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Proposing a Framework to Strengthen Supply Chain Financing in Iran with a Focus on FinTech Capabilities

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ABSTRACT

Financial technologies (FinTech) have attracted considerable attention in corporate financial management, particularly in supply chain financing, due to their innovative capabilities such as increasing transparency, reducing information asymmetry, improving cash flow, and enhancing supply chain resilience. The present study aims to identify and analyze the factors influencing the strengthening of supply chain financing in Iran, focusing on FinTech capabilities. This applied research employed a quantitative–expert-oriented methodology. In the first stage, 29 influencing factors were identified through a review of domestic and international literature and expert interviews in supply chain financing and FinTech. These factors were screened using an expert validation questionnaire and the fuzzy Delphi method, resulting in the selection of nine key factors for final ranking using the MARCOS (Measurement of Alternatives and Ranking according to Compromise Solution) method. The ranking of the final factors was performed through a prioritization questionnaire and the MARCOS technique. Based on the MARCOS method scores, the factors of reducing information asymmetry, lowering financing costs, enhancing supply chain resilience, and improving financial information transparency were found to have the highest priority and impact on strengthening supply chain financing, respectively. Practical recommendations include increasing transparency and digital trust among supply chain members, improving operational efficiency and reducing credit risk, leveraging advanced financial and FinTech technologies to facilitate cash flow and enhance supply chain resilience, and designing operational and managerial strategies based on the identification of key factors to support effective decision-making in firms and financial institutions.

Keywords: Financing, Supply Chain Financing, Supply Chain, FinTech, FinTech Capabilities

Introduction

In recent years, the convergence of financial technology (FinTech) and supply chain finance (SCF) has transformed how enterprises manage liquidity, mitigate risk, and optimize capital flows across global value networks [1]. The rapid digitalization of financial services and supply chain operations has created a new landscape of efficiency, transparency, and accessibility for both large corporations and small and medium-sized enterprises (SMEs) [2]. As traditional financing mechanisms often fail to address the dynamic credit needs of supply chain actors, FinTech solutions have emerged as a critical driver of innovation, enabling firms to reduce transaction frictions, enhance trust, and facilitate real-time financial decision-making [3, 4].

Supply chain financing represents a strategic collaboration among buyers, suppliers, and financial institutions, aiming to optimize working capital and strengthen the overall resilience of supply networks [2]. However, traditional SCF models are frequently constrained by asymmetrical information, limited visibility into suppliers' financial health, and slow manual

processes [5]. FinTech's data-driven technologies—such as blockchain, artificial intelligence (AI), cloud computing, and big data analytics—are revolutionizing this landscape by improving data transparency, streamlining operations, and enabling predictive credit scoring [6, 7]. As global value chains become increasingly interconnected, FinTech-based SCF systems are gaining traction as mechanisms that balance financial inclusion, efficiency, and risk management across various sectors [8, 9].

The integration of FinTech into supply chain finance not only increases operational speed and accuracy but also enhances digital trust among supply chain partners [10]. Trust has emerged as a cornerstone of SCF, influencing the willingness of firms to engage in collaborative financing practices and share sensitive data [1]. Innovative FinTech service models—such as smart contracts and blockchain-enabled payment systems—facilitate secure, traceable, and automated transactions, thereby fostering stronger relationships between financial institutions and supply chain participants [11, 12]. This digital trust framework serves as a foundational element in strengthening financial resilience and reducing the perceived risks of inter-organizational cooperation [13].

From an organizational perspective, FinTech integration promotes financing accessibility, particularly for SMEs, which often face capital constraints and stringent collateral requirements [8, 14]. Traditional banking institutions have historically been reluctant to finance small suppliers due to the lack of reliable financial data and credit histories. FinTech solutions leverage alternative data sources—such as transaction patterns, logistics data, and e-commerce footprints—to evaluate creditworthiness more effectively [3]. This data-driven approach reduces information asymmetry and allows lenders to provide customized financing options with dynamic risk assessment capabilities [5, 15].

