




The Impact of Alternative Financing on SMEs: The Mediating Role of Green Innovation and the Moderating Role of Managerial Capability

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Abstract

This study examines how alternative financing influences sustainable growth among small and medium-sized enterprises (SMEs), focusing on the mediating role of green innovation and the moderating role of managerial capability. Drawing on Pecking Order Theory, green entrepreneurship theory, and the managerial capability perspective, the study develops an integrated mediation and moderation framework explaining how FinTech-enabled financing translates into sustainable outcomes. Using survey data from 1007 SMEs in Ghana and Partial Least Squares Structural Equation Modelling (PLS-SEM), the findings show that access to alternative financing significantly enhances sustainable SME growth. Green innovation partially mediates this relationship, indicating that financing contributes to growth both directly and through innovation. Managerial capability is the strongest direct predictor of growth and modestly strengthens the financing-growth relationship. Overall, the findings highlight that the effectiveness of alternative financing depends on both innovation-driven resource use and managerial capability.

Keywords

Alternative Financing, Green Innovation, Managerial Capability, Sustainable SME Growth, FinTech, SME Development

1. Introduction

As financial exclusion intensifies and policymakers increase efforts to expand credit

access in developing economies, the adoption of alternative financing channels to balance economic inclusion with sustainable development continues to attract the attention of scholars and development practitioners (Stevenson et al., 2024; GSMA, 2024). A major contention is that alternative financing, defined as technology-enabled non-bank financing including crowdfunding, peer-to-peer lending, FinTech credit scoring, and mobile-money-linked loans, can improve SME growth and financial inclusion while reducing reliance on dysfunctional traditional banking systems (Cumming et al., 2023; Rau, 2023). However, the literature also suggests that alternative financing can be a double-edged sword, as it is associated with high interest rates (Asongu & Odhiambo, 2019) and may encourage over-indebtedness and short-term consumption rather than productive investment (Ozili, 2021). Under conditions of low financial literacy and weak institutional oversight, as is often the case in small and medium-sized enterprises (SMEs) in Sub-Saharan Africa (Atiase et al., 2023), business executives and policymakers are increasingly concerned about whether and when access to alternative financing translates into sustainable rather than extractive growth (Sulemana et al., 2025; Appiah-Kubi et al., 2024, 2025).

These concerns have spurred a growing body of research examining how and under what conditions access to alternative financing benefits SMEs. While most studies report positive effects (Khera et al., 2021; Stevenson et al., 2024), others highlight adverse outcomes (Ozili, 2021), suggesting that important contingencies shape the financing-growth relationship. Prior research identifies several such contingencies, including financial literacy (Khera et al., 2021), regulatory quality (Asongu & Odhiambo, 2019), entrepreneurial orientation (Boso et al., 2019), and institutional voids (Atiase et al., 2023). Consequently, recent studies have called for more contingency-based research in underexplored developing economy contexts (Stevenson et al., 2024; Cumming et al., 2023). However, a major limitation of existing studies is the implicit assumption that firms are homogeneous in their ability to convert financing access into productive investments and growth outcomes. In addition, prior contingency-based analyses typically examine these factors in isolation, offering fragmented insights into the boundary conditions of the financing-growth relationship. However, existing studies largely examine these contingencies in isolation and assume that SMEs are homogeneous in their ability to convert financing access into sustainable outcomes. This limits our understanding of the mechanisms through which alternative financing translates into growth and the firm-level conditions that shape this process. In particular, prior research has paid limited attention to how financing is channelled through innovation pathways and how managerial capability conditions these effects simultaneously.

To address these limitations, this study draws on Pecking Order Theory (Myers & Majluf, 1984), green entrepreneurship scholars (Dean & McMullen, 2007; Gast et al., 2017), and the managerial capability perspective (Teece, 2018; Khattak et al., 2024). These perspectives collectively suggest that while alternative financing provides critical capital to resource-constrained SMEs, its contribution to sustainable growth depends on both the pathways through which financial resources are de-

ployed and the firm's ability to utilise those resources effectively. Accordingly, this study examines both the mediating role of green innovation and the moderating role of managerial capability in the relationship between alternative financing and sustainable SME growth. Green innovation represents a key mechanism through which financial resources are channelled into environmentally responsible and efficiency-enhancing activities (Terán-Yépez et al., 2020; Achi, 2024). Managerial capability, in turn, reflects the extent to which managers possess the strategic, operational, and adaptive competencies required to recognise opportunities, allocate resources efficiently, and implement organisational change (Teece, 2018; Hlaing & Aung, 2025). This integrated perspective enables a more comprehensive explanation of how alternative financing influences sustainable SME growth and under what conditions these effects are strengthened or weakened.

Sustainable SME growth refers to a firm's capacity to achieve consistent economic performance while maintaining long-term viability and responsible resource utilisation (Terán-Yépez et al., 2020). In this study, sustainable SME growth is operationalised primarily in terms of sustained economic performance and long-term firm viability. While the concept encompasses environmental and social dimensions, the empirical measurement focuses on the economic sustainability of SMEs operating in resource-constrained environments. Accordingly, this study addresses the question: how does alternative financing influence sustainable SME growth through green innovation, and how is this relationship conditioned by managerial capability?

This study makes three key contributions. First, it advances the alternative financing literature by integrating mediation and moderation mechanisms into a unified framework, thereby explaining how financing translates into sustainable growth through green innovation. Second, it contributes to green entrepreneurship research by providing empirical evidence that alternative financing enables environmentally oriented investment among SMEs in a developing economy context. Third, it extends the managerial capability literature by demonstrating that managerial capability functions not only as a boundary condition but also as a critical driver of sustainable SME growth. Contextually, this study focuses on SMEs in Ghana, a setting characterised by high mobile-money penetration, limited access to formal bank credit, and a rapidly evolving FinTech ecosystem (GSMA, 2024; Ghana Statistical Service, 2024). This context provides a unique opportunity to examine how alternative financing operates in environments where traditional financial systems are constrained, but digital financial infrastructure is expanding. By doing so, the study contributes to broadening the empirical and theoretical understanding of alternative financing and sustainable development in under-researched Sub-Saharan African contexts.

2. Theoretical Framework and Hypotheses

2.1. Alternative Financing and Sustainable SME Growth

Access to external finance remains a critical constraint for SMEs in developing

economies. Information asymmetries, collateral shortages, and weak institutional frameworks exclude the majority of firms from formal bank credit, thereby forcing them into a narrow financing hierarchy dominated by retained earnings (Myers & Majluf, 1984; Quartey et al., 2017). Pecking Order Theory predicts that firms prefer internal financing first, followed by debt, and equity as a last resort (Myers & Majluf, 1984). This hierarchy is particularly rigid in developing economies, where banks impose stringent collateral requirements and reject a disproportionate share of SME loan applications (Beck et al., 2018; Djabang et al., 2025). As a result, many SMEs remain chronically undercapitalised, limiting their ability to invest in growth-enhancing activities.

