

Developing Data-Driven Payment Solutions to Improve Digital Financial Access for Underserved Small Businesses in the United States

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Abstract

Digital financial transformation has reshaped payment systems and financial service delivery across the United States, yet underserved small businesses continue to experience barriers to affordable and accessible financial services. Limited credit histories, restricted banking relationships, high transaction costs, fragmented financial records, and conventional credit assessment practices constrain the capacity of many enterprises to obtain appropriate financial products and working capital. This study examines the development of data-driven payment solutions as an integrated mechanism for improving digital financial access among underserved small businesses in the United States. The analysis focuses on the relationship between digital payment infrastructure, transaction-generated financial data, Artificial Intelligence (AI), predictive analytics, alternative credit assessment, and financial inclusion. Payment transactions provide continuous information concerning revenue patterns, cash-flow behaviour, transaction frequency, and operational activity, creating a broader evidence base for financial evaluation than conventional credit records alone. The study develops a conceptual framework that connects payment data collection, data processing, intelligent financial analysis, alternative credit evaluation, and digital financial access within an integrated financial ecosystem. Particular attention is given to data governance, privacy, cybersecurity, transparency, and institutional accountability because these factors influence the responsible use of business financial information. The framework positions payment-generated data as a central component of financial assessment and connects digital transaction activity with access to formal financial services. The study contributes to the literature by integrating payment technologies, data analytics, AI, and alternative financial assessment within a unified framework focused specifically on underserved small businesses in the United States.

Keywords: *Data-driven payment solutions, Digital financial access, Small businesses, Financial inclusion, Financial technology (FinTech), Artificial Intelligence (AI), Alternative credit assessment.*

1. Introduction

The rapid transformation of financial services through digital technologies has reshaped how businesses conduct transactions, manage financial information, and interact with financial institutions. Electronic payments, financial technology platforms, mobile banking, real-time payment systems, and data analytics are increasingly embedded in commercial activities, generating financial information beyond conventional accounting records. According to the U.S. Small Business Administration (2026), small businesses account for 99.9% of U.S. businesses, employ 62.3 million workers, and contribute 43.5% of gross domestic product, making their participation important to national economic activity. The Federal Reserve's 2025 Payments Study, released in 2026, recorded 236.6 billion noncash payments in 2024, demonstrating the scale of electronic payment activity across the U.S. economy. Payment transactions therefore generate information about revenue flows, transaction frequency, and business cash-flow patterns in addition to facilitating exchanges.

Despite this expansion, access to financing remains uneven across small businesses. The Federal Reserve Banks (2025) reported that 59% of employer firms sought new financing, yet only 41% of applicants received all the financing requested, while 36% received some and 24% received none. Barr (2025) further identified credit availability as a continuing challenge and noted disparities in access to safe and affordable credit among minority entrepreneurs and businesses in low- and moderate-income communities. Digital payment participation therefore does not by itself eliminate financing barriers. The central issue is the limited connection between information generated through routine payment activity and the financial assessment processes used to determine access to formal financial services. This conceptual study addresses that connection by developing a data-driven payment solution framework for underserved small businesses in the United States.

1.1 Background and Context of Digital Financial Access among Small Businesses

Digitalization has become increasingly embedded in the financial activities of U.S. small businesses, affecting how enterprises receive payments, manage cash flows, maintain financial records, and interact with financial service providers. The U.S. Small Business Administration (2026) reports that small businesses represent 99.9% of U.S. businesses, employ 62.3 million workers, and generate 43.5% of gross domestic product. At the payment-system level, the Federal Reserve's 2025 Payments Study recorded 236.6 billion noncash payments in 2024, with cards accounting for nearly four-fifths of transactions. The expansion of these payment channels has increased the availability of transaction-generated information, including payment frequency, transaction values, revenue movements, and other indicators of business

activity. Such information provides an additional view of operating activity and creates a potential foundation for data-driven financial assessment.

However, increased digital participation has not removed financing disparities. The Federal Reserve Banks (2025) reported that credit availability remained a challenge for more than one-quarter of small businesses, while rising costs, operating expenses, and uneven cash flows were among the frequently reported financial challenges. Barr (2025) similarly identified access to capital as a continuing challenge and noted that minority entrepreneurs and businesses located in low- and moderate-income communities can experience greater difficulty obtaining safe and affordable credit. These conditions are particularly relevant to businesses with limited borrowing histories or weaker relationships with conventional lenders. The resulting environment establishes the need to examine how payment-generated information can complement existing financial information without replacing established credit-assessment mechanisms.

1.2 Problem Statement

Persistent financing constraints remain a significant challenge for U.S. small businesses despite the continued expansion of digital payment infrastructure. The Federal Reserve Banks (2025) reported that 59% of employer firms sought new financing during the survey period, but only 41% of applicants received the full amount requested, while 36% received some financing and 24% received none. Financing outcomes also differed across lender types, while online-lender applicants were more likely to report high interest rates and unfavorable repayment terms as financing challenges. These outcomes demonstrate that access to financing remains influenced by credit conditions, lender characteristics, and the information available for financial assessment.

The problem also concerns the limited integration of transaction-generated information into financial evaluation. Conventional assessment processes continue to rely heavily on established financial records, credit histories, repayment information, and other indicators that may provide an incomplete representation of current business activity. At the same time, routine digital payments generate information capable of reflecting revenue movements, transaction consistency, and cash-flow behaviour. The existence of this information does not automatically mean that it is incorporated into financing decisions. The resulting disconnect can leave businesses with active digital transactions but insufficient financial visibility within conventional assessment systems. The central problem addressed by this study is therefore the limited conceptual integration of payment-generated information, analytical technologies, and alternative financial assessment within an approach to improving digital financial access.

Table 1. Financial Access Barriers Affecting Underserved Small Businesses

Barrier	Description	Financial Consequence
Limited Credit History	Insufficient borrowing and repayment records	Reduced credit eligibility
Restrictive Credit Standards	Stringent institutional lending criteria	Lower probability of full financing approval
High Financing Costs	High interest rates and unfavorable repayment conditions	Increased financing burden
Weak Banking Relationships	Limited engagement with conventional financial institutions	Reduced access to formal credit
Fragmented Financial Records	Incomplete or dispersed business financial information	Limited financial visibility
Limited Access to Digital Infrastructure	Unequal access to digital payment and financial technologies	Restricted digital participation
Information Asymmetry	Limited institutional visibility into business operations	Greater difficulty evaluating business performance
Limited Working Capital	Insufficient access to short-term business financing	Constraints on business continuity and growth

Source: Author's synthesis based on evidence from the **Federal Reserve Banks (2025)** concerning small-business financing outcomes, credit availability, financing costs, and lender experiences, together with established literature on information asymmetry and small-business finance.

1.3 Research Gap

Existing research provides substantial evidence on small-business financing, digital payments, financial technology, and credit accessibility, but these areas are often examined as distinct dimensions of financial development. The Federal Reserve Banks (2025) provides detailed evidence on financing applications, approval outcomes, lender experiences, and financial challenges among U.S. small businesses, while the Federal Reserve Payments Study documents the scale and development of noncash payment activity across the U.S. economy. These sources establish the importance of both financing access and digital payment infrastructure, but they do not by themselves provide an integrated framework explaining how payment-generated business information can connect with financial assessment and digital financial access. The gap therefore lies not in the absence of evidence on payments or financing, but in the limited integration of these dimensions within a single framework focused on underserved small businesses.

A further gap concerns the analytical transformation of payment information into indicators relevant to financial assessment. Digital payment systems generate transaction-level information, yet the existence of

such information does not ensure that it is systematically incorporated into credit or financial-access decisions. This issue becomes increasingly relevant as artificial intelligence adoption expands across the business population. The SBA (2026) reports that 7.6% of businesses used artificial intelligence between September 2024 and August 2025, indicating that adoption remained limited across the broader business population during that period. The research gap therefore concerns the limited conceptual integration of payment data, AI analytics, alternative financial assessment, and digital financial access into a unified framework designed specifically around the circumstances of underserved U.S. small businesses.

