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Abstract

Digital finance has emerged as one of the most promising tools for closing the gender gap in financial inclusion in recent years. As the vanguard of digital finance, digital payment can be an important on-ramp to the use of other financial products and services by ameliorating obstacles such as cost, distance barriers, and information asymmetry. Using 2018/19 Ethiopian socio-economic survey data, this paper investigates whether there is a gender gap in the use of financial services in Ethiopia and the role that digital payment services can play to narrow this gap, if any. The paper had three key findings: First, women are less likely to have an account at a formal financial institution, to save formally, and to use mobile and/or internet banking than men. Second, mobile and/or internet banking usage may promote the likelihood of saving formally at the individual level. This paper yields further evidence as to why the gender gap in financial inclusion might persist in Ethiopia. The fact that women have a lower income, are less likely to be employed, and are more likely to live in smaller and relatively less developed Ethiopian regional states explains why they are less likely to use mobile and/or internet banking than men. This suggests that gendered socio-economic disadvantages that created a gap in the use of traditional financial services still matter in the use of digital payment services. Therefore, policies aimed at tackling weak demand-side digital payment service usage drivers may further empower women by improving their financial inclusion.

Keywords: Financial inclusion, Digital payment, Gender gap, Women's empowerment, Non-linear decomposition, Ethiopia

1. Introduction

Digital financial inclusion (DFI) is widely believed to allow the country's financial system to serve a community from all walks of life, particularly the poor or previously financially excluded. The more financially inclusive the country is, the more likely it is that vulnerable groups will not opt for informal financial services (Tay et al., 2022). Moreover, effective financial systems encourage new businesses, both emerging and existing ones, to thrive and ultimately stimulate economic growth and development (Ajide, 2020). Digital financial services (DFS) can help overcome acknowledged obstacles to accessing financial services such as cost, distance barriers, and information asymmetry (Bharadwaj and Suri, 2020a; Aziz and Naima, 2021; Khera et al., 2022). The World Bank (2014) described financial inclusion as a situation in which the bulk of financial products and services within a country, such as payment, transfer, savings, credit, and insurance, reach a sufficiently large proportion of the population at an affordable cost as well as in a responsible and sustainable manner. DFI can be defined as digital access to and use of formal financial services (Lauer and Lyman, 2015).

Many countries in sub-Saharan Africa (SSA) have embraced the need to rapidly connect traditionally marginalized groups, particularly women, to DFS and embarked on some high-level policy initiatives and regulatory reforms to advance DFI, at least after the Maya Declaration in 2011. The African Development Bank has established a facility in 2019 to accelerate DFI across the continent, particularly to reduce the existing gender gap in DFS. Despite some progress in terms of advancing economic opportunities and equality for women via DFS, the gender gap in financial inclusion persisted in SSA (Gammage et al., 2017; Chamboko et al., 2018). It is important to emphasize that women's meaningful financial inclusion is a key building block for their economic empowerment and inclusive growth (Hendriks, 2019). Thus, increasing the level of financial inclusion for women can contribute to alleviating poverty and boosting economic growth (Ghosh and Vinod, 2017). Balasubramanian et al. (2019) assert that the number of women owning, possessing, and using their land for personal and entrepreneurial activities increased following an increase in financial inclusion in developing economies. Less-educated women and women living in rural communities are more likely to experience the positive effects of greater financial inclusion in terms of poverty reduction (Agyemang-Badu et al., 2018; Koomson et al., 2020; Yang et al., 2022; Kim, 2022). This supports the idea that financial inclusion can empower women.

Payment systems are widely documented, especially in policy circles, as a way of promoting financial inclusion and ensuring that economic gains reach the poorest members of society. Payment is often the first step and the optimal gateway to gaining access to financial services, while other aspects of financial services, such as savings, credit, and insurance, tend to come later with financial development and deepening (Jain et al., 2014; Khera et al., 2022). Moreover, digitizing payments has proven to be a powerful hook to increase access to and usage of other financial products for women (Suri and Jack, 2016). Digital payment and savings matter most for less privileged segments of the population and are more effective in reaching development goals such as poverty and inequality reductions (Demirguc-Kunt et al., 2017). According to Bharadwaj and Suri (2020b), digital banking, which includes but is not limited to digital payment, holds promise as an important source of financial inclusion. More recently, Tram et al. (2021) concluded that digital financial services have proved to be the foundation of financial inclusion in developing countries, especially for those who are isolated and financially underprivileged.

For many others, mainly in academia, a focus on financial inclusion as a poverty reduction tool seems to make little sense. High expectations for financial inclusion to serve as a core pro-poor intervention do not appear justified (Mader, 2018). Financial inclusion may entail insufficiently recognized regressive effects, for instance, if digital payment systems bring redistribution from poorer households to wealthier households (Schuh et al., 2010; Mader, 2018). This could direct policy interventions towards addressing very specific symptoms rather than the deeper causes of poverty and gender inequality. Mader (2018) suggests that maintaining the focus on the fight against poverty and economic inequality, limited access to jobs, and low income must be the first objective to build a financially inclusive society.

Existing empirical evidence on the gender gap in financial inclusion has yielded research results on various aspects (briefly reviewed in Section 2). At this time, there is very limited research and verified knowledge, especially in the SSA context, on the gender financial inclusion gap and the role that digital payments can play in decreasing this gap. Beyond filling this gap in the literature, this study attempts to bridge the gap between research and practice revolving around financial inclusion, using Ethiopia as an empirical case study. An attempt is made to address three sequential research questions: whether there is a gender gap in financial inclusion in Ethiopia focusing on account ownership, digital payment, and savings; whether digital payment usage promotes savings; and whether gender differences in socio-

economic status explain the gender gap in digital payment usage. Digital payment usage in this paper is captured by the use of mobile and/or internet banking as well as using mobile phones to pay bills (Khera et al., 2022). The latter corresponds more to mobile money accounts. Innovations with mobile money encourage households to save by minimizing transaction costs and the risk of informal savings (Nandhi, 2012). DFS such as mobile money can help promote formal savings via mobilizing much smaller sums of money efficiently (Bharadwaj and Suri, 2020a; Natile, 2020). Savings by mobile money accounts are often non-remunerated and can be easily transferred to an account at a formal financial institution to augment their impact on the life of the saver and the national economy. Most of the research on the link between digital payments and the saving behavior of economic agents is limited to the impact of mobile money on savings. To the best of our knowledge, only Ouma et al. (2017) and Loaba (2022) analyzed the role of mobile banking services in promoting saving in SSA.

Accordingly, this paper is expected to contribute to the literature on the role of digital payments and women's financial inclusion in at least two important ways. There is a growing body of literature that examines the role of digital payment methods in encouraging savings (e.g., Suri & Jack, 2016; Ouma et al., 2017; Loaba, 2022). Suri and Jack (2016) analyzed, among others, the effect of changes in access to mobile money – as measured by the geographic proximity of households to M-PESA agents, not adoption itself – on Kenyan households' financial savings behaviour. The authors found a positive and statistically significant impact of changes in M-PESA access on the financial savings of female-headed households. But they were unable to detect a differential gender effect of changes in M-PESA access on the likelihood of using various financial instruments to save, such as safety and convenience. One possible explanation for this is that the authors used access to mobile money as their variable of interest and not its usage. Access to mobile money is necessary but not sufficient to trigger mobile financial services usage. For meaningful financial inclusion to materialize, the capacity and agency to make meaningful use of its access are critically important. In other words, access to digital technologies alone does not necessarily lead to active use of financial accounts and services (Gammage et al., 2017; Mariscal et al., 2019).

Ouma et al. (2017) and Loaba (2022) addressed this concern by considering both the availability and usage of mobile phones to access mobile financial services. The former shows that the use of mobile financial services increases both the likelihood

to save and the amount saved by households in Kenya, possibly due to the frequency and convenience with which such transactions can be undertaken. However, their analysis does not distinguish between mobile money and mobile banking. Loaba (2022) indicates that the use of mobile banking increases the likelihood of formal saving more than mobile money does in West Africa. Both Ouma et al. (2017) and Loaba (2022) did not consider the gender gap issue, perhaps due to a lack of appropriate data. In fact, the latter claims that the likelihood of formal saving increases for women who use mobile banking. This study examined the role of both mobile and/or internet banking and mobile money usage in narrowing the gender gap in formal savings.

