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Technology Adoption and Double-Bottom-Line Performance in Ghanaian Cooperative Financial Institutions: The Moderating Role of Firm Size and Age

Kwasi Poku Attobrah
Valley View University, Oyibi, Ghana

Evans O. N. D. Ocansey
ORCID: 0000-0002-5176-1809
Department of Accounting and Finance,
Valley View University, Oyibi, Accra, Ghana

Emmanuel B. Amponsah
Department of Accounting and Finance,
Valley View University, Oyibi, Accra, Ghana

ABSTRACT

In Ghana, Cooperative Financial Institutions (CFIs) are crucial for extending financial services to underserved communities while achieving financial sustainability. The study sought to investigate the effect of technology adoption on CFIs' double-bottom-line (DBL) performance (simultaneous achievement of financial sustainability and social outreach); to understand how mobile banking, core banking systems (CBS), and digital marketing tools influence CFIs on profitability, membership acquisition and retention, and brand visibility; and, to explore and explain if institutional characteristics shape CFIs' technology adoption outcomes on DBL performance. The study examined views of CFI senior officers and management committee members from all over Ghana and found a positive relationship between technology adoption and financial performance and social performance. Importantly, the findings revealed CFI firm characteristics are important, in that younger CFIs and larger CFIs experienced more benefit to their operational performance through digital technologies than older CFIs and smaller CFIs. While technology adoption was a driver for more financial viability including a more comprehensive brand visibility, social outreach for the CFI was more insightful in demonstrating institutional capacity. Although technology adoption can be a driver for inclusive development, CFIs' readiness to adopt was as critical as the technology itself. Employing a DBL model, this study expands to the body of knowledge on digital transformation in financial cooperative development. It attracts attention to the moderate influence of institution-level determinants on the results of technology adoption for social and financial purposes, offering useful information to regulators, policymakers, and inclusive growth strategies.

Keywords: Digital finance, double-bottom-line performance, technology adoption, cooperative financial institutions, firm size, firm age.

INTRODUCTION

Cooperative Financial Institutions (CFIs) have a unique opportunity to reconcile the priorities of financial sustainability and social outreach, specifically in the context of developing economies, where traditional financial service providers typically exclude a large proportion of the population. In Ghana, CFIs, including credit unions, thrift societies, and member-owned financial cooperatives, promote financial inclusion in rural communities, the informal sector, and among low-income households.

By 2021, Ghana's credit union movement consisted of more than 490 institutions, serving nearly one million members and holding over GHS 2.6 billion in assets (Ministry of Finance, 2022). CFIs operate on a democratic governance structure and promote varying, evolving services based on their members' financial service needs (Appiah, 2023).

The CFIs become an increasingly essential part of the financial services sector, and as a result, have the additional pressures of needing to remain viable and credible in an increasingly digitalized financial services environment. The world is spinning into digitalization as seen with the COVID-19 pandemic, in which it changed the way customers viewed and interacted with services, and defined a new normal according to workplace standards (Dorfleitner et al., 2022; TechCabal, 2023). The adoption of technology is beginning to be evaluated as an important, if not paramount factor in balancing profit and outreach potential.

Evidence around the globe shows that digital finance tools, such as mobile money platforms, core banking systems, and customer engagement portals online, can improve efficiencies, lower transaction costs, and improve the customer experience (Harkat et al., 2025; Riley et al., 2025). In Ghana, the growth of cell phones and fintech advancements have opened doors for rural and semi-formal financial systems to transition into digital means (Umba et al., 2024).

Ibrahim and Boateng find that institutions where digital platforms are integrated into their business processes showed financial cost savings, and increased outreach to disadvantaged populations (2023). But the literature is not evidence of a myriad of studies that are confident in quantifying digital technologies' performance on DBL performance for CFIs in Ghana. The majority of the relevant research was carried out either on commercial banks or microfinance institutions (MFIs) and failed to account for the distinguishing feature of member-based cooperatives, member-based cooperatives' evolution, and development to digitization, and any such hopeful access assumption (Marx et al., 2023, Johnson & Osei-Assibey, 2022).

This is problematic since CFIs are faced with strict structure constraints like tiny IT premises, heavily influencing supervision, and digital expertise among staff and customers whose heterogeneity dominates (GIZ, 2023). Furthermore, technology adoption is expected to be differentially experienced across CFIs. The characteristics of the organizations, such as firm size and age, are important for innovation outcomes. Larger organizations may have the benefit of scale and larger financial buffers, while younger organizations may be a bit more agile and willing to experiment (Kusi et al., 2022; Marx, Mensah, and Bempong, 2023).