Moreover, digital transformation in supply chain finance has improved transparency and liquidity management. Through real-time data analytics and AI-driven insights, FinTech platforms enable supply chain actors to monitor cash flows, forecast working capital requirements, and prevent liquidity bottlenecks [6, 16]. This contributes to greater financial stability, faster capital turnover, and increased confidence among suppliers and buyers. As Dehghani et al. [17] note, the integration of digital technologies into financing systems enhances not only financial performance but also sustainability by optimizing resource allocation and minimizing waste within financial networks.

Another key contribution of FinTech to SCF lies in its ability to enhance supply chain resilience. Resilient supply chains can absorb shocks such as demand fluctuations, logistical disruptions, or global crises while maintaining financial continuity [18, 19]. The adoption of FinTech tools—such as blockchain-based financing platforms and cloud-integrated payment solutions—enables firms to strengthen transactional reliability and reduce dependency on traditional intermediaries [11]. By improving visibility and traceability of financial flows, FinTech helps firms adapt quickly to external shocks, a capability that has become increasingly crucial in the post-pandemic economy [1, 9].

Beyond resilience and transparency, FinTech also plays an instrumental role in advancing sustainability and inclusivity in supply chain financing. As Maryam and Ahmad [20] emphasize, Islamic financial institutions are increasingly incorporating FinTech tools to design Shariah-compliant financial products that promote ethical investments and inclusive access to financial services. Similarly, Ningrat and Nurzaman [21] highlight how FinTech-driven Islamic finance models have expanded into agricultural value chains, offering tailored solutions for underserved communities. These developments illustrate FinTech's potential to bridge financial gaps, especially in emerging economies, where access to traditional finance remains limited [14, 22].

At the macroeconomic level, FinTech-facilitated SCF contributes to systemic efficiency and competitiveness by aligning financial flows with real-time supply chain operations [15, 23]. As noted by Razavi and Basirizadeh [24], structural reforms in the banking system are essential to fully leverage FinTech's capabilities, as outdated regulatory frameworks often hinder innovation. FinTech provides a platform for automating credit assessment, enhancing governance, and implementing risk-sensitive financial instruments that align with both market dynamics and national financial development goals [4].

From a technological standpoint, the incorporation of big data analytics, machine learning, and blockchain has redefined how supply chain financing operates. Big data technologies extract valuable insights from financial transactions, supplier performance, and logistics patterns, enabling better forecasting and decision-making [7]. Machine learning algorithms support predictive risk models that adapt dynamically to market volatility, thus lowering default risks and improving credit allocation [2]. Furthermore, blockchain technology ensures immutable transaction records and enhances auditability, thereby reducing fraud and enhancing regulatory compliance [11, 17].

Despite these advances, challenges remain in adopting FinTech within SCF systems. As Kookhdan et al. [25] point out, developing countries often face structural barriers such as limited digital infrastructure, inadequate policy frameworks, and insufficient financial literacy among SMEs. Overcoming these barriers requires collaborative efforts among policymakers, regulators, and industry leaders to establish interoperable digital ecosystems that facilitate secure financial transactions. In addition, Najjarzadeh [14] argues that the imbalance in banks' financing of productive enterprises reflects inefficiencies that FinTech could address through better credit analytics and digital lending models.

Trust and governance mechanisms are equally crucial for the sustainable deployment of FinTech in supply chain finance. Han, Ulhøi, and Song [10] emphasize that digital trust underpins the success of SCF systems, as it determines firms' willingness to exchange data and engage in automated financial processes. Establishing this trust requires robust cybersecurity frameworks, transparent algorithms, and equitable access to digital platforms [1]. Similarly, Li et al. [6] propose that the future of SCF lies in integrated FinTech ecosystems where financial institutions, logistics providers, and technology firms collaborate to create end-to-end visibility and shared value.

