Filling the SME credit gap: a systematic review of blockchain-based SME finance literature

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Abstract

Purpose – The review examines the existing literature on blockchain-based small and medium enterprise (SME) finance and highlights its trend, themes, opportunities and challenges. Based on these factors, the authors create a framework for the existing literature on blockchain-based SME financing and lay down future research paths.

Design/methodology/approach – The review follows a systematic approach. It includes 53 articles encompassing multiple dimensions of blockchain-based SME finance, including peer-to-peer lending platforms, supply chain finance (SCF), decentralized lending protocols and tokenization of assets. The review critically evaluates these approaches' theoretical underpinnings, empirical evidence and practical implementations.

Findings – The review demonstrates that blockchain-based SME finance holds significant promise in addressing the credit gap by leveraging blockchain technology's decentralized and transparent nature. Benefits identified include reduced information asymmetry, improved access to financing, enhanced credit assessment processes and increased financial inclusion. However, the literature acknowledges several challenges and limitations, such as regulatory uncertainties, scalability issues, operational complexities and potential security risks.

Originality/value – The article contributes to the growing knowledge of blockchain-based SME finance by synthesizing and evaluating the existing literature. It also provides a framework for the existing literature in the area and future research paths. The study offers insights for researchers, policymakers and practitioners

seeking to understand the potential of blockchain technology in filling the SME credit gap and fostering economic development through improved access to finance for SMEs.

1. Introduction

Small and medium enterprises (SMEs) comprise the majority of businesses worldwide, playing a crucial role in driving economies and fostering innovation. The classification of SMEs varies significantly from country to country, with regions employing distinct criteria for this purpose. The number of employees, annual turnover, capital investment or a combination of these factors is used as the foundation for classification. The International Finance Corporation (IFC) identifies firms with fewer than 250 employees as SMEs. Similarly, the European Commission designates enterprises as SMEs if they employ fewer than 250 individuals, have an annual turnover below EUR 50 million or maintain a balance sheet total under EUR 43 million. In India, the micro, small and medium enterprise (MSME) classification is primarily based on turnover and investment in machinery. Businesses with a turnover below INR 250 crores and an investment in plants and machinery not exceeding INR 50 crores fall within the MSME category.

These businesses account for about 90% of all firms, 70% of all employment and 50% of the global gross domestic product (GDP) (United Nations, 2023). As the backbone of societies everywhere, these firms promote balanced regional development and help sustain livelihoods, particularly for people experiencing poverty, women, youth and vulnerable population segment. Thus, they are vital in achieving the Sustainable Development Goals through sustained and inclusive economic growth. According to the UN report, by 2030, 600 million jobs will be needed to accommodate the growing global workforce, making the development of SMEs a top priority for governments worldwide.

However, these enterprises face numerous challenges due to their limited resources and small size, hindering their growth and expansion (Yoshino and Taghizadeh Hesary, 2016). One of the most critical issues for SMEs is the lack of access to timely and sufficient capital, as financial institutions perceive them as risky due to their informal and opaque operations (Wang, 2016). Consequently, these firms often resort to informal sources for credit with high-interest rates, exacerbating their financial struggles. Governments have implemented measures like priority sector lending, credit guarantee mechanisms and credit rating promotion to enhance credit access for SMEs.

Despite these interventions, there remains a significant credit gap for SMEs worldwide. According to the IFC, formal SMEs have a credit gap of $5.2tn, which equals 1.4 times the total global SME credit. In addition, the conventional financial system is slow, costly and burdensome for SME borrowers (Shinozaki, 2014). Although technology in various forms, such as big data, machine learning and artificial intelligence, has attempted to improve SME lending, a paradigm shift is required to address the enduring obstacles in SME finance.

Blockchain, a decentralized peer-to-peer network, holds immense potential to revolutionize the SME finance ecosystem with decentralized ledgers, tokens and smart contracts (Asante Boakye et al., 2023). It challenges the traditional client–server architecture, eliminates the need for intermediaries and is likely to disrupt the existing economic monopolies (Yang et al., 2021). Additionally, smart contracts enable automation and establish a trusted business environment without third-party involvement. As a result, blockchain and smart contracts facilitate real-time transactions, reducing transaction and enforcement costs and processing time (Philipp et al., 2019).

The growing academic research on SME finance since 2005, with an increasing focus on new and innovative financing sources, emphasizes the significance of finance for SMEs and the evolving research landscape (Rao *et al.*, 2023). Recently, there has been a noticeable surge in academic exploration concerning the intersection of SME finance and blockchain technology. However, no systematic literature review comprehensively explains the relationship between blockchain technology and SME finance. This presents a challenge for researchers aiming to attain a coherent understanding of prevailing trends and the existing research gaps within this domain.

To address this gap, we conduct a systematic review of blockchain-based SME finance literature to offer a state-of-the-art understanding of the developments in blockchain-based SME financing. Our study explores the credit gap SMEs face due to constraints in the finance process and investigates how blockchain can bridge this gap. Furthermore, we explore the innovative financing models blockchain technology and smart contracts enable. While acknowledging the potential benefits, we also delve into the challenges specific to SMEs in adopting blockchain technology. Finally, we propose a framework for SME financing and blockchain, laying the groundwork for future research in this domain.

2. An overview of blockchain technology

Blockchain is a distributed, decentralized and replicated ledger, which can assume various forms such as public or private, permissioned or permissionless, and operated with or without tokenized crypto economics. This integrated system guarantees data immutability, cryptographic security, precise timestamping and complete audibility, collectively fostering an unadulterated and incorruptible transaction record (Chabani *et al.*, 2021). Its inherent attributes result in an ecosystem that stands impervious to censorship and tampering, ensuring the authenticity of transactions. Originally arrived at the limelight through the advent of Bitcoin (Blockchain 1.0), the technology subsequently expanded its horizons by introducing smart contracts (Blockchain 2.0) and by finding applications across a wide array of sectors (Blockchain 3.0) ranging from health, education and governance.

Born out of a paper titled "Peer-to-peer electronic cash transfer" with the pseudonym Satoshi Nakamoto in 2008, blockchain has gained widespread popularity (Nakamoto, 2008). This technology replaces the traditional centralized client–server model with a decentralized peer-to-peer network, offering various applications beyond the digital currency (Yang *et al.*, 2021). The journey of blockchain encompasses different phases, marked by its adoption in various sectors and the emergence of consensus algorithms, smart contracts, and blockchain tokens.

Blockchain networks rely on consensus algorithms to achieve agreement on transaction validity and sequence across participants (Zheng *et al.*, 2017). Various consensus algorithms serve different purposes. Prominent ones include Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS) and Practical Byzantine Fault Tolerance (PBFT). PoW, utilized by Bitcoin, validates transactions through resource-intensive mathematical problem-solving. PoS and DPoS offer alternatives that address energy concerns but introduce challenges like wealth concentration. PBFT is used in permissioned blockchains, ensuring consensus among trustworthy nodes.

Smart contracts are self-executing agreements encoded on the blockchain. They automate predefined rules upon specific triggers, eliminating intermediaries and enabling secure and trustworthy contract execution (Zheng *et al.*, 2017). Written in blockchain-specific programming languages, like solidity for Ethereum, smart contracts offer efficiency, security, transparency and immutability. They find applications in finance, supply chain management and real estate. Efforts are ongoing to enhance smart contract security through formal verification and interoperability between blockchain platforms.

Blockchain tokens are digital assets that hold value or utility within the blockchain ecosystem (Ante, 2020). They include cryptocurrencies and utility tokens. Cryptocurrencies, such as Bitcoin and Ethereum, function as digital currencies, while utility tokens provide access to specific functionalities within decentralized applications. Tokens facilitate frictionless transactions, offer transparency and enable new business models like decentralized finance. Emerging token standards, like ERC-20, ERC-721 and ERC-1155, expand the scope for unique assets and complex token ecosystems. Blockchain's evolution has led to its integration into diverse sectors, providing decentralized solutions to traditional challenges. Through consensus algorithms, smart contracts and blockchain tokens, this technology empowers a new paradigm of trust, transparency and efficiency in various aspects of the digital world.

3. Methodology

The study aims to review and examine the existing research and scholarly work on the intersection of SME finance and blockchain technology. The methodology employed in this study involves a systematic search and analysis of relevant literature in the area. We adopt a systematic literature review approach to synthesize pertinent literature on SME finance and blockchain following the guidelines outlined in (Kraus *et al.*, 2022; Paul *et al.*, 2021; Tranfield *et al.*, 2003). The process consists of four steps: establishing the research question, deciding the scope of the study, identifying, filtering, selecting relevant literature and reporting.

In recent years, blockchain technology has catalyzed innovation and has shown the potential to revolutionize numerous industries, including finance. With a distributed ledger that facilitates secure and transparent transactions without intermediaries, it holds promise for addressing the obstacles that SMEs face in obtaining credit. Using blockchain technology, SMEs may overcome traditional barriers and access broader financial services and funding opportunities.