The main contribution of this paper lies in seeking to identify why the gender gap in digital payment usage might persist. Aterido et al. (2013) show that lower use of formal banking services by women is not due to discrimination in the banking system or lower inherent demand by women. It is due to the gender gaps in other dimensions related to the use of financial services, such as their lower level of income and education, and their household and employment status. Their finding is corroborated by recent studies that show that mobile banking has increased access to traditional financial services in Tanzania, but the gender gap in access to and usage of these services persists (Were et al., 2021). It is interesting and important to identify whether gendered socio-economic disadvantages that created a gap in the use of conventional financial services still matter in the use of digital payment services. It is logical to think that this may not be the case if digital financial services can help to ameliorate obstacles to accessing conventional financial services such as cost, distance barriers, and information asymmetry. Yet Gillwald and Mothobi (2019) argue that digital exclusion in SSA is primarily an issue of poverty; those at the intersections of class, gender, and location are the most marginalized. It is important because if unequal social structures and relations and gendered socio-economic disadvantages still matter, then policy interventions may have to be directed towards addressing them to encourage financial inclusion.

The remainder of this paper is structured as follows: Section 2 provides background to the study, which includes an overview of the study country's context, a brief literature review, and a conceptual framework. Section 3 describes the data and discusses the methodology employed. This is followed by the presentation of results and discussion in Section 4. Section 5 concludes the paper.

2. Background

2.1 Country context

Ethiopia is one of the poorest performing countries in SSA when it comes to advancing financial inclusion. Even digital payment and transfer services, which are believed to allow traditionally neglected societies into the mainstream economy and hence access to economic opportunities, are rarely used. According to the 2014 Global Findex, only 0.03% of adults in Ethiopia had a mobile money account (World Bank, 2015). Getnet et al. (2021) argued that supply-side constraints account for the observed limited expansion of digital payment services in Ethiopia. In particular, the authors argued that competition problems in the essential digital infrastructure market and in the financial sector are responsible for the inadequate provision of digital payment services in the country. Public quasi-monopolies dominate both markets.

Recently, Ethiopia has engaged in a number of efforts to leverage the potential of DFS and advance inclusive growth. The country is a signatory of the Alliance for Financial Inclusion's Maya Declaration as of 2011. In January 2013, Ethiopia approved a mobile and agent banking regulatory framework, allowing banks and MFIs to offer various financial services via the use of mobile devices and agents as delivery channels. Fintechs were required to partner with banks and MFIs mainly as technology service providers (NBE, 2012). The national financial inclusion strategy was launched in 2017, and the digital transformation agenda was approved in 2020. More recently, the National Bank of Ethiopia (NBE) launched the National Digital Payments Strategy (NDPS) for 2021-2024 to transform the payment landscape. The NDPS is also considered a core component of Ethiopia's financial sector reform strategy (World Bank, 2020).

According to Cepheus (2021), reforms enacted over the last few years have substantially improved the digital infrastructure and connectivity landscape for an inclusive digital economy to emerge in Ethiopia. Telecom coverage has now reached 95% of the country by population and 85% by geographic area; mobile usage has reached 52 million subscribers; and internet access is available to 25 million users. Telecom costs have substantially declined, from 30 Birr cents to 6 cents per 1MB of data (Cepheus, 2021). More recently, the Ethiopian financial sector has seen a wave of DFS providers (Fintechs) following the replacement of the earlier mobile and agent banking services regulation in 2020, which allowed Fintech companies to be

service providers for mobile money and other digital payment instruments. Safaricom has entered Ethiopia's telecom and mobile money markets and the banking sector is now open to foreign competition.3 All these are expected to accelerate the provision of formal financial services in Ethiopia by ameliorating some major impediments to financial inclusion, such as low penetration levels, low internet speeds and usage, limited competition in the digital infrastructure market and in the financial sector, and a shortage of agent networks, among others. Particularly, the performance of the mobile money environment, which is the primary driver of accessing and using DFS in SSA, is expected to be substantially improved.

These developments could also significantly increase the scale of financial inclusion. Economies of scale arising from investment in technology may enable traditional financial institutions and Fintechs to provide digital payment and other financial services far better than any currently offered. However, the extent to which women will have equitable access to these services and benefit from them remains to be seen. Women and girls maintain about 50% of the Ethiopian population (CSA, 2013). Notwithstanding women's decisive place in the social and economic life of Ethiopia, there is a significant gender gap in financial inclusion (Mossie, 2022; Wuddasie, 2022; Achew et al., 2021). Evidence from the Ethiopian socioeconomic survey shows that the percentage of women owning a bank account increased from 17.5% in 2015/16 to 22.7% in 2018/19, but the gender gap has widened from 8.9 to 16.2 percentage points (Achew et al., 2021). To add to this, being a man in Ethiopia may increase financial inclusion by 17.6% (Wuddasie, 2022).

The Ethiopian government is realizing the value of gender equality in financial inclusion to drive overall financial inclusion and to increase the adoption of digital payment products by women. In particular, narrowing the gender gap in financial services use is considered a critical element of financial inclusion (NBE, 2021). The government has recognized the urgent need to target women's inclusion, especially in rural areas[4], in the financial sector, both as an enabler of increased use of digital financial services and as recipients of the financial inclusion benefits of digital payments (NBE, 2021). The government has also realized that advancing women's

[3] The Kenyan mobile money operator is currently on the verge of rolling out M-Pesa in Ethiopia, which is expected to compete with state owned Ethio-telecom service "Telebirr."
[4] Today, financial services in Ethiopia are highly concentrated in urban middle-income areas, with 35–75% of traditional bank infrastructures located in Addis Ababa (NBE, 2021).

financial inclusion requires intentionality – that is, a directed effort to foster an inclusive financial ecosystem for women.

However, achieving a strong impact on the financial inclusion of women is not a simple task. Multiple gender inequalities, especially among rural women, may stand in the way (Holloway et al., 2017). No matter the sophistication and digital technology put in place to promote financial inclusion, the gender gap will persist and may even be amplified until broader social constraints are addressed (Okoyeuzu, 2020). Pervasive poverty, low financial and digital literacy, low levels of average education, high unemployment, and low smartphone ownership are mentioned to limit consumer engagement with formal financial services in Ethiopia, posing challenges to building the DFS ecosystem (Lakew and Azadi, 2020; Wuddasie, 2022). These constraints may be severe and even binding in some Ethiopian regional states as well as rural and remote areas (Getnet et al., 2021).

2.2 Literature review

Earlier research focusing on traditional financial inclusion relied mostly on bank-level data, such as the number of bank branches and ATMs per capita, and the number of bank accounts per capita, with limited gender-disaggregated information on the extent of financial inclusion among the poor and other marginalized populations (World Bank, 2014). Following the increased availability of financial inclusion surveys such as the Global Findex database, a growing body of research has been devoted to analyzing both the demand- and supply-side drivers of financial inclusion in less developed economies (e.g., Demirguc-Kunt and Klapper, 2012). As expected, findings in most of these studies have revealed the existence of a pervasive gender gap with regard to access to and use of financial services.

There exists an extensive body of literature analyzing traditional financial inclusion and its main drivers in single and multi-country settings in SSA, incorporating the role of gender (e.g., Aterido et al., 2013; Asuming et al., 2019; Adegbite and Machethe, 2020; Giron et al., 2022). But only a few studies have delved into analyzing the gender gap, especially in DFS usage (Were et al., 2021). Aterido et al. (2013) assess differences in access and use of formal banking and informal financial services by individuals and explore drivers of the gender gap in the use of these services using probit regression applied to large survey data from nine countries in southern and eastern Africa. The authors also employ Fairlie's (2006) decomposition

technique to identify socio-economic characteristics that contribute to gender gap in the financial inclusion. They show that lower use of formal banking services by women is not due to discrimination in the banking system or lower inherent demand by women. It can be explained by gender gaps in other dimensions related to the use of financial services, such as their lower level of income and education, and their household and employment status. In particular, formally employed and self-employed individuals are more likely to use formal banking services than their non-employed counterparts.

Were et al. (2021) provide an in-depth analysis of gender disparities in financial inclusion in Tanzania, using indicators that encompass access to and use of traditional bank-based and digital financial services, particularly mobile money services. Using the logit model applied to large survey data, the authors show that mobile banking has increased access to formal financial services, although the gender gap in access to and utilization of these services persists. In particular, women are less likely to access digital and traditional financial services compared with men. Their results reveal that education, mobile phone ownership, formal employment, and income have a significant positive impact on the use of both mobile banking and traditional financial services. In addition to these factors, age, marital status, and the number of adult dependents determine the likelihood of saving and borrowing. The authors argue that women face further constraints on their access to formal financial services, assuming that they rank lower with regard to these factors.

