Digital Public Infrastructure and SME Financing in Africa: Evidence from Documented Country Experiences

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ABSTRACT

Digital public infrastructure is presented as a foundation for inclusive finance, yet its contribution to small and medium-sized enterprise financing in Africa remains insufficiently integrated and comparatively examined. This study investigated how digital identity, interoperable payments, credit-information systems and secure data-sharing arrangements influenced SME identification, transaction visibility, credit assessment and loan access in Nigeria, Ghana, Kenya and Ethiopia. A structured multiple document-based case study of Nigeria, Ghana, Kenya and Ethiopia was conducted using 34 peer-reviewed and institutional sources published mainly between 2021 and 31 May 2026. Evidence was assessed through a transparent search protocol, structured coding, source-quality appraisal, four-level evidence classification and cross-case synthesis.The findings showed that digital identity reduced onboarding and verification barriers, while interoperable payments generated transaction records supporting cash-flow assessment. Credit-information systems reduced information asymmetry, although informal enterprises remained inadequately covered. Secure data sharing offered potential for faster underwriting, but implementation and SME-level evidence remained limited. Kenya recorded the strongest transaction-based digital-credit experience; Nigeria and Ghana demonstrated mature payment foundations; and Ethiopia showed emerging identity-payment integration. Financing benefits depended on interoperability, institutional capacity, lender participation, affordability, data quality, cybersecurity and consumer protection. The study concludes that digital public infrastructure can improve SME financing, but may widen exclusion where rural, women-owned, informal and cash-dependent enterprises cannot participate effectively. It advances conditional policy propositions rather than statistical generalisations.

Keywords: credit information systems; digital identity; digital public infrastructure; interoperable payments; SME financing; sub-Saharan Africa.

INTRODUCTION

Digital transformation has moved beyond the adoption of isolated technologies towards the development of shared digital systems on which governments, businesses and financial institutions can build services. Digital public infrastructure (DPI) refers to foundational, interoperable and reusable digital systems that serve public and private users at scale. Its principal components include digital identity, interoperable payment systems and trusted data exchange, supported by cybersecurity, privacy protection, institutional accountability and accessible connectivity (World Bank, 2023). Unlike stand-alone applications, DPI provides common digital capabilities that multiple organisations can use for identification, authentication, payments and secure information exchange.

Africa has recorded considerable growth in digital identity programmes, instant-payment platforms, mobile money and credit-information systems. Between 2014 and 2021, approximately 191 million additional people in sub-Saharan Africa made or received a digital payment. However, the region retained a substantial usage gap: although 61% of the population lived within broadband coverage, many remained offline (World Bank, 2024). Mobile money has expanded transaction access, while central banks have increasingly pursued payment interoperability and regulatory arrangements for digital financial services. The International Monetary Fund (Ricci et al., 2025) nevertheless found that fragmented systems, high transaction costs, limited infrastructure and regulatory differences continued to constrain the reach and efficiency of digital payments in sub-Saharan Africa.

DPI can strengthen these effects through four connected mechanisms. First, reliable digital identity can reduce the cost and uncertainty of identifying business owners and completing know-your-customer procedures. Second, interoperable payments can convert previously invisible cash transactions into digital records. Third, credit registries and bureaus can consolidate borrowing and repayment information. Fourth, secure and consent-based data sharing can allow lenders to combine payment, account and business data when assessing creditworthiness. Together, these systems can shift lending decisions from heavy dependence on fixed collateral towards cash-flow and transaction-based assessment. Yet expanded data use also introduces risks relating to privacy, cybersecurity, inaccurate identity records, opaque scoring models and discriminatory exclusion.

Nigeria, Ghana, Kenya and Ethiopia provide useful but contrasting experiences. Nigeria combines a large national identity programme with the Nigeria Inter-Bank Settlement System's instant-payment infrastructure, credit bureaus and an emerging open-banking framework. Ghana has linked national identification reforms with an interoperable payment environment connecting banks and mobile-money providers. Kenya's extensive mobile-money market has generated large volumes of transaction data and digital-credit activity, although concerns about over-indebtedness, data use and consumer protection remain. Ethiopia represents a more recent state-led transition involving the Fayda digital identity system and an increasingly competitive and interoperable payment sector. Fayda has already been connected to financial-service use cases, including account opening and loan access (World Bank, 2025). These varied experiences permit examination of how similar digital foundations produce different financing outcomes under different institutional conditions.

African SMEs continue to face mutually reinforcing barriers to formal credit. Many lack acceptable identification, registration documents and reliable financial statements. Cash-based operations produce limited transaction histories, while weak credit-information coverage prevents lenders from observing past repayment behaviour. Information asymmetry, inadequate collateral and informality consequently increase customer-verification, loan-processing and monitoring costs. Fragmented payment platforms and incomplete data-sharing arrangements further prevent potentially valuable business information from being used in credit assessment. These constraints disproportionately affect informal, rural, young and women-owned enterprises.

African countries have invested in digital identity, payment interoperability, credit-reporting systems and data-sharing frameworks, but evidence connecting these investments to SME financing remains fragmented. Much of the literature examines fintech, mobile money, digital credit, financial inclusion or payment adoption as separate subjects. For example, studies show that digital finance can create transaction histories, reduce assessment costs and broaden financial access (Kame Babilla, 2023; Sanga & Aziakpono, 2023, 2024). However, these findings do not fully explain how public digital foundations interact to influence business identification, transaction visibility, credit assessment and eventual loan access.

This creates four related gaps. Conceptually, individual technologies are frequently analysed without treating DPI as an interconnected foundation. Empirically, direct evidence linking the combined infrastructure to SME loan availability, affordability and suitability remains dispersed. Comparatively, limited recent research has applied a common analytical framework to Nigeria, Ghana, Kenya and Ethiopia, which represent different financial markets and stages of digital development. At the mechanism level, reported associations between digitalisation and financial inclusion often leave the causal sequence insufficiently examined. This study addressed these gaps through structured within-case and cross-case analysis of documented country experiences.

This study examined how digital identity, interoperable payments, credit-information systems and secure data-sharing arrangements affected SME identification, transaction visibility, credit assessment and access to finance in Nigeria, Ghana, Kenya and Ethiopia. Its contribution is a mechanism-based comparison that distinguishes infrastructure availability, intended effects and documented financing outcomes. The study also identifies the institutional conditions under which reduced information and processing costs translate, or fail to translate, into accessible and suitable SME credit.

LITERATURE REVIEW AND ANALYTICAL FRAMEWORK

Digital public infrastructure and its financing channels

Digital public infrastructure (DPI) comprises foundational, interoperable and reusable digital systems through which governments, businesses and individuals can securely identify themselves, make payments and exchange authorised data. Its core layers commonly include digital identity, digital payments and consent-based data exchange, supported by laws, technical standards, institutional governance and security safeguards (World Bank, 2023). DPI is "public" primarily because it performs an economy-wide public function, not necessarily because the state owns or operates every component. Governments may establish rules and foundational systems, while banks, telecommunications companies, fintech firms and other private providers build products on the shared infrastructure.

Interoperability is a defining feature because it permits users and institutions operating on different platforms to exchange information or value without remaining within a single provider's closed network. Open or commonly accessible technical standards support this interaction, reduce duplication and allow services to be developed at scale. Reusability means that an identity credential, payment connection or authorised data record can support several services rather than requiring separate verification for each transaction. These characteristics can reduce entry costs for smaller providers and increase convenience for users, although poorly governed infrastructure can strengthen dominant platforms rather than competition.

Its developmental value depends on institutional governance. Clear responsibility is required for system design, access, data quality, dispute resolution, cybersecurity and accountability. Privacy-by-design, proportional data collection, informed consent and accessible grievance procedures are especially important because identity and financial-data systems can facilitate surveillance, fraud or exclusion if improperly managed. Responsible DPI must therefore combine scale and innovation with security, privacy, inclusion and meaningful remedies for affected users (Cambridge Centre for Alternative Finance, 2025).

A foundational identity establishes a person's legally recognised existence and basic attributes, while a functional identity is created for a particular purpose, such as taxation, banking, health insurance or business registration. Foundational systems can support several functional uses when identity credentials are verifiable and accepted across institutions. For SMEs, the relevant identity structure includes both the personal identity of owners or directors and the legal identity of the enterprise.