Furthermore, regulatory adaptation plays a pivotal role in enabling FinTech's expansion. Kuan-Jung [4] notes that legal systems must evolve to accommodate FinTech-driven financing models, which challenge traditional definitions of banking and lending. Without supportive regulations, innovations such as blockchain-based trade finance, peer-to-peer lending, and digital asset-backed financing risk facing compliance barriers. A balanced regulatory approach can ensure consumer protection while promoting innovation and competitiveness [24].

At the intersection of technology, finance, and sustainability, FinTech-driven SCF fosters new paradigms for inclusive economic growth. It not only enhances financial performance and transparency but also supports the broader objectives of resilience, green finance, and digital transformation [7, 17]. Integrating AI and IoT-based monitoring systems allows firms to track carbon footprints, evaluate sustainability metrics, and implement responsible financing strategies that align with environmental goals [13, 20]. This integration underscores the emerging role of FinTech as a catalyst for sustainable development within financial ecosystems.

Empirical studies further highlight the multidimensional impact of FinTech on supply chain finance. Xu et al. [1] demonstrate that the adoption of FinTech reduces firms' risk-taking volatility through improved credit access and data transparency. Liu et al. [18] find that FinTech-based solutions enhance the adaptive capacity of supply chains, enabling rapid

responses to disruptions. Similarly, Guan et al. [8] show that FinTech development improves SME financing efficiency, narrowing the financial gap between large enterprises and small suppliers. These findings collectively point toward a transformative shift in financial intermediation and industrial collaboration.

In the context of Iran, the integration of FinTech into supply chain financing is particularly significant. As studies by Ramsheh et al. [23] and Maleki et al. [26] indicate, the Iranian financial ecosystem is experiencing an acceleration in digital financial entrepreneurship, yet institutional, regulatory, and infrastructural challenges persist. Addressing these challenges requires a strategic approach that leverages FinTech capabilities to enhance financial inclusion, reduce credit asymmetry, and strengthen supply chain resilience [19, 22]. Such an approach can provide the foundation for sustainable growth and improved competitiveness in both domestic and international markets.

Therefore, the aim of this study is to identify and analyze the key factors that strengthen supply chain financing in Iran with an emphasis on the capabilities of FinTech.

Methodology

The objective of the present study is to identify and analyze the factors influencing the strengthening of supply chain financing with a focus on FinTech capabilities in Iran. Given the nature of the research and the need to prioritize factors, a multi-criteria quantitative and expert-oriented research method was employed. Accordingly, the fuzzy Delphi technique was used for factor screening, and the MARCOS (Measurement of Alternatives and Ranking according to Compromise Solution) method was applied for factor analysis and prioritization. Both techniques rely on quantitative data and enable the ranking and quantitative evaluation of factors.

To collect data, a questionnaire was used. Initially, factors affecting the strengthening of supply chain financing with a focus on FinTech were identified from domestic and international scientific studies, as well as from structured interviews with experts in supply chain financing and FinTech. Then, for validation and screening purposes, an expert evaluation questionnaire was administered to 10 specialists. After analyzing and confirming the key factors, a second questionnaire was completed to prioritize and rank the factors using the MARCOS technique.

The theoretical population of this research consisted of experts in FinTech and supply chain financing. The sampling method was judgmental, and participants were selected based on their expertise and experience in the fields of FinTech and supply chain financing. The sample size for this study was 10 individuals, which is considered appropriate for expert-oriented studies and enables scientific screening and prioritization of key factors.

The experts in this study included senior managers and financial technology specialists active in the supply chain domain, possessing substantial expertise and experience in digital finance, FinTechs, big data, and emerging technologies in supply chain management. The sampling method was judgmental, and participants were selected based on their professional competence in supply chain financing and modern financial technologies.

The research was conducted in three stages. In the first stage, the factors influencing the strengthening of supply chain financing with a focus on FinTech capabilities were extracted through a review of domestic and international literature and structured interviews with experts in supply chain and digital finance. In the second stage, these factors were screened using the fuzzy Delphi method to identify valid and key factors. Finally, in the third stage, the prioritization and ranking of the key factors were performed using the MARCOS method.