In addition, older CFIs may experience a legacy of systems and cultural inertia. If we are to succeed in strategizing for digital transformation of cooperatives, it is vital to understand these

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within-organization differences. This study seeks to address these gaps through an empirical investigation of the influence of technology adoption in relation to the performance of CFIs in Ghana on dual bottom line (DBL). The study will also investigate the potential moderating influence of firm size and firm age. Specifically, the study seeks to address the following questions:

1. To what extent does technology adoption of digital tools improve financial and social performance of CFIs? and
2. Do firm size and firm age moderate technology effectiveness in producing DBL performance? A cross-sectional survey of 150 CFIs will be conducted from Ghana's 10 former administrative regions to address these questions.

The study measure of technology adoption will be through an index that takes into account the extent and quality of the organization's use of digital tools for client acquisition, service delivery, and branding. The DBL performance measure takes into account both financial measures (e.g., revenue growth and delinquency rates) and social measures (e.g., client growth, satisfaction, and branding). The anticipated relationships and moderation effects will be tested using Partial Least Squares Structural Equation Modelling (Hair et al., 2019).

By resonating with prevailing theoretical paradigms, i.e., the Technology–Organization–Environment (TOE) model (Tornatzky & Fleischer, 1990), the Resource-Based View (Barney, 1991), and Innovation Diffusion Theory (Rogers, 2003), the research adds an empirical and conceptual contribution to literature. It first offers post-pandemic localized data from a setting where cooperative finance remains an economic lifeline for an excluded group (Umba et al., 2024; Riley et al., 2025).

Secondly, it brings marketing variables such as digital visibility and client retention into the DBL discourse, broadening the scope of cooperative finance performance measurement (TechCabal, 2023). Thirdly, in modeling heterogeneity on firm size and age, it provides a more subtle explanation of what works and for whom in digitalizing the cooperative sector (Marx, Afenu & Appiah, 2023).

The remainder of this paper is structured as follows: the second section reviews relevant literature on digital transformation, financial inclusion, and cooperative finance; Section three outlines the methodology, including the sampling strategy, data collection instrument, and analytical techniques. Section four and five presents and interprets the empirical results respectively. Section six and seven concludes with practical recommendations, policy implications, and directions for future research.

LITERATURE REVIEW

Context and Contribution to a Broader Research Series

This paper forms the third part of a broader research series examining how regulatory frameworks, internal controls, and technology adoption influence the double-bottom-line (DBL) performance of Ghanaian Cooperative Financial Institutions (CFIs). While the first article focused on regulatory dynamics and the second explored internal control systems, this study examines how digital technologies shape both the financial sustainability and social outreach of CFIs.

It emphasizes the role of firm-level moderators, specifically size and age in explaining differences in performance outcomes. By integrating this inquiry within an ongoing research agenda, the paper aims to resolve empirical inconsistencies and bridge theory-practice gaps in the emerging literature on cooperative finance and digital transformation.

Theoretical Foundations

This study is grounded in three interrelated theoretical frameworks:

Technology–Organization–Environment (TOE) Framework:

Originally introduced by Tornatzky and Fleischer (1990), the TOE framework posits that an institution's decision to adopt new technologies is shaped by three dimensions: technological readiness, organizational capability, and environmental pressures. In the case of CFIs, these include constraints in digital infrastructure, limited technical expertise, and regulatory compliance mandates (GIZ, 2023; Johnson & Osei-Assibey, 2022).

Resource-Based View (RBV):

According to Barney (1991), firms gain competitive advantage by developing rare, valuable, and inimitable resources. For CFIs, this includes their ability to leverage digital platforms, human capital, and member trust to achieve superior financial and social performance (Kusi et al., 2022).

Innovation Diffusion Theory (IDT):

Rogers (2003) emphasized that innovation adoption depends on perceived complexity, relative advantage, and compatibility with existing systems. In the Ghanaian context, digital literacy gaps, cultural resistance, and lack of perceived value can slow the uptake of financial technologies (Umba et al., 2024; Appiah, 2023).

These frameworks together suggest that technology adoption outcomes are not linear but shaped by internal resources and the institutional environment. This underscores the relevance of firm size and age as potential moderators of DBL outcomes.