These gains are conditional. A person excluded from registration may also become excluded from services that require the credential. Incorrect records, authentication failures and weak correction procedures can prevent legitimate users from opening accounts or obtaining finance. Women, migrants, rural residents and informal entrepreneurs face heightened risks where enrolment requires inaccessible documents, travel or technology. Weak data protection can also expose sensitive personal and commercial information. Digital identity should therefore be assessed by coverage, accuracy, accessibility, authentication reliability and effective remedies, not only by enrolment numbers.

Interoperable payment platforms allow funds to move across banks, mobile-money providers, fintech wallets and other authorised institutions. They include retail switches, instant-payment systems and related settlement arrangements. Interoperability reduces the need to maintain multiple accounts within closed networks and can expand the number of customers and suppliers with whom an SME transacts. Instant settlement can improve liquidity by reducing the delay between sale and receipt of funds, while lower transaction charges make digital acceptance more practical for low-value merchants.

Payment platforms also create transaction trails showing sales receipts, supplier payments, cash-flow frequency and account balances. These records can partly compensate for the weak financial statements of small and informal businesses. Fintech development can reduce the time and cost of gathering information and allow lenders to assess enterprises through their transaction histories (Sanga & Aziakpono, 2023). However, a digital trail becomes useful for lending only when the data are accurate, sufficiently long, portable and accep-

ted by lenders. Merchant adoption may remain limited where fees are high, connectivity is unreliable or cash remains easier to use. African Nenda (2024) reported that only about 35% of payments received by surveyed sub-Saharan African SMEs were digital, showing that infrastructure availability does not guarantee complete cash-flow visibility.

Credit-information systems comprise public credit registries generally managed by central banks and private credit bureaus that collect, verify and distribute borrower information. Negative reporting records defaults or arrears, whereas positive reporting also captures timely repayment, existing obligations and account performance. Comprehensive reporting enables lenders to distinguish relatively reliable borrowers from higher-risk applicants and can reduce dependence on personal relationships or physical collateral.

Greater data volume does not automatically ensure fairer assessment. Alternative data may be incomplete, inaccurate or weakly related to repayment capacity. Opaque algorithms can reproduce gender, geographic or income-based discrimination, while extensive data collection can undermine privacy. Credit-information development must therefore combine wider coverage with data-quality rules, explainability, correction rights and appropriate limits on data use.

Secure data sharing permits information held by one institution to be transmitted to another under lawful and controlled conditions. Open banking generally requires banks to share specified customer-authorised account data with licensed third parties through application programming interfaces (APIs). Open finance extends this principle to mobile money, insurance, pensions, investments and other financial records. Data portability allows an SME to transfer its information rather than rebuild a financial history whenever it changes provider.

Nevertheless, formal consent can become superficial when customers do not understand the information requested, the duration of access or possible secondary uses. Cyberattacks, weak third-party controls and unclear institutional responsibility can expose both personal and business data. Effective arrangements require authentication, encryption, access controls, audit trails, provider licensing, data minimisation and enforceable liability. Governance should also specify who corrects inaccurate data and compensates users when sharing causes loss.

Table 1: Digital Public Infrastructure Components and Their Expected Effects on SME Financing

DPI component	Immediate function	Financing mechanism	Expected SME financing outcome
Digital identity	Provides reliable authentication	Reduces verification, fraud and compliance costs	Easier account opening and loan application
Interoperable payments	Records digital transactions	Creates observable cash-flow histories	Better evidence of repayment capacity
Credit-information systems	Consolidate borrowing records	Reduce lender information asymmetry	Improved credit assessment and risk-based pricing
Secure data sharing	Permits controlled data exchange	Supports broader and faster underwriting	Faster decisions and access to suitable credit

SMEs, financing constraints and connecting mechanisms

There is no uniform African definition of an SME. Countries apply different employment, turnover, asset or sector thresholds, while banks and development institutions often use their own classifications. This variation complicates cross-country comparisons and can exclude enterprises that fall between microfinance and conventional bank definitions.

Financing needs change across the business life cycle. Start-ups require seed and working capital but rarely possess collateral or established records. Growing firms need larger and longer-term finance for equipment, employees and market expansion. Mature SMEs may require trade finance, asset finance or equity, while distressed firms need restructuring capital. DPI-supported financing must therefore provide more than quick short-term loans; it should help lenders offer products suited to different cash-flow patterns and investment horizons.

African SMEs obtain finance from bank loans, microfinance institutions, trade credit, cooperatives, rotating savings arrangements and retained earnings. Commercial banks can provide larger and longer-term loans but commonly require collateral, formal accounts and documented repayment capacity. Microfinance and cooperative finance are more accessible to small borrowers, although loan amounts may be limited and effective costs high. Trade credit allows suppliers to finance inventory but depends on established commercial relationships.

SME Financing Constraints

Information asymmetry is central to SME financing because lenders know less than business owners about the enterprise's ability and willingness to repay. Weak documentation, short credit histories and informal accounting intensify this problem. Lenders then rely heavily on collateral, yet many SMEs do not own formally registered land or other acceptable assets. Small loan sizes also produce high transaction costs relative to expected interest income because customer verification, appraisal, contracting and monitoring contain fixed-cost elements.

High interest rates reflect macroeconomic conditions, operating expenses and perceived credit risk, but they may make productive investment unviable. Limited financial literacy can weaken record keeping and cause borrowers to accept unsuitable terms. Gender inequality arises where women have less property ownership, identity coverage, mobility or control over financial accounts. Rural firms face longer distances to branches, weaker connectivity and thinner financial markets. Digital finance can reduce several constraints, but it may also introduce new ones through device costs, data charges, automated rejection and limited avenues for human review.

DPI affects SME financing through a sequence rather than a single direct relationship. Identity establishes who the borrower is; payments produce observable commercial activity; credit-information systems consolidate repayment behaviour; and secure data sharing makes relevant records available for underwriting. The expected mechanisms are summarised below.

These mechanisms are complementary. Identity without payment use produces little evidence of business performance, while payment records that cannot be shared may remain locked within one provider. Credit information may penalise defaults without rewarding timely repayment if only negative data are reported. Data sharing may increase competition, but it cannot correct inaccurate source data. DPI is most likely to improve financing when these components operate as a governed system.

Infrastructure alone does not ensure inclusive financing. Regulatory quality determines whether providers can innovate while remaining accountable for pricing, data use and consumer treatment. Institutional capacity affects system reliability, supervision and dispute resolution. Connectivity and electricity determine whether rural enterprises can transact consistently, while financial and digital literacy influence SMEs' ability to generate records, compare products and protect credentials.

Data protection and cybersecurity affect trust. Repeated fraud, identity theft or unexplained data use can discourage digital participation and weaken the records on which lending depends. Competition also shapes whether efficiency gains reach SMEs through lower prices or remain with incumbent providers. Institutional quality has been found to support the relationship between fintech development and SME digital finance across African countries (Sanga & Aziakpono, 2024). Affordability, gender inclusion and rural access are therefore substantive conditions, rather than secondary social considerations.

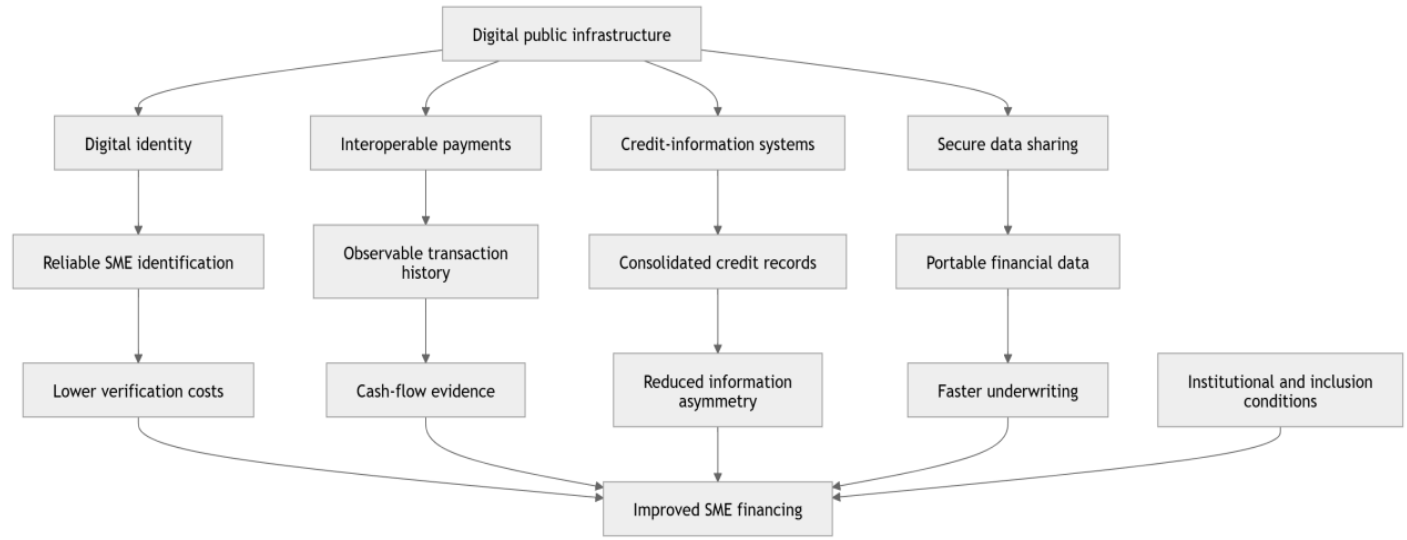


Figure 1. Digital public infrastructure-SME financing mechanism framework.