The extent of the literature on financial inclusion and its determinants in Ethiopia is still relatively scant. Some of the studies, including Desalegn and Yemataw (2017), Lakew and Azadi (2020), Abdu and Adem (2021), Mossie (2022), and Wuddasie (2022), show that young people and women are groups excluded from financial inclusion in the country. The authors suggest that income, education, and employment are among the key pillars for increasing financial inclusion. Mossie (2022) argues that the gender gap in financial inclusion is mainly due to women's exclusion from the non-financial sector.

At this time, there is very limited research and verified knowledge, especially in the SSA context, on the gender DFI gap and the role those digital payments can play in promoting the use of other financial products and services. In fact, there is a growing body of literature that deals with the role that mobile money plays in addressing the gender gap in accessing formal financial services (e.g., Suri and Jack, 2016).

However, claims surrounding the role of mobile money in promoting women's financial inclusion are attracting a growing critique (Kim, 2022). Research that underpins these claims has been produced by large multilateral institutions directly involved in funding the expansion of mobile money services, such as the World Bank, the IMF, and the Bill and Melinda Gates Foundations, or consultants and researchers funded by these institutions, including Suri and Jack (2016). Kim (2022) argues that mobile money has contributed to the financial inclusion and empowerment of women in Nairobi. To be more precise, mobile money has enabled women to benefit from instant remittance and payment services and offered a means of storing money safely – an attribute, according to the author, valued by younger women and those with lower levels of educational attainment and income.

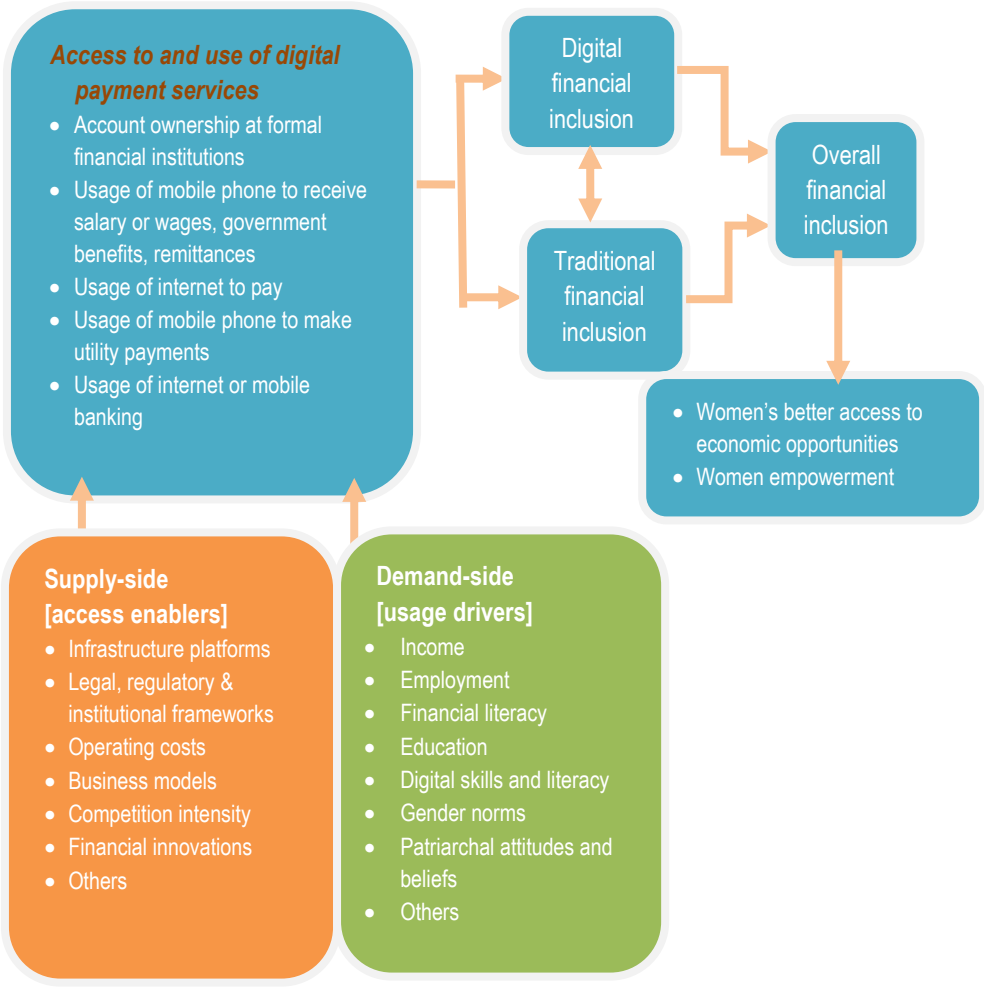
Loaba (2022) examines the impact of the use of mobile banking services on saving behavior in West Africa employing multinomial logit and probit models applied to the 2017 Global Findex database. The author shows that the use of mobile banking services increases the likelihood of formal savings. To add to this, women are more likely to have informal savings, but their likelihood of having formal savings increases if they use mobile banking services. Results in Loaba (2022) further reveal that greater education, employment (especially in the public sector), and income increase the likelihood of adopting mobile banking services. Similarly, Ouma et al. (2017) analyze the role of mobile financial services in expanding financial inclusion and promoting savings based on survey data from Kenya, Uganda, Malawi, and Zambia. Findings in this paper show that the availability and usage of mobile phones to provide financial services promote the likelihood of saving at the household level. A significant impact on the amounts saved is also detected, perhaps due to, according to the authors, the frequency and convenience with which such transactions can be undertaken using a mobile phone.

2.3 Conceptual framework

Two key principles in Jain et al. (2014) are useful to develop a conceptual framework in this paper. First, financial inclusion is a progression that develops in steps, with payment services as the optimal entry point. Second, usage of payment services is not guaranteed because of access and must be an explicit, proactively driven goal. As discussed earlier, Ethiopia has recently made huge strides to improve access to digital payment services. Many efforts have been made to build supply-side access enablers against the backdrop of very weak demand-side usage drivers for the

majority of the less privileged population (see Figure 1). The usage of digital payment services can also facilitate the adoption and usage of other (digital or traditional) financial products and services. Access alone, however, may not automatically lead to digital payment service usage, and not everyone owning a payment product uses it meaningfully. Therefore, for financial inclusion to take off in a big way from a very low base and to narrow the gender gap, attention should also be paid to usage drivers. That is, a directed effort is needed to address the unequal social structures and relations and gendered socio-economic disadvantages that created a gap in the first place.

Figure 1: Determinants of DFS use and financial inclusion



Source: Own construction, 2022

3. Research Design

3.1 Data

The 2018/2019 Ethiopian Socioeconomic Survey (ESS) is a multi-topic household survey collected by the World Bank as part of the Living Standard Measurement Study Integrated Surveys on Agriculture (LSMS-ISA) in collaboration with the national statistics agency. The ESS used a two-stage stratified cluster sampling design to collect data on demographic and socioeconomic variables at the individual, household, and community levels. It also applied a financial inclusion module developed in collaboration with the NBE to collect data on several financial matters, including current levels of financial access based on the prevalence of account ownership, use of financial services, types of institutions used, and their proximity to the household; household and individual financial decisions about savings, credit, insurance, and payment; and financial behavior, knowledge, and attitudes.

Integrating a financial inclusion module into a multi-topic household survey like the ESS makes it possible to explore how different community, spatial, demographic, and socioeconomic characteristics affect the financial decisions of individuals and households (Achew et al., 2021). The survey interviewed over 6,700 households from all parts of the country, which makes it representative at the national, rural, urban, and regional levels. All adults, 18 years old and older at the time of the survey, responded to the individual financial inclusion questions with a response rate of 99.5%.[5] Individuals are likely to have indirect access to financial services through other household members, which might reduce the representativeness, but the advantage of having individual-level data is the possibility of focusing specifically on the gender gap (Cull and Scott, 2010). Hence, this data is the best fit for undertaking research on the gender gap in financial inclusion with a focus on digital payments.

In this study, a sample from the 2018/2019 ESS is used, and a sample with non-missing information on all variables used in the econometric exercises is 2802, 2871, and 4004 for the analysis of individuals' decisions to save, to use mobile and/or online banking, and to use a mobile phone to pay bills, respectively. An attempt is made to account for the effect of excluded individuals on the obtained estimation results.

[5] Only adults aged 18 to 64 years old – that is, economically active individuals – are considered in this study. This is, in part, motivated by the interest in identifying the contribution of individual's employment status to gender gaps in digital payments usage.

3.2 Empirical approach

The study employs both descriptive and econometric tools for analyzing the data to address the predefined research questions. Hence, the first question is addressed through descriptive analysis, considering various indicators of access to and usage of both traditional and digital financial services (account ownership, payment, and savings). The descriptive methods include narrations, tabulations, ratios, and simple mathematical tools such as standard t-tests to check differences across gender.