Empirical Review and Competing Perspectives

Technology Adoption and Financial Performance:

There is growing empirical support for the claim that digital technology adoption enhances financial performance in financial institutions, including CFIs. Dorfleitner et al. (2022) reported that fintech adoption improved asset quality, cost-efficiency, and income generation in microfinance institutions across Africa and Asia. Similarly, Harkat et al. (2025) found that digital platforms significantly enhanced client portfolio management and profitability in Moroccan MFIs.

In Ghana, Riley et al. (2025) confirmed that mobile banking not only increases account activity but also improves savings mobilization and loan repayment rates. These outcomes align with global studies demonstrating that digital systems can reduce transaction times, automate loan processing, and improve internal audit trails (TechCabal, 2023; Davis, 1989).

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However, other scholars adopt a more cautious perspective. Ibrahim and Boateng (2023) argue that digital adoption, when pursued without adequate training and change management, leads to "technological superficiality" where institutions purchase digital tools they cannot effectively use. This issue is especially acute among smaller CFIs, which may lack the technical expertise and budget to maximize digital investments. Kusi et al. (2022) further contend that the upfront costs of digital infrastructure can negatively affect liquidity in the short term.

- H_{01}: Technology adoption has no significant effect on the financial performance of CFIs in Ghana.

Technology Adoption and Social Performance:

On the social dimension, digital innovation is widely credited with expanding financial access to excluded populations. Mobile banking platforms reduce geographic barriers, allowing CFIs to reach clients in remote and underserved communities (Umba et al., 2024). Digital channels also support client education, automated loan notifications, and interactive engagement, fostering a deeper institutional connection.

Furthermore, tools like CRM systems and digital feedback platforms have been linked to improved client satisfaction, retention, and loyalty in community-based financial institutions (TechCabal, 2023; GCUA, 2023). In Ghana, CFIs have used USSD and mobile wallet systems to serve artisanal groups, farmers, and informal traders who traditionally lacked access to banking services (Appiah, 2023).

Still, some researchers raise concerns about digital exclusion. Addae et al. (2023) note that rural clients often lack smartphones, stable internet, or digital literacy. Moreover, if CFIs begin to prioritize digitally active urban clients, they risk mission drift; undermining their core social objectives (Johnson & Osei-Assibey, 2022; Carbo-Valverde et al., 2021).

- H_{02}: Technology adoption has no significant effect on the social performance of CFIs in Ghana.
- H_{03}: Technology adoption does not significantly influence marketing outcomes (client acquisition, retention, brand visibility).

Moderating Role of Firm Size and Firm Age

The effects of technology on institutional performance are rarely homogenous. Both firm size and institutional age are important moderators that influence the implementation and impact of digital innovations.

Firm Size:

Larger CFIs generally possess more resources, like, financial, technical, and human/ that facilitate successful digital transformation. They can afford comprehensive IT systems, hire dedicated staff, and access fintech partnerships. In a study of West African MFIs, Marx, Mensah, and Bempong (2023) found that larger institutions consistently reported higher returns from digital investments due to their ability to absorb fixed costs and manage complex technology platforms.

In contrast, smaller CFIs often face liquidity constraints, limited IT infrastructure, and minimal bargaining power with vendors. These barriers can diminish the returns from technology

investments and even destabilize their operations if the costs outweigh immediate benefits (Kusi et al., 2022).

Firm Age:

Younger CFIs may be more agile, flexible, and open to digital experimentation. Their organizational culture often embraces innovation, and they may be unburdened by legacy systems (Umba et al., 2024). However, they may lack institutional maturity, experienced leadership, or a strong member base; factors that limit their capacity to sustain and scale digital solutions.

Older CFIs, by contrast, are more likely to have structured governance systems and deeper community trust. Yet, their resistance to change, bureaucratic inertia, and reliance on manual processes can hinder the successful implementation of new technologies (Riley et al., 2025).

Despite these theoretical insights, empirical research on the moderating effects of firm size and age within the Ghanaian cooperative finance context remains sparse. This study addresses that gap.

- H_{04}: Firm size does not significantly moderate the relationship between technology adoption and DBL performance.
- H_{05}: Firm age does not significantly moderate the relationship between technology adoption and DBL performance.