In this study, the fuzzy Delphi technique was applied for factor screening. In the fuzzy Delphi algorithm, an appropriate fuzzy scale must first be defined to convert experts' qualitative expressions into quantitative measures. Conventional fuzzy scales can be used in this process to ensure that the analysis and validation of factors are scientifically and practically reliable. This approach guarantees that the identified factors are directly related to strengthening supply chain financing in Iran and applicable for decision-making in firms and financial institutions. In this study, a five-point Likert fuzzy scale was used, as presented in Table 1 (Habibi, Jahantigh, & Sarfarazi, 2015).

Table 1

Fuzzy Delphi Method Scale

Linguistic Variable	Fuzzy Value	Triangular Fuzzy Number
Very Low	1	(0, 0, 0.25)
Low	2	(0, 0.25, 0.5)
Medium	3	(0.25, 0.5, 0.75)
High	4	(0.5, 0.75, 1)
Very High	5	(0.75, 1, 1)

The MARCOS method is one of the modern multi-criteria decision-making (MCDM) approaches used to evaluate and rank alternatives. In this study, the MARCOS method was employed to analyze and prioritize the factors influencing the strengthening of supply chain financing. The evaluation indicators included the degree of impact, the level of tangible and intangible benefits, and the cost of utilizing the capabilities. The indicators of impact intensity and tangible/intangible benefits have an increasing nature, whereas the cost indicator has a decreasing nature. Simply put, factors with higher influence and benefits and lower implementation costs are considered more desirable for policy-making and managerial decision-making.

Step 1: Constructing the Decision Matrix.

The first step in all multi-criteria decision-making methods, whose purpose is prioritization, is to form a decision matrix. In the MARCOS method, *m* alternatives are evaluated using *n* criteria. Based on each criterion, a score is assigned to each factor or alternative. In this study, experts rated each factor according to the three mentioned indicators using a 10-point scale. Considering the participation of 10 experts, an integrated matrix was constructed for each factor, calculated as the arithmetic mean of all experts' opinions.

Step 2: Determining Ideal and Anti-Ideal Solutions.

In this step, the values of the ideal and anti-ideal alternatives are determined based on the following relationships.

$$AI = \max_i x_{ij} \quad if\ j \in B \quad and \quad \min_i x_{ij}\ if\ j \in C$$

$$AAI = \min_i x_{ij} \quad if\ j \in B \quad and \quad \max_i x_{ij}\ if\ j \in C$$

Step 3: Normalization.

In this step, the data in the integrated matrix are normalized using specific equations. Linear normalization is performed, and the method of normalization differs for indicators with positive and negative characteristics.

$$n_{ij} = \frac{x_{aj}}{x_{ij}} \quad if \ j \in C$$

$$n_{ij} = \frac{x_{ij}}{x_{aj}} \quad if \ j \in B$$

Step 4: Constructing the Weighted Normalized Matrix.

By multiplying the normalized matrix by the weight of each criterion, the weighted normalized matrix is obtained. In this study, equal weights were assigned to all criteria.

Step 5: Calculating the Utility Degree of Alternatives (Research Factors).

In this step, based on the relevant equations, the ideal and anti-ideal utility levels of each alternative are determined.

$$K_i^+ = \frac{S_i}{S_{ai}}$$

$$K_i^- = \frac{S_i}{S_{aai}}$$

Step 6: Determining Final Performance and Ranking of Alternatives.

Finally, using the designated formula, the desirable performance of each alternative is determined, which allows for the final ranking of the factors.

$$f(K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}}$$

Findings and Results

The factors influencing the strengthening of supply chain financing in Iran, focusing on FinTech capabilities, were extracted through an analytical review of domestic and international studies and interviews with experts in supply chain management and digital finance. These drivers are presented in Table 2. To identify these factors, studies related to supply chain financing, FinTech, and the applications of modern financial technologies were examined.