Alternative financing is emerging as a critical disruptor of this hierarchy. It encompasses non-bank channels including crowdfunding, peer-to-peer lending, mobile money-linked credit, and FinTech-enabled credit scoring (Block et al., 2022; Rau, 2023). These mechanisms reduce information asymmetry and transaction costs, thereby expanding access to capital for firms that traditional banks routinely exclude (Cumming & Hornuf, 2018; Cumming et al., 2023). This transformation is consistent with broader FinTech innovation ecosystems that facilitate access to finance and support SME development (Alaassar et al., 2023). In Sub-Saharan Africa, the rapid expansion of mobile money infrastructure has accelerated this transformation. Ghana provides a compelling case, where only a minority of SMEs access formal bank loans, yet mobile money usage is widespread, and FinTech lending is rapidly expanding (GSMA, 2024; Ghana Statistical Service, 2024). This shift suggests that alternative financing has the potential to relax traditional financing constraints and enable SMEs to undertake investments that would otherwise be unattainable.

Despite these benefits, the literature presents mixed evidence on whether alternative financing translates into sustainable growth. Some studies report positive effects on firm productivity, revenue, and employment (Stevenson et al., 2024; Block et al., 2022), while others highlight adverse outcomes such as over-indebtedness, short repayment cycles, and capital misallocation toward consumption rather than productive investment (Asongu & Odhiambo, 2019; Ozili, 2021). Sustainable SME growth extends beyond short-term profitability to include long-term viability, innovation, and responsible resource utilisation (Terán-Yépez et al., 2020). In line with the conceptualisation adopted in this study, sustainable SME growth is operationalised primarily in terms of sustained economic performance and long-term firm viability in resource-constrained environments. The financing-growth relationship is therefore unlikely to be uniform across firms, as differences in how capital is deployed and managed may lead to divergent outcomes.

A key limitation of existing research is the assumption that all SMEs convert financing access into growth in similar ways. Prior studies predominantly focus on the direct effect of financing on firm performance, while overlooking the mechanisms through which financial resources are deployed and the firm-level conditions that influence their effectiveness (Khera et al., 2021; Beck et al., 2018). This

study addresses this limitation by proposing that alternative financing influences sustainable SME growth both directly and indirectly through green innovation, while managerial capability shapes the strength of this relationship. Access to alternative financing provides the financial resources necessary for investment, but the extent to which these resources translate into sustainable growth depends on how they are utilised within the firm. Accordingly, alternative financing is expected to have a direct positive effect on sustainable SME growth, reflecting its role in alleviating capital constraints and enabling firms to expand operations, improve productivity, and pursue long-term growth opportunities. At the same time, this direct relationship is embedded within a broader framework in which green innovation serves as a mediating mechanism and managerial capability operates as a moderating condition, highlighting that financing alone is insufficient without effective resource deployment and managerial competence.

Accordingly, this study hypothesises that:

H1: Access to alternative financing has a significant and positive effect on the sustainable growth of SMEs.

2.2. Green Entrepreneurship and Managerial Capability

Two complementary theoretical lenses inform this study: green entrepreneurship theory and the managerial capability perspective. Together, these frameworks explain both the mechanisms and boundary conditions through which alternative financing influences sustainable SME growth. Specifically, green entrepreneurship theory provides the basis for understanding the mediating role of green innovation, while the managerial capability perspective explains how firm-level competencies condition the effectiveness of resource deployment.

Green entrepreneurship theory posits that firms can pursue environmental innovation as a deliberate strategic pathway toward achieving both ecological and economic outcomes (Dean & McMullen, 2007; Gast et al., 2017). A central argument in this literature is that environmentally oriented investment is not merely a cost but a potential source of competitive advantage, particularly in markets where consumers and regulators increasingly reward sustainable practices (Hoogendoorn et al., 2019; Terán-Yépez et al., 2020). Increasing stakeholder and regulatory pressure for environmental responsibility further incentivises SMEs to adopt green innovation practices (Alessa et al., 2024). Green innovation, a core construct within this perspective, refers to the extent to which firms develop or adopt environmentally friendly products, processes, or business models that reduce environmental impact while creating economic value (Gast et al., 2017; Achi, 2024). Within the context of this study, green innovation represents a key mechanism through which financial resources obtained via alternative financing can be channelled into productive and sustainability-oriented investments. The theory, therefore, suggests that firms with access to capital are better positioned to invest in green innovation, provided they possess the motivation and strategic intent to allocate resources toward environmentally beneficial activities.

The managerial capability perspective complements this argument by emphasising the role of firm-level competencies in shaping resource utilisation. Managerial capability refers to the extent to which a firm's managers possess the knowledge, skills, and competencies required to acquire, combine, and deploy resources effectively toward organisational goals (Teece, 2018; Hlaing & Aung, 2025). This perspective contends that identical resource endowments can yield markedly different performance outcomes depending on the capabilities of the managers responsible for their deployment (Sirmon et al., 2011). In SME contexts in developing economies, where formal management training is often limited and institutional support structures are weak, managerial capability becomes particularly critical (Khattak et al., 2024). As such, managerial capability is expected to influence not only the efficiency with which financial resources are utilised but also the extent to which such resources are directed toward value-creating and growth-enhancing activities.

A key limitation of prior research is the insufficient consideration of this heterogeneity in managerial capability. Firms with weak managerial capability may access alternative financing yet fail to deploy it productively, allocating resources toward short-term operational needs rather than strategic investments. In contrast, firms with strong managerial capability are better positioned to leverage the same financial resources to achieve superior outcomes through effective planning, allocation, and execution. Accordingly, managerial capability is conceptualised in this study as a critical boundary condition that moderates the relationship between alternative financing and sustainable SME growth. By integrating green entrepreneurship theory and the managerial capability perspective, this study develops a more comprehensive framework in which alternative financing influences sustainable SME growth through green innovation (mediation), while managerial capability conditions the strength of this relationship (moderation). This integrated theoretical approach provides a clearer understanding of how financial resources are transformed into sustainable growth outcomes and why these effects vary across firms.