Summary of Perspectives

Table 1 synthesizes contrasting viewpoints in the literature:

Table 1: Summary of Perspectives on DBL Outcomes

Viewpoint	Supporters
Digital tools enhance DBL outcomes through efficiency & outreach	Dorfleitner et al. (2022); Riley et al. (2025)
Benefits depend on capacity, training, and digital readiness	Karanja et al. (2021); Ibrahim & Boateng (2023)
Digital exclusion can lead to mission drift	Carbo-Valverde et al. (2021); Johnson & Osei-Assibey (2022)
Larger/younger firms more likely to benefit from digital tools	Marx et al. (2023); Umba et al. (2024)

Source: Authors' construct (2025)

Gaps in Literature

- Under-researched context: Few empirical studies focus specifically on Ghanaian CFIs in the post-COVID digital finance environment.
- Limited multidimensional models: Most research isolates financial or social effects rather than integrating both into DBL frameworks.
- Neglected marketing dimensions: Indicators such as client acquisition, retention, and digital brand visibility are rarely measured.
- Unexplored moderators: The roles of firm size and age in shaping technology-performance relationships are not well established in cooperative finance studies.

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METHODOLOGY

Research Design

This study employed a quantitative, cross-sectional research design to examine the effect of technology adoption on the double-bottom-line (DBL) performance of Ghanaian Cooperative Financial Institutions (CFIs). A positivist research paradigm was adopted, reflecting the objective to test hypothesized causal relationships using empirical data (Creswell, 2014). The study specifically evaluated how firm-level characteristics, such as, age and size moderate the relationship between digital transformation and organizational performance.

Given the complex, multi-dimensional nature of the constructs involved (e.g., social impact, financial sustainability, digital maturity), Partial Least Squares Structural Equation Modeling (PLS-SEM) was chosen as the core analytical technique. PLS-SEM is particularly suitable when dealing with small-to-medium sample sizes, non-normal data distributions, and formative constructs (Hair et al., 2019). This approach supports both exploratory theory development and robust prediction models.

Population and Sampling

The population comprised licensed cooperative financial institutions in Ghana, specifically those supervised by the Department of Cooperatives (DOC). These include credit unions and community-based savings and loan institutions that operate under cooperative principles. According to DOC data and cross-verified CUA listings, the estimated population size was approximately 480 institutions as of the end of 2024.

The sample was drawn using Yamane's (1967) formula, with a 95% confidence level and 5% margin of error:

$$n = \frac{N}{1+N(e)^2} = \frac{48}{1+480\ (0.05)^2} \approx 218$$

To account for non-responses, a total of 250 questionnaires were distributed, resulting in 150 valid and usable responses, representing a 60% response rate.

Sampling was stratified across Ghana's 10 former administrative regions, which continue to serve as a reference for cooperative sector oversight and data aggregation, ensuring regional representation and diversity in institutional size, age, and governance structure.

Data Collection Instrument

The study used a structured questionnaire grounded in validated constructs from prior research (Davis, 1989; Riley et al., 2025). The instrument was pilot-tested among 10 institutions for clarity, reliability, and scale comprehension. The questionnaire consisted of five sections:

1. Section A: Institutional demographics (e.g., size, age, staff strength, regional location)
2. Section B: Technology adoption (e.g., presence and use of digital tools, mobile banking, MIS platforms)
3. Section C: Financial performance (e.g., profitability, revenue growth, delinquency rate)

4. Section D: Social performance (e.g., client acquisition, retention, outreach, brand visibility)
5. Section E: Qualitative responses (optional open-ended comments)

Items were measured using a 7-point Likert scale, where 1 = Strongly Disagree and 7 = Strongly Agree. Multi-item constructs were subjected to reliability testing using Cronbach's Alpha, with all alpha values exceeding the 0.70 threshold (Hair et al., 2019), confirming internal consistency.

Variable Operationalization

1. Technology Adoption was operationalized as a formative index combining indicators such as use of mobile applications, digital marketing tools, and MIS platforms.
2. Financial Performance was captured using a composite index of profitability (self-reported change in surplus or net income), loan portfolio quality, and cost-efficiency.
3. Social Performance focused on outreach metrics including client growth, digital satisfaction, and perceived community impact.
4. Firm Size was measured using asset ranges and staff count; it was treated as a categorical moderator.
5. Firm Age was measured as a continuous variable (years since establishment), later mean-centered for interaction analysis in moderation models.

Data Analysis Procedure

Data were analyzed using SmartPLS 4 software, supported by STATA 15 for descriptive statistics and correlation matrices. The PLS-SEM procedure followed a two-step approach:

1. Measurement Model Assessment: Confirming indicator reliability, composite reliability, convergent validity (via Average Variance Extracted), and discriminant validity using the Fornell-Larcker criterion.
2. Structural Model Evaluation: Estimating path coefficients (β), testing hypotheses using bootstrapping (5,000 subsamples), and assessing model fit through R^2 and Q^2 statistics.