Source: Authors' conceptualisation based on World Bank (2023c), Sanga and Aziakpono (2023, 2024), and Umar et al. (2025).

Theoretical foundation

Information Asymmetry Theory provides the primary theoretical foundation for the study. Akerlof (1970) demonstrated how unequal information about product quality can produce adverse selection, while Spence (1973) explained how credible signals reduce uncertainty. Applied to lending, Stiglitz and Weiss (1981) showed that imperfect information can cause credit rationing even when borrowers are willing to pay higher interest rates. Before lending, adverse selection prevents a financier from readily distinguishing productive, reliable SMEs from riskier applicants. After disbursement, moral hazard arises when the lender cannot fully observe how funds are used or whether the borrower takes additional risks.

These problems are severe in SME lending because financial statements, collateral and repayment histories are often limited. Digital identity can establish the borrower's legal identity; payment data can signal the scale and stability of business cash flow; and credit reports can reveal existing obligations and repayment behaviour. Consent-based data exchange can transmit these signals between institutions. The theory therefore explains why more verifiable information may improve credit assessment, reduce blanket rejection and permit more differentiated pricing.

Its strength lies in explaining the information-production and screening mechanisms central to DPI. However, more data do not necessarily mean better information. Digital records may be inaccurate, unrepresentative or manipulated, and predictive models may generate discrimination that borrowers cannot contest. The theory also gives limited attention to infrastructure costs, bargaining power, privacy and institutional trust.

Transaction Cost Economics complements this limitation. Coase (1937) established that economic coordination is shaped by the costs of using markets, while Williamson (1985) developed the framework around bounded rationality, opportunism, asset specificity and governance. In lending, transaction costs include searching for customers, verifying identity, collecting documents, assessing risk, drafting contracts, disbursing funds, monitoring repayment and enforcing claims. These costs can make small loans commercially unattractive even where SMEs are viable.

Reusable identity credentials, automated verification, interoperable payments and standardised APIs can reduce repeated onboarding, information collection and processing. Shared infrastructure may also permit smaller lenders to access services they could not economically build independently. Interoperability reduces switching and search costs, while common standards simplify connections among institutions. Yet Transaction Cost Economics can overstate efficiency if it ignores distributional consequences. Standardisation may exclude

firms that do not fit predefined data categories, and infrastructure can create concentration or surveillance risks.

Information Asymmetry Theory explains the value of credible SME information, while Transaction Cost Economics explains the value of producing and transmitting that information through shared systems at lower cost.

Accordingly, the analytical sequence is: digital identity and transaction data -> lower information asymmetry and transaction costs -> improved credit assessment -> expanded or more efficient SME financing. The framework treats institutional quality, competition, inclusion, data governance and cybersecurity as conditions that determine whether this sequence produces responsible credit outcomes.

Empirical evidence and research gap

Evidence available in 2026 increasingly connected alternative data and shared digital systems to underserved borrowers. The International Finance Corporation (IFC, 2026) reported that transaction, utility, mobile and platform data could extend credit assessment to small businesses lacking formal histories. It also cautioned that model governance, data quality and transparency were essential. Emerging evidence on open banking similarly showed that data portability could increase financial participation, although poorly targeted arrangements could reinforce exclusion (Nanziri et al., 2026).

In 2025, the IMF's regional assessment found that digital payments had continued to expand financial access in sub-Saharan Africa but remained constrained by fragmentation, pricing, limited interoperability and unequal digital capability (Ricci et al., 2025). The World Bank's review of alternative credit data found increasing collaboration among credit bureaus, fintech firms and scoring companies, but identified privacy, representativeness and explainability as continuing concerns (World Bank, 2025). These findings indicated that alternative data could reduce credit invisibility without automatically eliminating biased or inaccurate decisions.

Peer-reviewed African evidence in 2024 was broadly supportive but more cautious about institutional differences. Umar et al. (2025), using panel data from 17 African countries between 2011 and 2022, found that the volume and intensity of digital finance significantly improved SME financial inclusion. Sanga and Aziakpono (2024), examining 47 African countries, found heterogeneous gains: fintech development had stronger effects where digital-finance systems were already more developed, and institutional quality supported the outcome. Osabutey & Jackson (2024) concluded that mobile money had widened access and transaction convenience across Africa, but cybersecurity, fraud, digital capability and uneven infrastructure limited the benefits.

Earlier peer-reviewed studies clarified the financing mechanisms. Kame Babilla (2023) found that digital innovation eased financial frictions and improved SME access to finance in the West African Economic and Monetary Union. Sanga and Aziakpono's (2023) systematic review reported that fintech could widen SME financing by reducing information and transaction costs, generating digital footprints and supporting alternative lending. Mushtaq et al. (2022) found that ICT adoption and innovation were associated with improved SME financial access, but the benefits depended on firms' capabilities and their broader business environment. Evidence from 2021 also showed that digital finance increased speed and reach, while exclusion, over-indebtedness and weak consumer protection remained material concerns.

Country evidence revealed distinct pathways. In Nigeria, the infrastructure combined national identification, instant interbank payments, credit bureaus and regulatory movement towards open banking. The Central Bank of Nigeria's financial-inclusion architecture incorporated tiered customer verification, agent banking, fintech development and payment-system reforms (CBN, 2022). These systems could reduce onboarding costs and generate payment records, but weak SME documentation, uneven identity linkage, fraud and limited long-term digital credit remained constraints.

In Ghana, the Ghana Card and mobile-money interoperability created stronger connections among identity, banks and non-bank payment providers. Bank of Ghana reports documented continued growth in interoperable mobile-money transactions and fintech services (Bank of Ghana, 2025). The infrastructure expanded payment reach and transaction visibility, although the financing value of these records depended on credit-reporting coverage, merchant digitisation and affordable lender access to reliable data.

In Kenya, mobile money produced the region's most established example of digital transaction histories supporting payments, savings and short-term credit. However, rapid digital lending also generated concerns about high costs, aggressive collection, misuse of personal data and negative credit listings. The Central Bank of Kenya responded through the Digital Credit Providers Regulations 2022 and licensing requirements, reflecting the need to combine innovation with data and consumer protection (Central Bank of Kenya (2023)). Kenya therefore demonstrated both the financing potential and the risks of converting extensive digital footprints into automated credit.

In Ethiopia, evidence centred on the developing Fayda identity system, expansion of mobile-money competition and movement towards interoperable payments. The National Bank of Ethiopia (2024) reported efforts to integrate Fayda with instant-payment infrastructure to support a secure and inclusive payment environment. The World Bank (2025a) also documented Fayda's use in account opening and loan access. Ethiopia's experience remained less mature than those of Kenya or Nigeria, but it showed how identity, agricultural records and digital wallets could be designed together. Connectivity, institutional capacity, limited credit histories and implementation scale continued to shape practical outcomes.

Overall, empirical studies supported the proposition that digital identity, payments and alternative data can reduce financing frictions. However, most examined one technology, aggregate financial inclusion or fintech development. Few traced the complete mechanism across identity, transactions, credit information and secure data exchange using a consistent comparison of Nigeria, Ghana, Kenya and Ethiopia. This unresolved gap supported the study's multiple document-based case approach.

METHODS

Design, cases and documentary scope

The study adopted a pragmatic research philosophy. Pragmatism was appropriate because the inquiry sought context-sensitive explanations of how digital public infrastructure (DPI) affected SME financing, rather than testing a universal causal law. It permitted the integration of peer-reviewed research, policy documents, regulatory instruments and institutional reports with different methods and evidential strengths. The orientation also supported the development of policy propositions grounded in documented country experiences. Interpretation remained necessary because official reports did not always define DPI, SMEs or financing outcomes consistently. However, the analysis prioritised practical mechanisms, source triangulation and observable evidence rather than relying solely on subjective meanings.