The study employs an empirical analysis to establish a link between digital payment and saving decisions while controlling for other characteristics of individuals and households that influence the latter. The empirical model was based on theoretical foundations on savings (e.g., Deaton, 1992) combined with institutional theories (e.g., Beverly et al., 2008). Most existing theories of saving emphasize individual characteristics such as marital status, family size, differences in educational attainment, and religious affiliation to explain levels of wealth (Yamokoski & Keister, 2006; Keister, 2004 as cited in Beverly et al., 2008). Institutional theories emphasize institutions designed to promote saving.[6] In the current context, it includes innovations in the financial sector that uses digital financial products and services to promote access to and use of financial services.7 A logit model can be used to explore the relationship between saving decisions and a set of explanatory variables.

$$s_i = \alpha + \delta d_{\boldsymbol{i}} + \beta \boldsymbol{x}_i + \varepsilon_i \qquad \textbf{(1)}$$

Where s_i is a binary outcome variable that equals one if individual i has saved in any formal financial institution in the previous 12 months prior to the survey and zero otherwise and $d_{\boldsymbol{i}}$ is a binary variable of interest that equals one if individual i has used online and/or mobile banking in the previous 12 months prior to the survey and zero otherwise. Alternatively, $d_{\boldsymbol{i}}$ equals one if individual i has used mobile phone to pay bills in the previous 12 months prior to the survey and zero otherwise. $\boldsymbol{x}_i$ refers

[6] The term institutions in this paper refers to purposefully created policies, programs, products, and services that shape opportunities, constraints, and consequences (Beverly *et al*., 2008).

[7] For instance, saving at the Frontier programme – a partnership between Oxford Policy Management and MasterCard Foundations aims to identify innovative approaches by financial sector providers in Ghana, Tanzania and Zambia to extend financial inclusion (Uytterhaegen *et al*., 2022).

vector of control variables such as income and personal characteristics such as gender, age and its square (to capture non-linear effects), educational status, marital status, location (region dummy, rural vis-à-vis urban), distance from the nearest formal financial institution, mobile ownership, if the individual is head of the household, and employment status. ε_i is the statistical disturbance term with mean zero and unit variance. α, δ and β are parameters to be estimated.

The study employs the Fairlie non-linear decomposition technique (Fairlie, 2006) to identify the role of socio-economic factors in explaining gender gaps in digital payment use in Ethiopia. Fairlie decomposition technique is an extension of Blinder-Oaxaca decomposition (Oaxaca, 1973; Blinder, 1973). This technique allows us, among others, to estimate separate contribution of each explanatory variable to the overall gap.

Fairlie decomposition model can be specified as follows:

$$\overline{\mathrm{Y}}^{\mathrm{M}} - \overline{\mathrm{Y}}^{\mathrm{W}} = \left[\sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{M}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{M}}\hat{\beta}^{\mathrm{M}})}{\mathrm{N}^{\mathrm{M}}} - \sum_{\mathrm{i}=1}^{\mathrm{N}^{W}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{W}\hat{\beta}^{M})}{\mathrm{N}^{\mathrm{W}}}\right] + \left[\sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{W}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{W}}\hat{\beta}^{\mathrm{M}})}{\mathrm{N}^{\mathrm{W}}} - \sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{W}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{W}}\hat{\beta}^{W})}{\mathrm{N}^{\mathrm{W}}}\right] \quad \textbf{(2)}$$

$$\overline{\mathrm{Y}}^{\mathrm{M}} - \overline{\mathrm{Y}}^{W} = \left[\sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{M}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{M}}\hat{\beta}^{W})}{\mathrm{N}^{\mathrm{M}}} - \sum_{\mathrm{i}=1}^{\mathrm{N}^{W}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{W}\hat{\beta}^{W})}{\mathrm{N}^{W}}\right] + \left[\sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{M}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{M}}\hat{\beta}^{\mathrm{M}})}{\mathrm{N}^{\mathrm{M}}} - \sum_{\mathrm{i}=1}^{\mathrm{N}^{\mathrm{M}}} \frac{\mathrm{F}(\mathrm{X}_{\mathrm{i}}^{\mathrm{M}}\hat{\beta}^{W})}{\mathrm{N}^{\mathrm{M}}}\right] \quad \textbf{(3)}$$

Where N^j is the sample size for gender j ($M = Men, W = Women$). $\overline{Y}^j$ is the mean probability of outcome variable for sex j, X_i^j is the vector of independent variables for case i in sex j, $\hat{\beta}^j$ is the vector of coefficient estimates including a constant term, and F is the cumulative distribution function from the logistic distribution.

The first term in the bracket represents the part of the gender gap that is due to group differences in distribution of X (i.e., differences in the distribution of the independent variables), and the second term represents the part due to differences in the group processes determining (i.e., differences in the coefficients) levels of Y. The latter captures the portion of the gender gap due to group differences in non-measurable or unobserved endowments, but the interest is not usually in the "unexplained" portion of the gap, mainly due to the difficulty in interpreting results (Fairlie, 2017). Equations (2) and (3) are the same, except that men's coefficient estimates ($\hat{\beta}^M$) and

the women's distribution of independent variables (X_i^W) are used as weights in the first and second term of equation (2), respectively and vice versa in equation (3). Alternatively, one can use coefficient estimates from a pooled sample of the two groups as a weight for the first term of the decomposition expression.

Last but not least step is to calculate the contribution of gender differences in specific variables to the gap. Identifying the contribution of group differences in specific variables to the gender gap is not as straightforward. To simplify, first assume that X contains two variables, x_1 and x_2 and that $N^M = N^W$ and that there exists a natural one-to-one matching of women and men observations. Using a coefficient estimate from a logit regression for a pooled sample, $\hat{\pi}^*$, the independent contribution of x_1 to the gender gap can then be expressed as:

$$\frac{1}{N^W}\sum_{i=1}^{N^W} F(\hat{\delta}^* + {X_{1i}}^M \hat{\pi_1}^* + {X_{2i}}^M \hat{\pi_2}^*) - F(\hat{\delta}^* + {X_{1i}}^W \hat{\pi_1}^* + {X_{2i}}^M \hat{\pi_2}^* \quad \textbf{(4)}$$

Similarly, the contribution of x_2 can be expressed as:

$$\frac{1}{N^W}\sum_{i=1}^{N^W} F(\hat{\delta}^* + {X_{1i}}^W \hat{\pi_1}^* + {X_{2i}}^M \hat{\pi_2}^*) - F(\hat{\delta}^* + {X_{1i}}^W \hat{\pi_1}^* + {X_{2i}}^W \hat{\pi_2}^* \quad \textbf{(5)}$$

The contribution of each variable to the gap is thus equal to the change in the average predicted probability from replacing the women's distribution with the men's distribution of that variable while holding the distributions of the other variables constant. A useful property of this technique is that the sum of the contributions from individual variables will be equal to the total contribution from all of the variables evaluated with the full sample (Fairlie, 2017). One problem, however, is that unlike in the linear case, the independent contributions of x_1 and x_2 depend on the value of the other variable. This implies that the choice of a variable as x_1 or x_2 (or the order of switching the distributions) is potentially important in calculating its contribution to the gender gap. In practice, the sample sizes of the two groups are rarely the same, and a one-to-one matching of observations from the two samples is needed to calculate equations (4) and (5). For the sake of demonstration, assume that the women's sample size is smaller than the men's.

According to Fairlie and Robb (2007), a procedure more in line with the goal of hypothetically matching all men's observations to all women's observations is randomly matching the men's subsample and the full women's sample. Thus, the

decomposition estimates obtained from this procedure depend on the randomly chosen subsample of men. Ideally, the results from the decomposition should approximate those from matching the entire male sample to the entire female sample (Fairlie, 2017). A simple method of approximating this hypothetical decomposition is to draw a large number of random subsamples of men, randomly match each of these randomly drawn subsamples of men to the full women's sample, and calculate separate decomposition estimates. The mean value of estimates from the separate decompositions is calculated and used to approximate the results of the entire male sample. To ensure that the full men's distribution is approximated, a large number of replications should be performed.

4. Results and Discussion

The study used both descriptive and econometric analysis to address the predefined objectives accordingly. Findings of the latter methods substantiate the outputs of the former ones, which could enable the research to cross-check result through different methods.

4.1 Descriptive analysis results

The study used simple descriptive methods such as tabulations, narrations, figures, simple mathematical conversions as a descriptive method. Given this, the study employed econometric methods. Table 1 provides definitions for variables used in the econometric analysis to address the predefined objectives of the study.