Numerous studies have leveraged blockchain to address the gaps in SME finance. However, this area's existing body of knowledge remains fragmented, with varying perspectives on its application and use. Therefore, a systematic literature review is essential to synthesize the available research, identify key themes, evaluate the potential benefits and challenges and identify research gaps for future investigation. Accordingly, we seek to answer the following research questions:

RQ1. What are the major trends and themes in the literature on blockchain-based SME finance literature?

RQ2. What are the possible future research directions in the blockchain-based SME finance domain?

We selected blockchain-related articles focusing on financial applications for SMEs. These firms are known as SMEs and MSMEs. Hence, we searched for articles using both keywords. We included all the articles on this topic as this field has emerged recently (up to May 31, 2023). We used the Scopus database to capture articles on SME finance and blockchain. We also used Google Scholar but found that all the relevant articles obtained from here were already present in Scopus, so we stuck to a single database.

The search string was constructed by identifying keywords and their relevant synonyms from blockchain and SME Finance research. Then, the selected keywords and their alternative words were concatenated using the Boolean operators "AND" and "OR" to form the following search string:

TITLE-ABS-KEY (sme* OR msme* AND finance OR financing AND (Blockchain OR blockchain OR "block chain" OR "smart contract*"))

After the primary search, we examined the titles of the articles. Articles that did not explicitly relate to SME finance and blockchain were excluded. If there was still a lack of clarity following this, article abstracts were examined. We omitted articles that did not pertain to blockchain in the context of SME finance. The criteria to find relevant primary studies relating to our research objective and weed out studies out of the scope of this paper are given in Table 1 below.

Simply applying the search query yielded 72 results from Scopus. When we analyzed articles by their titles, abstracts and keywords using the inclusion and exclusion criteria listed in Table 1, the number of papers was reduced to 59. After analyzing the entire texts of these papers, we could choose a total of 53 papers. The article selection approach based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher *et al.*, 2009) is depicted in Figure 1.

In the next step, we thoroughly read these articles, and each piece of information was put into a spreadsheet for analysis. For analysis, the extracted data were kept in several sections of the data extraction, namely (1) themes and sub-themes; (2) newer models of financing and (3) opportunities and challenges. We walked through several steps to analyze the data, including reading and re-reading each retrieved data item carefully to familiarize ourselves with it.

In the last phase, the articles are examined thoroughly to find answers to the research questions. To ensure rigor and eradicate subjectivity, each author reviewed and coded the spreadsheet's details independently. In the event of disagreement, motifs were determined through consensus. The sections that follow present the results of the analysis.

4. Descriptive analysis

This section presents a descriptive analysis of the articles selected for the literature review. By analyzing the article's attributes, like the publishing year, originating country, type of article and collaboration, we present the trends and discuss their implications. The yearly publication trend of blockchain-related SME financing research articles is shown in Figure 2. It is evident from the figure that the research in the field is relatively new, as it began in 2017. But the trend is quite positive as the number of articles on the topic increased from just 2 in 2017 to 24 in 2021. This growth corresponds to blockchain technology's evolution, which has seen growing interest from academia, industry and governments since its inception. 2022 has seen a modest decline in publication to 15 articles. But the trend in the first five months of 2023, with ten articles already published by May, shows it is picking up again this year. It reflects the surging interest of researchers in the field of blockchain-based financing for SMEs.

The country-wise trends reflect the dominance of China in blockchain-based SME finance research. China prominently leads the blockchain-based SME finance research landscape, boasting 37 publications, a trend echoed by India with seven articles and the United Kingdom

Inclusion criteria	Exclusion criteria
Studies with a focus on the financial application of Blockchain for SMEs	Studies not relevant to the aims of the study
Studies with Blockchain-related financial theory building for SMEs	Studies written in a language other than English
Studies investigating adoption and illustrating challenges in Blockchain financial uses for SMEs	Duplicates and repeated studies
Source(s): Created by authors	

Identification

Articles identified through database
searching

(n = 72)

Screening

Articles after duplications removed

(n = 69)

Articles screened based on title &
abstract

(n = 69)

Records excluded

(n = 10)

Eligibility

Full text screening of articles

(n = 59)

Records excluded

(n = 6)

Included

Studies included in the review
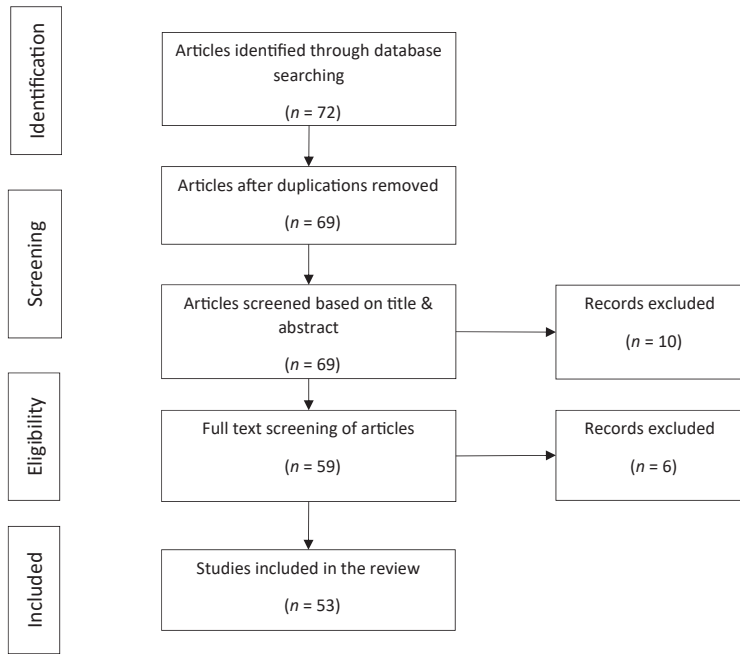
(n = 53)

Figure 1.
SLR study selection
process

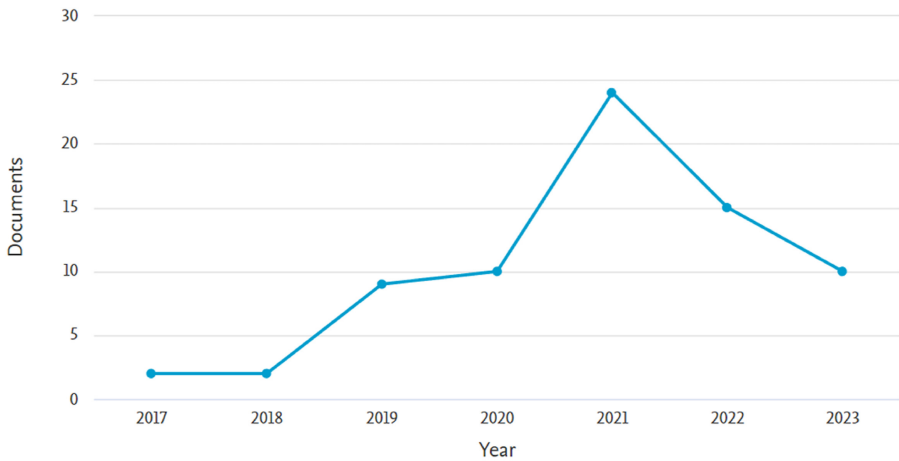**Source(s):** Created by authors

Figure 2.
Yearly publication
activity

Source(s): Created by authors

with six. This dominance underscores China's unwavering commitment to reshaping its
SMEs and cultivating a resilient financial ecosystem (Tan, 2022). The ascendancy of China in
researching the integration of blockchain technology into financial operations for SMEs can
be attributed to a convergence of influential factors. China's fervent embrace of digital

innovation, complemented by robust government endorsement for emerging technologies like blockchain, has nurtured an environment ripe for exploration and implementation (ESCAP, 2018). SMEs, pivotal drivers of the Chinese economy, are poised to reap the rewards of blockchain's potential to augment transparency, streamline efficiency and fortify security within financial workflows. Moreover, China's resilient technological infrastructure and symbiotic collaborations bridging academia, industry, and governance provide substantial impetus for continued investigation and realization of blockchain's capabilities in untangling financial intricacies for SMEs (Figure 3).

Figure 4 presents the distribution of studies by their article type. Among the literature published in this field, journal articles, conference proceedings, and book chapters comprise approximately 30 (56%), 19 (37%) and 4 (7%) articles, respectively.

Figures 5 and 6 show the collaboration trends in publishing. We can observe significant (21%) international collaboration in the field. This signifies the cross-border nature of technology and trade. However, it is important to note that academic–corporate collaboration is very low at 2%. This needs attention from academia and industry as their cooperation is critical for developing robust blockchain-based financial applications for SMEs.