A qualitative, multiple document-based case-study design was employed. Case-study research is suited to complex and context-dependent phenomena where institutional arrangements, implementation processes and outcomes cannot be separated readily from their settings (Greenhalgh et al., 2025). The design treated Nigeria, Ghana, Kenya and Ethiopia as four country cases. Within each case, digital identity, interoperable payments, credit-information systems and secure data-sharing arrangements constituted embedded units of analysis.

The embedded structure supported two levels of investigation. Within-case analysis examined how the four DPI components interacted with SME identification, transaction visibility, credit assessment and loan access in each country. Cross-case analysis then compared recurring mechanisms, differences and institutional conditions. The design sought analytical transferability through propositions and structured comparison, rather than statistical representativeness.

Purposive, theoretically informed case selection was applied. The countries were not selected as statistically

representative of Africa. They were chosen because they displayed variation in digital-finance maturity, regulatory design, financial-sector organisation and implementation capacity.

This variation allowed the study to compare relatively mature, payments-led systems with newer state-led infrastructure. It also made it possible to examine whether similar DPI components produced different SME-financing outcomes under different institutional conditions.

Table 2: Selected African Country Cases and Justification for Inclusion in the Study

Country	Case justification
Nigeria	Combined a large SME sector with national digital-identity expansion, instant interbank payments, credit bureaus and an emerging open-banking framework.
Ghana	Connected national identity reforms with mobile-money interoperability and an expanding digital-financial-services market.
Kenya	Provided a mature mobile-money environment, extensive digital-credit experience and substantial use of transaction and alternative data.
Ethiopia	Represented a state-led digital transformation involving the developing Fayda identity system and an evolving, increasingly interoperable payment market.

The documentary population comprised English-language publications issued between January 2021 and the 2026 search cut-off that addressed DPI, digital finance or SME financing in at least one selected country. It included peer-reviewed articles, central-bank reports and regulations, national policies, and publications from multilateral and development-finance institutions. Foundational theoretical works were exempted from the date restriction.

Document Search and Review Protocol

A structured document-review protocol guided source identification and selection. Searches covered Scopus, Web of Science, SSRN, World Bank Documents and Reports, IMF eLibrary, African Development Bank publications, and official central-bank, regulatory and government repositories in Nigeria, Ghana, Kenya and Ethiopia. The review covered documents published from 1 January 2021 to 31 May 2026, except indispensable theoretical, legal and historical sources.

Search terms combined four concept groups: DPI components (“digital identity”, “e-KYC”, “interoperable payments”, “mobile money”, “credit bureau”, “credit registry”, “alternative data”, “open banking”, “open finance”, “data sharing”); enterprise terms (“SME”, “MSME”, “small business”, “merchant”); financing terms (“credit”, “lending”, “loan access”, “credit assessment”, “digital credit”, “cash-flow lending”); and the four country names. The general search logic was:

(DPI term) AND (SME term) AND (financing term) AND (country).

Backward and forward citation tracking supplemented database searches. Records were entered into a document register, duplicates removed, and titles, abstracts or executive summaries screened before full-text assessment. Eligibility followed the criteria in Table 3: relevance to at least one selected country, DPI component or SME-financing mechanism; authoritative or peer-reviewed provenance; adequate factual or methodological detail; and full-text availability. Promotional, unverifiable, irrelevant, duplicate or superseded documents were excluded.

The final analytical corpus comprised 34 documents, including 11 peer-reviewed articles and 23 institutional, regulatory and multilateral documents. Country coding was non-exclusive: Nigeria appeared in 12 documents, Ghana in 10, Kenya in 12 and Ethiopia in nine, while 11 documents provided regional or cross-country evidence.

Source quality was assessed using five criteria: authority, methodological transparency, relevance, recency and

corroboration. Regulatory announcements were treated as evidence of intended arrangements unless implementation or financing outcomes were independently documented.

The selection process followed the reporting logic of PRISMA 2020, although PRISMA was used as a transparency device for documentary selection rather than as an indication that the study constituted an intervention-based systematic review.

Table 3. Document-Review Protocol

Protocol element	**Operational procedure**
Review design	Structured multiple document-based case review
Cases	Nigeria, Ghana, Kenya and Ethiopia
Academic databases	Scopus; Web of Science; SSRN
Multilateral sources	World Bank Documents and Reports; IMF eLibrary; African Development Bank publications
National institutional sources	Central banks; national identity authorities; financial regulators; relevant ministries and government agencies
Publication period	1 January 2021 to 31 May 2026
Exceptions	Foundational theory and indispensable legal/historical system documents
Core search concepts	Digital identity; payment interoperability; credit information; secure data sharing; SME/MSME; credit and financing
Search logic	DPI term AND SME term AND financing term AND country
Supplementary search	Backward and forward citation tracking; system-specific institutional searches
Screening stages	Identification → duplicate removal → title/abstract screening → full-text eligibility → inclusion
Final analytical corpus	34 documents
Country coding*	Nigeria = 12; Ghana = 10; Kenya = 12; Ethiopia = 9
Regional/cross-country evidence	11 documents
Analytical approach	Directed qualitative content analysis, within-case analysis, pattern matching and cross-case synthesis

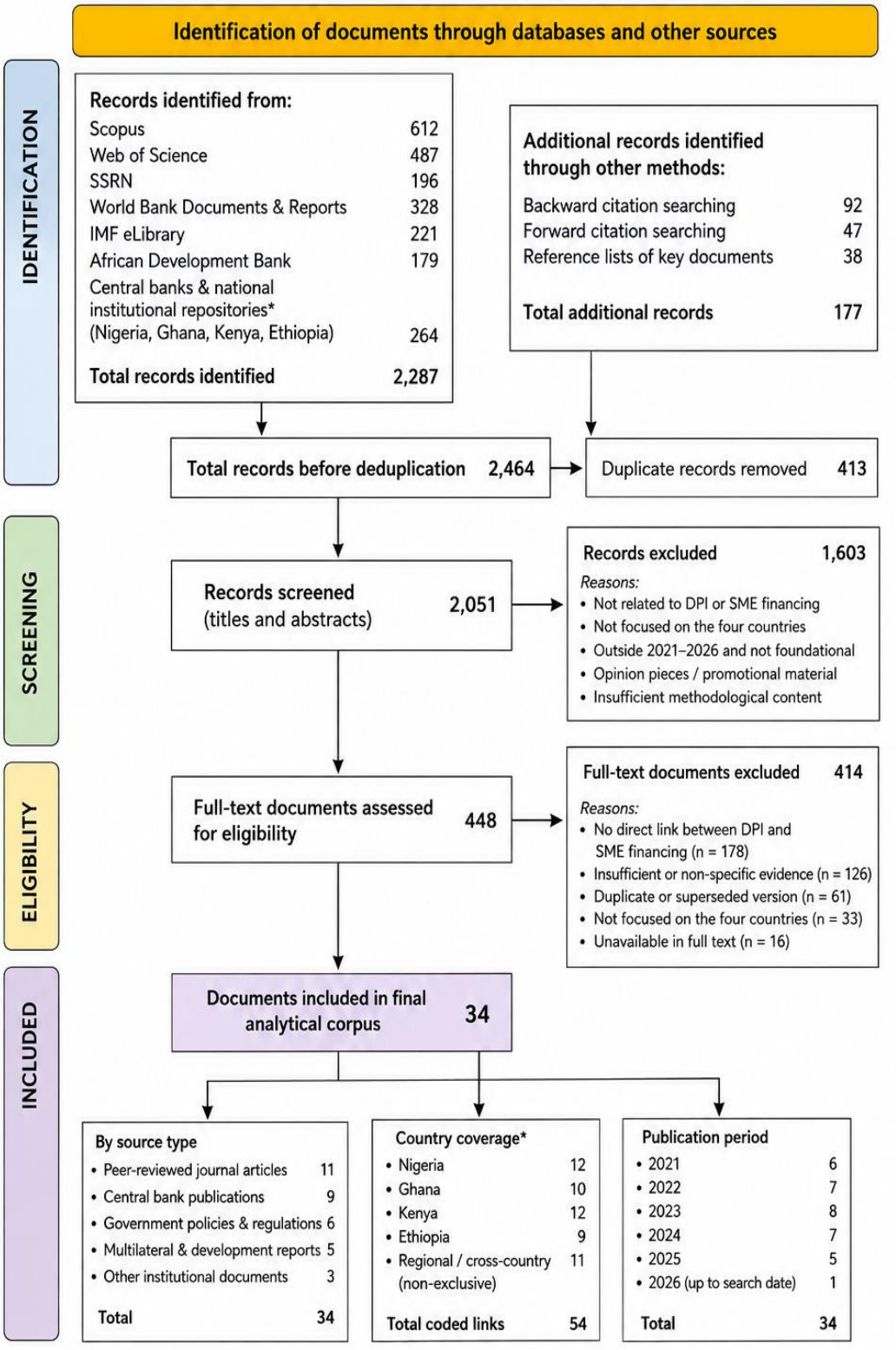


Figure 2. Document-Selection Flow Diagram for the Identification, Screening, Eligibility Assessment and Final Inclusion of Documentary Evidence.