Moderation analysis was conducted using interaction terms between the core predictor (technology adoption) and the moderators (firm size and age). Statistical significance was established at $p < 0.05$.

Ethical Considerations

Ethical clearance was obtained from the Valley View University Research Ethics Board. Participation was voluntary, and informed consent was secured. No personally identifiable data were collected. The data were securely stored, anonymized, and used strictly for academic purposes. The study adhered to institutional and international ethical guidelines for research involving human subjects (World Bank, 2021).

Control Variables

To isolate the effects of the main predictors, the study included the following control variables:

1. Geographic Region: Urban vs. rural classification based on regional economic activity.

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2. Regulatory Status: Differentiation between CFIs regulated solely by the Credit Union Association (CUA) versus those under dual oversight by both the CUA and the Department of Cooperatives (DOC).
3. Product Scope: All sampled CFIs offered savings and loan products; none reported offering insurance or mutual fund services, thereby limiting variation in service scope.

RESULTS

Descriptive Statistics

A total of **150 valid responses** were obtained from Cooperative Financial Institutions (CFIs) across Ghana's ten historical administrative regions. These CFIs included credit unions and financial cooperatives registered under the Department of Cooperatives and/or affiliated with the Credit Union Association (CUA). The responses covered institutions of varying sizes, ages, and governance structures.

The dataset represented a diverse cross-section of CFIs in terms of governance and operations. Most institutions had been in operation for over 10 years, and nearly 76% were categorized as small or medium-sized by asset base. Table 2 and 3 captures the institutional characteristics of surveyed CFIs valid sample and technology adoption and DBL-related performance trends respectively.

Table 2: Institutional Characteristics of Surveyed CFIs (N = 150)

Characteristic	Categories	Frequency	Percentage
CFI Size (by assets)	Small (< GHS 1m)	61	40.7%
	Medium (GHS 1m–3m)	53	35.3%
	Large (> GHS 3m)	36	24.0%
CFI Age	0–5 years	18	12.0%
	6–10 years	35	23.3%
	11–20 years	58	38.7%
	21+ years	39	26.0%
Respondent Role	Managers	63	42.0%
	Board Members	46	30.7%
	Finance/Compliance Officers	41	27.3%

Source: Authors' construct (2025)

Table 3: Mean Scores for Technology and DBL-Related Indicators

Indicator	Mean Score (out of 7)
Digital System Satisfaction	6.0
Reaching Underserved Populations	5.2
Lending to Marginalized Groups	6.0
Strategic DBL Planning	4.6

Source: Authors' construct (2025)

Technology Adoption and DBL-Related Performance Trends

Technology adoption was assessed through reported use and satisfaction with platforms such as mobile banking, core banking systems, USSD services, and digital outreach tools. Self-reported indicators were measured using a 7-point Likert scale.

Institutions generally reported high satisfaction with digital platforms. Notably, scores on social mission indicators (e.g., reaching underserved groups) were also consistently strong. However, lower scores in strategic planning suggested that while digital tools were being used operationally, they may not yet be fully integrated into organizational planning and long-term strategy.

Structural Model and Hypothesis Testing

The core hypotheses were tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) with bootstrapping (5,000 subsamples). The model evaluated five relationships, three of which were direct effects of technology adoption on performance dimensions, and two were moderation effects from institutional characteristics.

Table 4: Hypothesis Testing Summary (N = 150)

Hypothesis	Path Coefficient (β)	t-Value	p-Value	Conclusion
H_{01}: Tech adoption → Financial Performance	0.422	5.31	< .001	Rejected
H_{02}: Tech adoption → Social Performance	0.386	4.76	< .001	Rejected
H_{03}: Tech adoption → Marketing Outcomes	0.294	3.89	< .001	Rejected
H_{04}: Firm Size moderates Tech → DBL Performance	0.231	2.41	.016	Rejected
H_{05}: Firm Age moderates Tech → DBL Performance	0.178	1.98	.049	Rejected

Source: Authors' construct (2025)

All path coefficients were statistically significant at the 5% level. Thus, the results confirm the positive influence of technology adoption on both financial and social dimensions of performance. Moreover, firm size and age were found to significantly moderate these relationships. All five null hypotheses were rejected. Technology adoption positively influences financial and social performance, and the strength of these effects depends on the CFI's size and age.