5. Thematic analysis

This section categorizes and organizes the selected literature into various themes. First, we conduct a keyword analysis of the selected literature, shown in Figure 7. The growing trend of almost all the keywords indicates the increasing importance of research in blockchain-based SME finance. The figure shows that supply chain finance (SCF) has dominated the research in blockchain-based SME financing. This dominance stems from the inherent complexity of supply chains, which involve many actors, intricate processes and a cascade of transactions (Chen *et al.*, 2020). With its significant attributes, blockchain technology is a potent solution to simplify these convoluted processes. By leveraging the capabilities of decentralized ledgers and smart contracts, blockchain promises to address the complex challenges that have long plagued SCF.

By their very nature, supply chains are complex networks of interconnected stakeholders, each contributing their part to creating and delivering goods or services. These intricate networks often suffer inefficiencies due to a lack of transparency, trust and real-time visibility (Christian *et al.*, 2020). Blockchain, through its immutable and transparent ledger, offers a
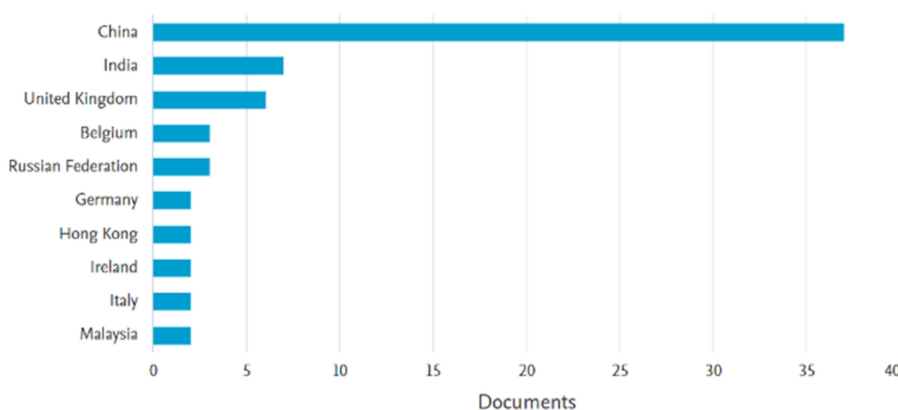

Source(s): Created by authors

Figure 3.
Country-wise
publication activity

Book Chapter (7.5%)

Conference Pape... (35.8%)

Article (56.6%)
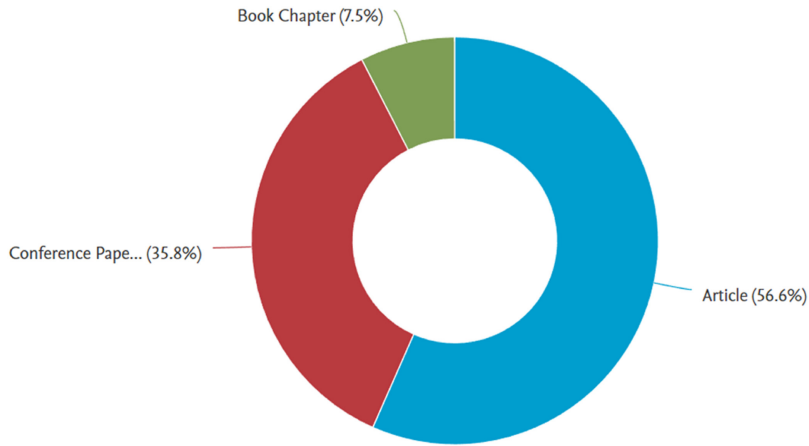
Figure 4.
Documents by type

Source(s): Created by authors

Metric		Scholarly Output
■ International collaboration	20.8%	11
■ Only national collaboration	7.6%	4
■ Only institutional collaboration	56.6%	30
■ Single authorship (no collaboration)	15.1%	8

Figure 5.
Geographical
collaboration activity

Source(s): Created by authors

Metric		Scholarly Output
■ Academic-corporate collaboration	1.9%	1
■ No academic-corporate collaboration	98.1%	52

Figure 6.
Academic-corporate
collaboration activity

Source(s): Created by authors

single source of truth that all participants can trust. Integrating smart contracts amplifies the transformative impact of automating contractual agreements and transactions. By replacing traditional intermediaries with decentralized validation mechanisms, blockchain minimizes friction, reduces delays and ultimately streamlines complex supply chain processes.

The potential of blockchain to reshape SCF is not confined to theoretical speculation. It can tackle real-world challenges that SMEs and supply chain participants encounter daily. The cumbersome documentation procedures often accompanying financing activities can be significantly streamlined through blockchain's digital record-keeping (Chen *et al.*, 2020). This digitization expedites the verification process and mitigates the risks associated with manual errors and discrepancies. Moreover, blockchain's traceability prowess enhances visibility across the supply chain, allowing stakeholders to track the journey of goods, monitor quality, and respond swiftly to disruptions.

A A A relevance of keyphrase | declining A A A growing

Source(s): Created by authors

The synergy between SCF and blockchain heralds a new era in SME financing. As this symbiotic relationship continues to evolve, its implications reverberate beyond the realms of finance. The real-time data insights made possible by blockchain can inform decision-making, inventory management and even sustainability initiatives (Paliwal *et al.*, 2020). As blockchain's capabilities mature and its integration becomes more widespread, SMEs stand to gain enhanced access to funding, reduced risks and increased operational efficiency, cementing their role as vital contributors to global economic growth.

The reviewed articles encompass a diverse range of geographical contexts, shedding light on the global interest in understanding the implications of blockchain technology for SMEs. The investigation spans various regions, including India (Kaur *et al.*, 2022; Paliwal *et al.*, 2020; Sahoo and Thakur, 2023), Ghana (Asante Boakye *et al.*, 2022, 2023), Saudi Arabia (Alshareef and Tunio, 2022), China (Chen *et al.*, 2021; Sun *et al.*, 2021a, b), Qatar (Dahdal *et al.*, 2020) and Russia (Christian *et al.*, 2020), and examines sectors as varied as housing (Utkarsh *et al.*, 2022), trade finance (Dahdal *et al.*, 2020; Truby *et al.*, 2022), livestock export (Miller *et al.*, 2023), e-commerce (Jiang and Chen, 2021; Li *et al.*, 2020) and automotive retail (Chen *et al.*, 2020). This diverse representation underscores the ubiquity of the exploration into blockchain's potential impact on SMEs across different nations and industries. The interest in Indian, Ghanaian and Saudi Arabian SMEs suggests a focus on emerging and developing economies, where blockchain could potentially offer transformative solutions for challenges such as transparency, trust, and access to finance.

Industries like e-commerce, trade finance and housing demonstrate an awareness of blockchain's capacity to streamline transactions, enhance supply chain traceability and reduce fraud. Additionally, the exploration of blockchain in the livestock export and automotive retail sectors showcases the technology's potential to improve authenticity verification, data sharing and the overall efficiency of complex value chains. The various countries and industries studied indicate recognition of blockchain's capacity to transcend borders and sectors, making it a subject of interest for SMEs seeking innovative ways to overcome operational hurdles and bolster their competitiveness in a rapidly evolving global landscape.

From the analysis of keywords and review of the articles' titles and content, the articles have been categorized into various themes presented in Table 2. The themes were extracted from the keyword analysis, and then articles in each theme were analyzed regarding their content to identify subthemes. Blockchain-related research on SME Financing has covered

themes like SCF, credit, capital markets and SMEs' adoption of blockchain-based financial solutions. These broader themes include different subthemes, which we discuss in the next section, and Figure 8 depicts a visualization of the same.

5.1 Supply chain finance

SCF has drawn the most widespread attention from researchers in blockchain-based SME finance, as reflected by the highest proportion of articles on the topic. SCF is a financing process in which banks rely on core enterprises to finance upstream and downstream businesses. Accounts receivable finance, account prepayment financing and inventory financing are three types of SCF solutions. Ineffective supply chain financing frequently leaves SMEs with few funding options at the end of the chain. The presence of asymmetric information between banks and businesses and the constrained scope of credit spread within the supply chain are the key obstacles to financing for SMEs. Due to their mistrust of commercial banks, SMEs find it difficult to secure finance (Liu *et al.*, 2023).

Blockchain technology has the potential to address these issues and lower transaction costs and information asymmetry in supply chain financing thanks to its technological properties of decentralization, information transparency, safety and reliability (Feng and Wang, 2022). Various entities involved in SCF have diverse coordination and cooperation requirements (Zhang *et al.*, 2021). The functions of blockchain technology align well with these requirements. By fostering mutual trust between all supply chain organizations, blockchain technology enhances the coordination efficiency of numerous participants in SCF.