1.4 Research Aim and Objectives

The expansion of digital payment activity has created an increasingly information-rich financial environment in which routine transactions generate records of business activity. The Federal Reserve's 2025 Payments Study recorded 236.6 billion noncash payments in the United States during 2024, illustrating the scale of contemporary electronic payment activity. At the same time, financing constraints remain evident among small businesses, with the Federal Reserve Banks (2025) reporting that 24% of financing applicants received none of the financing they sought and 36% received only some of the amount requested. These conditions establish the basis for examining how payment-generated information can be connected to financial assessment and digital financial access.

The study aims to develop a **conceptual data-driven payment solution framework** for improving digital financial access among underserved small businesses in the United States. The framework integrates payment-generated information, AI, predictive analytics, alternative credit assessment, and digital financial infrastructure into a unified conceptual structure. The study pursues the following objectives:

1. To examine the barriers limiting digital financial access among underserved small businesses in the United States.
2. To evaluate the role of data-driven payment technologies in improving financial accessibility.
3. To examine the role of AI and predictive analytics in financial evaluation and decision-making.
4. To develop an integrated data-driven payment solution framework for underserved small businesses.
5. To examine privacy, security, governance, and institutional considerations associated with data-driven financial systems.

1.5 Research Questions

Financing constraints continue to affect small businesses even as digital payment activity expands across the U.S. economy. Evidence from the Federal Reserve Banks (2025) indicates continuing challenges involving credit availability, financing costs, and financing outcomes, while the Federal Reserve Payments Study records the substantial scale of noncash payment activity in the United States. These conditions establish the context for examining whether information generated through digital transactions can contribute to broader financial assessment and access.

The research questions therefore focus on the relationship between payment technologies, transaction-generated information, AI, financial assessment, and access to formal financial services. They correspond directly with the research problem and objectives and provide the analytical direction for developing the proposed conceptual framework. The study addresses the following questions:

1. What factors limit digital financial access among underserved small businesses in the United States?
2. How can data-driven payment solutions contribute to digital financial access among underserved small businesses?
3. What role can AI and predictive analytics play in financial evaluation and decision-making?
4. How can payment-generated transaction data contribute to credit evaluation and access to business financing?
5. What privacy, security, governance, and institutional factors shape the implementation of data-driven payment systems?

2. Literature Review

Digital financial access has increasingly been examined as an interconnected process involving payment systems, financial information, digital platforms, analytical technologies, and financing mechanisms rather than as a collection of separate financial services. For small businesses, this relationship is important because participation in digital payment systems produces records of commercial activity that can complement conventional financial information. **Federal Reserve Banks (2025)** report continuing differences in small-business financing outcomes across credit-risk categories, lender types, and financing conditions, demonstrating that participation in financial systems does not automatically produce equal financing outcomes. At the same time, the **Board of Governors of the Federal Reserve System (2026)**

reported 236.6 billion noncash payments in the United States during 2024, confirming the extensive scale of electronically recorded financial activity.

The literature further indicates that technological expansion creates both opportunities and governance requirements. Digital payment infrastructure can increase the availability of transaction-level information, while artificial intelligence (AI) and predictive analytics provide mechanisms for processing such information within financial decision-making. **Gambacorta et al. (2024)** found that machine-learning models using non-traditional data improved credit-risk prediction in their analysis of transaction-level data from a Chinese fintech firm. This evidence demonstrates the analytical value of information beyond conventional credit variables, although its empirical setting is outside the United States. **NIST (2023)** establishes the AI Risk Management Framework (AI RMF 1.0) as a structured approach for managing AI-related risks throughout the AI lifecycle. These developments establish the foundation for examining how payment information, analytical technologies, alternative assessment, and digital financial access can be integrated within underserved small-business finance.

2.1 Digital Financial Inclusion and Small Business Development

Access to appropriate digital financial services has become increasingly connected with the ability of small businesses to participate in formal economic activity, process transactions, manage financial resources, and obtain external financing. Digital financial inclusion encompasses access to electronic payment channels, banking services, credit facilities, and technology-enabled financial products that reduce dependence on conventional physical financial infrastructure. **Federal Reserve Banks (2025)** report that small businesses obtain financing from banks, credit unions, online lenders, and other financial providers, with financing experiences differing according to business characteristics, credit risk, and lender type. Digital channels therefore form an important part of the financial environment in which small businesses conduct routine commercial activities and establish records of financial behaviour.

The significance of digital participation extends beyond transaction processing because electronic financial activity creates records that can increase the visibility of business operations. The **Board of Governors of the Federal Reserve System (2026)** reported that noncash payments reached 236.6 billion transactions in 2024, demonstrating the scale of electronically recorded financial activity within the U.S. economy. For small businesses, repeated electronic transactions can produce information concerning payment frequency, transaction values, revenue movements, and patterns of commercial activity. Digital financial inclusion therefore involves not only the ability to use electronic financial services but also participation in financial

systems where ongoing economic activity can be recorded and potentially incorporated into broader financial processes.

2.2 Challenges Facing Underserved Small Businesses

Financial access remains uneven across the small-business population because enterprises differ in creditworthiness, financing history, revenue stability, collateral availability, and relationships with financial institutions. **Federal Reserve Banks (2025)** report that credit availability remains an important challenge, with financing outcomes differing according to business credit risk and lender characteristics. High interest rates, unfavorable repayment terms, and insufficient financing amounts also contribute to financing difficulties. These conditions are particularly consequential for enterprises with limited borrowing histories because conventional financial assessment places substantial importance on established credit information and documented financial performance. The resulting constraints can limit working-capital availability and affect the capacity of smaller enterprises to maintain operations and pursue growth.

Digital participation does not remove these structural financing barriers. Businesses can maintain electronic transaction activity while remaining subject to conventional credit-assessment requirements that depend heavily on established financial and credit information. **Federal Reserve Banks (2025)** document substantial differences in financing outcomes between low-credit-risk and medium- or high-credit-risk businesses, illustrating the continuing influence of established risk-assessment practices. Financing challenges therefore reflect an interaction among credit history, institutional requirements, financing costs, and the availability of usable financial information. For underserved enterprises, the difference between actual commercial activity and the information recognized within formal financial assessment remains an important dimension of financial exclusion.

2.3 Evolution of Digital Payment Technologies

Payment systems in the United States have undergone substantial technological transformation, moving from predominantly cash- and check-based transactions toward increasingly electronic and interconnected payment channels. The **Board of Governors of the Federal Reserve System (2026)** reported that total noncash payments reached 236.6 billion transactions in 2024, more than three times the level recorded in 2000. Cards represented 79% of noncash payments by number, while ACH payments accounted for almost three-quarters of noncash payment value. These developments demonstrate the central role of electronic payment mechanisms within contemporary commercial activity. The evolution also includes real-time payment infrastructure, including the Federal Reserve's FedNow Service, which provides participating financial institutions with continuously available payment and settlement capabilities.

The transformation of payment technologies has changed not only how funds move but also the quantity and structure of information generated through transactions. Contemporary electronic payment systems produce records containing information about transaction amounts, timing, payment channels, and other characteristics of payment activity. The **Board of Governors of the Federal Reserve System (2026)** provides aggregate evidence of the expanding scale of these electronically recorded transactions. This development increases the informational significance of payment infrastructure because transaction records can form part of broader financial information systems. For small businesses, the transition toward electronic payments therefore represents both an operational transformation and an expansion of digitally generated information that can contribute to financial assessment.

2.4 Payment Data and Financial Information

Digital payment activity generates recurring financial records that provide evidence of commercial transactions and business operating patterns. Transaction amounts, payment frequency, revenue movements, settlement activity, and account activity provide information about ongoing operations that differs from historical credit records. The **Board of Governors of the Federal Reserve System (2026)** reported 236.6 billion noncash payments in 2024, demonstrating the extensive scale of electronically recorded financial activity in the United States. The scale of digital transactions consequently provides an important informational environment in which payment activity can contribute to the broader understanding of business financial behaviour.

Payment information becomes particularly relevant when conventional financial records provide an incomplete view of current business activity. Transaction histories can capture payment regularity, revenue movements, seasonal patterns, and other indicators of ongoing operations. **Gambacorta et al. (2024)** provide evidence that machine learning combined with non-traditional data can improve credit-risk prediction under certain conditions, demonstrating the analytical relevance of information beyond conventional credit variables. Their study, however, uses transaction-level data from a Chinese fintech firm and therefore provides supporting international evidence rather than direct evidence concerning U.S. small businesses. Payment data consequently represent an additional information layer that can complement established financial records within broader financial assessment processes.