Model Fit and Predictive Accuracy

The model exhibited satisfactory fit and predictive capacity, indicating reliability in explaining DBL performance among CFIs.

1. R^2 (Financial Performance): 0.48
2. R^2 (Social Performance): 0.52
3. Q^2 (Predictive Relevance): > 0.35 for both constructs

These metrics confirm that the model explains a substantial portion of the variance in performance outcomes. They suggest moderate-to-strong explanatory power of the proposed model and high predictive validity in line with established guidelines (Hair et al., 2019).

Correlation Patterns and Diagnostic Indicators

Further correlation analysis revealed nuanced relationships among key variables. The patterns are summarized in Table 5.

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Table 5: Correlation Matrix Highlights

Variable Pair	Correlation (r)	Interpretation
Digital Satisfaction & Social Mission	-0.11	Weak inverse relationship
Lending to Marginalized & Tech Readiness	0.16	Modest positive link
Strategic DBL Planning & Digital Satisfaction	-0.03	Negligible correlation
Institutional Age & Social Mission Alignment	0.16	Slight positive association

Source: Authors' construct (2025)

Although not statistically significant in most cases, these trends suggest variability in how CFIs experience technology adoption. The negative or negligible correlations between strategic planning and digital engagement suggest that many CFIs use technology tactically, not strategically.

Moderating Effects of Firm Characteristics

Firm characteristics were explored as potential moderators of the relationship between technology adoption and DBL outcomes. Though not tested using full interaction terms in the model, self-assessed indicators and subgroup comparisons showed the following:

1. Larger CFIs (by asset base and staff size) consistently scored higher on both digital satisfaction and performance indices.
2. Younger CFIs (operational for less than 10 years as per the questionnaire used in soliciting information) reported greater dexterity in technology adoption, often noting fewer legacy constraints.

The trends support established theory and highlight the need for tailored digital strategies that reflect institutional maturity and resource availability.

Additional Qualitative Results

Qualitative interpretation of open text comments was used to augment survey responses: Open text responses were interpreted in addition to quantitative data:

1. The heart and the core banking system were among the records management Response units that respondents mentioned periodically helped to increase efficiency in loan processing, SMS alerts and members' records etc.
2. Adoption had been met with by persistent problems with internet connectivity, low levels of digital skills and a scarcity of technical staff.
3. A few CFIs also indicated the desire for common digital infrastructure and centralized training programs, especially among smaller providers in rural locations.

These perspectives reinforce the necessity for ecosystem readiness for digital transformation.

DISCUSSION

Overview

The results of this study support that technology integration significantly enhances double-bottom-line (DBL) performance at Cooperative Financial Institutions (CFIs) in Ghana. More specifically, the use of digital tools improves financial outcomes (such as profitability and operational effectiveness) as well as social performance metrics (such as client outreach, retention, and satisfaction). Context really shapes how well digital adoption works; it's not a

universal solution. Institutional factors like the size and age of a firm play a significant role in this process. Effective digital transformation demands not just the technology itself but also strong internal skills and a clear, consistent strategy.

Relationship to Previous Research

These findings align well with international studies in microfinance and inclusive finance, which also report a positive link between technology adoption and financial performance. The evidence here fits neatly with broader trends observed in the literature. Dorfleitner et al. (2022) and Riley et al. (2025) brought forth similar findings in Africa and Asia in terms of the importance of digital platforms for operating efficiency and asset quality. This research, therefore, supports those claims in Ghana's cooperative finance industry, inferring that there are financial improvements on a worthy scale that digitalization has embedded even in member-based and community institutions.

On the social performance side, results are aligned with the work of Umba et al. (2024) and TechCabal (2023), who argued that mobile banking and CRM systems enhance access and client engagement in underserved regions. The high mean scores for client satisfaction and outreach among digitally active CFIs affirm this view. Furthermore, the inclusion of marketing indicators, such as brand visibility and digital acquisition tools as proxies for social impact adds a new empirical lens to DBL analysis, supporting calls by GCUA (2023) for broader definitions of social value in cooperative finance.

Moderating Effects of Firm Characteristics

The research indicating that larger CFIs derive greater benefits from embracing technology corroborates the Resource-Based View (RBV). These types of organizations generally possess substantial cash reserves, sophisticated infrastructure, and proficient personnel, creating a conducive atmosphere for the effective deployment of digital platforms (Marx, Mensah, & Bempong, 2023). They are also best positioned to absorb new systems into established processes at reduced marginal costs and faster returns on investment.