The blockchain-based cross-layered architecture allows for the organization and management of resources, workflows and decisions involved in SCF. Smart contracts are crucial in associating and coordinating with various agents (multi-agent systems) throughout the SCF lifecycle. These smart contracts operate autonomously and efficiently in a trusted runtime environment, resulting in a reliable, transparent, high-efficiency and cost-effective process for dynamic pledge management. The built-in trust mechanism eliminates the need for intermediaries, such as banks, making transactions faster and more economical, which is crucial in the time-sensitive supply chain and logistics service industry. Additionally, smart

Cluster 1: Supply chain finance		Cluster 3: Capital market
Chen *et al.* (2020)	Wu and Xue (2021)	Ante (2020)
Chen *et al.* (2021)	Xiao *et al.* (2022)	Block *et al.* (2021)
Christian *et al.* (2020)	Xie (2022)	Chang and He (2018)
Cui (2021)	Xu *et al.* (2021)	Liu *et al.* (2021)
Dahdal *et al.* (2020)	Yang (2021)	Psarrakis and Kaili (2019)
Deng *et al.* (2023)	Yang *et al.* (2021)	Shi and Huang (2022)
Feng and Wang (2022)	Yu (2021)	Vasudevan (2022)
Jiang and Chen (2021)	Yu *et al.* (2021)	Xinlong *et al.* (2021)
Li *et al.* (2019)	Zhang *et al.* (2021)	Cluster 4: Blockchain adoption
Li *et al.* (2020)	Zhang *et al.* (2023)	Alshareef and Tunio (2022)
Liu *et al.* (2023)	Zhou *et al.* (2021)	Asante Boakye *et al.* (2022)
Miller *et al.* (2023)	Zhu *et al.* (2023)	Asante Boakye *et al.* (2023)
Nijeholt *et al.* (2017)	Cluster 2: Credit	Chabani *et al.* (2021)
Rao and Li (2022)	Guan and Zhang (2020)	Ilbiz and Durst (2019)
Sahoo and Thakur (2023)	Kinai *et al.* (2017)	Kaur *et al.* (2022)
Tong *et al.* (2022)	Sun *et al.* (2021b)	Ozili (2022)
Truby *et al.* (2022)	Utkarsh *et al.* (2022)	Paliwal *et al.* (2020)
Wang (2021)	Wang *et al.* (2019)	Sun *et al.* (2021a)
	Zou *et al.* (2020)	

Source(s): Created by authors

Table 2.
Clustering of articles
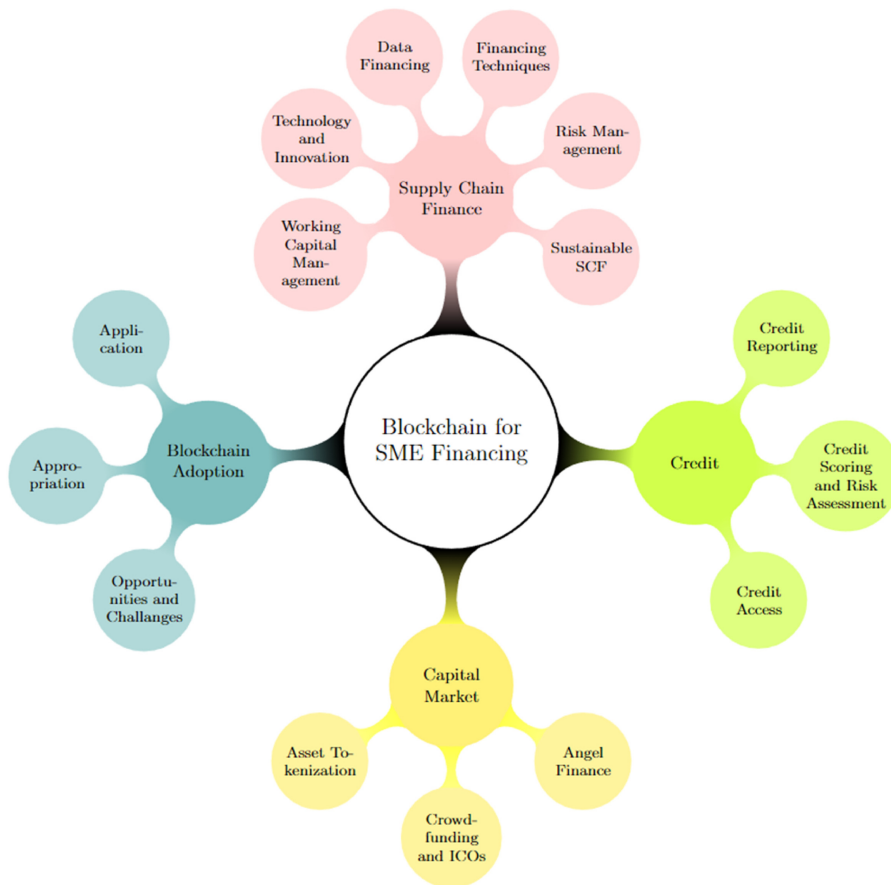
Figure 8.
Themes and subthemes in blockchain-based SME finance literature

Source(s): Created by authors

contracts automate workflows in SCF, reducing human errors and disruptions during contract execution.

Blockchain also addresses the issue of weakening links in the supply chain. In traditional models, information about firms at the margins of the supply chain becomes less available, depriving them of financial access. Xu *et al.* (2021) illustrate the impact of blockchain technology on credit access, credit line, and credit supervision in transportation SCF. They investigate the attenuation of credit transmission in transportation finance, including intrinsic, physical and cognitive attenuation.

Blockchain can help reduce attenuation and enhance credit access for SMEs at the end of the chain by shortening the chain and improving traceability, transparency, and authenticity. Through methods such as verifying transaction behaviors, introducing credit insurance and enhancing the understanding of enterprise repayment ability, blockchain can increase the credit granted by financial institutions to SMEs. Establishing an alliance chain further allows for the objective financial debt structure in the transportation capacity supply chain, enabling autonomous capital flow direction and facilitating credit supervision through transaction, delivery and capital closed loops.

5.1.1 Working capital management. Managing working capital is a critical aspect of financial operations for SMEs. In recent years, the emergence of blockchain technology has shown promising potential in transforming the landscape of working capital management for SMEs. Traditional working capital management practices in SME finance often face challenges such as limited access to credit, high financing costs and inefficient payment processes. Blockchain technology offers a decentralized, transparent and secure platform that can potentially address these challenges. The literature emphasizes that blockchain-enabled solutions can improve working capital management for SMEs by streamlining payment processes, reducing transaction costs and enhancing supply chain financing options (Xu *et al.*, 2021). Blockchain-based smart contracts can automate payment terms and conditions, reducing administrative burdens and minimizing the risk of payment delays. Additionally, blockchain's immutable and transparent nature can enhance trust and reduce the risk of fraud in supply chain financing arrangements.

5.1.2 Technology and innovation in supply chain finance. Traditional practices in SCF are often burdened by long payment cycles, information asymmetry and limited credit access, which can hinder the growth and competitiveness of SMEs. However, technological innovations, particularly blockchain, offer potential solutions to these challenges. By providing transparency, security and efficiency in financial transactions, blockchain technology can revolutionize SCF for SMEs. Blockchain can address these challenges by streamlining payment processes, automating reconciliation and enabling real-time tracking of transactions and inventory. These advancements can result in reduced administrative costs, faster payment cycles and improved cash flow for SMEs.

Chen *et al.* (2021) presented a novel technical architecture and implementations for a blockchain-powered SCF management system. To boost the efficiency of financing, they also introduced the concept of credit disassembly. Similarly, Chen *et al.* (2020) developed BCautoSCF, a blockchain-powered SCF platform tailored to the Chinese auto retail industry. In a separate study, Li *et al.* (2020) created a blockchain-enabled logistics finance execution platform (BcLFEP) as an integrated solution to facilitate logistics finance within the context of e-commerce retail.

Financial relationships rely heavily on trust, and blockchain technology seeks to address trust-related issues. MSMEs confront cash flow challenges, financing difficulties and high financing costs. Yang (2021) proposes a series of blockchain-based design patterns for SCF to address these issues. These design patterns include components such as Pledge Template, Pledge Register, Ownership Channel, Two-way Payment Channel and Transfer, which collectively contribute to improving the efficiency and effectiveness of SCF.

5.1.3 Data financing and information collateral. The concentration of data with primary enterprises creates "information islands" in which minimal data available to upstream and downstream businesses and buyers and sellers is available. As a result, banks and financial institutions have limited access to information due to core corporations' very low level of disclosure. Using blockchain-based invoices, businesses at the end of the supply chain can obtain low-cost financing and financing services. When a blockchain-based bill is created, the distributed storage of the blockchain ensures that newly established data are certified by all participating nodes, ensuring authenticity and preventing manipulation (Wu and Xue, 2021).

Blockchain can leverage alternative data sources for lending and increase data financing. Jiang and Chen (2021) demonstrate, within the framework for SMEs' blockchain-based e-commerce platforms, that the authenticity, transparency and immutability of trading and logistical data can serve as a source of data financing for SMEs. Data finance differs from collateral financing in that loan providers are not required to provide collateral to prove their capacity to repay. In the data financing process, banks use historical transaction and logistics data to evaluate loan firms; the available data serves as information collateral. Oracles can also be used to obtain multiple data inputs, improving the screening of borrowers.