2.3. Alternative Financing and Green Innovation

Green innovation is inherently resource-intensive, requiring substantial upfront investment in new technologies, production processes, and organisational routines (Tariq et al., 2025; Achi, 2024). For many SMEs in developing economies, such investments are difficult to finance through traditional banking channels due to collateral constraints and information asymmetries. Alternative financing alters this dynamic by providing access to non-bank sources of capital. FinTech-enabled credit mechanisms, mobile money-linked loans, and digital crowdfunding platforms offer flexible and accessible funding options that SMEs can allocate toward innovation activities (Block et al., 2022; Cumming et al., 2023). Recent evidence suggests that green finance initiatives play a critical role in enabling SMEs to undertake environmentally sustainable investments (Andriyani et al., 2025). By

reducing financing constraints, these mechanisms enable firms to undertake investments that are otherwise unattainable through conventional financial systems. In addition, some digital lenders in emerging markets have begun incorporating environmental performance criteria into their credit assessment models, thereby creating further incentives for green-oriented investments (Rau, 2023; Stevenson et al., 2024).

Evidence from the green entrepreneurship literature indicates that access to financial resources is a critical enabler of environmental innovation in SMEs (Gast et al., 2017; Hoogendoorn et al., 2019). Firms with greater access to capital are better positioned to experiment with and adopt environmentally friendly products, processes, and business models. However, this relationship is not automatic. Access to capital must be accompanied by firm-level motivation and strategic intent to direct financial resources toward green activities (Dean & McMullen, 2007). In this regard, alternative financing provides not only the liquidity required for innovation but also the flexibility that allows SMEs to allocate resources toward longer-term and sustainability-oriented investments. In contexts such as Ghana, where regulatory pressure for environmentally responsible practices is increasing, and consumer awareness of sustainability issues is expanding, SMEs with access to alternative financing are increasingly positioned to respond to these pressures through green innovation (Ghana Statistical Service, 2024; Terán-Yépez et al., 2020). Thus, within the framework of this study, green innovation is conceptualised as a key mediating mechanism through which alternative financing is transformed into sustainable SME growth outcomes. Access to alternative financing expands the resource base available to firms, thereby enhancing their capacity to invest in environmentally beneficial innovations that contribute to long-term performance.

Accordingly, this study hypothesises that:

H2: Access to alternative financing has a significant and positive effect on green innovation in SMEs.

2.4. Green Innovation and Sustainable SME Growth

Green innovation contributes to sustainable SME growth through multiple inter-related pathways. It enhances operational efficiency by reducing material waste and energy consumption, thereby lowering production costs and improving resource utilisation (Tariq et al., 2025). It also enables firms to develop differentiated products and services that appeal to environmentally conscious consumers, thereby generating competitive advantage and facilitating market expansion (Achi, 2024; Qing et al., 2022). Prior research also demonstrates that innovation capabilities significantly enhance organisational performance outcomes (AlTaweel & Al-Hawary, 2021). Beyond direct financial benefits, green innovation supports firms in reducing regulatory risks, strengthening environmental legitimacy, and attracting socially responsible investors and strategic partners. Collectively, these benefits enhance the long-term viability and performance of SMEs, aligning with the eco-

conomic dimension of sustainable growth adopted in this study.

The relationship between green innovation and firm performance, however, is not uniformly positive. Some studies suggest that green innovation can impose short-term cost burdens, divert resources from core business activities, and increase operational complexity, particularly for resource-constrained SMEs (Yao et al., 2025). These potential trade-offs highlight that the benefits of green innovation may not be immediate and may depend on the firm's ability to effectively manage innovation processes and absorb associated costs. Nevertheless, the balance of empirical evidence, particularly in developing-country contexts, indicates that green innovation generates net-positive outcomes when firms are able to implement and manage such initiatives effectively (Terán-Yépez et al., 2020; Hoogendoorn et al., 2019). Within the framework of this study, green innovation represents a critical mechanism through which financial resources are translated into sustainable SME growth. By enabling firms to improve efficiency, differentiate their offerings, and strengthen their market position, green innovation serves as a key link between resource availability and long-term performance outcomes. Thus, firms that engage more intensively in green innovation are expected to achieve higher levels of sustainable growth compared to those that do not.

Accordingly, this study hypothesises that:

H3: Green innovation has a significant and positive effect on the sustainable growth of SMEs.

2.5. Green Innovation as a Mediator

The arguments developed in Hypotheses 2 and 3 jointly suggest that green innovation constitutes a critical pathway linking alternative financing to sustainable SME growth. This mediating relationship is grounded in a two-stage process. Access to alternative financing expands the financial resources available to SMEs, enabling them to invest in innovation activities that would otherwise be constrained. Green innovation, in turn, enhances operational efficiency, supports product and service differentiation, and strengthens market positioning, thereby contributing to sustained firm performance and long-term viability (Gast et al., 2017; Terán-Yépez et al., 2020). Thus, the effect of alternative financing on sustainable SME growth is expected to operate not only directly but also indirectly through its influence on green innovation.

This mediating logic is consistent with the green entrepreneurship perspective, which posits that environmental innovation is not merely a byproduct of firm growth but a strategic mechanism through which firms transform financial resources into sustainable competitive advantage (Dean & McMullen, 2007; Hoogendoorn et al., 2019). In this context, green innovation functions as a resource transformation mechanism that converts access to capital into value-creating activities that enhance firm performance. A key limitation of prior research on alternative financing is its predominant focus on direct financial outcomes, with limited attention to the processes through which financial resources are deployed to generate sus-

tainable growth (Beck et al., 2018; Stevenson et al., 2024). This study addresses this limitation by explicitly modelling green innovation as an intervening mechanism in the financing-growth relationship. By incorporating green innovation as a mediating construct, this study provides a more nuanced understanding of how alternative financing contributes to sustainable SME growth, highlighting the importance of innovation-driven resource utilisation.

Accordingly, this study hypothesises that:

H4: Green innovation mediates the relationship between alternative financing access and sustainable SME growth.

2.6. Managerial Capability and the Financing-Growth Relationship

The relationship between alternative financing and sustainable SME growth is unlikely to be uniform across firms. Managerial capability constitutes a critical boundary condition that shapes how effectively financial resources are utilised. Firms with strong managerial capabilities are better positioned to evaluate financing options strategically, negotiate favourable terms, and allocate capital toward high-return and growth-enhancing activities (Teece, 2018; Sirmon et al., 2011). Their managers possess the financial literacy, planning skills, and strategic foresight required to translate access to capital into competitive advantage and sustained performance (Hlaing & Aung, 2025; Khattak et al., 2024). In contrast, firms with weak managerial capability may secure alternative financing but deploy it inefficiently, allocating resources toward short-term operational needs rather than long-term strategic investments. This heterogeneity is particularly pronounced in SME contexts within developing economies. Evidence from Ghana and comparable Sub-Saharan African settings indicates that managerial skill deficits are widespread and represent a key constraint on firm performance, independent of capital availability (Ghana Statistical Service, 2024; Beck et al., 2018). In such contexts, access to financial resources alone is insufficient to guarantee improved performance outcomes, as the effectiveness of resource utilisation depends heavily on managerial competence.