2.5 AI and Predictive Analytics in Financial Decision-Making

The increasing availability of structured financial data has expanded the role of AI and predictive analytics in financial decision-making. Analytical systems can process large datasets, identify relationships among financial variables, detect patterns, and generate predictive assessments from historical and current

information. **Gambacorta et al. (2024)**, using transaction-level data from a Chinese fintech firm, found that machine-learning models using non-traditional data performed better than traditional models in predicting losses and defaults, particularly during periods of financial stress. The findings demonstrate the analytical potential of combining machine learning with broader information sources, although the evidence comes from a Chinese fintech setting and does not constitute direct empirical evidence from U.S. small businesses.

AI-based financial assessment also requires careful management of model and data risks. **NIST (2023)** establishes the AI Risk Management Framework as a structured approach for managing risks associated with AI systems across their lifecycle, emphasizing governance, measurement, monitoring, transparency, and accountability. Within financial decision-making, these requirements are important because analytical outputs can influence credit evaluation and access to financial services. Model performance therefore depends not only on computational capability but also on data quality, reliability, transparency, explainability, security, and appropriate management of potential bias. The framework consequently positions AI governance as an integral component of data-driven financial assessment rather than as a separate technical concern.

2.6 Alternative Credit Assessment and Financial Inclusion

Conventional credit assessment relies substantially on established financial histories, repayment records, credit scores, collateral, and other indicators that may provide limited information about businesses with short operating histories or restricted borrowing experience. **Federal Reserve Banks (2025)** demonstrate the importance of credit-risk classification in small-business financing outcomes, with businesses facing higher credit risk experiencing less favorable financing results. These patterns highlight the importance of the information available to lenders when determining financial eligibility. Alternative assessment approaches have consequently become relevant to financial inclusion because they expand the information base through which business performance and financial capacity can be examined.

Caballero et al. (2025) report that digital innovation and the use of data by fintech and big-tech lenders can improve aspects of small-firm credit access by reducing information and collateral constraints in emerging-market economies. Their analysis concerns emerging-market economies rather than the United States and therefore serves as supporting international evidence for the relationship between digital information and small-business credit assessment. **Gambacorta et al. (2024)** similarly demonstrate the predictive value of machine learning and non-traditional data using transaction-level information from a Chinese fintech firm. Alternative assessment therefore represents an approach in which historical credit

information can be complemented by broader indicators of observable business activity and financial behaviour.

2.7 FinTech and Inclusive Payment Ecosystems

The development of financial technology (FinTech) has expanded the range of digital channels through which businesses interact with financial institutions, payment providers, and other financial-service platforms. Digital platforms increasingly connect payment processing, account management, financial information, and technology-enabled financial services within integrated environments. The **Board of Governors of the Federal Reserve System (2026)** documents the continued expansion of electronic payment activity across cards, ACH transfers, and other payment mechanisms, confirming the central role of digital infrastructure in contemporary U.S. financial activity. This development has increased the importance of interoperability between payment systems and other financial services.

Inclusive payment ecosystems depend not only on transaction speed but also on the capacity of financial infrastructure to connect transaction activity with broader financial services. The Federal Reserve's FedNow Service represents an important development in continuously available payment infrastructure, providing participating financial institutions with real-time payment and settlement capabilities. **Caballero et al. (2025)** identify digital innovation and data use by fintech and big-tech lenders as mechanisms that can reduce information constraints in small-firm lending, although their evidence concerns emerging-market economies. The interaction among payment providers, financial institutions, digital platforms, and analytical technologies therefore forms an increasingly integrated financial ecosystem.

2.8 Privacy, Security, and Data Governance

The increasing use of payment data in financial analysis creates significant requirements for privacy, security, data integrity, and accountable information management. Financial transaction records contain information concerning business revenues, customers, counterparties, account activity, and commercial behaviour, making unauthorized access or inappropriate processing capable of creating financial and operational risks. **NIST (2023)** establishes risk-management principles for AI systems that are relevant where sensitive financial information is processed through AI-enabled analytical environments. Privacy and security considerations are therefore integral to the development of data-driven payment systems because expanded analytical capabilities increase the range of purposes for which transaction information can be processed.

Security and governance requirements become more complex when payment information is processed through AI systems. **NIST (2023)** establishes the AI Risk Management Framework as a basis for managing AI-related risks through governance, measurement, and continuous management across the AI lifecycle. These principles are relevant to data-driven payment environments because financial decisions may depend on automated processing of large volumes of transactional information. Maintaining data integrity, controlling access, protecting information throughout its lifecycle, and ensuring accountable analytical processes are therefore central to responsible financial data management. The governance of payment data consequently extends beyond cybersecurity to include privacy protection, model accountability, data quality, and institutional controls over financial information.

Table 2. Synthesis of Previous Studies and Identified Research Gaps

Literature Area	Key Evidence	Established Knowledge	Identified Gap
Digital Financial Inclusion	Federal Reserve Banks (2025); SBA (2026)	Digital financial services provide small businesses with access to payment, banking, and financing channels, but financing outcomes remain uneven across firms.	Limited integration between digital financial participation and the use of payment-generated information in financial assessment.
Small-Business Financing	Federal Reserve Banks (2025)	Credit risk, financing costs, lender characteristics, and financing conditions influence small-business financing outcomes.	Conventional assessment can provide limited financial visibility for businesses with restricted credit histories and borrowing records.
Digital Payments	Board of Governors of the Federal Reserve System (2026)	Noncash payment activity has expanded substantially across the U.S. economy, increasing the scale of electronically recorded transactions.	Limited integration between expanding payment activity and mechanisms for improving small-business financial access.
Payment Data	Board of Governors of the Federal Reserve System (2026); Gambacorta et al. (2024)	Digital transactions generate financial information that can provide additional indicators of business activity, while machine-learning research demonstrates the potential value of transaction-level and non-traditional data in credit-risk prediction.	Limited integration of payment-generated information with alternative financial assessment specifically for underserved U.S. small businesses.
AI and Predictive Analytics	Gambacorta et al. (2024); NIST (2023)	Machine-learning models using non-traditional data can improve credit-risk prediction under certain conditions, while trustworthy AI	Limited integration of predictive analytics and trustworthy AI governance within a payment-based

		requires structured risk management, transparency, and accountability.	financial-access framework for underserved small businesses.
Alternative Credit Assessment	Federal Reserve Banks (2025); Caballero et al. (2025)	Digital innovation and alternative information can broaden the information available for small-business credit assessment. Caballero et al. (2025) provide evidence from emerging-market economies rather than the United States.	Limited U.S.-focused frameworks connecting payment-generated indicators with alternative credit assessment and financial inclusion.
FinTech Ecosystems	Board of Governors of the Federal Reserve System (2026); Caballero et al. (2025)	Digital payment infrastructure and FinTech platforms increasingly connect transaction activity with financial services and data-driven lending. Evidence from Caballero et al. (2025) is specific to emerging-market economies.	Limited integration of payment infrastructure, AI analytics, alternative assessment, and financial-access mechanisms within a unified U.S. small-business framework.
Privacy and Data Governance	NIST (2023, 2025)	AI and payment-data environments require privacy protection, security, accountability, transparency, and structured risk management.	Limited integrated treatment of privacy, security, AI governance, and payment-data management within data-driven financial-access frameworks.

Source: Author's synthesis based on Federal Reserve Banks (2025), Board of Governors of the Federal Reserve System (2026), SBA (2026), Gambacorta et al. (2024), Caballero et al. (2025), and NIST (2023, 2025).

3. Theoretical and Conceptual Framework

A coherent explanation of digital financial access requires an analytical structure that connects technological adoption, financial information, institutional decision-making, and the conditions under which small businesses participate in formal financial systems. This study develops a **conceptual framework** that brings these dimensions together by examining how digital payment technologies generate financial information, how such information can be processed through artificial intelligence (AI) and predictive analytics, and how resulting indicators can complement conventional financial assessment. The framework recognizes that access to financial services is influenced by technological capabilities, organizational conditions, institutional practices, and external financial environments rather than technology alone. This perspective is consistent with evidence from the **Federal Reserve Banks (2025)**

showing differences in small-business financing outcomes according to credit risk, lender type, and financing conditions.