5.1.4 Financing techniques in supply chains. The most prominent financing technique discussed in the literature is SCF programs, which involve collaboration between SMEs, financial institutions, and other supply chain partners. These programs aim to provide early payment to suppliers and extended payment terms for buyers, thereby enhancing working capital management for SMEs. SCF programs offer improved cash flow, reduced financing costs, and enhanced liquidity. Blockchain technology can be crucial in optimizing and securing transactions within these programs, ensuring transparency and trust among supply chain participants.

Another financing technique explored in the literature is invoice financing, which allows SMEs to access immediate funds by selling their outstanding invoices to financial institutions (Xu *et al.*, 2021). Blockchain technology can enhance the efficiency and security of invoice financing by providing an immutable and transparent record of invoice ownership. It facilitates verification and validation processes, reducing the risk of fraud in the financing process.

Based on Hyperledger Fabric, Kinai *et al.* (2017) designed a simple platform for SME distributed financing. This portal provided Kenyan retail commerce SMEs with financial products. It included a blockchain backend based on Hyperledger Fabric, smartphone Android, feature phone SMS applications and an online stakeholder dashboard. The platform's primary objective was to enhance point-of-sale financing and stakeholder communication.

Trade finance is another area of focus in the literature, given its critical role in supporting international trade for SMEs (Dahdal *et al.*, 2020). Blockchain technology can potentially enhance trade finance by digitizing and automating trade-related documents, such as letters of credit and bills of lading. This digitalization improves efficiency, reduces costs and mitigates fraud risks associated with trade finance transactions. Dynamic discounting is also discussed as a financing technique for SMEs. This approach enables SMEs to receive early payment from buyers in exchange for offering a discount on the invoice amount. Dynamic discounting helps SMEs improve their cash flow and working capital position. Blockchain technology can automate and streamline the dynamic discounting process by enabling real-time payment settlements, smart contract execution and secure validation of discount terms.

Trade finance's complicated application and high rejection rate deter SMEs. Traditional trade financing faces rising costs and regulations. Data capture, storage and sharing, essential in trade finance, can be cheaper with blockchain technology. A blockchain-based supply chain tracing solution reduces the risk of fraudulent document tampering and increases transparency. Transparency and reduced risk may improve SME trade financing payment terms. Blockchain's interconnected and transparent process benefits buyers, buyer's banks, seller's banks, sellers and shippers. SME liquidity needs may reduce with trust and risk reduction.

The existing trade financing system requires smaller banks to maintain significant global contacts, which is costly and time-consuming. Blockchain technology makes trade financing simpler and cheaper, enabling smaller institutions to participate, which can increase trade financing competition and business access for smaller banks. Automation can speed up the application process, reduce fraud and open new markets for enterprises. Blockchain speeds up, simplifies and improves trade finance instrument access, application and performance (Dahdal *et al.*, 2020).

5.1.5 Risk management. In SCF, blockchain technology is significant in risk management and fraud prevention. It reduces credit risk for SME financing and operational risk in SCF by increasing information transparency (Li *et al.*, 2019). Blockchain facilitates low-cost, real-time monitoring of pledge values, mitigating the risk of price fluctuations. In addition, a lack of transparency and information asymmetry in SCF can result in double financing. Nijeholt *et al.*

(2017) propose a "DecReg" framework that utilizes the Tendermint consensus protocol. This framework detects and thwarts such attempts swiftly.

Wang (2021) develops an SCF credit risk assessment system. The system uses blockchain technology to establish a financial system for the supply chain and incorporates supply chain financial data into blocks. They leverage fuzzy neural network algorithms for financial data processing and risk assessment to effectively address and enhance the risk processing level. In scenarios where the retailer has minimal initial capital and high production costs, the BPF (Business Pay Financing) financing model is preferred by the manufacturer, distributor and retailer, according to the study.

In addition, when the product success rate is high, BPF outperforms the supplier inventory financing (SIF) model for all partners. The study also proposes a method for minimizing conflicts between the manufacturer and retailer in the selection of financing. It reveals that when the retailer's initial capital is high, BPF benefits the manufacturer, while SIF benefits the retailer, indicating a conflict in financing selection between them. The research demonstrates that risk sharing can reduce financing selection conflicts and enhance the BPF model's financing effectiveness.

5.1.6 Sustainable supply chain finance. The scholarly literature on sustainable SCF and blockchain technology emphasizes the potential integration of sustainable practices, SCF and blockchain to address SMEs' financing challenges while promoting environmental and social sustainability (Paliwal *et al.*, 2020). These studies highlight the significance of sustainable SCF in improving SMEs' access to working capital and alleviating their financial constraints. By incorporating sustainable financing practices like green financing and ethical sourcing, SMEs can align their financial strategies with their environmental and social goals, fostering long-term sustainability.

Utilizing blockchain-based platforms offers secure and transparent solutions for supply chain financing, including invoice financing, purchase order financing and inventory financing, benefiting both SMEs and their financiers. The literature underscores the potential of blockchain technology, specifically tokenization and Smart contracts, in streamlining and automating financial processes within SCF. Tokenization enables the fractional ownership of assets and the creation of digital securities, which improves liquidity and facilitates investment in SMEs. Smart contracts automate credit agreements, repayment terms and collateral management, reducing costs and increasing efficiency.

By addressing legal and regulatory gaps in the supply chain and optimizing the overall ecological environment of SCF, blockchain-based solutions are being utilized to establish sustainable SCF models. IBM's 2017 blockchain-based supply chain financing platform, "we.trade" and Linklogis, a blockchain-powered supply chain financing platform based in Shenzhen, China, are notable examples. These platforms address the issues of low visibility and credibility within the supply chain, allowing many deep-tier SMEs to access bank financing effectively.

5.2 Credit

SMEs face a high prevalence of financing difficulties and expensive credit (Zhang *et al.*, 2021). The challenges SMEs encounter in obtaining loans are primarily attributable to two factors. There is a significant information asymmetry between banks and businesses, to begin with. This information asymmetry leads to adverse selection, in which banks ration credit as a rational response (Stiglitz and Weiss, 1981). Second, inadequate collateral is a significant barrier for many SMEs. Numerous high-quality and low-risk SMEs struggle to demonstrate their creditworthiness effectively, causing banks to restrict credit (Bester, 1987).

Information asymmetries can be reduced by increasing information availability, processing efficacy and information exchange. The distributed ledger technology used by

blockchain to record and share every information item solves the information asymmetry problem. Utkarsh *et al.* (2022) propose a decentralized system that stores debt history, including debt repayment and default records, allowing low-risk and high-quality SMEs to access loans without collateral by demonstrating their credibility and key performance indicators via transparent information dissemination.

Information asymmetry and credit rationing issues can be mitigated with decentralized consensus and information distribution among all participants (Wang *et al.*, 2019). Using the decentralized nature of data storage and transaction recording, blockchain stores encrypted blocks comprising data such as an organization's assets, profitability and investment status. Therefore, banks can monitor the enterprise's conditions in real time, reducing the information asymmetry prevalent in conventional credit markets. Using time stamps and digital signatures, blockchain technology can speed up the verification and processing of financial data (Li *et al.*, 2020). Figure 9 illustrates how blockchain technology and its facilitating mechanisms can improve the credit process for SMEs.

In case of default, the information can be simultaneously transmitted and published to all institutions and businesses with access to the blockchain. Implementing blockchain technology discourages adverse selection by increasing the default cost for companies. Wang *et al.* (2019) show that the increased default cost associated with blockchain technology can serve as a screening mechanism. As the potential default cost of an enterprise rises, riskier businesses are less likely to pursue blockchain-based financing. At the same time, SMEs with low risk and high quality can demonstrate their credibility and risk profile. This permits the blockchain-based credit system to differentiate between debtors according to their risk profiles and operate more efficiently.