Within the framework of this study, managerial capability is conceptualised as a moderating variable that conditions the strength of the relationship between alternative financing and sustainable SME growth. Firms with higher managerial capability are more likely to convert financial resources into productive investments, including innovation and efficiency-enhancing activities, thereby achieving superior growth outcomes. Conversely, firms with lower managerial capability are less able to leverage alternative financing effectively, resulting in weaker growth effects. Importantly, this moderating role complements the mediating role of green innovation by highlighting that the impact of financing depends not only on how resources are channelled (mediation) but also on the firm's ability to deploy those resources effectively (moderation). This integrated perspective reinforces the argument that both resource availability and managerial competence are necessary for achieving sustainable SME growth.

Accordingly, this study hypothesises that:

H5: Managerial capability positively moderates the relationship between alternative financing and sustainable SME growth, such that the relationship is stronger when managerial capability is high.

The conceptual relationships among the study variables are presented in **Figure 1**.

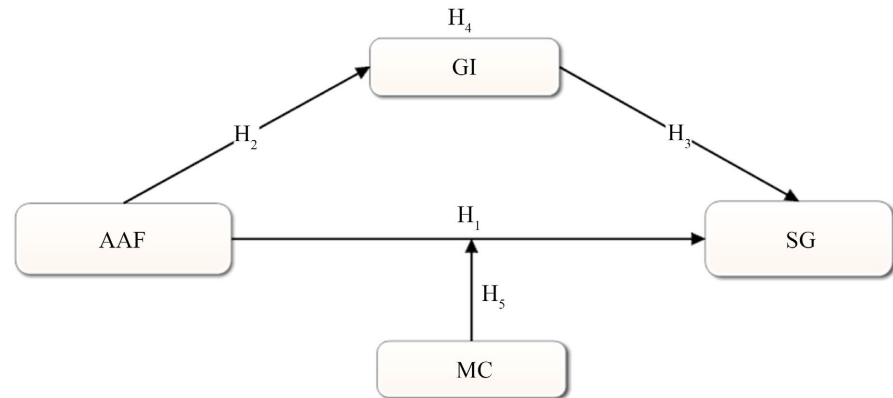


Figure 1. Conceptual model.

3. Methodology

This study adopts a cross-sectional quantitative design to examine the proposed mediation and moderation relationships (Bryman, 2016; Creswell & Creswell, 2017). Ghana provides the empirical context due to its combination of limited formal credit access and a rapidly expanding FinTech ecosystem (GSMA, 2024; Ghana Statistical Service, 2024). The sampling frame was drawn from the Ghana Integrated Business Establishment Survey (IBES) 2024, and a stratified random sampling approach was used to ensure representation across industry, firm size, region, and age.

A total of 2850 SMEs were contacted, with 1007 usable responses obtained (response rate = 35.3%). Missing data were confirmed as completely at random (Little's MCAR: $\chi^2 = 124.56, p = 0.315$), justifying listwise deletion (Hair et al., 2021). Data were collected via face-to-face (68%) and telephone interviews (32%), with no significant mode differences ($p > 0.05$). Respondents were key informants, including owners (13.1%), co-owners (71.9%), and managers (11.7%), selected based on their knowledge of firm financing, innovation, and performance. The representativeness of the sample relative to the population is confirmed in **Appendix A (Table A1)**.

All constructs were measured using validated scales adapted from prior studies. Specifically, green innovation items were adapted from Achi (2024), managerial capability from Teece (2018), and sustainable SME growth from Terán-Yépez et al. (2020), with minor wording modifications to reflect the Ghanaian SME context and ensure clarity for respondents. Alternative financing access, green innovation, managerial capability, and sustainable SME growth were adapted from established

literature and contextualised to the Ghanaian SME setting. Alternative financing was modelled as a formative construct, while other variables were reflective. Reliability and validity thresholds were met, and discriminant validity was confirmed using HTMT (< 0.90). Eight control variables were included: firm age, firm size, industry, region, prior performance, digital intensity, entrepreneurial orientation, and ownership structure. These were selected based on prior evidence of their influence on SME growth and innovation. The full list of measurement items, indicator loadings, and formative weights is reported in **Appendix A (Table A2)**.

PLS-SEM (SmartPLS 4.0) was employed due to its suitability for complex models with formative and reflective constructs and for prediction-oriented research designs (Akter et al., 2017; Hair et al., 2021). The analysis simultaneously tests direct (H1), mediation (H2 - H4), and moderation (H5) effects. Mediation was assessed using bootstrapping (5000 resamples). A statistical power analysis confirms that the sample size is adequate for detecting the proposed effects (see **Appendix A, Table A3**).

Common method bias was assessed using Harman's single-factor test (33.8%), full collinearity VIF (< 3.3), and a marker-variable approach, indicating no major concern (Podsakoff et al., 2003; Kock, 2015). Detailed results of common method bias tests are reported in **Appendix B**.

Endogeneity was addressed using a Gaussian copula and Heckman two-stage approaches. The distance to the nearest mobile money agent served as the instrument ($F = 127.3$). Additional robustness and endogeneity test results are provided in **Appendix C**. This instrument affects access to alternative financing through proximity to digital financial infrastructure but does not directly influence firm growth once controls are included. Results remained robust across both procedures (Park & Gupta, 2012; Becker et al., 2024).

4. Results and Discussion

4.1. Demographics

The final sample comprised 1007 SME respondents, including owners, co-owners, and managers, drawn from four major economic regions of Ghana. This broad coverage enhances the generalizability of the findings across diverse SME contexts. The detailed demographic profile of respondents is presented in **Appendix A (Table A4)**.

The sample shows a balanced gender distribution (55.1% male; 44.9% female) and a relatively experienced respondent base, with 77.6% aged 31 years and above. Educational attainment is diverse, reflecting the heterogeneous nature of SME leadership. Most respondents were co-owners (71.9%), followed by owners (13.1%) and managers (11.7%), indicating that data were obtained from individuals with direct knowledge of firm financing and strategic decisions.

The sample spans multiple sectors, including manufacturing, trade, services, agriculture, and information technology, and includes firms at different stages of

development. Overall, the diversity of the sample supports its suitability for analysing the relationships examined in this study.