Source: Authors' compilation based on the structured document-review protocol and adapted from the PRISMA 2020 reporting framework (Page et al., 2021).

Structured Coding and Evidence-Mapping Framework

A common coding framework was applied across Nigeria, Ghana, Kenya and Ethiopia to link documentary evidence to the four DPI components and the stages of SME financing. The DPI codes were digital identity (DID), interoperable payments (IPP), credit-information systems (CIS) and secure data sharing (SDS).

Financing-stage codes covered identification/onboarding, transaction visibility, borrower profiling, credit assessment, loan decision/disbursement, and final financing outcomes.

Each relevant passage was mapped as:

Source → Country → DPI component → Financing stage → Mechanism → Outcome → Institutional condition → Evidential strength.

Coding was non-exclusive because one document could address several components or financing stages. However, infrastructure existence was not treated as evidence of financing impact. Policy or regulatory provisions were coded as intended functionality unless actual implementation was documented; digital-payment activity was coded as observed usage only where practical use was established; and financing outcomes were recorded only where evidence linked DPI to loan access, approval, processing time, cost, amount, maturity or suitability.

Contextual codes captured factors affecting the pathway, including institutional capacity, interoperability, competition, connectivity, affordability, data quality, cybersecurity, privacy and consumer protection. Missing relationships were recorded as not documented rather than inferred, while contradictory evidence was retained for within-case and cross-case analysis.

This framework ensured that the same analytical rules were applied across all four country cases and provided a traceable link between documentary evidence, DPI mechanisms and reported SME-financing outcomes.

Table 4. Structured Coding Framework Linking DPI Components to Stages of SME Financing

DPI component	Main code focus	Financing stage	Evidence sought
Digital identity	Identification, authentication, business linkage	Onboarding	Verified identity use, e-KYC, reduced verification barriers
Interoperable payments	Payment connectivity, transaction records	Transaction visibility	Merchant use, digital cash-flow records, lender use
Credit-information systems	Credit records, borrower coverage, data quality	Borrower profiling/assessment	Credit histories, scoring, risk assessment
Secure data sharing	APIs, portability, consent-based exchange	Underwriting/decision	Operational data exchange and lending use
Financing outcomes	Access, speed, cost, amount, maturity, suitability	Final outcome	Documented change attributable to DPI

Source: Authors' conceptualisation based on the reviewed literature and coding framework.

Standardised Indicators and Evidence Classification

Cross-country comparison distinguished four evidence levels: infrastructure availability, intended functionality, observed usage, and demonstrated financing outcomes. This prevented the existence of a DPI system from being interpreted automatically as evidence of improved SME finance.

Standardised comparison covered digital identity coverage, payment interoperability, credit-information coverage, data-sharing maturity, and SME financing access. Where comparable quantitative indicators were available, they were used as contextual benchmarks; otherwise, a common documentary scale was applied:

0 = Absent/no verifiable evidence; 1 = Emerging; 2 = Partially developed; 3 = Relatively developed and operational.

Financing outcomes were assessed separately from infrastructure maturity and covered documented effects on loan access, processing speed, cost, amount, maturity, and suitability. A score therefore reflected the strength of documented evidence rather than an overall national ranking.

The same definitions and scoring rules were applied to Nigeria, Ghana, Kenya and Ethiopia to support consistent cross-case comparison.

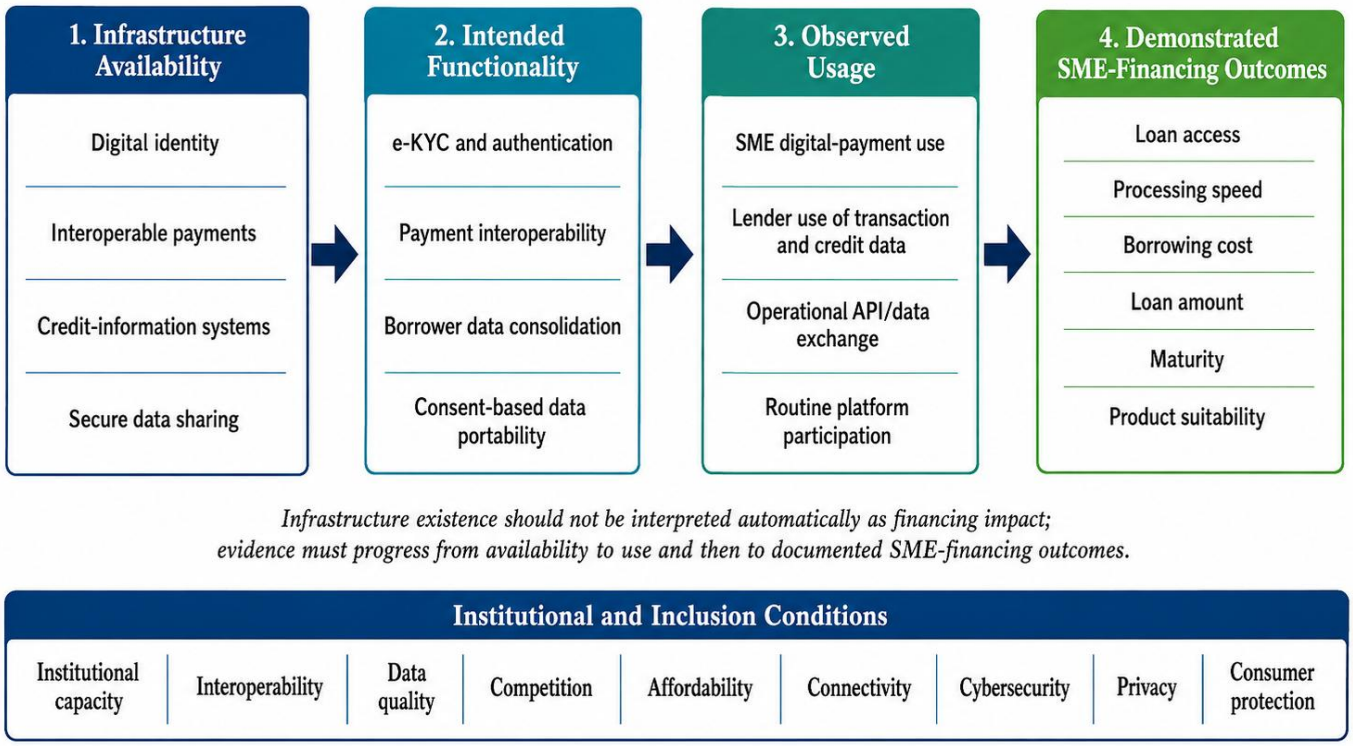


Figure 3. Evidence Pathway Linking Digital Public Infrastructure Availability, Intended Functionality, Observed Usage and Demonstrated SME-Financing Outcomes.

Source: Authors' conceptualisation based on the study's analytical framework and documentary coding protocol.

Figure 3 summarises the evidence pathway applied in distinguishing infrastructure availability, intended functionality, observed usage and demonstrated SME-financing outcomes, together with the institutional and inclusion conditions affecting progression across these stages.

Trustworthiness and analytical rigour. Credibility was strengthened through source triangulation, consistent application of the coding framework, verification of regulatory and system characteristics against primary documents, and retention of contradictory evidence. Missing evidence was recorded rather than inferred. Policy intentions, observed implementation and demonstrated financing outcomes were analysed separately. These procedures reduced selective interpretation and supported consistent comparison across the four country cases.

RESULTS AND DISCUSSION

Profile, Coding Coverage and Strength of the Evidence

The final analytical corpus comprised 34 documents. Each document was coded using the common evidence-mapping framework described in Section 3.3. Coding was non-exclusive because individual documents could address several countries, DPI components or stages of the financing process. The analysis therefore focused on the strength and location of evidence within the financing pathway rather than on simple frequencies of favourable findings.

