-tax payment system began as a trial phase in 2017/18 and was officially active in 2018/19. It is operational only in Addis Ababa for those paying federal taxes such as VAT, withholding tax, dividends, and annual profit taxes. Also, only taxes paid on time can be paid using the e-tax payment system. Taxes past their due date cannot be paid using this system. Until June 2021, only taxpayers who are customers of CBE were able to use the system, thus excluding other bank customers. However, in June 2021, the Ministry of Revenue signed an agreement with four private banks, which allowed them to make the E-tax payment system operational in their bank.

This system had the same advantage as the bank-to-bank system, but it was an improvement in some ways. The evidence shows that it eradicated face-to-face interactions between taxpayers and tax officials. This reduced the chance of negotiation between the two and the corruption in tax administration. In addition, there was no longer a need to queue in tax offices or banks, which used to waste taxpayers' time. There was no need to come to tax offices to report their tax amount because they could do it using the E-filing system, nor was there a need to queue in banks to pay their taxes. This enhanced the tax administration and compliance of taxpayers because it made it easier to digitize tax payments and reduced the cost of paying taxes. Moreover, it eliminated cash transactions, which reduced the time taken to count cash and the probability of theft (see Figure 8).

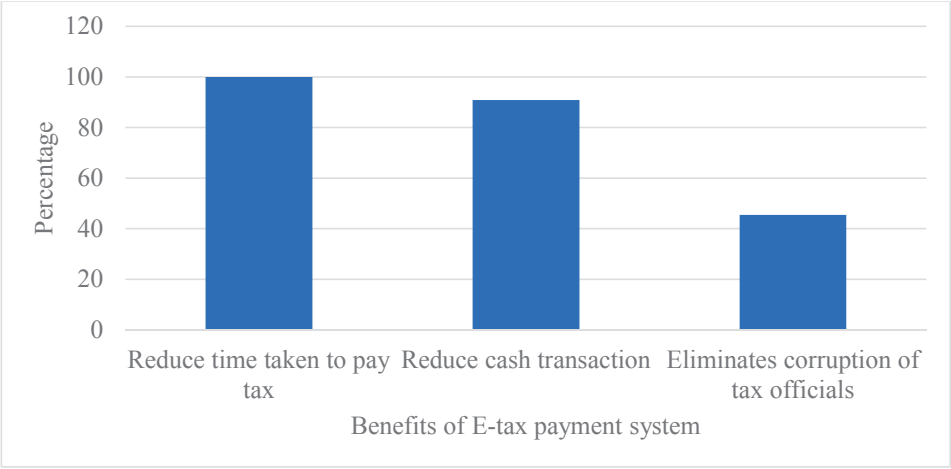

Figure 8: Benefits of the E-tax payment system

Nevertheless, this system encountered different challenges (see Figure 9). Due to the country's internet infrastructure shortage, few taxpayers can use it. Most of those using it faced difficulty because of frequent internet connection interruptions. Furthermore, most taxpayers claimed that lack of knowledge was a challenge in using the E-tax payment system. Because the system was new, few people were familiar with its use. Another challenge in using this system was that taxpayers did not receive the receipt on time. The receipt proved the completion of the tax payment. When taxpayers did not receive the receipt as soon as they paid, they could not be certain if the payment was successful. Sometimes, if they waited long to receive the receipt, the deadline to pay their tax would pass, and they risked the probability of paying a fine.

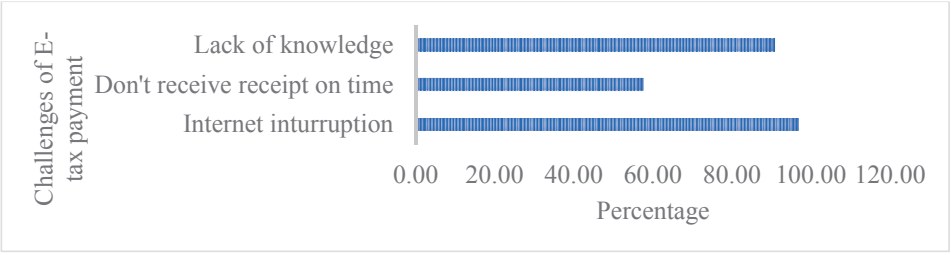

Figure 9: Challenges of the E-tax payment system

In addition, the system is currently available only in the capital city. Other regions are yet to have the opportunity to use it. Making it national requires much work and improvement in the existing communication technology.

5. Conclusion and policy implications

This study examines how financial inclusion contributes to Ethiopia's tax administration and compliance. The extension of credit by formal financial sectors improves the country's tax administration by revealing the true worth of businesses and reducing their involvement in the informal market. However, the contribution of digital payment systems such as debit and credit cards cannot be identified because of their limited use in transactions. Meanwhile, the bank-to-bank and E-tax payment systems improve the tax administration and the compliance behavior of taxpayers. These systems reduce the compliance cost of tax payments as well as improve taxpayers' convenience and their relationship with tax officials. Therefore, financial inclusion opens the opportunity to provide different financial services, which improves tax administration and taxpayers' compliance behavior while reducing tax evasion.