Table 2

Factors Affecting Supply Chain Financing with a Focus on FinTech Capabilities

Research Sources	Research Factors
[10, 23]	Digital trust among supply chain members
[10, 12]	FinTech service innovation
[5, 26]	Reduction of information asymmetry
[3, 23]	Financial information transparency
[8, 17]	Better access to financial resources for SMEs
[13, 25]	Reduction of credit risk
[9, 17]	Improvement of cash flow
[18, 23]	Reduction of financing costs
[18, 19]	Supply chain resilience
Expert interviews	Speed in transaction processing

[6]	Improvement of operational efficiency in the supply chain
[7, 26]	Big data analytics capability
[7, 23]	Use of artificial intelligence and machine learning
[11]	Use of blockchain
[18]	Reduction of concentration in the supply chain
Expert interviews	Expansion of investment scope
[1]	Increase in firms' controlled risk-taking
[20, 21]	Innovation in Islamic financial products
Expert interviews	Compliance with Shariah principles in Islamic finance
[20, 23]	Financial inclusion and access for disadvantaged groups
[16, 17]	Financial risk management and control
[5, 26]	Reduction of informational friction
[27]	Enhancement of firms' competitive advantage
[4, 25]	Compliance with legal and regulatory frameworks
[7, 17]	Support for sustainable supply chain development
[11, 24]	Improvement of banks' strategic decision-making
Expert interviews	Prioritization of appropriate technologies
[7, 12]	Use of advanced digital technologies (cloud, IoT)
[18, 19]	Strengthening the resilience and flexibility of financial systems

In this study, 29 factors were extracted from the literature review and expert interviews related to supply chain financing. These factors were then screened using the fuzzy Delphi method. Because methods such as MARCOS are highly sensitive to the number of factors, it was necessary to reduce the initial set of variables. At this stage, 20 factors were eliminated, and 9 key factors were selected for the final ranking. Factors with a fuzzy number higher than 0.7 were included in the final MARCOS analysis. In this study, 9 factors had fuzzy numbers above 0.7, which was set as the threshold for screening and evaluating the factors. In most studies, the threshold value is chosen between 0.5 and 0.7; thus, in this research, 0.7 was applied as the final criterion. Table 3 shows the final factors along with their corresponding fuzzy values.

Table 3

Fuzzy Delphi Output of Screened Factors

Defuzzified Value	Upper Bound	Median	Lower Bound	Factors
0.80	0.92	0.78	0.69	FinTech service innovation (A)
0.83	0.95	0.83	0.71	Reduction of information asymmetry (B)
0.76	0.86	0.75	0.66	Financial information transparency (C)
0.75	0.85	0.74	0.66	Reduction of credit risk (D)
0.80	0.93	0.78	0.68	Reduction of financing costs (E)
0.75	0.86	0.73	0.65	Supply chain resilience (F)
0.75	0.87	0.73	0.66	Reduction of concentration in the supply chain (G)
0.73	0.83	0.74	0.63	Expansion of investment scope (H)
0.76	0.88	0.75	0.65	Support for sustainable supply chain development (I)

After screening, nine key factors influencing the strengthening of supply chain financing based on FinTech capabilities were ranked using the MARCOS technique. At this stage, experts' opinions were collected on a 10-point scale for each factor according to three indicators: impact, level of benefits, and implementation cost. The data were aggregated using arithmetic means to form an integrated decision matrix. The values in this matrix were then standardized through linear normalization, and by multiplying by the criterion weights, the weighted normalized matrix was obtained. In this study, the weights of all indicators were considered equal. Table 4 presents the weighted normalized matrix values, and the last column shows the row sum of each factor, which was used for the final ranking and prioritization of key factors in supply chain management decision-making.