Nigeria was represented in 12 documents, Ghana in 10, Kenya in 12 and Ethiopia in nine, while 11 documents provided regional or cross-country evidence. At the DPI-component level, payment systems received the greatest documentary coverage, appearing in 25 documents, followed by credit information and alternative data in 16, digital identity in 14 and secure data sharing in 11.

The distribution of codes was uneven across the financing pathway. Evidence was strongest for the existence and operation of infrastructure and for intermediate mechanisms such as identification, payment use, transaction visibility and borrower assessment. It was considerably weaker for final SME-financing outcomes, particularly loan pricing, maturity, loan size, product suitability and repayment performance. Accordingly, the study did not interpret infrastructure establishment or digital usage as evidence of improved SME financing unless a documentary source demonstrated the relevant connection.

The coding distribution indicated that documentary evidence was strongest for infrastructure availability and observed payment use, moderate for credit-information applications, and weakest for operational data sharing and demonstrated SME-level financing outcomes.

Nigeria

Nigeria's identification layer was built around the National Identification Number and its growing connection to financial accounts and customer-verification processes. Identity integration reduced dependence on repeated physical documentation and supported electronic know-your-customer procedures. The World Bank (2023a) reported that the Nigeria ID4D programme also strengthened data minimisation, digital security and personal-data protection. However, incomplete enrolment, inconsistent records and difficulties correcting identity details continued to affect informal and geographically remote entrepreneurs.

Nigeria's instant interbank payment infrastructure connected banks, fintech firms and payment-service providers. Its scale allowed SMEs accepting transfers, mobile payments or point-of-sale payments to generate transaction histories. The evidence showed that fintech platforms increasingly combined payments with business accounts, bookkeeping and credit products. For example, Moniepoint reported processing more than 800 million monthly transactions in 2024 while expanding its integrated business services (Reuters, 2024). Such records increased cash-flow visibility, although cash-dependent firms remained largely invisible.

Credit bureaus and the Central Bank of Nigeria's Credit Risk Management System supplied formal borrowing information. The open-banking framework created a basis for customer-authorised account-data sharing through standardised interfaces. Together, these arrangements could permit lenders to combine identity, bank-account and repayment information. Their practical financing effect remained uneven because formal bureau coverage was thinner among micro and informal businesses, while implementation of open banking was still developing.

The evidence indicated that digital platforms improved application speed and supplied short-term working capital to merchants with observable payment histories. However, it did not establish a general reduction in interest rates or a broad expansion of long-term investment finance. Digital records improved lender screening, but macroeconomic risk, funding costs and short loan maturities continued to shape credit conditions.

Ghana

Ghana's identification architecture centred on the Ghana Card, which became increasingly important for financial-account verification and public-service access. Linking a widely accepted identity credential to banking and mobile-money services reduced documentation duplication. Yet possession of an individual identity did not automatically provide a complete business identity or financial record for an informal enterprise.

Ghana developed an integrated payment environment through the Ghana Interbank Payment and Settlement Systems. Mobile-money interoperability allowed funds to move among mobile wallets, bank accounts and e-zwich channels. Ghana was among the first countries to implement national interoperability across banks and

mobile-money providers (World Bank, 2023). Bank of Ghana data also showed continued growth in mobile-money customers and interoperable transactions (Bank of Ghana, 2025).

The system widened the range of digital transactions available to small merchants. It also reduced network fragmentation, giving SMEs a stronger reason to accept digital payments regardless of the customer's provider. Peer-reviewed evidence found that public institutions, banks, telecommunications firms, agents and users jointly contributed to Ghana's fintech development and financial inclusion (Coffie & Zhao, 2023).

Ghana's private credit bureaus supported conventional credit reporting, while payment records offered additional evidence of business activity. However, the documentary record provided less evidence of systematic integration between mobile-money data and SME credit decisions than of payment expansion itself. Secure, consent-based data sharing remained less developed than identity and payment interoperability.

Digital channels improved transaction convenience and created potential inputs for cash-flow lending. Nevertheless, evidence of sustained reductions in loan prices or collateral requirements was limited. Merchant fees, taxes previously imposed on electronic transfers, digital literacy and incomplete formalisation affected SMEs' willingness to maintain consistent digital records.

Kenya

Kenya's strongest DPI-related asset was its mature mobile-money environment. Mobile payments allowed SMEs to receive revenue, pay suppliers and retain digital records without relying on bank branches. The transaction history generated through mobile wallets reduced the invisibility of small cash-based firms and created a basis for savings and short-term digital credit. Research across Africa confirmed that mobile money improved access and transaction efficiency, although benefits varied by infrastructure and user capability (Osabutey and Jackson (2024)).

Kenya demonstrated the clearest connection among mobile money, transaction data and automated credit. Lenders used payment behaviour, airtime use, account flows and other digital indicators to make rapid lending decisions. These systems reduced documentary requirements and processing time, but often produced small, short-term loans rather than patient capital for productive investment.

The experience also revealed the risks of data-driven credit. Rapid market growth was associated with high charges, repeat borrowing, aggressive collection and negative credit listings. The Central Bank of Kenya introduced the Digital Credit Providers Regulations 2022 and licensing requirements after digital lending had expanded with limited oversight (Central Bank of Kenya (2023)). Its National Payments Strategy also identified interoperability, APIs, cybersecurity and data portability as priorities (Central Bank of Kenya (2022)).

Digital credit expanded immediate liquidity, particularly for working capital and emergencies, but access was not equivalent to suitable SME finance. Small limits, short repayment periods and opaque pricing could weaken enterprise cash flow. Kenya therefore supplied the strongest evidence for Proposition 2 while also demonstrating that transaction-based lending could increase over-indebtedness where product governance was weak.

Ethiopia

Ethiopia's Fayda programme represented the most recent and state-led identity development among the cases. Fayda supported secure authentication and was progressively connected to banks, Telebirr and public services. The World Bank (2025a) documented its use in account opening and access to loans, particularly for women, internally displaced persons and other groups previously lacking recognised identification. Early evidence therefore supported improved on boarding, but national coverage and service integration were still developing.

The payment market expanded through mobile-money entry, digital government payments and the development of instant-payment infrastructure. The National Bank of Ethiopia (2024) identified the proposed

integration of Fayda with instant payments as a means of creating a more secure and interoperable financial environment. The draft National Digital Payments Strategy 2026–2030 nevertheless reported that only 21% of adults had made or received a digital payment in the preceding year, indicating a considerable gap between infrastructure development and routine use (National Bank of Ethiopia 2025).

Ethiopia's credit-information and consent-based data-sharing layers were less mature. The proposed linkage of Fayda, agricultural records, wallets and lender information showed potential for reducing paperwork and building borrower profiles. Yet much of the evidence described intended system integration rather than demonstrated SME loan outcomes.

Fayda and digital payments improved the foundations for account ownership and eventual cash-flow assessment. However, connectivity, electricity, limited formal transaction histories, lender capability and restricted credit supply constrained immediate SME benefits. Ethiopia therefore showed that foundational infrastructure could be necessary without being sufficient for expanded finance.

Cross-country comparison

The standardised comparison showed that DPI availability, practical usage and SME-financing outcomes did not advance at the same rate across the four countries. Kenya recorded the strongest documented link between digital transactions, alternative data and credit access, although loan size, maturity, pricing and over-indebtedness remained concerns. Nigeria combined strong payment infrastructure with growing merchant-credit applications, but evidence of lower borrowing costs or expanded long-term SME finance remained limited.

Ghana demonstrated relatively strong identity and payment foundations, but direct evidence connecting these systems to SME loan outcomes was weaker. Ethiopia showed the clearest gap between infrastructure development, intended functionality and demonstrated financing effects, as identity-payment integration and credit-data use remained at an earlier stage.

Overall, the comparison confirmed that infrastructure maturity alone did not establish financing impact. Documented outcomes depended on actual SME usage, lender adoption, data quality, interoperability, institutional capacity, affordability and consumer protection.

Table 5 presents the standardised country scores, while Figure 2 summarises the comparative pattern visually.

Dimension	Nigeria	Ghana	Kenya	Ethiopia
Digital identity infrastructure	2	3	2	1
Payment interoperability	3	3	3	1
Credit-information system	2	2	3	1
Secure data-sharing maturity	1	1	2	1
Observed digital transaction use relevant to financing	2	2	3	1
Documented DPI-related SME-financing outcome	2	1	3	1

Interpretation: 0 = absent/no verifiable evidence; 1 = emerging; 2 = partially developed; 3 = relatively developed. Scores represent the status documented in the reviewed evidence and should not be interpreted as national performance rankings.