The framework also incorporates principles of trustworthy AI because the use of automated analytical systems in financial assessment raises issues of reliability, transparency, privacy, security, accountability, and fairness. The **NIST (2023)** establishes the AI Risk Management Framework as a structured approach for identifying, assessing, and managing risks throughout the AI lifecycle. These principles are particularly relevant when payment-generated information contributes to financial assessment because analytical outputs may influence access to credit and other financial services. Accordingly, the framework establishes conceptual relationships among digital payment infrastructure, payment-generated information, analytical processing, financial assessment, and digital financial access.

3.1 Theoretical Foundations

The study draws on the **TOE framework** to explain the conditions influencing the adoption and implementation of data-driven financial technologies. The technological dimension concerns payment infrastructure, data-processing capabilities, interoperability, and analytical technologies; the organizational dimension concerns the resources, capabilities, and digital readiness of small businesses; and the environmental dimension encompasses financial institutions, regulatory requirements, market conditions, and broader institutional structures. These dimensions provide a basis for understanding why the availability of digital payment technologies does not necessarily produce equivalent financial-access outcomes across businesses. The **Federal Reserve Banks (2025)** evidence on differences in small-business financing outcomes provides an institutional context for examining these relationships.

The framework also draws on **Information Asymmetry Theory**, which explains how unequal access to reliable information can influence financial relationships between businesses and lenders. Businesses with limited financial histories or restricted borrowing records may provide lenders with less information through conventional assessment channels, potentially increasing uncertainty regarding financial capacity and risk. Payment-generated information can provide additional evidence of observable business activity through transaction values, payment frequency, revenue movements, and cash-flow patterns. This information can therefore complement established financial records when assessing businesses whose conventional documentation provides limited evidence of current operations. The framework is further informed by the **NIST (2023)**, which emphasizes the importance of validity, reliability, security, transparency, explainability, privacy, and fairness in the responsible development and use of AI systems.

Together, these perspectives establish the theoretical basis for connecting technology, information availability, analytical processing, institutional assessment, and financial access.

Table 3. Theoretical Constructs and Their Application to the Study

Theoretical Foundation	Theoretical Construct	Application to the Study
Technology–Organization–Environment (TOE) Framework	Technological Conditions	Digital payment infrastructure, data-processing capabilities, interoperability, and AI and analytical technologies that support data-driven financial services.
TOE Framework	Organizational Conditions	Digital capabilities, resources, financial-management capacity, and operational readiness of small businesses.
TOE Framework	Environmental Conditions	Financial institutions, regulatory requirements, market conditions, and institutional structures influencing digital financial access.
Information Asymmetry Theory	Information Availability	Differences in the financial information available to small businesses and financial institutions during financial assessment.
Information Asymmetry Theory	Financial Information	Payment-generated information as complementary evidence of business activity, revenue movements, transaction patterns, and cash-flow behaviour.
NIST AI Risk Management Framework	Validity and Reliability	Accuracy, consistency, and dependable performance of AI-based analytical outputs used in financial assessment.
NIST AI Risk Management Framework	Transparency and Explainability	Clarity regarding how AI-supported financial indicators are generated and how analytical outputs contribute to financial assessment.
NIST AI Risk Management Framework	Privacy and Security	Protection of payment-generated and financial information throughout data collection, processing, analysis, and use.
NIST AI Risk Management Framework	Fairness	Consideration of potential bias and equitable treatment in AI-supported financial assessment and access decisions.

Source: Author's synthesis based on the TOE framework, Information Asymmetry Theory, and the NIST AI Risk Management Framework (NIST, 2023)

3.2 Conceptual Relationships among Key Variables

The conceptual framework consists of interconnected components that describe how payment activity can contribute to broader financial assessment. **Digital payment infrastructure** represents the technological

foundation through which small businesses conduct transactions and generate electronic records. These records may contain information concerning transaction values, payment frequency, revenue movements, settlement activity, and cash-flow patterns. **Payment-generated information** therefore represents the primary informational input within the framework. Data processing subsequently organizes, validates, and structures this information for analytical use. The **Board of Governors of the Federal Reserve System (2026)** reported 236.6 billion noncash payments in the United States during 2024, demonstrating the extensive scale of electronically recorded payment activity.

The conceptual relationship then progresses from payment-generated information to **AI and predictive analytics, financial assessment, and digital financial access**. Analytical techniques can identify patterns in transaction information and generate indicators relating to business activity and financial behaviour. These indicators are conceptualized as complementary evidence rather than replacements for established measures such as credit history, repayment records, and financial statements. This distinction is important because the **Federal Reserve Banks (2025)** reports substantial differences in financing outcomes according to credit risk and lender characteristics. The framework therefore proposes the following conceptual pathway: **digital payment infrastructure → payment-generated information → data processing → AI and predictive analytics → financial assessment → digital financial access**. Privacy, security, transparency, explainability, accountability, and fairness operate as cross-cutting governance dimensions throughout the pathway.

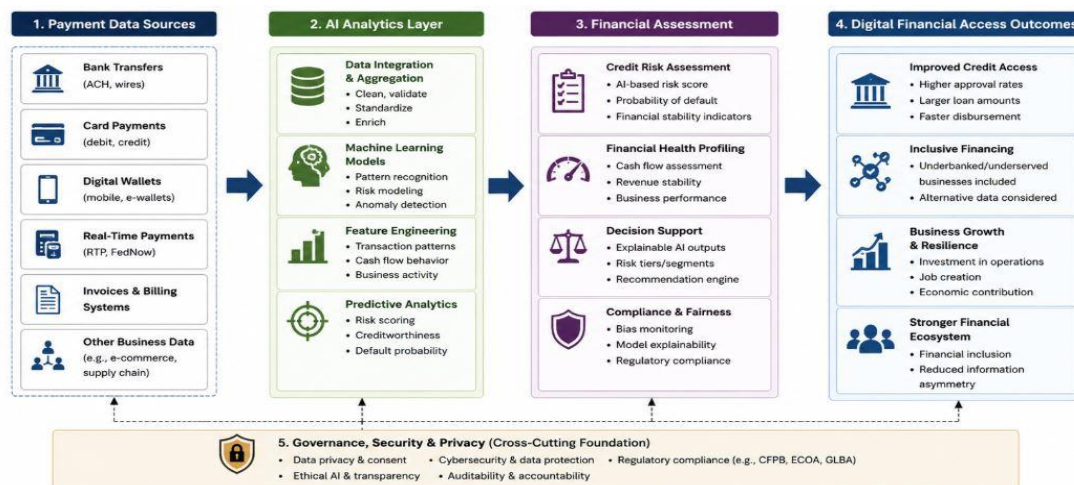
3.3 Proposed Data-Driven Payment Solution Framework

The proposed framework integrates digital payment infrastructure, payment-generated information, data processing, AI and predictive analytics, financial assessment, and digital financial access into a unified conceptual structure. The process begins with routine digital transactions conducted by small businesses, through which payment systems generate records concerning transaction amounts, frequency, revenue movements, and payment behaviour. These records are subsequently organized and validated within a data-integration layer before being made available for analytical processing. The resulting information can provide additional evidence of recurring business activity and financial behaviour, complementing rather than replacing conventional financial records. The **Board of Governors of the Federal Reserve System (2026)** evidence on the scale of U.S. noncash payment activity provides the broader payment-system context for this framework.

The analytical layer applies AI and predictive techniques to processed payment information to identify patterns and generate indicators relevant to financial assessment. These indicators are conceptually

incorporated alongside conventional financial information, creating a broader information base for evaluating business activity and financial capacity. The assessment layer then connects with digital financial access through financing and other formal financial services. Governance mechanisms operate across the framework through privacy protection, cybersecurity, transparency, explainability, accountability, fairness, and data-quality controls. The **NIST (2023)** provides the governance basis for managing risks associated with AI systems throughout their lifecycle. The proposed framework consequently establishes a conceptual relationship between payment activity, financial information, analytical technologies, financial assessment, and digital financial access without claiming that the framework has been empirically tested or validated within this study.