4.2. Measurement Model

The measurement model was evaluated prior to assessing the structural relationships. All reflective constructs demonstrated satisfactory internal consistency reliability, with Cronbach's alpha values ranging from 0.86 to 0.88 and composite reliability values between 0.88 and 0.91. Average variance extracted (AVE) values exceeded the recommended threshold of 0.50, confirming convergent validity (Hair et al., 2021). These results, as shown in **Table 1**, indicate that the reflective constructs are both reliable and adequately capture their underlying latent variables. For the formative construct, alternative financing access, all indicator variance inflation factor (VIF) values were below 3.0, indicating the absence of multicollinearity among indicators. Convergent validity for the formative construct was further confirmed through redundancy analysis. This supports the appropriateness of modelling alternative financing as a formative construct capturing multiple financing channels.

Table 1. Internal consistency and convergent reliability statistics.

	CA	CR (Rho_C)	AVE
AAF	0.873	0.879	0.727
GI	0.926	0.932	0.819
MC	0.823	0.836	0.740
SG	0.898	0.900	0.767

Table 2. Discriminant validity—Heterotrait-Monotrait (HTMT) ratio.

	AAF	FAGE	FSIZE	GI	IND	MC	SG
AAF							
FAGE	0.029						
FSIZE	0.073	0.031					
GI	0.630	0.028	0.054				
IND	0.030	0.072	0.012	0.027			
MC	0.573	0.045	0.063	0.894	0.054		
SG	0.669	0.037	0.057	0.899	0.053	0.153	

Discriminant validity was assessed using the Heterotrait-Monotrait ratio (HTMT) as shown in **Table 2**. Two construct pairs, managerial capability and green innovation (HTMT = 0.894), and green innovation and sustainable growth (HTMT = 0.899), approached the threshold of 0.90 but remained within acceptable limits (Henseler et al., 2015). This suggests that while the constructs are conceptually related, they remain empirically distinct, supporting their inclusion in the proposed

mediation and moderation framework. Overall, the measurement model demonstrates adequate reliability and validity, justifying the use of the constructs for subsequent structural model analysis.

4.3. Structural Model and Hypothesis Tests

The structural model results are presented in **Table 3**, while the measurement indicators are illustrated in **Figure 2** based on 5000 bootstrap resamples with bias-corrected confidence intervals. The model explains 74.2% of the variance in green innovation and 90.2% in sustainable SME growth, indicating substantial explanatory power.

Table 3. Structural model results (N = 1007).

	Path	β	SE	t-value	p	95% BCa CI	f ²	Decision
H1	AAF → Sustainable Growth (direct)	0.237	0.021	11.156	<0.001	[0.195, 0.278]	0.112	Supported
H2	AAF → Green Innovation	0.861	0.010	86.907	<0.001	[0.841, 0.879]	2.861	Supported
H3	Green innovation → Sustainable Growth	0.117	0.016	7.228	<0.001	[0.086, 0.149]	0.027	Supported
H4	Indirect AAF → GI → SG (mediation)	0.101	0.014	7.156	<0.001	[0.074, 0.129]	-	Supported
H5	MC × AAF → Sustainable Growth (moderation)	0.056	0.006	8.789	<0.001	[0.044, 0.069]	0.019	Supported
	Controls: Industry → SG	0.021	0.009	2.304	0.021	[0.003, 0.038]	-	-
	Firm Size → SG	0.031	0.009	3.451	0.001	[0.014, 0.049]	-	-
	Firm Age → SG	0.003	0.009	0.357	0.721	[-0.014, 0.023]	-	-

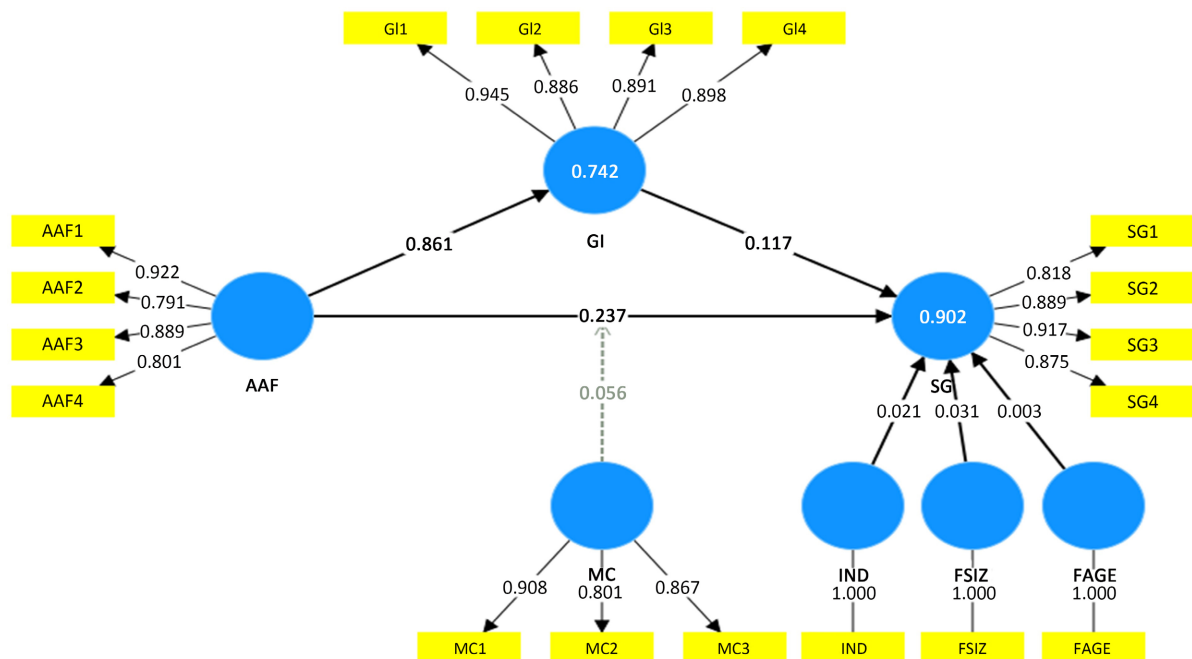


Figure 2. Indicators' reliability loadings.

The results from **Table 3** and **Figure 2** reveal that managerial capability exerts a strong and significant direct effect on sustainable SME growth ($\beta = 0.706, p < 0.001, f^2 = 0.987$). This represents the largest effect in the model, indicating that managerial capability is the strongest predictor of sustainable SME growth within the proposed framework (Cohen, 1988; Hair et al., 2021).