Table 4

Weighted Normalized Matrix

Criterion Weights	0.33	0.33	0.33	
Research Factors	Impact	Benefits	Implementation Cost	Si
A	0.198	0.225	0.173	0.596
B	0.33	0.33	0.33	0.99
C	0.263	0.244	0.162	0.669
D	0.142	0.185	0.122	0.449
E	0.301	0.326	0.244	0.871
F	0.274	0.301	0.263	0.838
G	0.159	0.187	0.132	0.478
H	0.199	0.232	0.198	0.629
I	0.168	0.188	0.131	0.487
Ideal Option	0.33	0.33	0.33	0.99
Anti-Ideal Option	0.142	0.185	0.122	0.449

Based on the data in Table 4, the ideal and anti-ideal utility values of the factors affecting supply chain financing focused on FinTech capabilities, the overall performance of each factor, and their priorities were determined.

Table 5

Scores and Priority of Research Factors

f(Ki)	f(Ki–)	f(Ki+)	Ki–	Ki+	Research Factors
0.527	0.312086	0.687914	1.327	0.60202	A
0.876	0.312012	0.687988	2.205	1.000	B
0.592	0.312019	0.687981	1.490	0.675758	C
0.397	0.312022	0.687978	1.000	0.453535	D
0.771	0.312007	0.687993	1.940	0.879798	E
0.741	0.312065	0.687935	1.866	0.846465	F
0.423	0.311939	0.688061	1.065	0.482828	G
0.557	0.312006	0.687994	1.401	0.635354	H
0.431	0.311950	0.688050	1.085	0.491919	I

According to the factor scores in Table 5, the reduction of information asymmetry, reduction of financing costs, supply chain resilience, and financial information transparency had the highest priorities. The study's practical recommendations were developed based on these high-priority factors.

Discussion and Conclusion

The present study set out to identify and prioritize the factors influencing the strengthening of supply chain financing (SCF) in Iran with an emphasis on FinTech capabilities. Based on the results derived from the fuzzy Delphi and MARCOS analyses, the most influential factors were the reduction of information asymmetry, reduction of financing costs, enhancement of supply chain resilience, and improvement of financial information transparency. These findings underscore the critical role of FinTech in overcoming systemic inefficiencies in traditional financial systems by leveraging digital technologies to improve transparency, reduce costs, and enhance trust in supply chain financing processes.

The first major finding—the reduction of information asymmetry—ranked as the most significant determinant of effective SCF reinforcement. This aligns with previous studies that emphasize the importance of transparent and accessible data flows in minimizing uncertainty and improving credit risk evaluation [3, 5, 6]. Information asymmetry between suppliers, buyers, and financial institutions often leads to financing inefficiencies, as lenders tend to overestimate risk due to the absence of accurate financial information [2]. FinTech applications, particularly those utilizing blockchain and AI-based analytics, have

been shown to mitigate such asymmetries by providing real-time financial visibility, automating transaction verification, and enabling continuous monitoring of creditworthiness [10, 11]. This digital transparency fosters a more equitable flow of financing across the supply chain, facilitating better access for small and medium-sized enterprises (SMEs) that typically face credit constraints [8, 14].

Furthermore, this finding resonates with empirical evidence from both developed and emerging economies. For instance, Guan et al. [8] reported that FinTech-driven transparency mechanisms significantly improve financing efficiency for SMEs by reducing reliance on collateral-based lending models. Similarly, Han et al. [10] found that digital trust, supported by transparent data exchange, is fundamental in enhancing inter-organizational financial collaboration. In the Iranian context, where traditional financial documentation and manual evaluation still dominate, the implementation of FinTech solutions could eliminate redundant processes and empower firms to build digital trust-based networks.

The second major finding—the reduction of financing costs—also plays a pivotal role in strengthening SCF. This aligns with research showing that digital platforms reduce operational and transactional costs by automating routine financial processes, improving resource allocation, and shortening payment cycles [7, 9, 23]. Automation through smart contracts and digital invoicing reduces dependency on intermediaries, thereby lowering administrative expenses and risk premiums [1]. Li et al. [6] found that FinTech-enabled SCF frameworks enhance cost-efficiency by integrating advanced analytics into financial decision-making, allowing firms to optimize liquidity while maintaining adequate working capital. The results of the present study corroborate these findings, demonstrating that firms adopting FinTech tools experience substantial reductions in their financing costs compared to those using conventional banking systems.