Fig 1 : Conceptual Framework Linking Payment Data, AI Analytics, Financial Assessment, and Digital Financial Access



Payment records provide useful information about business activity, while AI analytics can process such information to support financial assessment. Gambacorta et al. (2024) provide supporting evidence from a Chinese fintech setting on the use of non-traditional data in AI-based credit-risk prediction.

4. Methodology

The methodology establishes the procedures through which the study examines digital financial access and develops the proposed data-driven payment framework for underserved small businesses in the United States. The study uses secondary evidence from authoritative government institutions, regulatory organizations, and scholarly literature to examine the relationships among digital payment systems, payment-generated financial information, AI analytics, alternative financial assessment, and access to financial services. This approach corresponds with the study's framework-oriented purpose because the

research addresses a technology and financial-access problem through systematic examination and integration of existing evidence. The **Federal Reserve Banks (2025)** provides evidence concerning small-business credit access, financing conditions, lender characteristics, and borrowing experiences, while the **U.S. Small Business Administration (2026)** provides current information concerning the scale and economic importance of U.S. small businesses. These sources establish the institutional and economic context for the study.

The methodological structure combines documentary analysis, thematic synthesis, conceptual analysis, and framework development. Evidence is examined according to the research questions and organized around financial access barriers, digital payment technologies, payment data, AI analytics, alternative credit assessment, FinTech infrastructure, and data governance. The **Board of Governors of the Federal Reserve System (2026)** provides evidence on the development and scale of noncash payment activity, while **NIST (2025)** provides authoritative guidance concerning privacy and technology-related risk management. Peer-reviewed studies complement institutional evidence by providing theoretical explanations and empirical findings relevant to digital financial inclusion and data-driven financial services. The methodology therefore maintains a direct connection between the research problem, available evidence, analytical procedures, and development of the proposed framework.

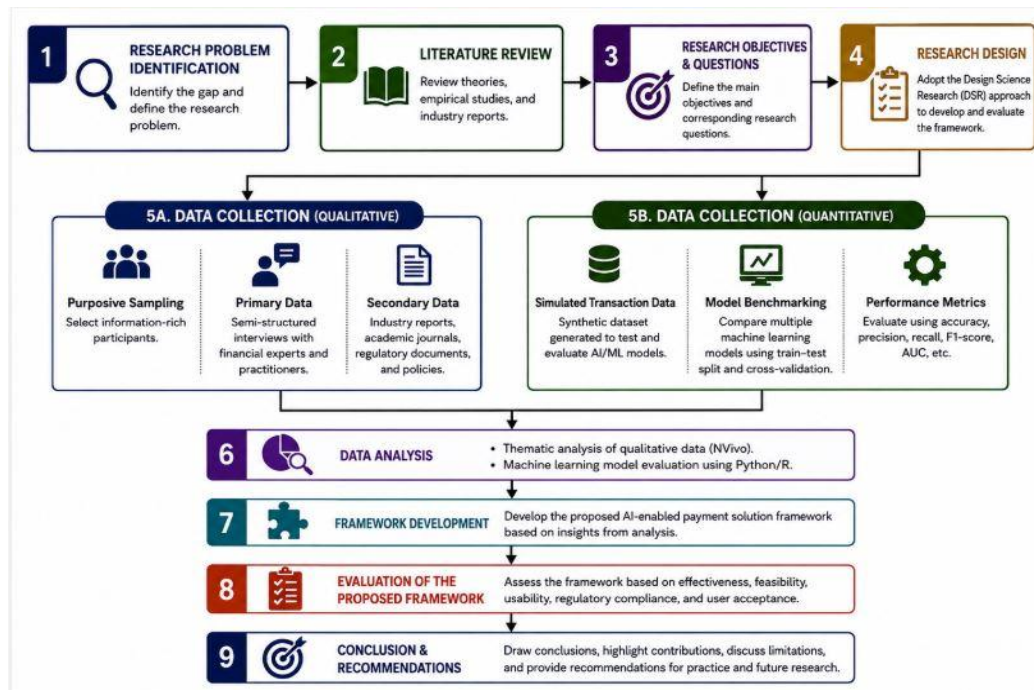
4.1 Research Design

The study adopts a **design science research** approach because its principal methodological outcome is the development of an integrated framework addressing an identified problem in digital financial access. Design science research emphasizes the systematic creation and evaluation of artifacts intended to address identified organizational and technological problems. **Hevner et al. (2004)** establish the foundations of design science research by emphasizing the relevance of practical problems, the rigor of knowledge foundations, and the iterative development and evaluation of research artifacts. **Peppers et al. (2007)** further provide a structured Design Science Research Methodology involving problem identification and motivation, definition of objectives, design and development, demonstration, evaluation, and communication. These principles provide the methodological basis for developing the proposed data-driven payment framework.

The research design incorporates documentary evidence and conceptual analysis rather than a primary survey or institutional transaction experiment. Evidence concerning small-business financing is obtained from the **Federal Reserve Banks (2025)**, which documents credit availability, financing challenges, and lender characteristics. Evidence concerning payment-system development is obtained from the **Board of**

Governors of the Federal Reserve System (2026), which reports extensive noncash payment activity within the U.S. financial system. Scholarly literature provides additional theoretical and empirical foundations for examining digital financial inclusion, AI analytics, alternative assessment, and FinTech. The design consequently establishes a systematic pathway from problem identification and evidence examination through framework development and conceptual validation.

Fig 2: Research Methodology Flowchart



Source: Author's methodological synthesis based on Hevner et al. (2004) and Peffers et al. (2007), with the study's secondary evidence informing the framework development and analysis.

4.2 Data Sources and Selection Criteria

The study relies on secondary evidence obtained from government agencies, regulatory institutions, recognized research organizations, and peer-reviewed academic literature. Major institutional sources include the **Federal Reserve Banks, Board of Governors of the Federal Reserve System, U.S. SBA, and NIST**. These sources provide evidence concerning small-business financing, payment systems, business characteristics, technology adoption, privacy, cybersecurity, and AI governance. Academic sources provide theoretical and empirical evidence concerning digital financial inclusion, FinTech, payment technologies, alternative credit assessment, predictive analytics, and data-driven financial

services. The use of these sources establishes a multidimensional evidence base covering the financial, technological, institutional, and governance dimensions of the research problem.

Selection criteria focus on relevance, credibility, verifiability, methodological quality, and publication recency. The study prioritizes recent evidence while retaining earlier scholarly sources where they provide established theoretical or methodological foundations. Sources are considered relevant when their content directly addresses U.S. small businesses, digital financial access, payment technologies, financial data, AI, predictive analytics, credit assessment, privacy, or governance. Publications with unclear authorship, unverifiable information, weak institutional authority, or insufficient connection with the research questions are excluded. The **Federal Reserve Banks (2025)** small-business financing evidence and the **Board of Governors of the Federal Reserve System (2026)** payment-system evidence constitute important components of the selected evidence base.

4.3 Data Analysis Approach

The analysis uses thematic synthesis to examine recurring relationships across the selected literature and institutional evidence. Information extracted from each source is organized around the principal dimensions established by the research questions, including financial access barriers, digital payment infrastructure, payment-generated data, AI analytics, alternative credit assessment, FinTech ecosystems, and governance. Thematic analysis enables recurring concepts, relationships, institutional patterns, and research gaps to be identified across different categories of evidence. **Braun and Clarke (2021)** provide methodological guidance for systematic thematic analysis and the development of meaningful patterns from qualitative information.

Comparative analysis is also applied to examine how findings from different sources correspond or differ across financial and technological dimensions. Evidence from the **Federal Reserve Banks (2025)** concerning small-business financing is examined alongside the **Board of Governors of the Federal Reserve System (2026)** evidence concerning noncash payment activity. Findings from **NIST (2025)** concerning privacy and risk management are incorporated into the governance analysis, while peer-reviewed research provides additional conceptual interpretation. The resulting synthesis connects payment activity with financial information, analytical processing, financial assessment, and digital financial access. Because the study is based on secondary evidence and framework development, the analysis does not involve the collection, training, or empirical testing of a proprietary transaction dataset.