Table 1: Variable definitions

VARIABLE NAME	Variable definition
ACCOUNTFFI	1 if the respondent has an account at any formal financial institution; 0 otherwise
ONLINEMB	1 if the respondent has used online and/or mobile banking 12 months prior to the survey; 0 otherwise
PAYBILL	1 if the respondent has personally used mobile phone to pay bills 12 months prior to the survey; 0 otherwise
SAVEFORM	1 if the respondent has saved in any formal financial institution 12 months prior to the survey; 0 otherwise
SAVEINFORM	1 if the respondent has saved in any informal place 12 months prior to the survey; 0 otherwise
BANKACCOUNT	1 if the respondent knows how to open a bank account; 0 otherwise
DISTANCEFFI	Distance from where an individual lives to the nearest formal financial institution (in km)
FEMALE	1 if female; 0 otherwise
MOBILE	1 if the respondent owns any mobile phone, exclusively or jointly with someone else; 0 otherwise
MOBILEJO	1 if the respondent owns mobile phone jointly with any household member; 0 otherwise
INCOME	Respondent perceived current price of his/her mobile phone - used as a proxy for income

lnCONS	Nominal total consumption in adult equivalent (in logs) - household level
HEADHH	1 if head of household; 0 otherwise
HH_SIZE	Household size (in numbers)
READRT	1 if the individual can read and write in any language
AGE	Age of the respondent (in years)
NEVERMRD	1 if the respondent has never been married; 0 otherwise
MARRIED	1 if the respondent is married; 0 otherwise
MTTSOTHER	1 if the respondent is divorced, separated, widowed or cohabiting; 0 otherwise
NOSCHOOL	1 if the respondent has never been at school; 0 otherwise
PRIMARY	1 if the respondent has completed primary or less education; 0 otherwise
SECONDARY	1 if the respondent has not completed or completed lower secondary education; 0 otherwise
HIGHER	1 if the respondent has completed only primary or less education; 0 otherwise
UNEMPLOYED	1 if the respondent is unemployed; 0 otherwise
EMPLOYED	1 if the respondent is employed; 0 otherwise
EMPLOYED_Agri	1 if the respondent is employed in the agricultural sector, 0 otherwise
EMPLOYED_NA	1 if the respondent is employed in the non-agricultural sector; 0 otherwise
EMPLOYED_NANW	1 if the employment status of the respondent is non-wage employment in non-agricultural sector; 0 otherwise
EMPLOYED_NAW	1 if the employment status of the respondent is wage employment in non-agricultural sector; 0 otherwise
EMPLOYED_NAWPu	1 if the employment status of the respondent is wage employment in non-agricultural public sector; 0 otherwise
EMPLOYED_NAWPr	1 if the employment status of the respondent is wage employment in non-agricultural private sector; 0 otherwise
RURAL	1 if rural resident; 0 otherwise
Ri	1 if resident in region i; 0 otherwise; i = 1, 2,…7, 12,13,14,15

Table 2 below reports descriptive statistics of individuals' characteristics. Women account for about 34.6% of the sample of individuals used in the econometric exercises. Having an account at a formal financial institution and mobile phone ownership are considered pre-conditions to using digital payment services but also to saving formally. On average, about 43.3% of respondents have an account with a formal financial institution. While 45.6% of men have an account, only 39.1% of women have the same, leading to a statistically significant gender gap in account ownership. Around 40% of respondents do not know how to open a bank account, suggesting a substantial barrier to wider financial inclusion. Fanta and Mutsonziwa (2016) identify remote bank branches, a lack of finances, and financial illiteracy as the main barriers to women's financial inclusion in southern African development community countries.

Another important barrier to having a formal account and to the use of financial services is distance from formal financial institutions (Demirguc-Kunt and Klapper, 2012). The distance from where individuals live to a formal financial institution is still high in Ethiopia – that is, 13.1 km on average. This is in part due to the fact that financial institutions are concentrated in some major urban areas and the low level of mobile banking, despite recent initiatives to increase financial inclusion. Average mobile phone ownership among the entire sample of individuals stood at 59.5%, which is low compared to, for instance, 83.9% in Kenya as of 2018 (Johnen and Mubhoff, 2022). There is a statistically significant gender gap in mobile phone ownership, with female being 0.078 percentage points less likely to own a mobile phone than their male counterparts.

Formal saving practice in Ethiopia, irrespective of gender, is higher than previously documented (e.g., Hailesellasie et al., 2013). On average, about 75.5% of respondents saved formally in the 12 months prior to the survey. As expected, men are more likely to save- both formally and informally- than women, although there is no significant gender gap in terms of average income. In this study, average income is proxied by the respondent's perceived current price of his or her mobile phone.[8,9] This implies that women are more likely to be excluded from access to formal savings due to corresponding exclusion from access to their formal accounts. This is

[8] For respondents who do not own a mobile phone exclusively or jointly with others, the mean is calculated by treating income as missing values. Although it is a onetime purchase, buying a phone, especially smartphone may not be an easy task for low-income individuals. Some individuals may have to make a long-term plan to buy one.

[9] Quite a number of studies have used phone survey data to predict socioeconomic levels of individuals and regions (e.g. Blumenstock and Eagle, 2010; Blumenstock *et al*., 2015; Khan *et al*., 2015).

in line with the experience in other parts of Africa. Aterido et al. (2013) document that women in southern and eastern African countries are more likely to use informal financial services than men and are less likely to be excluded from informal financial services. Were et al. (2021) note that women in Tanzania are less likely to save compared with men, with a higher percentage opting to keep cash at home or save with informal saving groups. According to Mossie (2022), women in Ethiopia are less likely to save for a farm or business.

Table 2: Descriptive statistics of respondents

Respondent characteristics	Sample size	Total sample meanδ	Male meanδ	Female meanδ	Differenceδ	P-valueβ
ACCOUNTFFI	5576	0.433	0.456	0.391	-0.065	0.0026
ONLINEMB	2871	0.182	0.197	0.147	-0.050	0.0812
PAYBILL	4004	0.112	0.112	0.112	-0.0007	0.9624
SAVEFORM	2802	0.755	0.762	0.741	-0.021	0.4526
SAVEINFORM	2802	0.340	0.359	0.296	-0.063	0.0533
BANKACCOUNT	5576	0.604	0.626	0.562	-0.064	0.0772
DISTANCEFFI	5576	13.082	13.990	11.360	-2.63	0.0021
FEMALE	5576	0.346	-	-	-	-
MOBILE Access	5576	0.595	0.634	0.556	-0.078	0.0000
INCOME	5576	1056.10	1074.63	1013.71	-60.925	0.3410
HEADHH	5576	0.502	0.649	0.224	-0.425	0.0000
AGE	5576	30.292	31.510	27.990	-3.52	0.0000
NEVERMRD	5576	0.340	0.358	0.306	-0.052	0.0150
MARRIED	5576	0.597	0.623	0.548	-0.075	0.0001
MTTSOTHER	5576	0.063	0.019	0.146	0.128	0.0000
NOSCHOOL	5576	0.005	0.005	0.006	0.000	0.9895
PRIMARY	5576	0.625	0.636	0.603	-0.034	0.0917
SECONDARY	5576	0.177	0.173	0.185	0.012	0.4896
HIGHER	5576	0.193	0.185	0.207	0.022	0.1504
UNEMPLOYED	5576	0.125	0.071	0.227	0.156	0.0000
EMPLOYED	5576	0.875	0.929	0.773	-0.156	0.0000
EMPLOYED_Agri	5576	0.560	0.637	0.415	-0.222	0.0000
EMPLOYED_NA	5576	0.424	0.418	0.436	0.018	0.4777
EMPLOYED_NANW	5576	0.216	0.197	0.252	0.055	0.0014
EMPLOYED_NAW	5576	0.209	0.222	0.184	-0.038	0.0586
EMPLOYED_NAWPu	5576	0.094	0.096	0.092	-0.004	0.7443
EMPLOYED_NAWPr	5576	0.114	0.126	0.092	-0.034	0.0166

Source: Own computation based on 2018/19 ESS

δ all means are computed by applying survey weight using Stata's svy function.

β statistical difference is computed with the adjusted Wald test.