Dimension	Nigeria	Ghana	Kenya	Ethiopia
Digital identity infrastructure	2	3	2	1
Payment interoperability	3	3	3	1
Credit-information system	2	2	3	1
Secure data-sharing maturity	1	1	2	1
Observed digital transaction use relevant to financing	2	2	3	1
Documented DPI-related SME-financing outcome*	2	1	3	1

0 = Absent/ no verifiable evidence | 1 = Emerging | 2 = Partially developed | 3 = Relatively developed

Figure 4. Standardised Cross-Country Assessment of Digital Public Infrastructure Development and SME-Financing Evidence in Nigeria, Ghana, Kenya and Ethiopia.

Source: Authors' cross-country synthesis based on the reviewed peer-reviewed, regulatory, central-bank and multilateral evidence. Scores: 0 = absent/no verifiable evidence; 1 = emerging; 2 = partially developed; 3 = relatively developed. The financing-outcome score reflects the strength of documented evidence linking DPI to SME credit outcomes rather than the maturity of the underlying infrastructure.

Mechanisms, institutional conditions and inclusion risks

Across the cases, digital identity reduced onboarding barriers when credentials were accessible, accurate and accepted by financial institutions. Payment interoperability generated transaction records and reduced the fragmentation of business cash flows. Credit-information systems reduced information asymmetry for firms already visible within formal lending, while alternative transaction data extended assessment to some previously unscored firms.

The strongest documented gains concerned faster verification, application and disbursement. Evidence of expanded loan access was clearest in Kenya and among Nigerian digital merchants. Evidence of lower prices, longer maturities or better product suitability was much weaker. This distinction qualified the assumption that reduced processing costs would automatically be passed to SMEs. Lenders could retain efficiency gains, while risk, funding costs and market concentration continued to influence pricing.

Central-bank leadership was decisive in establishing interoperability and supervising digital credit. Ghana's mandated payment interoperability, Nigeria's payment and open-banking rules, Kenya's digital-credit regulation and Ethiopia's identity-payment integration illustrated different forms of regulatory coordination. Public-private participation accelerated service development, but required clear access rules to prevent dominant providers from controlling shared infrastructure.

Data governance, cybersecurity and consumer protection determined whether SMEs trusted digital systems. Competition encouraged product variety, while weak competition reduced the likelihood that lower transaction costs translated into cheaper credit. Digital and financial literacy also affected whether firms could maintain useful records, understand loan terms and protect credentials.

DPI could exclude firms lacking devices, connectivity, electricity or formal identity. Gender and rural disparities remained important because women often had weaker documentation, asset ownership and digital access. Identity errors could prevent legitimate onboarding, while cash-dependent SMEs generated insufficient data for automated assessment.

Alternative-data models could discriminate through opaque proxies for income, location or gender. Kenya's experience showed that rapid digital lending could encourage repeat borrowing and harmful collection practices. Data misuse, cyberattacks and market concentration introduced additional risks. Thus, digital visibility could improve access for some SMEs while creating a new divide between data-rich and data-poor firms.

Theoretical interpretation and refined propositions

The findings supported Information Asymmetry Theory: verified identity, payment histories and credit records improved lenders' knowledge of applicants. They also supported Transaction Cost Economics because reusable credentials, interoperable platforms and automated data exchange reduced search, verification and processing costs.

The evidence nevertheless qualified both theories. Better information did not guarantee suitable or affordable credit, and lower transaction costs did not necessarily reach borrowers. Institutional capacity, competition, data quality and consumer protection shaped the distribution of benefits. Ethiopia further showed that infrastructure establishment could precede widespread use, while Kenya demonstrated that information-rich lending could still produce unsuitable debt.

The revised propositions indicated that DPI affected SME financing through conditional mechanisms rather than an automatic technological effect.

Table 6: Evaluation and Revision of the Study's Propositions Based on the Evidence

Proposition	Decision and revision
P1	Retained with qualification: Accessible, accurate and correctable digital identity reduces onboarding barriers when financial institutions accept it.
P2	Retained with qualification: Interoperable payments improve credit visibility only where SMEs transact digitally and lenders can lawfully interpret the records.
P3	Modified: Credit-information systems improve assessment more readily than loan access; financing gains depend on coverage, data quality and lender response.
P4	Provisionally retained: Secure data sharing can improve underwriting, but direct SME outcome evidence remained limited.
P5	Retained and strengthened: Institutional capacity, competition, interoperability, inclusion, cybersecurity and data governance condition every financing mechanism.
P6	Retained: DPI can widen financing inequality by separating digitally visible firms from cash-dependent, rural, women-owned and informal SMEs.

POLICY IMPLICATIONS, CONCLUSION AND RESEARCH AGENDA

Policy implications

Governments should make digital-identity enrolment affordable and accessible, provide prompt correction of identity errors, and connect personal identification to proportionate business-registration processes. Interoperability standards should cover banks, mobile-money operators, fintech firms and payment-service providers. Investments in electricity, broadband and assisted access must accompany DPI because infrastructure cannot support SMEs that cannot use it reliably. Performance reporting should extend beyond enrolment and transaction volumes to loan approval, price, maturity, suitability, rural access and gender inclusion.

Central banks should combine payment interoperability with positive credit reporting and carefully governed open-finance rules. Consent should be informed and revocable; providers should minimise data, maintain access logs, apply retention limits and carry clear liability for failures. Digital-credit supervision should address total borrowing costs, repeat lending, collection practices and complaint resolution. Automated scoring

should be tested for discriminatory effects, give applicants understandable reasons for adverse decisions and provide an effective review process.

Banks and fintech lenders should use verified payment and account data to complement conventional assessment and build products around business cash cycles. Faster verification should result in measurable improvements in decision time, charges or loan conditions. Credit bureaus should incorporate lawful positive data from microfinance, mobile money and trade credit, update records promptly and offer simple dispute procedures. SME-development agencies should support bookkeeping, separation of personal and business finances, digital security, consent management and gradual formalisation, with targeted assistance for rural and women-owned enterprises.

Regional and development institutions should promote compatible identity assurance, payment, data-protection and cross-border data standards. Technical assistance and guarantees should be linked to independently measured improvements in underserved-firm access and product suitability. The central policy test is therefore outcome-based: whether DPI produces accessible, affordable and responsible finance, rather than merely larger identity registers or payment volumes.

Conclusion

Digital public infrastructure can materially improve SME financing in Africa, but the relationship is conditional rather than automatic. Digital identity can make entrepreneurs easier to verify; interoperable payments can convert business activity into observable records; credit-information systems can reveal borrowing behaviour; and secure data exchange can make these records available for more timely assessment. Together, these functions can reduce information asymmetry and transaction costs, the two principal theoretical channels examined in the study.

The financing outcome depends, however, on effective interoperability, broad identity coverage and reliable transaction and credit data. Data sharing must be secure, proportionate and based on meaningful consent. Regulators require sufficient capacity to supervise payment providers, digital lenders, credit bureaus and automated scoring systems. Lenders must participate by developing suitable cash-flow-based products and passing at least part of the efficiency gains to SMEs through faster decisions, lower charges or improved loan conditions.

Affordability and inclusion remain decisive. Infrastructure that serves only digitally sophisticated urban firms may improve efficiency while widening the financing gap facing rural, informal and women-owned enterprises. DPI should therefore be judged by whether it produces accessible, suitable and responsible finance, rather than by identity enrolments, payment volumes or application speed alone. The comparative evidence supported carefully governed DPI as a financing foundation, not as a substitute for competition, institutional capability, appropriate loan products and broader SME-development policies.

LIMITATIONS AND FUTURE RESEARCH

The study had several limitations. Documentary sources differed in purpose, scope, method and evidential quality. Peer-reviewed studies generally provided stronger analytical assessment, while institutional reports supplied recent implementation details but sometimes emphasised programme achievements. Source triangulation reduced, but could not eliminate, these differences.

Comparable SME-level evidence on loan approval, price, maturity and repayment remained limited. Several documents reported general financial inclusion or payment expansion rather than financing outcomes attributable specifically to DPI. Rapid changes in identity, payment, open-banking and digital-credit policies could also affect the continued accuracy of the findings.

Nigeria, Ghana, Kenya and Ethiopia represented varied but incomplete African experiences. The cases could not capture every legal tradition, language region, income level or financial-market structure. Finally, the

qualitative multiple-case design supported mechanism-based explanation and policy propositions, but it did not establish statistical causality or estimate the magnitude of DPI effects.