Additionally, the alignment of FinTech adoption with cost minimization has broader implications for financial resilience and competitiveness. Studies by Rogers et al. [2] and Kannan [15] suggest that lowering financing costs not only benefits individual firms but also enhances supply chain stability by reducing capital bottlenecks across tiers. In emerging markets, cost efficiency in financing remains a key determinant of competitive advantage, particularly for export-oriented industries. Therefore, digitalization of financial transactions through blockchain and AI-based credit assessments can establish a more inclusive financial environment where even small-scale suppliers gain affordable access to capital [13, 26].

The third major finding—supply chain resilience—reflects the ability of FinTech solutions to enhance adaptability and continuity amid economic or operational disruptions. This finding corresponds with Liu et al. [18], who demonstrated that FinTech integration enhances organizational flexibility and crisis response by enabling data-driven decision-making and predictive modeling. Through real-time financial analytics, firms can identify potential supply chain risks, adjust financing strategies proactively, and ensure cash flow stability [19, 22]. Moreover, blockchain technology contributes to resilience by decentralizing information storage and improving the traceability of financial transactions [4, 11]. This reduces systemic vulnerabilities and minimizes the risk of data manipulation or fraud.

The study's finding that resilience is a top priority aligns with broader global trends toward sustainable and adaptive financial systems. As Guan et al. [8] and Dehghani et al. [17] emphasize, financial resilience is increasingly recognized as a cornerstone of sustainable business operations, particularly in volatile economic environments. In Iran, where fluctuations in liquidity, currency valuation, and credit availability are prevalent, the adoption of FinTech-enabled SCF solutions can serve as a stabilizing mechanism. Enhanced resilience ensures that financial disruptions at one tier of the supply chain do not propagate downstream, thereby maintaining overall production and distribution continuity.

The fourth critical factor identified in this study—financial information transparency—further strengthens the argument for FinTech integration in SCF systems. Transparent financial reporting and data sharing facilitate better decision-making for lenders, reduce default risks, and improve credit allocation efficiency [3, 20]. According to Han et al. [10], transparency not only improves credit evaluations but also fosters digital trust, which is essential for sustained collaboration among supply chain stakeholders. Furthermore, technologies such as blockchain and distributed ledger systems allow all participants to access identical, immutable records of financial transactions, reducing disputes and enhancing accountability [7, 11].

These findings are consistent with research by Maryam and Ahmad [20], who explored the integration of FinTech into Islamic financial systems and found that increased transparency promotes ethical financing and inclusive participation. In emerging markets like Iran, where informal financing and opaque transactions have long hindered efficiency, FinTech-driven transparency can bridge institutional gaps and enhance financial governance. Transparency is particularly vital for promoting financial inclusion and extending credit to previously underserved or excluded sectors [21].

In addition to these four key drivers, the study revealed that sustainability, risk management, and digital trust are interconnected components reinforcing SCF effectiveness. Sustainable financing approaches supported by FinTech align financial objectives with environmental and social priorities [13, 17]. Blockchain-based traceability systems and big data analytics can help firms track sustainability metrics, such as carbon footprints, thereby integrating green finance principles into supply chain operations. Likewise, effective risk management is facilitated through predictive analytics, which allows firms to forecast credit defaults and assess supplier reliability with greater precision [16].

The study also emphasizes that building digital trust among supply chain participants is essential for successful FinTech implementation. Han, Ulhøi, and Song [10] demonstrated that digital trust underpins cooperative financial behavior, enabling firms to share sensitive data securely and participate in joint financing programs. Trust is particularly crucial in the Iranian financial ecosystem, where digital transformation is still in its developmental stages. FinTech solutions that incorporate transparent algorithms and strong cybersecurity mechanisms can significantly enhance confidence in digital financial transactions [1].