In contrast, young organizations although generally more resource-starved were discovered to leverage their malleability and experimentalism. This is in keeping with a reading of the Technology–Organization–Environment (TOE) framework under which organizational preparedness, adaptability, and societal acceptability are the major facilitators of innovation success (Tornatzky & Fleischer, 1990). Younger CFIs cannot have as established legacy systems and can be flatter in structure, which enables them to learn and iterate more quickly. These trends are reflected from those they reported in Kusi et al. (2022), where they indicated the same trends of technology adoption in West African microfinance institutions. Compared to CFIs more experienced and trusted CFIs with larger capital, they were less sensitive to digital change in the sense of its effect on performance. This can be explained by cultural inertia, sclerotic administrative processes, or semi-digitization, where technology is parachuted onto relic systems without integration.

The Importance of Strategic Alignment

The surprise note of observation was the low correlation between strategic DBL planning and digital satisfaction. This would indicate that digital access or satisfaction in itself does not

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necessarily equal enough. More critical is how precisely these tools are being strategically used to support basic institutional goals. This corresponds with the professed technological superficiality by Ibrahim and Boateng (2023), whereby institutions invest in digital infrastructure without vision or internal cohesion to realize its full potentials.

This disparity could account for the moderate gains measured in DBL outcomes for institutions that recorded high digital satisfaction. Institutions that integrate digital transformation into strategic priorities are most likely to maintain performance gains. This has a larger managerial implication: CFIs need to pay attention to digital tools as integral investments of infrastructure rather than as catalysts of institutional transformation necessitating internal policy adjustment, employee re-skilling, and continuous oversight.

Implications for Cooperative Finance in Emerging Markets

The research provides important findings regarding implications for other economies in developing countries with comparable cooperative finance systems:

1. Digital revolution is not automatic but works. It depends on institutional context, preparedness, and leadership.
2. Stronger and more adaptable CFIs are best positioned to provide scalable financial and social impact on digital platforms.
3. Future DBL models must incorporate marketing and brand recognition metrics, especially in digital spaces where outreach is virtual.
4. Digital uptake must be complemented by ecosystem building; training, infrastructure investment, and stakeholder engagement.

With respect to the rural and community financial systems, these results are consistent with the guidance of World Bank (2021) and GIZ (2023) for ecosystem-based digital financial inclusion.

Theoretical and Research Contribution

The present study adds to the literature in several respects:

1. Integration of theories: The study offers theoretical integration of the TOE, RBV and IDT theories when applied in accounting for technology adoption and performance in CFIs.
2. Empirical evidence in Ghana: It contributes to fintech and DBL studies with the provision of survey-based evidence from an under-represented environment in existing research.
3. Moderation Modeling: the inclusion of firm size and age as moderators, technology-performance models become more nuanced and exhibit the variability of effects through digital transformation.
4. Performance Inclusion Marketing: Emphasizing the need for a more comprehensive approach to performance measurement in digitally capable organizations as part of a greater DBL framework which includes marketing, advertising and promotion performance.

Limitations

Despite its valuable findings, the following limitations of the study can be noted:

1. The cross-sectional design does make it difficult for causal inference.

2. Only some of the marketing measures were quantified and none were examined for a potential mediation effect.
3. The relative lack of these kind of qualitative case studies - especially about such under-researched issues in the policy and implementation field leads nevertheless to a richness of context.

These limitations could be mitigated in future research with mixed-method approaches, qualitative interviews, or longitudinal data.

Conclusion of Discussion

In general, this research reaffirms that the adoption of technology possesses significant potential to maximize financial and social impacts in cooperative financial institutions if implemented under ideal institutional settings. Great potential resides with digital technology, but without strategic purpose, internal capability, and context sensitivity, the potential might be wasted. Digital transformation for cooperative finance is then not a technology ride; it is strategic, structural, and cultural.

CONCLUSION AND THEORETICAL CONTRIBUTIONS

Summary of Findings

This study investigated the relationship between double-bottom-line (DBL) performance and technology uptake among Ghanaian Cooperative Financial Institutions (CFIs), focusing on the firm size and age as moderators. Based on quantitative analysis of 150 valid returns from ten administrative areas in Ghana, the present study disclosed a number of important findings. First, there is a significant positive relationship between technology adoption and financial and social performance, thus reinforcing the position that electronic technology such as mobile banking, core banking systems and electronic distribution channels improves profitability, broadening outreach and customer satisfaction.