The collateral issue is also solved using tokenization in blockchain technology. SMEs can convert their physical or financial assets into tokens which can be used as collateral (Ante, 2020). Also, the wide availability of transparent and authentic data has given rise to a concept of information collateral which alleviates the need for physical collateral. Smart contracts in the innovative credit system enhance contractibility and enforceability, particularly in contingent situations where the exchange of loan principal, interest, penalty and costs are algorithmically automated. Additionally, combining Internet of Things (IoT) technology and blockchain improves traditional banks' ability to acquire information and facilitates the transformation of credible information, thereby reducing collateral risk.
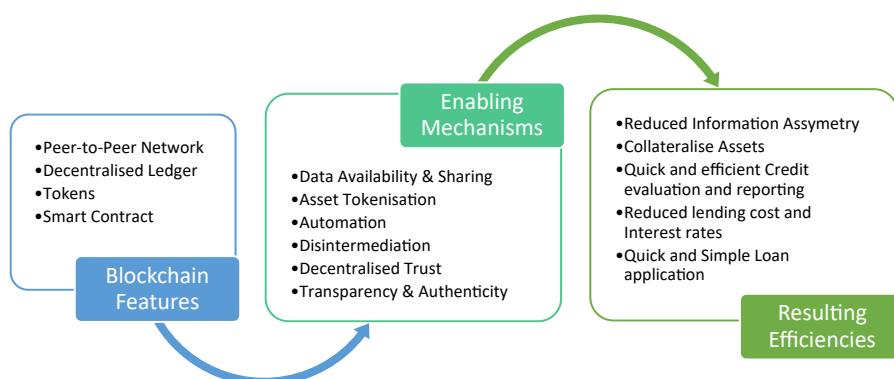
Figure 9.
Blockchain features, enabling mechanisms and resulting efficiencies in credit process for SMEs

Source(s): Created by authors

5.2.1 Access to credit for small businesses. Blockchain technology can enhance access to credit for small firms through various mechanisms. First, blockchain-based identity verification and digital reputation systems can enable small firms to establish their creditworthiness and credibility in a transparent and immutable manner. By securely storing and sharing information, blockchain can provide lenders with reliable data to assess the creditworthiness of small firms, thereby reducing information asymmetry. Liu *et al.* (2021) established an inclusive finance consortium blockchain platform for SME secure data storage and value analysis.

Moreover, smart contracts on blockchain platforms can automate and streamline the loan origination and disbursement processes. Smart contracts can enforce predetermined loan terms, track repayments and trigger automatic transactions, eliminating the need for intermediaries and reducing administrative costs. This automation can enhance the efficiency and speed of credit evaluation and decision-making for small firms, making it easier for them to access credit. Shi and Huang (2022) established a multiparty joint financial service platform based on blockchain technology to assist SME financing institutions in reducing transaction costs and, consequently, loan rates.

Blockchain can also facilitate the creation of decentralized lending platforms or peer-to-peer lending networks. These platforms connect borrowers directly with lenders, bypassing traditional financial intermediaries. By eliminating intermediaries, blockchain-based lending platforms can reduce costs, offer competitive interest rates, and provide more flexible credit options for small firms. Decentralized Finance (DeFi) has gained momentum with the developments around Central Bank digital currencies.

5.2.2 Credit scoring and risk assessment. Credit scoring and risk assessment are critical for lenders to evaluate small firms' creditworthiness and default risk. The integration of blockchain technology has emerged as a potential solution to enhance credit scoring and risk assessment methodologies by addressing data accuracy, transparency and privacy challenges. Erstwhile credit evaluation systems had problems such as the forgery of corporate credit records and imperfect evaluation indicators.

Blockchain technology can improve credit scoring for small firms by enabling a more accurate and reliable assessment of their creditworthiness. Blockchain's distributed ledger system can securely store and verify financial and non-financial data, such as transaction history, credit records, business performance and customer feedback. By leveraging this data, lenders can develop more comprehensive and accurate credit scoring models, reducing the reliance on traditional credit history and collateral-based assessments. Wang *et al.* (2019) proposes a blockchain-based distributed credit evaluation system with intelligent protocols and distributed features to give credit records through unchangeable timestamps and distributed ledger and improve centralized systems.

5.2.3 Credit reporting. Traditional credit reporting models are inadequate for assessing the creditworthiness of SMEs due to their limited scope, delayed report generation and reliance on unidimensional information. Blockchain technology can enhance credit reporting for SMEs by enabling a more accurate, reliable and secure exchange of credit information. The decentralized and immutable nature of blockchain's distributed ledger system ensures the integrity of credit data and minimizes the risks of data manipulation and fraud. This transparency and immutability foster trust among stakeholders, including lenders, credit reporting agencies and SMEs. Furthermore, blockchain can facilitate the development of decentralized credit reporting platforms or networks, empowering SMEs to have greater control and ownership over their credit data. Through blockchain-based credit reporting platforms, SMEs can securely store their credit information and grant access to authorized parties, enhancing privacy and data security.

For example, Sun *et al.* (2021b) propose an innovative credit reporting framework for SMBs in China that utilizes big data technologies and blockchain as fundamental

components. Their architecture includes five essential modules for data acquisition, data authentication, credit evaluation, credit report generation and information exchange. Incorporating both hard and soft data and considering the personal credit status of enterprise proprietors, particularly for non-corporate SMEs, their framework offers a comprehensive approach. In addition, applying big data tools enables the real-time collection, storage, administration and analysis of enterprise data from multiple sources. This enables dynamic credit evaluation and automatic credit report generation, fostering effective information exchange between various entities. In assessing the credit of enterprises issuing commercial paper, Zou *et al.* (2020) propose a supply chain financial service system based on a consortium blockchain. This system enables banks and financial institutions to utilize blockchain data to review commercial paper, evaluate creditworthiness and monitor fund flows, addressing challenges related to verifying the authenticity of commercial paper and assessing enterprise credit.

5.3 Capital market

Blockchain technology can potentially revolutionize capital market financing for SMEs by enhancing transparency, reducing costs and expanding access to global investors. As the technology continues to evolve, it is expected to create new opportunities and reshape traditional financing models, offering greater financial inclusion and growth prospects for SMEs worldwide. Blockchain-based platforms and protocols can connect SMEs directly with a global pool of investors, eliminating geographical barriers and expanding the potential investor base (Xinlong *et al.*, 2021).

5.3.1 Tokenization of small business assets. Tokenization refers to converting real-world assets, such as equity, intellectual property or revenue streams, into digital tokens that can be bought, sold and traded on blockchain-based platforms. Tokenization offers several potential benefits for SMEs. First, it can enhance liquidity by enabling fractional ownership and easier transferability of assets (Ante, 2020). Small business owners can tokenize their assets and offer them to a wider investor base, including retail investors, allowing for greater liquidity and potentially unlocking value previously illiquid or difficult to access. Additionally, tokenization can enable SMEs to access a broader range of investors. By breaking down assets into smaller, more affordable tokens, SMEs can attract a diverse pool of investors, including those with limited capital. This democratization of investment opportunities can help SMEs raise capital more efficiently and expand their investor base.

5.3.2 Crowdfunding and initial coin offerings (ICOs). Crowdfunding allows multiple lenders to contribute small amounts towards a loan. Many crowdfunding platforms have come up in the recent past. These platforms enable small firms to connect with individual investors directly, bypassing traditional intermediaries. Blockchain-powered crowdfunding can offer several advantages for small firms, including increased access to capital, a wider pool of potential investors, reduced costs and enhanced transparency. Blockchain's transparent and immutable nature provides trust and accountability in crowdfunding campaigns, instilling confidence in investors.

Based on crowdfunding designs, blockchain has given way to innovative financing mechanisms such as initial coin offerings (ICOs) and STOs (security token offerings). They have emerged as alternatives to traditional initial public offerings (IPOs) and venture capital financing. ICOs involve the issuance of digital tokens or coins, while STOs involve the issuance of security tokens representing ownership in a company. ICOs and STOs can potentially democratize access to capital for small firms, allowing them to raise funds from a global investor base (Ante, 2020). These mechanisms enable small firms to tokenize their assets, such as equity or revenue streams, and offer them to investors through blockchain-based platforms.

In contrast to ICOs, which issue utility tokens, STOs issue security tokens that are likely to generate revenue in the same manner as bonds or stocks. These models have prompted many countries and exchanges to develop and test blockchain-based applications for raising equity capital for SMEs and trading such securities. Tokenization enables fractional ownership, liquidity and the ability to trade assets more efficiently (Block *et al.*, 2021; Psarrakis and Kaili, 2019). This can also help to attract retail investor participation in SME financing. SMEs can issue tokens representing shares or securities, enabling them to raise funds by selling them to investors.

5.3.3 Angel finance. Centralized financing mechanisms can suffer from Agency problems. Many marketplace lenders operate as intermediaries, facilitating the matching process between lenders and borrowers. However, this agency arrangement raises concerns about opportunistic behavior, whereby agents may exploit their position for personal gain rather than acting in the best interests of the principals. Such opportunism increases transaction costs and can lead to market failure. Moreover, investors must place trust in and monitor the agents and borrowers, further adding to the monitoring costs. Chang and He (2018) propose an Angel Financing Platform that utilizes a permissioned blockchain as a distributed matching platform for angel investors and entrepreneurs to address these issues.

The features of blockchain technology help mitigate the problem of asymmetric information between the matching agency and network members. The platform enables direct interaction between angel investors and unfamiliar entrepreneurs through matching contracts, promoting transparency, and reducing the need for intermediaries. The agency's role primarily involves platform maintenance, access control management, and resolving disputes between angel investors and entrepreneurs. While SMEs significantly contribute to the economy, traditional financial channels often ignore their financing needs. Fintech solutions, such as DeFi powered by blockchain technology, help bridge this financing gap. However, it is crucial to recognize that adopting such technologies raises concerns regarding cybersecurity for SMEs (Vasudevan, 2022).