Access to alternative financing has a positive and significant direct effect on sustainable growth ($\beta = 0.237, p < 0.001, f^2 = 0.112$), supporting H1. This finding confirms that alternative financing alleviates capital constraints and contributes to firm performance, although its effect is smaller relative to managerial capability.

In line with H2, alternative financing has a strong and significant effect on green innovation ($\beta = 0.861, p < 0.001$). This substantial effect highlights the role of alternative financing in enabling SMEs to undertake innovation activities, particularly those requiring upfront investment. Green innovation, in turn, positively influences sustainable growth ($\beta = 0.117, p < 0.001$), supporting H3. Although modest in magnitude, this effect is consistent with the view that innovation contributes to long-term firm performance.

The mediation analysis provides support for H4. The indirect effect of alternative financing on sustainable growth via green innovation is positive and significant ($\beta = 0.101, p < 0.001, 95\%CI [0.074, 0.129]$). To further assess the integrated nature of the model, the conditional indirect effect of alternative financing on sustainable SME growth via green innovation at different levels of managerial capability was examined using bootstrapping procedures. The results indicate that the indirect effect remains positive and significant across low, mean, and high levels of managerial capability, suggesting that the mediating role of green innovation is robust, although its strength varies with managerial capability. The variance accounted for (VAF) is 29.9%, indicating partial mediation. This suggests that alternative financing influences sustainable SME growth both directly and indirectly through green innovation, confirming its role as an important but incomplete transmission mechanism.

The moderation results support H5. The interaction between alternative financing and managerial capability is positive and significant ($\beta = 0.056, p < 0.001$), although the effect size is small ($f^2 = 0.019$). This indicates that managerial capability strengthens the positive relationship between alternative financing and sustainable growth, but its moderating contribution is limited relative to its strong direct effect.

Simple slope analysis further illustrates this interaction. At high levels of managerial capability ($+1SD$), the effect of alternative financing on sustainable growth is stronger ($\beta = 0.293, p < 0.001$), compared to the mean ($\beta = 0.237$) and low levels ($-1SD: \beta = 0.181$). These results confirm that while alternative financing benefits all firms, those with higher managerial capability are better able to leverage financial resources for superior growth outcomes. Importantly, the financing-growth relationship remains positive and significant across all levels of managerial

capability, indicating that the benefits of alternative financing are broadly distributed rather than confined to highly capable firms.

Robustness checks using the Gaussian copula approach and the Heckman two-stage correction produced consistent results, confirming that the findings are not driven by endogeneity or selection bias (Park & Gupta, 2012; Becker et al., 2024). These results reinforce the reliability of the estimated relationships within the proposed mediation and moderation framework. These findings remain consistent across alternative estimation procedures reported in **Appendix C**.

5. Discussion

This study advances research on when and how alternative financing promotes sustainable SME growth in developing economies (Block et al., 2022; Stevenson et al., 2024). Drawing on Pecking Order Theory, green entrepreneurship theory, and the managerial capability perspective, the study develops a framework that explains how alternative financing influences sustainable SME growth through green innovation and how this relationship is conditioned by managerial capability. Data from 1007 SMEs in Ghana provide empirical support for the proposed relationships.

The findings show that access to alternative financing has a positive and significant direct effect on sustainable SME growth. This suggests that alternative financing alleviates capital constraints and enables firms to expand operations and improve performance, particularly in contexts characterised by limited access to formal bank credit. However, in the absence of such financing, SMEs remain constrained by the rigid financing hierarchies described by Pecking Order Theory.

The results further indicate that alternative financing is a strong driver of green innovation. SMEs with access to FinTech-enabled credit channels are more likely to invest in environmentally oriented processes and technologies. This finding highlights the role of alternative financing in enabling resource-intensive innovation activities that would otherwise be difficult to undertake. In contrast, limited access to financing restricts SMEs' ability to engage in green innovation.

Consistent with expectations, green innovation positively contributes to sustainable SME growth. Firms that adopt environmentally friendly products, processes, and business models achieve better long-term performance outcomes. This supports the view that innovation serves as a key mechanism through which financial resources are translated into sustainable growth. Moreover, the mediation results confirm that green innovation partially explains the relationship between alternative financing and sustainable growth, indicating that financing contributes to performance both directly and indirectly through innovation.

The moderation analysis reveals that managerial capability strengthens the relationship between alternative financing and sustainable growth. Firms with higher managerial capability are better able to deploy financial resources effectively, resulting in stronger growth outcomes. However, the moderating effect is relatively small compared to the substantial direct effect of managerial capability on sustain-

able growth. This suggests that managerial capability functions primarily as a key driver of firm performance, while also enhancing the effectiveness of alternative financing.

Importantly, the positive effect of alternative financing on growth remains significant across all levels of managerial capability, indicating that its benefits are broadly distributed, although amplified in firms with stronger capabilities. Overall, these findings reinforce the argument that the impact of alternative financing on SME performance is contingent on both how resources are utilised (mediation through green innovation) and the capabilities of those managing them (moderation through managerial capability).

5.1. Contributions and Research Implications

This study makes several important theoretical and empirical contributions. First, it extends Pecking Order Theory by demonstrating that FinTech-enabled alternative financing can reshape the traditionally rigid financing hierarchy observed in developing economies. Prior applications of Pecking Order Theory assume relatively fixed financing structures that limit SMEs' access to external capital (Myers & Majluf, 1984; Djabang et al., 2025). In contrast, this study shows that alternative financing relaxes these constraints and enables firms to achieve positive growth outcomes even under conditions of limited managerial capability. This finding suggests that FinTech mechanisms lower barriers to external financing, thereby broadening the applicability of Pecking Order Theory in digitally evolving financial environments (Rau, 2023; Cumming et al., 2023).

Second, the study contributes to the green entrepreneurship literature by providing empirical evidence that alternative financing promotes green innovation among resource-constrained SMEs. While prior research highlights the importance of capital availability for environmental investment (Dean & McMullen, 2007; Gast et al., 2017; Terán-Yépez et al., 2020), limited empirical work has examined this relationship in developing economy contexts. This study addresses this gap by demonstrating that alternative financing significantly drives green innovation and, through partial mediation, contributes to sustainable SME growth. This finding confirms that green innovation serves as a key mechanism through which financial resources are translated into performance outcomes, while also indicating that additional direct pathways exist (Block et al., 2022; Khera et al., 2021).