Table 4. Data Sources, Variables, and Analytical Methods

Data Source	Key Variables/Information	Analytical Method	Purpose
Federal Reserve Banks (2025)	Credit access, financing applications, approval outcomes, lender types, financing conditions, and reported financing challenges	Comparative analysis	Examine small-business financing barriers and access outcomes
Board of Governors of the Federal Reserve System (2026)	Noncash payments, payment channels, transaction volumes, and payment-system characteristics	Descriptive analysis	Examine the development and scale of digital payment activity
U.S. Small Business Administration (2026)	Business population, employment, economic contribution, and AI adoption	Descriptive analysis	Establish the economic and technological context of U.S. small businesses
NIST (2025)	Privacy-risk management, cybersecurity, privacy considerations, and data governance	Thematic analysis	Examine privacy and data-governance requirements
Hevner et al. (2004)	Design science principles, artifact development, relevance, rigor, and evaluation	Methodological analysis	Establish the theoretical foundation for the design science research approach
Peppers et al. (2007)	Problem identification, objectives, design and development, demonstration, evaluation, and communication	Process analysis	Structure framework development and conceptual evaluation
Peer-reviewed literature	Digital financial inclusion, FinTech, AI, payment data, alternative credit assessment, and predictive analytics	Thematic synthesis	Establish theoretical and empirical foundations for the proposed framework

Source: Author's synthesis based on Federal Reserve Banks (2025), Board of Governors of the Federal Reserve System (2026), U.S. Small Business Administration (2026), NIST (2025), Hevner et al. (2004), Peppers et al. (2007), and the peer-reviewed literature reviewed in the study.

4.4 Framework Development and Validation

Framework development follows a structured process through which findings from the literature and secondary evidence are translated into interconnected technological, informational, analytical, and

institutional components. The first analytical stage identifies barriers affecting digital financial access among underserved small businesses. The second establishes the role of digital payment infrastructure in generating transaction-level information. The third connects payment data with data processing, AI analytics, and financial assessment. The final stage incorporates digital financial access and governance requirements into the integrated framework. This sequence maintains consistency with the relationships established in the theoretical and conceptual framework.

Validation is conducted through evidence comparison, conceptual consistency, and alignment with the research questions. Each component of the framework is examined against authoritative evidence to determine whether the proposed relationships are consistent with documented financial and technological conditions. The **Federal Reserve Banks (2025)** provides evidence concerning small-business financing conditions and outcomes, while the **Board of Governors of the Federal Reserve System (2026)** documents the scale and development of electronic payment activity. The **NIST AI Risk Management Framework** provides an additional basis for examining trustworthy AI considerations, including transparency, reliability, privacy, security, and fairness. Framework validation therefore establishes conceptual consistency among the identified research problem, theoretical foundations, secondary evidence, and proposed technological relationships rather than empirical validation through a primary transaction dataset.

4.5 Ethical, Privacy, and Data Governance Considerations

The use of payment-generated information introduces ethical considerations because transaction records can contain sensitive information concerning business revenues, customers, counterparties, account activity, and commercial behaviour. Appropriate management of such information requires controls covering collection, storage, processing, access, disclosure, and retention. **NIST (2025)** emphasizes privacy-risk management within contemporary data environments and the relationship between privacy protection and cybersecurity. These considerations are particularly important within data-driven financial systems because payment information may be processed through automated analytical technologies and subsequently incorporated into consequential financial assessments.

Data governance also encompasses accuracy, transparency, accountability, security, and fairness throughout the information lifecycle. The **NIST AI Risk Management Framework (2023)** provides a basis for responsible AI risk management, while the **Federal Reserve Banks (2025)** demonstrates the financial significance of credit assessment for small businesses. Data quality is equally important because incomplete, inaccurate, or historically biased information can affect analytical outputs and financial

decisions. Within the proposed framework, governance therefore extends from payment-data collection through processing, AI analysis, financial assessment, and financial-service delivery. Privacy protection, cybersecurity, responsible data use, transparency, and fairness consequently constitute integrated considerations throughout the proposed data-driven payment environment.

5. Development of the Data-Driven Payment Solution

The development of the data-driven payment solution centers on connecting digital payment activity with financial information, analytical processing, financial assessment, and access to formal financial services. The scale of the contemporary payment environment provides a foundation for this structure. The **Board of Governors of the Federal Reserve System (2026)** reported 236.6 billion noncash payments in the United States during 2024, demonstrating the extensive scale of electronically recorded payment activity. Payment systems therefore represent not only mechanisms for transferring funds but also sources of information concerning transaction patterns and business activity.

The solution developed in this study integrates payment-data collection, data processing, AI analytics, alternative credit evaluation, digital financial access, and governance into a connected conceptual architecture. Evidence from the **Federal Reserve Banks (2025)** indicates that 59% of surveyed employer firms sought new financing during the preceding 12 months, while only 41% of applicants received all the financing requested. These financing conditions demonstrate the continuing importance of financial assessment within small-business access to capital. Caballero et al. (2025), examining small firms in emerging-market economies, similarly provide evidence that digital innovation and data use can reduce information constraints affecting small-business credit. Their findings are used here as supporting international evidence rather than as direct evidence from U.S. small businesses.

5.1 Payment Data Collection and Integration

The collection stage captures financial information generated through ordinary digital payment activity. Transaction records may contain information such as transaction value, frequency, timing, payment channel, settlement activity, and recurring revenue patterns. These records provide potentially useful evidence of commercial activity and establish the primary information input within the proposed framework. The **Board of Governors of the Federal Reserve System (2026)** reports that cards, ACH payments, and checks remain major components of the U.S. noncash payment environment, with total noncash payments reaching 236.6 billion transactions in 2024. The diversity of payment channels therefore creates a broad information environment from which business-level transaction characteristics can potentially be derived.

Integration involves organizing information generated across different payment channels into a structured analytical environment. Variations in data formats, transaction identifiers, timestamps, classifications, and settlement procedures can be addressed through standardized data structures that permit information to be examined consistently. The **Consumer Financial Protection Bureau (2026)** provides evidence of the institutional development of standardized small-business lending data collection in the United States. Within the proposed solution, payment records are therefore conceptually linked with relevant financial information while maintaining consistent identifiers, data-quality controls, privacy safeguards, and appropriate separation of sensitive information. The resulting integrated information structure provides the foundation for subsequent processing and financial analysis.

5.2 Data Processing and Analytics

Raw payment records require systematic processing before they can provide meaningful financial information. Processing may involve data validation, removal of duplicate records, classification of transactions, treatment of missing information, temporal organization, and standardization of financial variables. These procedures establish greater consistency across records generated through different payment channels and create structured inputs for analytical processes. The **Consumer Financial Protection Bureau (2025)** addresses data-quality and reporting considerations within the regulatory framework governing small-business lending information. Data quality is therefore an important component of the proposed analytical architecture.

Analytical processing converts standardized payment records into indicators describing business financial activity. Descriptive analysis can identify patterns such as transaction frequency, average transaction values, revenue concentration, and changes in payment activity, while predictive analysis can examine relationships among variables associated with financial outcomes. Tigges et al. (2024) found that AI and alternative data can contribute to credit-risk assessment while also raising concerns regarding data quality, transparency, representativeness, and potential misuse. The analytical layer therefore functions as both a computational and interpretive component of the proposed solution, transforming payment information into structured indicators while maintaining attention to the quality and meaning of the underlying data.

5.3 AI-Based Financial Assessment

Financial assessment within the proposed solution incorporates AI into the interpretation of payment-generated information and other available financial indicators. Transaction frequency, revenue patterns, payment regularity, cash-flow behaviour, and changes in business activity can provide measurable characteristics of ongoing commercial operations. These characteristics may be particularly relevant where

conventional financial records provide an incomplete representation of current business performance. The **Federal Reserve Banks (2025)** reported that 24% of financing applicants received none of the financing requested, while 36% received only some of the amount sought, illustrating the continuing importance of financial assessment within small-business financing.