As expected, there is a statistically significant gender gap in digital payment usage; women are less likely to use online and/or mobile banking than men. This can partly be explained by the statistically significant gender gap in formal account and mobile phone ownership. The average age of respondents was 30 years. On average, women are three and a half years younger than men. Married individuals account for the lion's share of the total sample of individuals considered here. Interestingly, there seems to be no substantial gender gap when it comes to educational attainment, with the exception of primary level education, in which case women are relatively less likely to have completed primary or lower schooling. As expected, there is a statistically significant gender gap in terms of employment status, with women being 15.6 percentage points more likely than men to be unemployed.

4.2 Econometric analysis results

In this section, the paper attempts to address the two empirical research questions: (i) whether digital payment service usage and socio-economic factors influence the probability of formal saving; (ii) whether gender differences in employment status, income, education, marital status, and location, among others, contribute to gender disparities in digital payment service use. A pair-wise correlation matrix is generated to examine whether the analysis is subject to multicollinearity, a common identification problem with cross-sectional data. Results in Table AI show that the degree of correlation amongst the explanatory variables is very weak since all the coefficients are very far from the threshold (0.85) of strong correlation. This implies that the multicollinearity among the explanatory variables is less likely to be an issue in the specified models. The Archer and Lemeshow test is employed to test the goodness of fit of the models, which accounts for the survey weight (Archer & Lemeshow, 2006). A low p-value in this test corresponds to a poor fit of the model. In addition, a link test, which uses the predicted value and its square as the predictor to rebuild the model, is performed to detect whether all relevant explanatory variables are included in the specified model. The predictor variable should be statistically significant but not its square for the functional model to be adequate, or relevant variables should be included (Dudek & Lisicka, 2013).

Table 3 below reports estimates from the logit regression for the probability of formal savings. Marginal effects and their standard errors are reported. Two variables of interest included in equation (1) are: using online and/or mobile banking conditional on having an account with formal financial institutions; and using a mobile phone to pay bills conditional on having a mobile phone. Gender, head of household, income

(in logs), distance from formal financial institutions, informal saving, age and its square, marital status, education, employment status, regional distributions, and rural-urban status are included as explanatory variables. Motivated by existing empirical evidence, an interaction term between gender and head of household is also included to explore whether female-headed households behave differently when it comes to formal saving. Columns (1) and (2) in Table 3 are the same except that the dummy for employment status (EMPLOYED) is disaggregated in the latter case. As expected, income (in logs) is statistically significant and influences the probability of formal saving positively. The coefficient on informal saving is statistically significant and considerably associated with formal saving, implying that formal and informal saving may complement each other in Ethiopia. This is in line with some evidence from Ghana, Tanzania, and Zambia.[10] . There is a claim that savings group membership such as susu increases savings. Saving in a financial account (personal account), on the other hand, leads to better money management and eases transfers through banks or mobile banking.

Interestingly, individuals who use online and/or mobile banking are more likely to save formally, as revealed by a positive and statistically significant coefficient on ONLINEMB. To be precise, a one-unit increase in online and/or mobile banking usage increases the probability of saving formally by about 8.7 percentage points, holding all other variables included in the model constant. The coefficient on PAYBILL is positive but statistically significant only at the 10% level. These results are consistent with previous studies showing that the use of mobile banking increases the likelihood of formal saving more than mobile money does (Loaba, 2022). Marital status is important in explaining individuals' decisions to save formally. In particular, divorced, separated, widowed, or cohabiting individuals are less likely to save formally compared to never-married individuals. Education is weak in explaining the probability of saving formally. Individuals with high school-level education are more likely to save formally than those with primary-level education, but the difference is significant only at the 10% significance level.[11] Ouma et al. (2017) found a positive and statistically significant effect of education on individuals' decisions to save and the amount saved in Kenya.

[10] This refers to a qualitative impact evaluation studies (see in Uytterhaegen *et al*., 2022) into the impact of a series of financial innovations designed to link informal savings mechanisms to formal financial services under the Savings at the Frontier Programme.

[11] In this study education is defined as no school, primary, secondary, and higher, which means it was with four categories.

Table 3: Logistic regression results for saving at formal financial institutions

VARIABLES	Marginal Effects	
	(1)	(2)
ONLINEMB	0.0870**	0.0849**
	(0.0432)	(0.0397)
PAYBILL	0.0738	0.0768*
	(0.0458)	(0.0455)
lnINCOME	0.0402***	0.0378***
	(0.0123)	(0.0120)
SAVEINFORM	0.383***	0.379***
	(0.0439)	(0.0437)
MTTSOTHER	-0.0821*	-0.0870**
	(0.0442)	(0.0425)
SECONDARY	0.0608*	0.0543
	(0.0354)	(0.0345)
EMPLOYED	0.0981***	
	(0.0268)	
EMPLOYED_NANW		0.108***
		(0.0343)
EMPLOYED_ Agri		0.00494
		(0.0483)
EMPLOYED_ NAWPu		0.121***
		(0.0332)
EMPLOYED_NAWPr		0.0995***
		(0.0272)
Regional controls	YES	YES
Rural status control	YES	YES
Observations	2,802	2,802
hat (p-value)	0.000	0.000
hat2 (p-value)	0.681	0.763
Archer-Lemeshow test	0.992	0.647

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

NEVERMRD, PRIMARY, UNEMPLOYED and R1 are the left-out categories for the dummies of marital status, education, employment status and region respectively. Estimations are calculated using STATA 11.

Control variables included in the regression but not reported here for the sake of clarity and space are FEMALE, FEMHEAD, HEADHH, DISTANCEFFI, AGE, AGE2, MARRIED, NOSCHOOL, HIGHER. Note that these variables are not statistically significant.

As far as the role of individuals' employment status is concerned, the results in Table 3 can be summarized as follows: Employed individuals are more likely to save formally compared to unemployed ones, as revealed by a positive and statistically

significant coefficient on "EMPLOYED". Accordingly, a transition from unemployment status to employment may increase the probability of saving formally by about 9.8 percentage points on average. However, a transition from unemployment to employment in the agricultural sector may not improve the probability of saving significantly as revealed by a coefficient on "EMPLOYED_Agri" (Table 3, column (2)). In contrast, a transition from unemployment to wage employment in the non-agricultural public sector increases the probability of saving formally by about 12.1 percentage points. These results are in line with those found by Aterido et al. (2013) and Loaba (2022). Results associated with the Archer and Lemeshow tests indicate no poor fit in the model. The specified model is also adequate, as revealed by link-test results.

Table 4 below reports estimation results from a logit regression for the probability of using online and/or mobile banking (columns (1) and (2)) and of using a mobile phone to pay bills (columns (3) and (4)) conditional on having an account at a formal financial institution and a mobile phone, respectively. Columns (1) and (3) include only a dummy variable for gender. Women are less likely to use online and/or mobile banking than their male counterparts. It seems that there is a trivial gender gap when it comes to the probability of using a mobile phone to pay bills. Columns (2) and (4) include measures of income, head of household, age, marital status, education, employment status, and region, in addition to the gender dummy variable. A measure of whether the individual uses a mobile phone jointly with household members is also included in column (4).

As expected, age influences the probability of using online and/or mobile banking nonlinearly but is statistically significant only at the 10% level. Thus, online and/or mobile banking usage increases with age, but above a certain threshold, its increment may reduce usage. This is consistent with the findings in Wuddasie (2022). The coefficient on marital status (married) is large and significant, implying that married individuals are less likely to use online and/or mobile banking compared to those who have never been married. The age issue might be at play here too: married individuals are, on average, older than those who have never been married [34 years vs. 24 years]. As expected, income, education, and employment status are important determinants of the probability of using online and/or mobile banking. These results are in line with the findings in the literature (e.g., Were, 2021; Mossie, 2022). In particular, individuals with higher education have a 17.4 percentage point higher probability of using online and/or mobile banking than those with only primary education and a lower level of education.

Table 4: Logistic regression for using online and/or mobile banking and of using mobile phone to pay bills

Variables	Marginal Effects			
	(1)	(2)	(3)	(4)
MOBILEJO				0.0656***
				(0.0199)
FEMALE	-0.0522*	-0.0423*	-0.000715	-0.0055
	(0.0307)	(0.0224)	(0.0151)	(0.0194)
lnINCOME		0.0485***		0.0368***
		(0.00870)		(0.0107)
AGE		0.0214*		0.00534
		(0.0119)		(0.00634)
AGE2		-0.000315*		-8.18e-05
		(0.000162)		(8.6e-05)
MARRIED		-0.0641**		-0.0266
		(0.0303)		(0.0220)
MTTSOTHER		-0.0749		-0.1055***
		(0.0489)		(0.0342)
NOSCHOOL		0.150		0.2336***
		(0.153)		(0.0881)
HIGHER		0.174***		0.0599***
		(0.0411)		(0.0188)
EMPLOYED_Agri		0.00633		-0.0429**
		(0.0445)		(0.0216)
EMPLOYED_NAWPu		0.105***		0.0180
		(0.0405)		(0.0227)
EMPLOYED_NAWPr		0.00466		-0.0469**
		(0.0428)		(0.0194)
Regional controls	NO	YES	NO	YES
Observations	2,871	2,871	4,004	4,004
hat (p-value)		0.000		0.033
hat2(p-value)		0.149		0.463
Archer-Lemeshow test		0.116		0.683

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

NEVERMRD, PRIMARY, UNEMPLOYED and R1 are the left-out categories for the dummies of marital status, education, employment status and region respectively. Estimations are calculated using STATA 11. Control variables included in the regression but not reported here for the sake of clarity and space are HEADHH, SECONDARY, EMPLOYED_NANW. Note that these variables are not statistically significant.