Third, the study advances the managerial capability literature by distinguishing between its direct and moderating roles. Prior research predominantly conceptualises managerial capability as a contingency factor that enhances the returns to resources (Teece, 2018; Sirmon et al., 2011). However, the findings reveal that managerial capability is not only a moderator but also the strongest direct predictor of sustainable SME growth. This suggests that managerial capability functions both as an independent driver of performance and as a factor that conditions the effectiveness of alternative financing. This dual role highlights the need for a more nuanced theoretical understanding of managerial capability in SME contexts, par-

ticularly in developing economies where capability constraints are prevalent (Khattak et al., 2024).

Finally, by focusing on Ghana, the study provides important contextual insights into the functioning of alternative financing and green innovation in Sub-Saharan Africa. Ghana represents a setting characterised by limited access to formal banking, widespread mobile money adoption, and an emerging FinTech ecosystem (GSMA, 2024; Ghana Statistical Service, 2024). The findings demonstrate that alternative financing can generate positive growth and innovation outcomes in such environments, while also highlighting that these benefits depend on how financial resources are utilised and the capabilities of firm managers. This contributes to a more nuanced understanding of the conditions under which FinTech supports sustainable development in developing economies.

5.2. Managerial and Policy Implications

Beyond its theoretical contributions, this study offers important practical implications for SME managers and policymakers in developing economies. The findings indicate that SMEs can enhance sustainable growth outcomes by actively engaging with alternative financing channels, even when managerial capability is relatively modest. This suggests that expanding access to alternative financing can generate broad-based benefits across firms with varying capability levels. However, the results also show that the effectiveness of financing is strengthened when firms strategically allocate resources toward innovation.

From a managerial perspective, SMEs should align access to alternative financing with deliberate green investment strategies. This involves directing financial resources toward environmentally beneficial activities such as adopting cleaner production technologies, improving resource efficiency, and developing green products that respond to evolving regulatory and market demands (Ghana Statistical Service, 2024; GSMA, 2024). In line with the mediation findings, green innovation serves as a key mechanism through which financing translates into sustainable growth, underscoring the importance of innovation-oriented resource allocation. At the same time, managers should recognise that the returns to alternative financing increase with higher managerial capability. Firms that invest in managerial development, particularly in areas such as financial planning, strategic decision-making, and innovation management, are better positioned to convert financial resources into sustained performance gains.

From a policy perspective, the findings highlight the importance of expanding inclusive access to alternative financing. Governments and stakeholders should ensure that FinTech-enabled credit is widely accessible rather than restricted to firms with pre-existing capabilities. The results show that financing generates positive growth outcomes across all capability levels, although these effects are amplified in more capable firms. In addition, policymakers should integrate managerial capability development into financing programmes. Embedding training initiatives within FinTech lending schemes can enhance SMEs' ability to utilise finan-

cial resources effectively, thereby improving both firm performance and loan repayment outcomes.

Furthermore, policy interventions should encourage the alignment of financial access with sustainability objectives. This may include incentives for FinTech lenders to support green-oriented investments and the development of training programmes focused on green technology adoption, financial management, and strategic planning. Such initiatives can strengthen the link between alternative financing, green innovation, and sustainable SME growth, contributing to broader economic and environmental development goals.

5.3. Limitations and Future Research

This study has several limitations that provide avenues for future research. First, the study conceptualises alternative financing, green innovation, and managerial capability as unidimensional constructs. However, prior literature suggests that these constructs are inherently multidimensional. Future research could enhance theoretical precision by disaggregating these constructs into their constituent dimensions, such as distinguishing between different forms of alternative financing (e.g., crowdfunding, mobile money credit, peer-to-peer lending), types of green innovation (e.g., product, process, and business model innovation), and components of managerial capability (e.g., financial literacy, strategic planning, and operational competence).

Second, while this study focuses on green innovation as a mediating mechanism, other pathways may also link alternative financing to sustainable SME growth. Future studies could extend the mediation framework by incorporating additional mechanisms, such as working capital efficiency and digital technology adoption, to provide a more comprehensive understanding of how financial resources are translated into firm performance. Furthermore, additional boundary conditions may influence these relationships. Researchers could examine the moderating roles of contextual and market-level factors, including regulatory quality, environmental, social and governance (ESG) policy frameworks, green consumer awareness, and competitive intensity.

Third, the study is subject to empirical and methodological limitations. The cross-sectional design limits causal inference, and the use of data from SMEs in a single country constrains the generalisability of the findings. Future research should employ longitudinal or quasi-experimental designs to strengthen causal interpretation and assess the dynamic effects of alternative financing over time. Additionally, the Ghanaian context, while appropriate for examining FinTech-driven financing in developing economies, may differ from more institutionally developed settings. Comparative studies across countries and regions would therefore be valuable in assessing the robustness of the findings.

Finally, the reliance on single-source survey data introduces the possibility of common method bias, despite the procedural and statistical controls applied. Future studies could mitigate this limitation by using multi-source data, including

archival records and administrative datasets, to improve measurement accuracy and reduce bias. Overall, extending this study across different contexts, methodologies, and conceptualisations would contribute to a deeper understanding of the mediated and moderated relationships between alternative financing, green innovation, managerial capability, and sustainable SME growth.

6. Conclusion

This study advances understanding of when and how alternative financing promotes sustainable SME growth in developing economies. Drawing on Pecking Order Theory, green entrepreneurship theory, and the managerial capability perspective, the study develops and tests a framework that explains how alternative financing influences sustainable SME growth through green innovation and how this relationship is conditioned by managerial capability. Evidence from 1007 SMEs in Ghana confirms that the financing-growth relationship is more complex than previously assumed.

The findings show that access to alternative financing has a positive and significant effect on sustainable SME growth, supporting the view that FinTech-enabled financing reduces information asymmetries and expands access to capital for previously excluded firms. However, the results also demonstrate that financing alone is insufficient, as its impact depends on how financial resources are utilised within the firm. In particular, SMEs that channel alternative financing into green innovation are more likely to achieve stronger growth outcomes. The study further demonstrates that green innovation partially mediates the relationship between alternative financing and sustainable growth. This confirms that innovation serves as a key mechanism through which financial resources are transformed into performance outcomes, while also indicating that additional direct pathways contribute to growth. These findings extend the green entrepreneurship literature by providing empirical evidence on the financing-innovation-growth linkage in a Sub-Saharan African context.

In addition, the results reveal that managerial capability is both the strongest direct predictor of sustainable SME growth and a significant moderating factor. This highlights the dual role of managerial capability as both a driver of firm performance and a condition that enhances the effectiveness of alternative financing. Importantly, the positive effect of alternative financing remains significant across all levels of managerial capability, suggesting that its benefits are broadly distributed, although amplified in more capable firms. Overall, this study contributes to theory by demonstrating that FinTech-enabled alternative financing can reshape traditional financing constraints, that green innovation acts as a key transmission mechanism, and that managerial capability conditions the effectiveness of resource utilisation. Together, these findings provide a more integrated understanding of how financial access, innovation, and managerial competence interact to shape sustainable SME growth.