AI-based assessment can process payment information to identify relationships and patterns that may be difficult to capture through isolated financial indicators. Predictive models can classify financial characteristics, estimate risk patterns, and generate indicators for consideration within financial decision-making. Gambacorta et al. (2024), using transaction-level data from a Chinese fintech firm, found that machine-learning models using non-traditional information improved credit-risk prediction under the conditions examined. This provides supporting evidence for the analytical value of information beyond conventional credit variables, although it does not constitute direct evidence from U.S. small businesses. The assessment layer therefore connects payment information with structured financial indicators while retaining conventional financial information within the broader assessment environment.

5.4 Alternative Credit Evaluation

Conventional credit evaluation relies substantially on established credit histories, repayment records, financial statements, collateral, and previous relationships with lenders. Businesses with limited operating or borrowing histories may consequently have less conventional evidence available for financial evaluation. Caballero et al. (2025), focusing on emerging-market economies, identify information and collateral constraints as important barriers to small-firm credit and examine how digital innovation and data use can influence these constraints. The proposed framework incorporates payment-generated information into this assessment environment as an additional source of evidence concerning business activity.

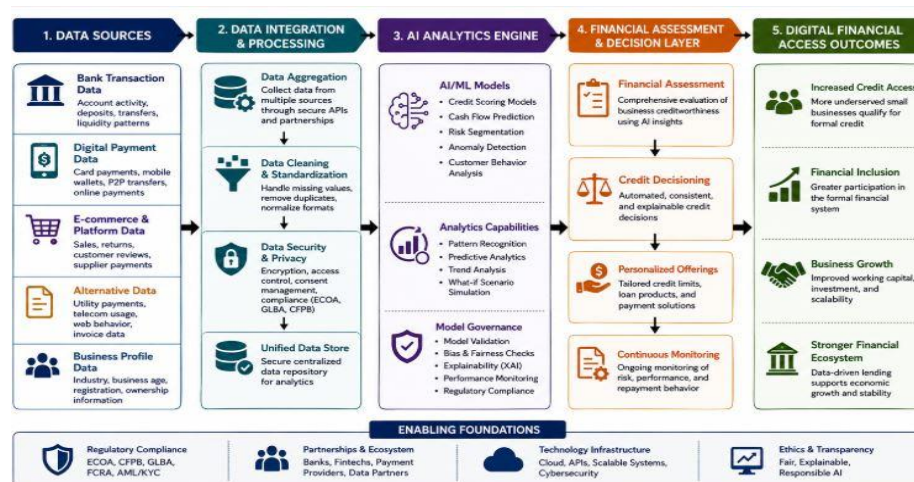
Payment information can provide indicators of recurring revenue, transaction consistency, seasonal patterns, payment frequency, and changes in financial activity. These characteristics can provide a longitudinal representation of business operations that complements conventional credit information. The proposed alternative credit evaluation therefore represents an expanded information structure rather than a replacement for established credit-assessment practices. Its purpose within the framework is to demonstrate how payment-generated indicators could potentially complement conventional information when evaluating the financial position of underserved small businesses.

5.5 Digital Financial Access Mechanism

The access mechanism connects financial assessment with formal digital financial services through an integrated financial-information environment. Once payment information has been processed and relevant financial indicators have been generated, these indicators can become part of the information considered during interactions between small businesses and financial-service providers. The **Federal Reserve Banks (2025)** found that small businesses continue to seek loans, lines of credit, and other forms of financing to meet operating and expansion needs, confirming the importance of financing access within business operations. The proposed mechanism therefore establishes a conceptual connection between everyday payment activity and formal financial services.

Digital payment infrastructure also creates a broader connection between payment participation and financial-system participation. Cornelli et al. (2024) examine the development of retail fast-payment systems and their role in the expansion of digital finance. Within the proposed solution, payment activity generates financial information, processed information produces analytical indicators, and those indicators can contribute to financial assessment and access processes. The **Consumer Financial Protection Bureau (2026)** further demonstrates the institutional importance of structured small-business lending information for understanding lending activity. The access mechanism consequently connects transaction activity, financial information, assessment, and formal financial services within the proposed conceptual environment.

Fig 3. Integrated Data-Driven Payment Solution Framework



Source: Developed by the Author based on the proposed framework and the **NIST AI Risk Management Framework (2023)**.

5.6 Governance and Security Architecture

Governance and security operate across the proposed payment-data lifecycle, including collection, integration, processing, storage, AI analysis, financial assessment, and information exchange. Payment records may contain commercially sensitive information concerning revenues, customers, counterparties, account activity, and transaction behaviour. The **Consumer Financial Protection Bureau (2025)** addresses privacy and information-management considerations within the regulatory treatment of small-business lending data. These considerations demonstrate the importance of governance structures capable of controlling access and protecting financial information throughout its lifecycle.

Security architecture also encompasses the integrity and accountability of AI-based analytical processes. Tigges et al. (2024) identify concerns involving algorithmic transparency, data quality, traceability, responsibility, bias, discrimination, and data misuse in AI- and alternative-data-based credit assessment. The **NIST AI Risk Management Framework (2023)** provides a complementary governance structure for managing risks associated with AI systems, including considerations relating to validity, reliability, transparency, explainability, privacy, security, and fairness. Governance within the proposed solution therefore encompasses access controls, authentication, secure storage, monitoring, data integrity, privacy protection, model accountability, transparency, and fairness. These controls are integrated throughout the proposed data pathway rather than being treated as a separate security stage.

Table 5. Components and Functions of the Data-Driven Payment Solution

Component	Primary Function	Key Information/Process	Supporting Source
Payment Data Collection	Captures business transaction activity	Transaction values, frequency, timing, payment channels	Federal Reserve (2026)
Data Integration	Combines payment information	Standardized transaction records and financial information	CFPB (2026)
Data Processing	Prepares information for analysis	Validation, cleaning, classification, and organization	CFPB (2025)
Data Analytics	Identifies financial patterns	Revenue trends, transaction consistency, and cash-flow indicators	Tigges et al. (2024)
AI-Based Financial Assessment	Processes financial characteristics	Predictive indicators and financial-risk patterns	Zhang et al. (2026)

Alternative Credit Evaluation	Expands the evidence used in assessment	Payment and alternative data alongside conventional information	Caballero et al. (2025)
Digital Financial Access	Connects assessment with financial services	Digital financing and financial-service channels	Cornelli et al. (2025)
Governance and Security	Protects data and analytical processes	Privacy, security, transparency, accountability, and fairness	CFPB (2025); NIST

Source: Developed by the Author based on empirical and institutional evidence from the **Federal Reserve (2026)**, **CFPB (2025, 2026)**, **Caballero et al. (2025)**, **Cornelli et al. (2024)**, **Tigges et al. (2024)**, and **Zhang et al. (2024)**.

6. Implications and Discussion

The findings establish a relationship between digital payment activity, payment-generated information, AI analytics, financial assessment, and access to financial services. The proposed framework positions payment data as an additional source of business information that can complement conventional financial records, particularly for small businesses with limited credit histories or borrowing records. The **Federal Reserve Banks (2025)** reported that 59% of surveyed small employer firms sought new financing, while 41% of applicants received all the financing requested, 36% received some, and 24% received none. These findings demonstrate the continuing relevance of financing constraints and the information used in financial assessment.

The framework also indicates that digital payment infrastructure alone does not guarantee improved financial inclusion. Payment information must be appropriately processed, interpreted, and incorporated into financial assessment before it can potentially contribute to improved access. **Caballero et al. (2025)** found that digital innovation and improved data use can reduce information constraints affecting small-firm lending in emerging-market economies, although their findings should not be interpreted as direct evidence for U.S. small businesses. Similarly, **Cornelli et al. (2024)** found that retail fast-payment systems are associated with greater adoption of digital finance applications across countries, with stronger effects in lower-income economies. The study was published in November 2024 and revised in June 2025, so the manuscript should consistently cite it as **Cornelli et al. (2024)**.

6.1 Implications for Digital Financial Inclusion

Digital payment participation can create an information trail through which routine business activity becomes more visible within formal financial environments. Transaction frequency, payment values, revenue activity, and payment consistency can provide additional information about ongoing business

operations. The **Federal Reserve Payments Study** reported 236.6 billion noncash payments in the United States during 2024, demonstrating the scale of electronically recorded payment activity.