Based on the findings, the following policy implications can be deduced. The contribution of debit and credit cards to tax administration could not be identified. Thus, their use in transactions should be encouraged throughout the country to improve tax administration. This requires the expanded availability of POS machines in all retail shops and an increment in business owners' and buyers' awareness.

The small credit amount and the long credit extension process in formal financial sectors restricted people from borrowing. These reduced the contribution of credits to tax administration. Therefore, financial sectors should improve their credit extension system and reduce the time it takes for borrowers to get credit.

The overloading of the bank system and the long queues in banks during tax payment periods limit the contribution of the bank-to-bank system to tax administration. Because taxpayers' waiting till the deadline is causing the overload, they should pay their taxes during the whole period. Moreover, because the bank network system frequently crashes during tax payment seasons, financial sectors should improve their network infrastructures and avoid interruptions as much as possible. In addition, allocating some cashiers only to receive taxes during tax season and allowing tax payments using mobile banking can significantly reduce the overload and improve the bank-to-bank system.

Furthermore, using CBE as the primary bank for tax payments is causing network overload and discourages using other private banks. Therefore, tax authorities should expand their range to include all private banks in the bank-to-bank and E-tax payment system without additional fees.

Since a lack of knowledge on how to use the system is a bottleneck for E-tax payment, more training should be given to taxpayers in all regions of the country. This helps to make the system fully operational. In addition, the network should be improved so taxpayers can rely on the E-tax payment system while paying their taxes.

So far, the direct cooperation of tax authorities is only with banks. However, given the significance and expanded availability of MFIs in different parts of the country, mainly rural areas, the tax authority should formulate a working relationship with these institutions. This can magnify the contribution of financial inclusion to tax administration while improving taxpayers' compliance behavior and reducing tax evasion.

Data availability statement

The data used in this study are available from the corresponding author upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author.

Ethics Declaration

The author(s) has obtained ethics approval from the Norwegian Agency for Shared Services in Education and Research (NSD) under reference number 921873. The author(s) has also obtained informed consent from the respondents using a format provided by NSD.

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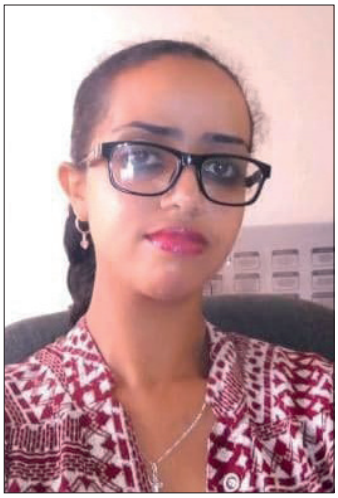

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Wuddasie Dereje Bekele was born in Hawassa, Ethiopia, in 1990. She holds a BA Degree in Economics (2011) and MA Degree in Development Economics from Hawassa University (2015). The thesis consists of an introduction and four independent papers. The papers aim at investigating the trend, determinant, and contribution of financial inclusion. Paper I analyzes the dynamic and spatial trend of financial inclusion in Ethiopia. Results suggest that the level of financial inclusion in Ethiopia is growing but low. There is discrepancy among the regions attributed to their difference in literacy, percentage of rural population and religion. Paper II deals with factors affecting financial inclusion in Kenya and Ethiopia. Results indicate that Kenya has a higher level of financial inclusion than Ethiopia. Differences in financial system policy, GDP, and mobile money operation are some of the reasons. The results further indicate that gender, age, education, employment, and ownership of mobile phones had a positive effect on financial inclusion, whereas lack of documentation, lack of trust, and lack of money were the main barriers. Paper III examines the contribution of financial inclusion to enhance the climate resilience of farm households in the Sidama region. Results show that financial inclusion had a significant and positive contribution to climate resilience. Ownership of financial sector accounts, mobile money accounts, and access to credit played a role in building climate resilience. Despite this, there is low availability of financial services in the region. Paper IV investigates the role of financial inclusion in improving the tax administration and compliance of taxpayers in Ethiopia. Results suggest that the credit extension system, the bank-to-bank, and E-payment systems were the major services provided by the financial sectors, which contributed to the tax administration of the country. However, lack of collateral, lack of interest, fear of debt, and the long process it took to obtain credit hindered business owners from requesting credit from formal financial sectors. Also, the bank-to-bank system suffered from overload, which caused tax payments to take longer than necessary. Moreover, the E-tax payment system suffered from frequent interruptions of the internet. Lack of knowledge on how to use the system, late delivery of receipts, and the availability of the system only in the capital city were other bottlenecks that hindered the fast expansion of this system, thus reducing its contribution to tax administration and compliance of taxpayers.

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