5.4 Blockchain-based finance adoption by SMEs

Investment in blockchain-based business solutions is growing exponentially, but the adoption of blockchain by businesses has been low, especially SMEs (Ozili, 2022; Asante Boakye *et al.*, 2023). The reasons are apparent as the novelty of the technology and its complexity, which is not easy to understand given the relatively lower technical capabilities of small firms. Not many projects have seen their migration from proof of concept to wider applications. Instead, the usage is fragmented. This section discusses the application, appropriation and adoption of blockchain-based financial solutions and the associated opportunities and challenges.

5.4.1 Blockchain applicability and appropriation for SMEs. Assessing the viability is crucial to facilitate SMEs' adoption and utilization of blockchain technology. Chabani *et al.* (2021) conducted a study on the applicability of blockchain technology to small and medium-sized enterprises. The authors highlight numerous benefits associated with the adoption of blockchain technology by SMBs, including the promotion of transparency within the organization, the facilitation of market analysis for enhanced decision-making, the elimination of reconciliation costs and the simplification of auditing procedures. However, they acknowledge certain disadvantages, such as the possibility of reorganizing job positions and unclear industry standards.

It is essential to recognize that blockchain, like any other technology, may not apply to all business types and sizes. A conceptual framework proposed by Ilbiz and Durst (2019) identifies nine determinants for blockchain technology adoption. These elements include cost reduction, internalization of processes, digital representation of assets, immutable data

recording, network size, transparent and synchronized ledger, scalability, promotion of fair trade and financing facilitation. Organizations can better comprehend and evaluate blockchain technology implementation's potential benefits and obstacles by contemplating these factors.

5.4.2 Opportunities and challenges in blockchain adoption by SMEs. Blockchain-based financial solutions present numerous opportunities for SMEs to enhance their operations. These solutions offer benefits such as expanded access to finance through tokenization, enabling crowdfunding, peer-to-peer lending and participation in ICOs or security token offerings (STOs). They also provide cost reductions by eliminating intermediaries and automating processes using smart contracts, resulting in lower transaction fees and improved cash flow management. Blockchain technology improves transparency and trust in financial transactions, allowing SMEs to maintain transparent records, ensure accountability and build trust with stakeholders. Moreover, blockchain offers robust security measures to safeguard sensitive financial data from unauthorized access and tampering, mitigating fraud risks.

However, challenges must be addressed for successful adoption, including technical complexity, scalability limitations, evolving regulatory frameworks and a lack of awareness and understanding among SMEs. SMEs can collaborate with technology providers, partner with blockchain-focused companies and seek education to overcome these challenges. Further research, stakeholder collaboration and supportive policy frameworks are necessary to leverage blockchain-based financial solutions' potential for SMEs fully.

Literature has many studies focusing on the adoption of blockchain-based finance by SMEs. They use different frameworks to study the same and have highlighted the unfolding opportunities and challenges. Asante Boakye *et al.* (2023) use the technological, organizational and environmental (TOE) framework to investigate the determinants of blockchain SCF adoption among Ghanaian SMEs. Paliwal *et al.* (2020) conducted a socio-technical analysis of blockchain technology adoption in Indian MSMEs focusing on supply chain management. Alshareef and Tunio (2022) examine blockchain adoption's leadership role and potential advantages for SME financing.

Applying complexity theory, Sun *et al.* (2021a) investigate the factors influencing the use of blockchain-based loan systems by SMBs, focusing on the effects of perceived risk, perceived fairness and reward sensitivity. Kaur *et al.* (2022) emphasize that technological barriers substantially hinder blockchain adoption. Asante Boakye *et al.* (2022) discuss how blockchain, IoT and distributed ledger technologies (DLTs) can reduce transaction and monitoring costs. Table 3 summarizes blockchain technology's opportunities and challenges for SME Finance.

Cost and complexity must be addressed to popularize blockchain technology. Small and medium-sized organizations may benefit from Blockchain-as-a-Service (BaaS) instead of Private and Consortium blockchains (Yu, 2021). BaaS is a managed blockchain platform that allows users to construct blockchain apps and digital services on a decentralized network. The vendor provides infrastructure and blockchain-building tools. BaaS, like software-as-a-service, will enable enterprises to develop apps quickly and easily, accelerating blockchain adoption. Many issues impede the sector from fully adopting blockchain technology. First, the topic is understudied. Second, businesses are hesitant to employ the technology unless national and international legislation and standards support it. Education and guidelines are needed for widespread adoption.

6. Discussion and directions for future research
In this literature review, we examined the intersection of SME finance and blockchain technology to address the credit gap SMEs face. The review synthesized findings from various

Papers	Opportunities	Challenges
[1] Alshareef and Tunio (2022)	Save costs [1] [2] [4] [6]	Technical complexity [6] [8]
[2] Asante Boakye et al. (2022)	Improve efficiency [1] [2]	Scalability [7]
[3] Asante Boakye et al. (2023)	Enhance trust and transparency [1] [4] [5] [7]	Integration with legacy systems [8]
[4] Chabani et al. (2021)	Increased access to finance [1]	Regulatory uncertainty [9]
[5] Paliwal et al. (2020)	Reduce risks [2] [5]	Low awareness [3]
[6] Sun et al. (2021a)	Improved auditing and compliance [4] [5] [7]	Lack of industrial standards [4]
[7] Ilbiz and Durst (2019)	Sustainability [5]	Cost considerations [7]
[8] Kaur et al. (2022)	Increased liquidity [9]	Low resources [4]
[9] Ozili (2022)		
Source(s): Created by authors		

academic studies and highlighted key insights and trends. The study revealed that blockchain technology has the potential to revolutionize SME finance by providing innovative solutions to address the credit gap. Distributed ledger systems ensure transparent record-keeping and reduce the risk of fraud, enhancing trust among stakeholders. Smart contracts enable the automation of financial processes, reducing administrative costs and streamlining operations for SMEs and lenders. The technology is revolutionizing SCF, credit process and capital market access for SMEs. Along with improving the traditional models, it has also given birth to new models and mechanisms for SME financing. Figure 10 depicts some of these novel mechanisms.

The financial ecosystem of SMEs is poised to be re-invented by blockchain, which is expected to save SMEs a significant amount of money in terms of financing costs (Chabani et al., 2021). Financial transactions using blockchain can drastically cut transaction costs, minimize transaction processing time, and improve transaction information security due to characteristics such as decentralization, robust authentication and tamper resistance.

The amalgamation of SCF intricacies with blockchain heralds a transformation that empowers SMEs with enhanced access to capital which can bolster their financial resilience and operational efficacy (Christian et al., 2020). As such, the ongoing evolution of this synergistic relationship presents a compelling outlook, propelling SMEs into an era marked by transparency, efficiency and sustained growth within the realm of financing. As SMEs continue to play a vital role in the
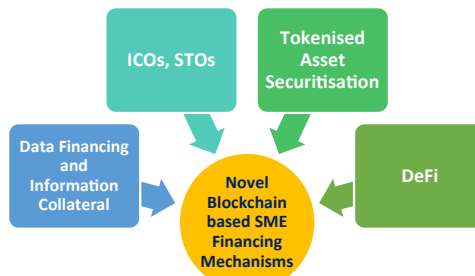
Source(s): Created by authors

global economy, embracing blockchain technology can empower them to thrive in an increasingly competitive market while reshaping the future of supply chain finance.