However, financial inclusion should not be equated with payment participation alone. The potential value of payment-generated information depends on whether such information can be reliably processed and appropriately incorporated into financial assessment. **Caballero et al. (2025)** show that digital innovation and improved data use can address some information constraints affecting small-firm credit access, while **Cornelli et al. (2024)** provide evidence that fast-payment systems can contribute to wider adoption of digital financial applications. Within the proposed framework, payment data therefore represent a potential connection between business activity and formal financial services rather than an automatic solution to financial exclusion.

6.2 Implications for Small-Business Financing

The financing implications arise from the possibility of using payment-generated information alongside conventional financial indicators. The **Federal Reserve Banks (2025)** reported that 59% of surveyed small employer firms sought new financing, while only 41% of applicants received all the financing requested. The findings indicate that financing constraints remain relevant and that financial assessment continues to influence access to capital.

Payment-generated indicators can provide additional information about transaction frequency, revenue patterns, payment consistency, and other aspects of ongoing business activity. **Caballero et al. (2025)** found that digital innovation and improved data use can reduce information constraints affecting SME lending in emerging-market economies. Similarly, **Tigges et al. (2024)** examine the use of AI and alternative data in fintech lending and identify important concerns surrounding data quality, transparency, and responsible use. The implication for the proposed framework is therefore not that payment data should replace conventional credit assessment, but that appropriately governed transaction information may complement existing financial evidence.

6.3 Technological and Institutional Implications

The technological implications concern the integration of payment infrastructure, data-management systems, analytical technologies, and digital financial platforms. The scale of U.S. noncash payment activity demonstrates the extensive technological environment within which transaction information is generated. The proposed framework therefore requires interoperable systems capable of collecting, standardizing, processing, and securely transmitting relevant financial information across participating systems.

Institutionally, the framework involves interactions among payment providers, financial institutions, technology providers, regulators, and small businesses. The **CFPB's small-business lending data requirements** illustrate the increasing institutional importance of standardized information within small-business lending. The framework consequently requires appropriate arrangements for data sharing, regulatory compliance, system oversight, and accountability. These institutional requirements are necessary to ensure that technological capabilities are translated into responsible financial-service delivery.

6.4 Governance, Privacy, and Security Implications

The use of payment information in financial assessment creates governance requirements because transaction records can contain sensitive commercial and financial information. Data collection, storage, processing, and sharing therefore require appropriate controls for confidentiality, integrity, access, and responsible use. The framework incorporates these requirements throughout the payment-data lifecycle rather than treating governance as a separate final stage.

AI-based financial assessment also introduces concerns relating to transparency, explainability, fairness, reliability, and accountability. **Tigges et al. (2024)** identify data quality, transparency, bias, discrimination, and data misuse as important issues associated with AI and alternative-data credit assessment. The **NIST AI Risk Management Framework** provides a governance basis for managing such risks across AI-system development and use. Governance within the proposed framework therefore combines privacy protection, cybersecurity, data quality, model accountability, transparency, and fairness to ensure that payment-generated information is used responsibly in financial assessment.

7. Conclusion

The analysis establishes that digital payment systems have developed beyond their conventional function of transferring funds and increasingly generate financial information concerning business activity. For underserved small businesses, payment records can provide evidence of transaction frequency, revenue activity, payment consistency, and operational continuity that may complement conventional financial records. The **Federal Reserve Banks (2025)** reported continuing financing challenges among small employer firms, while the **Board of Governors of the Federal Reserve System (2026)** documented the substantial scale of noncash payment activity in the United States. These conditions establish the relevance of connecting payment infrastructure with financial information and financial assessment. The proposed framework integrates these elements through payment-data collection, processing, AI analytics, alternative financial assessment, and digital financial access.

The study further establishes that the potential value of payment-generated information depends on how such information is integrated, processed, assessed, and governed. Payment data do not automatically improve financial access; rather, they provide an additional information source that may complement conventional financial information when appropriately managed. **Caballero et al. (2025)** demonstrate the relevance of digital innovation and improved data availability to SME financing, while **Cornelli et al. (2024)** examine the role of retail fast-payment systems in the development of digital finance. The framework therefore presents digital financial access as an interconnected process involving payment participation, information visibility, analytical assessment, institutional decision-making, and responsible data governance.

7.1 Conclusion

The findings demonstrate that financial-access barriers among underserved small businesses are partly associated with limitations in conventional financial information and assessment processes. Businesses with limited credit histories, short operating records, or restricted banking relationships may have fewer established indicators available for conventional financial evaluation. Digital payment systems can generate continuous records of commercial activity that provide additional information concerning revenue patterns, transaction frequency, payment behaviour, and business continuity. The **Federal Reserve Banks (2025)** reported continuing financing challenges among small businesses, while the **Board of Governors of the Federal Reserve System (2026)** documented the substantial scale of electronic payment activity across the U.S. economy. These findings establish the relevance of payment-generated information as a complementary source of financial evidence.

The proposed data-driven payment solution connects payment infrastructure with data integration, processing, AI analytics, alternative credit evaluation, and digital financial services. The framework positions payment data as an informational bridge between everyday business transactions and financial assessment without treating such information as a substitute for established credit and financial records. It also incorporates privacy, security, transparency, explainability, and fairness because the processing of financial information and the use of AI in assessment require appropriate governance. The **NIST AI Risk Management Framework (2023)** provides a basis for addressing these trustworthiness considerations, while **Caballero et al. (2025)** demonstrates the relevance of digital innovation and improved information to SME financing. The study therefore establishes an integrated framework connecting digital payments, financial information, analytical processing, financial assessment, and digital financial access.

7.2 Theoretical and Practical Contributions

The study contributes theoretically by integrating the Technology–Organization–Environment (TOE) framework and Information Asymmetry Theory with payment-generated financial information and AI-based assessment. The framework extends the analysis of digital financial inclusion beyond technology adoption by emphasizing the informational value created through routine payment activity. Within the TOE perspective, digital payment infrastructure represents the technological context, business resources and capabilities represent organizational conditions, and financial institutions, regulatory requirements, and market structures represent environmental conditions. Information Asymmetry Theory explains why additional payment-generated information may be relevant where conventional financial information provides an incomplete representation of business activity. The integration of these perspectives establishes a conceptual relationship between technological participation, information availability, analytical processing, and financial access.

Practically, the framework provides an integrated structure connecting payment-data collection, data integration, analytics, AI-based assessment, alternative credit evaluation, and digital financial services. The framework does not propose replacing conventional credit assessment; instead, it establishes how payment-generated information may complement established financial information within a broader assessment environment. The **CFPB (2026)** small-business lending data initiative further demonstrates the institutional importance of systematic and reliable information within the U.S. small-business credit environment. The framework also incorporates privacy protection, cybersecurity, transparency, explainability, and fairness as governance requirements. Its practical contribution therefore lies in connecting payment infrastructure with financial assessment within a coherent data-driven architecture while recognizing the technological, institutional, and governance conditions required for responsible implementation.

7.3 Limitations and Future Research

The study is limited by its reliance on secondary evidence and conceptual framework development rather than proprietary institutional transaction data. It does not involve direct access to payment-platform databases, lender-level transaction records, or longitudinal business-level credit datasets. Consequently, the framework establishes conceptual and evidence-based relationships but does not provide empirical estimates of how specific payment variables affect individual credit decisions or financing outcomes. The absence of primary transaction-level data also means that the study does not empirically measure model accuracy, predictive performance, false-positive or false-negative rates, or differences in outcomes across specific categories of underserved businesses. These limitations distinguish the study's framework-development contribution from empirical testing of a deployed financial system.

Future research should empirically examine the proposed framework using appropriately governed transaction and financial datasets. Longitudinal datasets could be used to investigate relationships among payment behaviour, business performance, credit outcomes, and financing access over time. Comparative research could also evaluate conventional and alternative assessment approaches using consistent performance and fairness criteria. Further studies should examine explainability, privacy protection, cybersecurity, data quality, algorithmic fairness, and regulatory compliance across different financial institutions and payment environments. The **NIST AI Risk Management Framework (2023)** provides a relevant basis for examining AI-related risks, while continuing developments in small-business lending data collection provide opportunities for more detailed empirical investigation. Such research would extend the present framework from conceptual development toward systematic empirical evaluation.

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