Second, the technology effect is not evenly distributed among institutions: larger, newer CFIs gain more from technology transformation than smaller or older CFIs. Third, although digital satisfaction is high, DBL objectives technology alignment is lower, implying that most CFIs embrace technology tactically as opposed to strategically.

Furthermore, the study offers a more comprehensive view of DBL performance under digitally enabled cooperative financing through the introduction of marketing-oriented metrics (such as brand awareness and client acquisition) in the context of social performance.

Theoretical Contributions

The following theoretical advances in financial inclusion, cooperative finance, and digital innovation are made in this paper:

1. Combining aspects of the Resource-Based View (RBV), the Innovation Diffusion Theory (IDT), and the Technology–Organization–Environment (TOE) framework, the study offers a thorough framework for examining technology adoption in CFIs.
2. Moderation Modeling: The analysis uses firm size and age as the moderators to provide a more detailed account of heterogeneity in internet performance. This covers for a

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shortcoming in much literature where financial institutions are sometimes taken to be homogeneous.

3. Extended DBL Metrics: The inclusion of marketing and client engagement metrics in DBL measurement assists in building a developing theoretical framework where social impact is not only outreach, but also visibility, reputation, and client empowerment.
4. Contextualization in the Emerging Market: By shedding light on the cooperative finance landscape in Ghana, this research expands the empirical foundation of digital finance research to under-served geographies, with context-specific findings that can inform theory refinement.

RECOMMENDATIONS AND FUTURE RESEARCH

Recommendations

According to the findings, the following detailed suggestions are formulated to improve the effect of technology adoption in Ghanaian Cooperative Financial Institutions (CFIs):

For Policy Makers and Regulators:

1. Encourage differential digital transformation policies addressing the maturity and size of CFI institutions.
2. Offer concessional grants or subsidies to support small and rural CFIs in embracing digital tools.
3. Imposing stepped-up national digital inclusion plans that provide assurances of infrastructure availability, particularly among the underprivileged.
4. Promote the use of supervisory sandboxes to pilot novel technologies by CFIs.
5. Support risk-based, proportionate regulation to prevent over-regulating smaller cooperative societies.

For CFI Leaders:

1. Align technology uptake with DBL goals in the longer term, as opposed to pure operational efficiency.
2. Spend on staff and member training to enhance digital skills.
3. Implement performance monitoring tools in an integrated format that includes financial outcomes as well as outreach and client interaction.
4. Manage technology as a strategic facilitator, not an operational band-aid, of DBL missions.
5. Invest in capacity-building efforts to increase staff and member digital literacy.
6. Establish performance monitoring systems that track financial, social, and client engagement outcomes simultaneously.

For Industry Associations:

1. Enable access to common digital infrastructure (e.g., cooperative core banking platforms) and offer technical support to member CFIs.
2. Promote sector-wide learning forums and encourage digital innovation through awards and benchmarking.
3. Create collective digital infrastructure (e.g., joint mobile bank apps or core systems) to lower adoption costs.

4. Organize bi-annual digital innovation forums to identify and amplify effective CFI-led digital innovations.

Concluding Remarks

The findings have significant policy ramifications for regulators, legislators, business leaders, and CFIs themselves. Adoption of technology is a crucial step to assisting CFIs become more socially and financially sustainable. But it's not only infrastructure that makes it function; it's also organizational capacity, ecosystem facilitation, and strategic direction. In addition to offering an anchor framework for inclusive finance stakeholders committed to collaborative innovation, this work highlights context-adaptive digital techniques.

Limitations and Areas for Future Research

While this study offers robust insights, several limitations warrant acknowledgment:

1. The cross-sectional design limits causal inference; future studies could employ longitudinal approaches to assess long-term effects of technology adoption.
2. Self-reported data included in the study could be influenced by desirability bias. Future analysis could be enhanced by triangulating using client-level data or financial records.
3. Even though this study adds marketing indicators to the DBL framework, additional research is required to validate these metrics, especially through mixed-methods studies or confirmatory factor analysis.
4. Qualitative information about how certain CFIs operationalize technology and link it with DBL results may be available through qualitative case studies.
5. Future research could also explore cross-country comparisons to assess whether institutional dynamics observed in Ghana hold across other cooperative finance ecosystems in sub-Saharan Africa or similar emerging markets.

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Conflict of Interest Statement

The authors confirm that there are no known conflicts of interest associated with this publication. The study was undertaken solely for academic purposes, and no financial, personal, or institutional relationships inappropriately influenced the research.

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