Based on the survey, a literature framework on SME finance and blockchain Technology is created and presented in Figure 11. It provides an understanding of various tools of blockchain technology and the areas of SME finance it impacts. It also shows how traditional finance processes are being improved and the novel financing mechanisms have evolved. Along with the potential benefits, the technology also has some challenges and gaps that must be addressed. But blockchain technology is still evolving, and with time the solutions to these challenges will emerge, making the blockchain-based decentralized systems more robust.
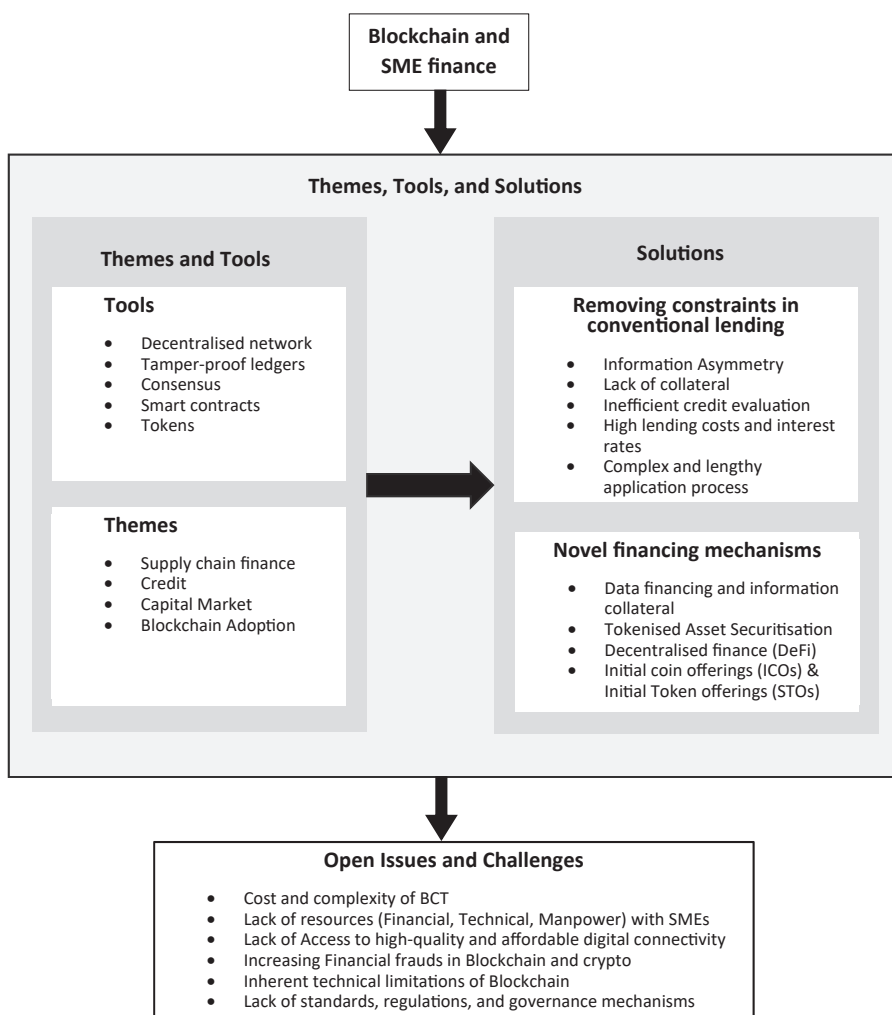
Figure 11.
A framework for current literature on blockchain-based SMEs financing

Source(s): Created by authors

Research into the application of blockchain technology in the SME finance landscape is gaining momentum. However, a targeted approach is imperative to address blockchain-based SME finance literature gaps effectively. These gaps span various facets of blockchain-based SME financing. For instance, they encompass investigating how blockchain can reshape supply chain finance for SMEs, introducing inventive funding mechanisms and mitigating complexities within intricate supply chains. In credit, the gaps relate to harnessing blockchain's potential for enhanced credit scoring transparency, precision and equity and exploring the viability of blockchain-based asset tokenization as collateral for loans. Capital markets trigger inquiries into adapting ICOs and STOs for SME funding, alongside assessing the advantages and challenges of asset tokenization for fractional ownership.

Adoption and regulation considerations encompass strategies for cost-effective blockchain integration, user-friendly interfaces and specific regulatory nuances of blockchain-based SME financing. Lastly, miscellaneous gaps delve into evaluating blockchain's role in fostering financial inclusion, comprehending its economic implications, studying hybrid models that amalgamate traditional systems and scrutinizing the broader sustainability consequences of blockchain-based SME financing. To facilitate further exploration, these gaps and possible research questions have been organized and listed in Table 4, building on the identified themes from Table 2. This can guide researchers in addressing critical issues at the nexus of SME finance and blockchain.

This systematic review contributes to the growing knowledge of blockchain-based SME finance by synthesizing and evaluating the existing literature. It also develops a framework for the area's existing literature and lays down future research paths. The study offers insights for researchers, policymakers and practitioners seeking to understand the potential of blockchain technology in filling the SME credit gap and fostering economic development through improved access to finance for SMEs. SMEs play a crucial role in driving economic growth and job creation. They can be a key stakeholder in achieving sustainable development goals. Lack of timely and adequate capital inhibits their growth. Blockchain technology has emerged as a potential solution for bridging the SME credit gap by offering innovative financing options. This can provide sustainable financing options for SMEs and catalyze their financial inclusion.

Despite some skepticism and concerns about complexity and risks, blockchain technology has demonstrated its resilience and continuous growth, gradually gaining the trust and interest of stakeholders. For instance, El Salvador has adopted Bitcoin as a legal tender. It plans to offer crypto-based loans to SMEs, with a $10m line of credit to be introduced through the Solana-based lending platform Acumen in the first quarter of 2022. Texas has also taken a significant step by implementing regulations for virtual currency, officially recognizing cryptocurrencies in state commercial law, effective September 1, 2021.

In India, eleven banks, including ICICI, HDFC, Axis and Yes Bank, have collaborated to form the Blockchain Infrastructure Company and established India's first blockchain-linked lending initiative for MSMEs, aiming to address challenges related to bad debts and defaulters. Additionally, Infosys and seven Indian banks launched the India Trade Connect, a blockchain-based trade network, to enhance transparency and risk management in trade finance and reduce delivery time for supply-chain financing. These developments highlight the increasing recognition and adoption of blockchain technology as a valuable tool in SME financing, with the potential to narrow the financing gap for these enterprises. It is high time we prioritize and focus on leveraging the technology and what it offers to enable SMEs to be the next engine of growth in the world economy.

Domain	Research questions
Supply chain finance	• How can Blockchain-based supply chain finance solutions be utilized to provide novel funding mechanisms for SMEs involved in complex supply chains? • What are the specific challenges and opportunities in leveraging Blockchain for transparent and efficient financing of SMEs involved in complex supply chains? • How can Blockchain-based supply chain finance solutions help address the lack of collateral for SMEs by leveraging transactional data and asset-tracking capabilities?
Credit	• How can Blockchain technology be utilized to enhance information transparency and mitigate information asymmetry issues in SME financing? • How can Blockchain technology improve the accuracy and reliability of credit scoring models for SME financing? • How can Blockchain technology enable the development of decentralized credit scoring models that reduce adverse selection and enable fair evaluation of SMEs' creditworthiness? What are the potential data sources, algorithms, and governance structures that can be employed to create robust and unbiased credit scoring systems on the Blockchain? • How can Blockchain-based asset tokenization enable SMEs to create and represent digital assets that can be used as loan collateral? What are the legal, technical, and economic considerations in implementing and valuing tokenized collateral on the Blockchain? • How can Smart contracts on the Blockchain automate and streamline the lending process for SMEs, reducing complexity and improving efficiency? • How can Blockchain technology help reduce lending costs and interest rates by eliminating intermediaries and streamlining processes in SME financing? What are the potential efficiency gains, cost savings, and risk reduction benefits that can be achieved using Blockchain in the lending value chain?
Capital market	• How can ICOs and STOs be tailored to meet the funding needs of SMEs? What are the regulatory considerations and investor protection measures required? • How can Blockchain-based crowdfunding platforms be developed to enable decentralized funding for SMEs? • What are the potential benefits and challenges of tokenizing SME assets and facilitating fractional ownership through Blockchain?
Blockchain adoption and regulation	• What strategies and frameworks can enable the cost-effective adoption of Blockchain technology for SMEs with limited financial capacity? • How can SMEs leverage shared infrastructure, cloud-based solutions, or consortium models to reduce the costs associated with Blockchain implementation and maintenance? • How can user-friendly interfaces and tools be designed to simplify the interaction of SMEs with Blockchain technology? What are the potential solutions to overcome the technical complexities and provide intuitive interfaces that enable SMEs to leverage the benefits of Blockchain without requiring extensive technical expertise? • What are the potential service models, including Blockchain-as-a-service (BaaS) or platform-as-a-service (PaaS), that can provide SMEs with affordable and simplified access to Blockchain infrastructure and functionality? • What are the regulatory challenges and considerations specific to Blockchain-based SME financing, and how can they be addressed? • How can Blockchain platforms incorporate regulatory requirements such as anti-money laundering (AML) and know-your-customer (KYC) regulations while ensuring the efficiency and accessibility of SME financing?

(*continued*)

Table 4.
Suggestions for the future research

Domain	Research questions
Miscellaneous	• How can Blockchain-based SME financing contribute to financial inclusion and support underserved or marginalized SMEs? What are the potential social impact metrics and evaluation frameworks to assess the effectiveness of Blockchain-based solutions in promoting equitable access to financing? • What are the economic implications and market dynamics of Blockchain-based SME financing, such as changes in competition, pricing, and risk management? • What are the potential synergies and trade-offs in combining traditional financial systems with Blockchain technology for SME financing? How can hybrid approaches, such as integrating Blockchain with existing payment systems or credit scoring models, enhance SMEs' financial services? • What are the environmental, social, and economic sustainability implications of Blockchain-based SME financing?

Table 4.

Source(s): Created by authors

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