The status of employed individuals can be categorized into agricultural and non-agricultural employment. Non-agricultural employment can be wage-based or non-

wage. The former can be either in the public or private sector. Interestingly, the coefficient on non-agricultural wage employment in the public sector is large and statistically significant (Table 4, column (2)). Wage-employed individuals in the non-agricultural public sector have a 10.5 percentage point higher probability of using online and/or mobile banking than those who are unemployed. As expected, smaller and relatively less developed regions of Ethiopia, with the exceptions of Somali and Harari, have a lower probability of using online and/or mobile banking than the Tigray region.[12] Both supply-side access enablers and demand-side usage drivers might be at play here. For example, lack of understanding of the benefits of using digital financial services, which can be tied to low literacy (including digital literacy), seems to be an issue in Afar (Alemu et al., 2021). Surprisingly, using online and/or mobile banking seems to be more prevalent in the Tigray region than in Addis Ababa, although the coefficient on the latter is significant only at the 10% significance level. The inclusion of control variables has a notable effect on the gender coefficient (Table 4, column (2)). The coefficient on the gender dummy declined (in absolute terms) from 0.52 to 0.42. Archer and Lemeshow test results indicate no poor fit in the model. The specified model is also adequate, as revealed by link-test results.

Gender is less important in explaining the probability of using a mobile phone to pay bills (Table 4, columns (3) and (4). Contrary to one's expectations, those individuals who use mobile phones jointly with other household members are more likely to use them to pay bills. This can possibly be explained by the fact that digital payment development in Ethiopia is still in its infancy; people use their phones mainly to pay for airtime or to recharge. Mobile money is a relatively new concept in Ethiopia, and it is used mostly to buy airtime (NBE, 2021, p. 36).

Income, marital status, and education are important determinants of the probability of using a mobile phone to pay bills. Income influences the probability of using a phone to pay bills positively. The probability of using a phone to pay bills is lower among divorced, separated, widowed, or co-habiting individuals as compared to those who have never been married. Individuals with no schooling and those with higher education are more likely to use their phones to pay bills than those with only primary schooling or a lower level of education. However, it is possible that those with no schooling and those with higher education use their phones to make different

[12] Results on the region dummies are not reported here for the sake of clarity and space.

bill payments. In particular, the latter are more likely to make relatively advanced pill payments – that is, beyond airtime payments, for example, school fee payments and traffic penalties. Individuals who are employed not only in the agricultural sector but also in the non-agricultural private sector are less likely to use their phones to pay bills than unemployed individuals. The former is in line with one's expectation: there is limited or no incident of using mobile phones in rural Ethiopia to pay bills apart from the airtime payment. Unemployment entails underemployment, and family members engaged, for instance, in part-time jobs and homemaking are more likely to take on the responsibility of paying bills than those who are wage-earning in the private sector.

As far as the decomposition of gender gaps in digital payment service usage is concerned, an attempt is made to address the concern that the decomposition estimates could be sensitive to the ordering of variables because of the nonlinearity of the prediction equations. Concerns over path dependence due to the ordering of variables in the nonlinear decomposition technique[13] can be addressed by randomly ordering the variables and increasing the number of replications of the procedure (Fairlie, 2017). In this study, 1000 replications are considered.[14] As regards the choice across alternative methods of calculating the first term of the decomposition (see Section 3.2), coefficient estimates from a pooled sample of the two groups, as suggested in Oaxaca and Ransom (1994), are used. In this case both groups (men and women) contribute to the estimation of the parameters instead of only one group. Sample weights are also incorporated in the decomposition by randomly drawing each subsample in proportion to the original sample weights.

Table 5 below reports decomposition results for the gender gaps in online and/or mobile banking usage (column (1)) and in using a mobile phone to pay bills (column (2)). The gender gap in online and/or mobile banking usage is non-trivial (0.0499 or 4.99 percentage points). Gender differences in head of household, age, marital status, and rural status are less important in explaining the gap. Gender differences in employment status, income, regional distributions, and education are significant factors in the decomposition model. This is consistent with the findings in Aterido et al. (2013).

[13] The non-linear decomposition technique uses logit coefficients directly in the decomposition and gender differences in distributions of characteristics.
[14] Fairlie (2017) suggests increasing the number of replications when randomizing the order of variables. 1000 should be considered a minimum number for most applications.

Table 5: Decomposition results for gender gaps in online and/or mobile banking usage and in using mobile phone to pay bills

VARIABLES	Decomposition coefficient	
	(1)	(2)
EMPLOYED	0.00935**	0.00107
	(0.00422)	(0.00405)
lnINCOME	0.00378**	0.00251*
	(0.00165)	(0.00135)
HEADHH	0.0135	0.00267
	(0.00907)	(0.00806)
AGEd	0.00146	
	(0.00595)	
MARTSTAT	-0.000181	0.00467**
	(0.00627)	(0.00228)
EDUCATION	-0.0180***	-0.00894***
	(0.00333)	(0.00264)
RURAL	-0.00371	-0.00721
	(0.00677)	(0.00469)
REGION	0.00942**	0.00264
	(0.00384)	(0.00257)
MOBILEJO		0.00239*
		(0.00127)
Difference	.049951	.000714
Total explained	.015358	-.000212
Observations	2,871	4,004

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

AGEd: AGE AGE2; MARTSTAT: NEVERMRD, MARRIED, MTTSOTHER; EDUCATION: NOSCHOOL, PRIMARY, SECONDARY, HIGHER; RURAL: rural-urban status; region: R1, R2, R3, R4, R5, R6, R7, R12, R13, R14, R15. Estimations are calculated using STATA 11.

However, only the first three explain the gender gap. In particular, the logit regression results in Table 4 show that wage employment in the non-agricultural public sector increases the probability of using online and/or mobile banking by 10.5 percentage points compared to unemployment. The share of wage employment in the non-agricultural public sector is similar for women and men (27.2% vs. 26.5%), while the share of unemployment stands at 21.3% and 9.8%, respectively. This implies that had women had similar employment status distributions as men – that is, if the unemployment rate for women was comparable to that of men – the observed

gap in online and/or mobile banking use might have declined by 18.7% (Table 5, column (1)).

The decomposition estimate indicates that gender differences in income (in logs) and regional distributions account, respectively, for 7.57% and 18.86% of the online and/or mobile banking usage rate gap. Gender differences in education distribution have the opposite effect in explaining the gap. Logit regression results in Table 4 above show that individuals with higher education are more likely to use online and/or mobile banking as compared to those with only primary or lower education. While women had lower primary and secondary education levels on average than men, they had relatively better access to higher education. Only 29.8% and 18.7% of women had primary or lower and secondary levels of education, while these shares stood at 32% and 20.7% for their male counterparts, respectively. Interestingly, 51.3% of women included in the sample had a higher level of education, while only 46.9% of men had the same. Had women had a similar educational distribution (especially higher education) as men, the observed gap in online and/or mobile banking use would have widened by 36% (0.018/0.04995). Overall, results in Table 5 suggest that the fact that women have a lower income, are more likely to live in smaller and relatively less developed regions of Ethiopia, and are less likely to be employed explains why they are less likely to use online and/or mobile banking services than men.

4.3 Robustness checks

In this section, an attempt is made to validate the baseline results by running a number of robustness checks. First, regressions in Table 3 column (1) and Table 4 column (2) are re-run excluding the household head dummy, given its relatively higher correlation with the age dummy (39.67%). Second, household-level nominal total consumption in adult equivalent (in logs) is used as an alternative proxy for individuals' income in both cases. This is particularly important given that income variables largely account for the excluded individuals. In the baseline case, income is proxied only for individuals who own a mobile phone. Third, instead of the education dummy, an alternative variable that captures individuals' extent of literacy – that is, whether the individual can read and write in any language is used in both cases. Fourth, an interaction term between being women and marital status is included in both cases. Existing evidence shows that married women are the most likely to be excluded from access to formal financial services due to a variety of reasons, such as having limited resources of their own amidst numerous family

demands such as childcare as well as other intra-household relations (Were et al., 2021). In addition, the regression in Table 3 column (1) is re-run by including household size as a determinant of the probability of saving. Estimation results reported in Table 6 show no difference in terms of coefficient sign and a trivial difference in the statistical significance of some coefficients.