From a practical perspective, SMEs should actively leverage alternative financ-

ing while prioritising investment in green innovation and managerial capability development. Policymakers should promote inclusive access to FinTech financing, integrate managerial training into lending programmes, and create incentives that support green-oriented investments. Future research should extend this work by employing longitudinal designs and multi-source data to further examine the dynamic and causal relationships among alternative financing, green innovation, managerial capability, and sustainable SME growth across different contexts.

Authors' Contributions

All authors have accepted responsibility for the entire content of this manuscript and consented to its submission to the journal, reviewed all the results and approved the final version of the manuscript.

Dominic Achari: Conceptualization, methodology, software, validation, formal analysis, investigation, resources, project administration, data curation, writing (original draft), writing (review & editing) and visualization.

Yusheng Kong: Supervision, resources, project administration and funding acquisition.

Seth Boahen: Software, validation, writing (review & editing) and proofreading.

Richard K. Kuffour: Writing (review & editing) and proofreading.

Martin Kwesi Appah: Writing (review & editing) and proofreading.

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Data Availability Statements

The raw data supporting the conclusions of this article will be made available by the authors on request.

Ethical Conduct/Institutional Review Board Statement

The study was an open research study and did not require any ethical approval. Because the research presented no more than minimal risk to participants and involved anonymous surveys, it was classified as exempt from requiring formal ethical review. Prior to participation, all participants were informed about the nature of the study and provided their consent. Participation was entirely voluntary, and respondents' anonymity was preserved throughout the research process.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Table A1. Sample representativeness vs. population (GSS-NBSSI registry).

Stratum	Population (%)	Sample (%)	χ^2
Greater Accra	42.1	41.8	0.78
Ashanti	28.4	29.1	
Western + Eastern	29.5	29.1	
Micro (1 - 5 emp.)	61.4	60.8	0.81
Small-Medium	38.6	39.2	

Table A2. Measurement items, and standardised loadings.

Construct & Indicator	Wording (English)	Std. Loading	Weight (AAF Only)	VIF
Alternative Financing Access (AAF)—Formative	Over the past 24 months, to what extent has your firm used the following sources? (0 = not used, 4 = heavily used)	-	-	-
AAF1	Crowdfunding platforms		0.312	1.87
AAF2	Peer-to-peer lending platforms		0.289	1.72
AAF3	FinTech/digital lenders (e.g., Fido, Bloom, Carbon)		0.378	2.04
AAF4	Mobile-money-linked loans (e.g., MTN Qwikloan)		0.456	2.31
AAF5	Angel investors		0.194	1.58
AAF6	Venture capital		0.167	1.44
Green Innovation (GI)—Reflective				
GI1	Our firm has introduced new or significantly improved products/services with a lower environmental impact	0.892		
GI2	We have adopted cleaner production processes that reduce waste/emissions	0.914		
GI3	We use renewable or recycled materials in our core operations	0.907		
GI4	We have implemented energy-saving technologies or practices	0.876		
GI5	We have reduced water consumption through new processes	0.901		
Managerial Capability (MC)—Reflective				
MC1	Top management is highly skilled at identifying new business opportunities	0.834		
MC2	Our managers effectively coordinate resources to pursue opportunities	0.879		
MC3	Top management has strong strategic planning capabilities	0.856		

Continued

MC4	Our managers successfully implement sustainability-related initiatives	0.841
MC5	Top management continuously learns and adapts to market changes	0.868
MC6	Our managers make high-quality decisions under uncertainty	0.852
SME Growth (SG)—Second-Order Reflective	Over the past 3 years...	
Revenue Growth (3 items, $\alpha = 0.91$)	e.g., Our sales revenue has grown significantly	0.88 - 0.93
Employment Growth (2 items)	e.g., The number of full-time employees has increased substantially	0.89 - 0.91
Market Expansion (2 items)	e.g., We have entered new geographic markets	0.87 - 0.90
Technological Upgrading (1 item)	We have invested heavily in new equipment/software	0.85

Table A3. Statistical power analysis (Monte-Carlo simulation).

Minimum R ² in Model	Power at N = 1007 ($\alpha = 0.05$)
0.10	>0.999
0.25	>0.999
0.50	>0.999

Table A4. Demographics of respondents (N = 1007).

Item	Category	Frequency (n)	Percentage (%)
Gender	Male	555	55.1
	Female	452	44.9
Age	Below 20 years	8	.8
	21 - 30 years	218	21.6
	31 - 40 years	395	39.3
	41 - 50 years	226	22.4
	51 years and above	160	15.9
Education	Junior high school	349	34.7
	Senior high school	231	22.9
	Bachelor	146	14.5
	Postgraduate	145	14.4
	Others	136	13.5
Position	Owner	132	13.1
	Co-owner	724	71.9
	Manager	118	11.7
	Other	33	3.3

Continued

Tenure	Less than 1 year	160	15.9
	1 - 5 years	644	64.0
	6 - 10 years	60	6.0
	11 - 15 years	127	12.5
	16 years and above	16	1.6
Sector	Manufacturing and production	354	35.2
	Services	166	16.4
	Trade (retail/wholesale)	220	21.9
	Information technology	127	12.6
	Agriculture	140	13.9
Years of Operation	1 - 5 years	619	61.5
	6 - 10 years	212	21.1
	11 years and above	176	17.4
Business Location	Suburban	648	64.3
	Rural	359	35.7

Appendix B: Common-Method Variance Tests

- 1) Harman's single-factor test: 33.8 % variance explained (well below 50% threshold).
- 2) Full collinearity VIFs (Kock, 2015): highest = 2.87 → no pathological collinearity.
- 3) Measured latent marker (social desirability, 4 items): all path adjustments < 0.02 and non-significant.

Appendix C: Endogeneity and Robustness Checks

- 1) Gaussian copula approach (Park & Gupta, 2012) for AAF → no significant copula terms ($p > 0.30$).
- 2) Heckman two-stage model:
 - a) First stage: Distance to nearest mobile-money agent (km) as excluded instrument (strongly significant, $F > 120$).
 - b) Lambda non-significant in second stage → selection not a major concern.
- 3) Alternative estimation: Consistent PLS (PLSc) and CB-SEM (AMOS) on reflective-only sub-model yield identical significance patterns.
- 4) Control function approach with prior revenue growth and digital intensity → core results unchanged.