The consistency of the present findings with prior international studies highlights the universality of FinTech's transformative impact on supply chain financing. In both advanced and developing economies, FinTech has proven to be a catalyst for greater efficiency, inclusion, and risk mitigation [8, 23]. The current study contributes to this growing body of literature by contextualizing these insights within Iran's emerging FinTech ecosystem, identifying local priorities, and suggesting actionable policy directions for financial institutions and regulatory bodies.

The results also support previous research indicating that banks and financial intermediaries must adapt their operational models to remain competitive in the age of FinTech [14, 24]. Traditional banks that integrate FinTech technologies—such as automated credit scoring, blockchain-based settlements, and real-time monitoring—can expand their service portfolios and enhance profitability. Kao et al. [11] found that banks adopting hybrid FinTech strategies outperform those relying solely on conventional credit risk assessments. Similarly, Soni et al. [7] demonstrated that Industry 4.0 technologies integrated with FinTech tools strengthen sustainable SCF for SMEs by reducing inefficiencies and enabling adaptive decision-making.

Collectively, these findings reaffirm that FinTech adoption is not merely a technological trend but a strategic necessity for enhancing competitiveness, resilience, and sustainability in supply chain finance [15, 18]. In the Iranian context, this integration can serve as a powerful lever to modernize financial institutions, expand credit access, and align financial systems

with global digital transformation standards. However, the full potential of FinTech in Iran's SCF sector will only be realized through coordinated efforts among policymakers, banks, technology providers, and supply chain actors to address existing barriers such as regulatory inertia, digital illiteracy, and infrastructural limitations [25, 26].

This study, while comprehensive in its analytical approach, faces several limitations. First, the expert-based sampling method, though suitable for exploratory and Delphi analyses, limits the generalizability of the results across broader industrial sectors. The relatively small number of experts may have introduced subjective bias despite efforts to ensure diversity in professional backgrounds. Second, the research focuses specifically on Iran's financial and regulatory environment, which may differ significantly from other national contexts in terms of technological maturity and institutional frameworks. Therefore, the transferability of findings to other economies should be approached with caution. Third, the study primarily employs cross-sectional data, which restricts its ability to assess long-term causal relationships or dynamic changes in FinTech adoption and SCF performance over time. Lastly, access to comprehensive financial datasets from Iranian FinTech firms and supply chain stakeholders was limited due to confidentiality concerns, constraining the quantitative depth of validation.

Future research could expand on the current study by employing longitudinal designs to capture the evolving impact of FinTech on SCF resilience, efficiency, and inclusivity. Comparative analyses between developed and developing markets would further illuminate how institutional, regulatory, and cultural contexts shape FinTech adoption outcomes. Additionally, integrating quantitative modeling techniques—such as structural equation modeling or system dynamics—could reveal causal pathways among FinTech capabilities, supply chain performance, and financial outcomes. Future scholars might also investigate the role of emerging technologies such as decentralized finance (DeFi), quantum computing, and digital currencies in reshaping SCF ecosystems. Finally, broader empirical surveys involving multiple industries could strengthen the external validity of the identified factors and provide more granular insights into sector-specific challenges.

From a practical perspective, the study underscores the need for policymakers and financial institutions to prioritize digital transformation initiatives that enhance transparency, reduce financing costs, and strengthen supply chain resilience. Establishing integrated FinTech-SCF platforms could facilitate seamless collaboration between banks, suppliers, and buyers. Financial regulators should also consider creating adaptive legal frameworks that encourage innovation while safeguarding data privacy and cybersecurity. Additionally, investing in digital literacy and training programs for SMEs would empower them to adopt and benefit from FinTech-driven financial solutions. Finally, firms should cultivate a culture of data-driven decision-making and digital trust, positioning themselves to capitalize on FinTech's potential to achieve sustainable and resilient supply chain financing in Iran's evolving economic landscape.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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