Table 6: Logistic regression for saving at formal financial institution

VARIABLES	Marginal Effects			
	(1)	(2)	(3)	(4)
ONLINEMB	0.0898**	0.0961**	0.0898**	0.0874**
	(0.0445)	(0.0453)	(0.0421)	(0.0434)
PAYBILL	0.0737	0.0817*	0.0693	0.0717
	(0.0462)	(0.0450)	(0.0469)	(0.0461)
lnINCOME	0.0399***		0.0414***	0.0401***
	(0.0124)		(0.0117)	(0.0123)
SAVEINFORM	0.385***	0.382***	0.383***	0.382***
	(0.0444)	(0.0431)	(0.0441)	(0.0439)
MARRIED	-0.0448	-0.0596	-0.0644*	-0.0836**
	(0.0304)	(0.0370)	(0.0363)	(0.0388)
MTTSOTHER	-0.0657	-0.0828*	-0.0875*	-0.0737
	(0.0418)	(0.0430)	(0.0472)	(0.0454)
SECONDARY	0.0575*	0.0653*		0.0610*
	(0.0347)	(0.0344)		(0.0353)
EMPLOYED	0.1000***	0.0984***	0.0982***	0.0988***
	(0.0267)	(0.0281)	(0.0269)	(0.0265)
lnCONS		0.0277		
		(0.0205)		
READRT			0.0447	
			(0.117)	
HH_SIZE				0.00199
				(0.00511)
FEMMARRIED				0.0600
				(0.0455)
Regional controls	YES	YES	YES	YES
Rural status controls	YES	YES	YES	YES
Observations	2,802	2,802	2,802	2,802
hat(p-value)	0.000	0.000	0.000	0.000
hat2(p-value)	0.665	0.735	0.994	0.529
Archer-Lemeshow test	0.843	0.721	0.608	0.942

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

As far as the re-estimation of regression in Table 4 column (2) is concerned, the Archer and Lemeshow test results show poor fit of the model under all scenarios, with the exception of scenario 3 – that is, when whether an individual can read and

write in any language is used instead of education dummy. Thus, it makes little sense to discuss here observed differences when the other three scenarios are considered. Replacing the education dummy yielded no material difference in terms of coefficients sign or their significance level. In fact, non-linear Blinder-Oaxaca decomposition results reported in Table 5 can serve as a robustness check to validate the baseline results in Table 4 column (2).

Table 7: Logistic regression for using online and/or mobile banking

VARIABLES	Marginal Effects			
	(1)	(2)	(3)	(4)
FEMALE	-0.0455**	-0.0661***	-0.0265	-0.0301
	(0.0229)	(0.0230)	(0.0225)	(0.0344)
lnINCOME	0.0493***		0.0632***	0.0632***
	(0.00861)		(0.00949)	(0.00942)
AGE	0.0205*	0.0217*	0.0241**	0.0241**
	(0.0122)	(0.0114)	(0.0120)	(0.0119)
AGE2	-0.000304*	-0.000316**	-0.000355**	-0.000355**
	(0.000167)	(0.000157)	(0.000167)	(0.000166)
MARRIED	-0.0490*	-0.0477*	-0.0758**	-0.0783**
	(0.0275)	(0.0257)	(0.0316)	(0.0357)
MTTSOTHER	-0.0521	-0.0589	-0.113*	-0.112*
	(0.0461)	(0.0477)	(0.0583)	(0.0592)
SECONDARY	0.0921*	0.0936**		
	(0.0500)	(0.0448)		
HIGHER	0.183***	0.192***		
	(0.0392)	(0.0389)		
EMPLOYED_NAWPu	0.110***	0.113***	0.171***	0.171***
	(0.0410)	(0.0388)	(0.0400)	(0.0398)
lnCONS		0.0879***		
		(0.0170)		
READRT			0.00488	0.00510
			(0.0782)	(0.0780)
FEMMARRIED				0.00743
				(0.0528)
Regional controls	YES	YES	YES	YES
Observations	2,802	2,802	2,802	2,802
hat (p-value)	0.000	0.000	0.000	0.000
hat2 (p-value)	0.118	0.017	0.223	0.222
Archer-Lemeshow test	0.028	0.456	0.108	0.023

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5. Concluding Remarks

Digital finance has emerged as one of the most promising tools for closing the gender gap in financial inclusion in recent years, particularly in SSA. It can help to ameliorate obstacles to accessing conventional financial services such as cost, distance barriers, and information asymmetry. In this paper, an attempt is made to investigate the gender gap in financial inclusion and the role that digital payment service usage can play in narrowing this gap, using Ethiopia as an empirical case study. Ethiopia is one of the poorest performing countries in SSA when it comes to advancing financial inclusion. Recently, the nation has made a huge stride to improve access to digital payment services. Many efforts have been made to build supply-side access enablers against the backdrop of very weak demand-side usage drivers for the majority of the less privileged population. A focus on payment services is justifiable as it is the first step and the optimal gateway to gaining access to other financial services. However, usage of payment services is not guaranteed because of access and must be an explicit, proactively driven goal. It is also important from a policy perspective to identify whether gendered socio-economic disadvantages that created a gap in the use of traditional financial services still matter in the use of digital payment services.

Consistent with existing evidence, women are less likely to have an account at formal financial institutions, to save formally, and to use mobile and/or internet banking than men. There is a significant gender gap in account ownership and mobile and/or internet banking usage. Formal saving practice in Ethiopia, irrespective of gender, is higher than previously documented (Hailesellasie et al., 2013). Digital payment service usage promotes the likelihood of formal savings at the individual level. Thus, beyond providing alternative means of access to those already financially included, digital financial services may broaden financial inclusion, including via traditional means. As expected, the probability of formal savings is positively associated with income, marital status, and employment status. This paper provides additional evidence as to why the gender gap in the use of digital payment services might persist in Ethiopia. The fact that women, on average, have a lower income, are more likely to live in smaller and relatively less developed Ethiopian regional states, and are less likely to be employed explains why they are less likely to use digital payment services compared to men. This suggests that the limited absorptive capacity of the formal urban sector and consequently the pervasive unemployment rate in Ethiopia may pose challenges for the DFS to take hold.

These findings support the assertion that financial exclusion is a reflection of socio-economic exclusion (Sarma and Pais, 2011; Mader, 2018). This paper suggests that integrating gender considerations into policies and initiatives to encourage digital payment services use in Ethiopia– notably with respect to access to economic assets, infrastructure and opportunities, income, and employment – is likely to translate into narrowing the gender gap in both digital and traditional financial inclusion, further empowering women. An attempt by policymakers, the government, and donors to address very specific symptoms, rather than deeper causes, of financial exclusion may exacerbate the challenge.

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Appendix:

AI: Pairwise correlation

	INCOME	HEADHH	FEMALE	AGE	MARRIED	MTTSOT~R	NOSCHOOL
INCOME	1.0000						
HEADHH	0.0189	1.0000					
FEMALE	-0.0363	-0.3844	1.0000				
AGE	0.0244	0.3967	-0.1662	1.0000			
MARRIED	-0.0424	0.3012	-0.1363	0.3721	1.0000		
MTTSOTHER	-0.0262	0.1235	0.2463	0.1375	-0.3676	1.0000	
NOSCHOOL	-0.0210	0.0102	-0.0034	0.0185	0.0166	0.0054	1.0000
SECONDARY	-0.0458	-0.1172	-0.0019	-0.1798	-0.1033	-0.0189	-0.0247
HIGHER	0.2606	0.0103	0.0330	0.0712	-0.0303	-0.0571	-0.0379
EMPLOYED	0.0159	0.1626	-0.1694	0.1290	0.0817	0.0103	0.0069
MOBILEJO	-0.0506	0.0775	-0.0314	0.0061	0.0912	-0.0236	-0.0119

	SECOND~Y	HIGHER	EMPLOYED	MOBILEJO
SECONDARY	1.0000			
HIGHER	-0.4146	1.0000		
EMPLOYED	-0.0831	0.0555	1.0000	
MOBILEJO	0.0223	-0.0765	-0.0082	1.0000

Source: Own elaboration, Stata output