Future studies should conduct firm-level surveys to measure how identity ownership, payment use and credit-data visibility affect loan applications, approval, pricing and maturity. Interviews with SMEs, lenders, regulators, credit bureaus and payment providers would clarify how formal rules operate in practice.

Longitudinal research should examine whether newly digitised firms eventually obtain larger, cheaper or longer-term loans. Comparative studies should include Francophone, Lusophone and North African countries to test whether the propositions hold under different regulatory and institutional arrangements. Quantitative research could test the relationships represented in the analytical mechanism model, while retaining careful measures of institutional conditions.

Gender-disaggregated and rural–urban analysis is particularly necessary because aggregate financial-inclusion indicators can conceal unequal outcomes. Further research should also examine data protection, cybersecurity, algorithmic credit scoring, identity errors and the treatment of cash-dependent SMEs. These areas would clarify whether DPI reduces established financing barriers or replaces them with less visible digital forms of exclusion.

REFERENCES

1. Akerlof, G. A. (1970). The market for “lemons”: Quality uncertainty and the market mechanism. The Quarterly Journal of Economics, 84(3), 488–500. https://doi.org/10.2307/1879431
2. Alyaqoub, R., Alsharairi, A., & Aslam, M. Z. (2024). Elaboration of underpinning methods and data analysis process of directed qualitative content analysis for communication studies. Journal of Intercultural Communication, 24(2), 108–116. https://doi.org/10.36923/jicc.v24i2.573
3. Annamalah, S., Aravindan, K. L., Ahmed, S., & Sentosa, I. (2025). Exploring the relevance and rigour of case study research in business: A contemporary perspective. Journal of Sustainability Research, 7(2), Article e250032. https://doi.org/10.20900/jsr20250032
4. Bank of Ghana. (2025). FinTech sector report 2024. https://www.bog.gov.gh/wp-content/uploads/2025/03/FinTech-Sector-Report-2024-FY.pdf
5. Brixiová, Z., Kangoye, T., & Yogo, T. U. (2020). Access to finance among small and medium-sized enterprises and job creation in Africa. Structural Change and Economic Dynamics, 55, 177–189. https://doi.org/10.1016/j.strueco.2020.08.008
6. Cambridge Centre for Alternative Finance. (2025). Digital public infrastructure and digital financial services: Convergence, landscape and regulatory considerations. Cambridge Judge Business School, University of Cambridge. https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/digital-public-infrastructure-and-digital-financial-services/
7. Central Bank of Kenya. (2022). National payments strategy 2022–2025. https://www.centralbank.go.ke/wp-content/uploads/2022/02/National-Payments-Strategy-2022-2025.pdf
8. Central Bank of Kenya. (2023). Kenya’s payments journey. https://www.centralbank.go.ke/wp-content/uploads/2023/02/Kenyas-Payments-Journey.pdf
9. Central Bank of Nigeria. (2022). National financial inclusion strategy 3.0. https://www.cbn.gov.ng/FinInc/
10. Coase, R. H. (1937). The nature of the firm. Economica, 4(16), 386–405. https://doi.org/10.1111/j.1468-0335.1937.tb00002.x
11. Coffie, C. P. K., & Zhao, H. (2023). FinTech market development and financial inclusion in Ghana: The role of heterogeneous actors. Technological Forecasting and Social Change, 186, Article 122127. https://doi.org/10.1016/j.techfore.2022.122127
12. Dzirutwe, M. (2024, October 29). Google among investors putting $110 million into Nigeria’s Moniepoint. Reuters. https://www.reuters.com/technology/google-among-investors-putting-110-million-into-nigerias-moniepoint-2024-10-29/
13. Greenhalgh, T. (2025). Case studies: A guide for researchers, educators, and implementers. BMJ Medicine, 4(1), Article e001623. https://doi.org/10.1136/bmjmed-2025-001623

14. International Finance Corporation. (2026). Cracking the credit code: Alternative data and AI for financial inclusion. World Bank Group. https://www.ifc.org/en/insights-reports/2026/cracking-the-credit-code-alternative-data-and-ai-for-financial-inclusion
15. Kame Babilla, T. U. (2023). Digital innovation and financial access for small and medium-sized enterprises in a currency union. Economic Modelling, 120, Article 106182. https://doi.org/10.1016/j.econmod.2022.106182
16. Mushtaq, R., Gull, A. A., & Usman, M. (2022). ICT adoption, innovation, and SMEs' access to finance. Telecommunications Policy, 46(3), Article 102275. https://doi.org/10.1016/j.telpol.2021.102275
17. Nanziri, L. E., Gbahabo, P. T., & Ofori-Sasu, D. (2026). Open banking and financial inclusion in South Africa (Working Paper No. WP/26/07). South African Reserve Bank. https://www.resbank.co.za/content/dam/sarb/publications/working-papers/2026/26-07/financial-inclusion-sa.pdf
18. National Bank of Ethiopia. (2024). Financial stability report. https://nbe.gov.et/wp-content/uploads/2024/11/Financial-Stability-Report_NOV2024.pdf
19. National Bank of Ethiopia. (2025). National digital payments strategy 2026–2030 [Draft]. https://nbe.gov.et/wp-content/uploads/2025/12/NATIONAL_DIGITAL_PAYMENT_STRATEGY_2026-2030_Draft_Document.pdf
20. Osabutey, E. L. C., & Jackson, T. (2024). Mobile money and financial inclusion in Africa: Emerging themes, challenges and policy implications. Technological Forecasting and Social Change, 202, Article 123339. https://doi.org/10.1016/j.techfore.2024.123339
21. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, Article n71. https://doi.org/10.1136/bmj.n71
22. Ricci, L. A., Ahokpossi, C., Quayyum, S. N., Turk, R. A., Belianska, A., Cangul, M., Fuje, H., Lee, S., Li, G. B., Li, X., Mu, Y., Mwase, N., Ree, J. J., Shi, H., & Kramarenko, V. (2025). Digital payment innovations in Sub-Saharan Africa (Departmental Paper No. 2025/004). International Monetary Fund. https://doi.org/10.5089/9798400232220.087
23. Sanga, B., & Aziakpono, M. (2023). FinTech and SMEs financing: A systematic literature review and bibliometric analysis. Digital Business, 3(2), Article 100067. https://doi.org/10.1016/j.digbus.2023.100067
24. Sanga, B., & Aziakpono, M. (2024). FinTech developments and their heterogeneous effect on digital finance for SMEs and entrepreneurship: Evidence from 47 African countries. Journal of Entrepreneurship in Emerging Economies, 17(7), 127–155. https://doi.org/10.1108/JEEE-09-2023-0379
25. Spence, M. (1973). Job market signaling. The Quarterly Journal of Economics, 87(3), 355–374. https://doi.org/10.2307/1882010
26. Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. The American Economic Review, 71(3), 393–410. https://www.jstor.org/stable/1802787
27. Umar, U. H., Baita, A. J., Hamadou, I., & Abduh, M. (2025). Digital finance and SME financial inclusion in Africa. African Journal of Economic and Management Studies, 16(1), 18–33. https://doi.org/10.1108/AJEMS-08-2023-0323
28. Williamson, O. E. (1985). The economic institutions of capitalism: Firms, markets, relational contracting. Free Press.
29. World Bank. (2023a). Creating digital public infrastructure for empowerment, inclusion, and resilience. https://www.worldbank.org/en/results/2023/10/12/creating-digital-public-infrastructure-for-empowerment-inclusion-and-resilience
30. World Bank. (2023b). Digital progress and trends report 2023. https://openknowledge.worldbank.org/server/api/core/bitstreams/95fe55e9-f110-4ba8-933f-e65572e05395/content
31. World Bank. (2023c). G20 policy recommendations for advancing financial inclusion and productivity gains through digital public infrastructure. https://openknowledge.worldbank.org/bitstreams/c5f1fc39-7a91-41e6-9965-6355465b5f72/download
32. World Bank. (2024). Digital transformation drives development in Africa.

https://www.worldbank.org/en/results/2024/01/18/digital-transformation-drives-development-in-afe-afw-africa

33. World Bank. (2025a). The transformative power of Ethiopia's digital ID: Unlocking a better future for all. https://www.worldbank.org/en/news/feature/2025/02/27/the-transformative-power-of-ethiopia-afe-digital-id-unlocking-a-better-future-for-all
34. World Bank. (2025b). The use of alternative data in credit risk assessment: Opportunities, risks, and challenges. https://openknowledge.worldbank.org/entities/publication/7738aa96-6c1b-4fa3-86cb-be30f69d5a30