



Banking in the Digital Era: A Novel Supply Chain Finance Model to Enhance SME Financial Inclusion

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ABSTRACT

Fintech innovation, Supply Chain Finance, and Stakeholder Collaboration are reshaping access to finance and enabling sustainable growth in banking. New access to financial products is now crucial to bridge liquidity gaps, improve the provision of capital, and enhance financial inclusion, particularly for Small and Medium-sized Enterprises (SMEs). In spite of SMEs contributing significantly to economies worldwide, they mostly endure poor financing due to stringent credit terms and collateral limitations. This study examines the role of Fintech adoption, supply chain financing, and stakeholder coordination in enhancing financial access and its impact on SME finance growth in the banking sector. Through the use of a quantitative approach, the study utilizes Structural Equation Modeling (SEM) in its empirical testing of direct and indirect relationships between the most applicable financial enablers and SME finance. Data were collected from banking experts, providers of financial services, fintech experts, and stakeholders of SMEs. It recognizes that Fintech innovations, financial institution strategic collaboration, and supply chain finance are crucial in enabling access to finance, hence promoting SME finance growth. Out of all the independent variables, Fintech adoption contributes the most, once again demonstrating that it is at the forefront of contemporary banking activities. In addition, the statistical function of access to finance as a mediator is material, as it indicates the necessity for a permanent digital financial system. This research adds to the literature in the sense that it brings financial innovations in supply chain and digital finance together under a single canopy of the whole banking sector with special focus being laid on how banking institutions can adopt technologically driven financial solutions. The research provides implications for practical usage to Islamic and conventional banks by calling for intensified financing infrastructure digitalization, policy measures, and social financial institutions to facilitate the reduction of SMEs' finance gap. Second, the theoretical framework put forth gives a conceptual model that could further be studied on the finance sector contribution from digital transformation by following an inclusive, efficient, and sustainable banking sector.

Introduction

The Pakistani financial condition is dominated by Small and Medium Enterprises (SMEs), which provide nearly 40% of GDP and have the largest percentage of over 80% of non-farm workers (Khawaja & Iqbal, 2019). While SMEs significantly control economic development, Pakistani SMEs have long-term financial problems that limit their opportunities to grow (Khan et al., 2021). The traditional sources of finance, controlled by conventional banks, are not providing finance to SMEs in the form of high collateral and interest charges (Rehman, Aslam, & Iqbal, 2021). This is leading to the unavailability of finance, which is obstructing the growth of SMEs as well as the industrialization process in the new digital economy of Pakistan (Haider, Hashmi, & Maryam, 2024). In such a constrained context, Islamic banking offers a solution in the form of Shariah-compliant financial products offering SME finance needs in the form of risk-sharing and asset-based financing arrangements (Khan, 2015; Aslam & Haron, 2020).

More recently, Fintech innovation, supply chain financing, and collective stakeholder efforts have transformed worldwide financial situations with higher financial inclusion and prudent banking tradition (Ali, Gongbing, & Mehreen, 2020; Sanga & Aziakpono, 2023). The synergy between Digital Supply Chain Finance (DSCF) and Islamic banking has presented a new option to address liquidity issues and support SME access to finance (Harsanto et al., 2024). DSCF enables blockchain technology, artificial intelligence, and smart contracts to increase the transparency of transactions, automate risk assessment, and reduce financing costs (Javaid et al., 2021; Mahyarnia et al., 2024). All this digitalization is most directly applicable in the case of Pakistan, where formal credit is scarce for over 70% of SMEs, further increasing financial exclusion and economic injustice (State Bank of Pakistan, 2024).

Besides that, Shariah compliance of digital banking is also on the rise where Islamic banks are using Fintech more and more to cater to ethically conscious firms and the unbanked (Ab. Aziz et al., 2023; Aziz et al., 2023). Empirical studies show that Shariah-based financial literacy leads to increased operational effectiveness with improved financial decision-making of SMEs (Shehadeh et al., 2024; Maheshwari & Kamble, 2023). The use of Islamic Fintech technologies improves international trends of digital financial inclusion and can be a tool through which Pakistan's Islamic banking industry can convert its financial landscape into a digital one in harmony with religious beliefs (Ahmed, 2024; Rabbani et al., 2020).

Supply Chain Finance (SCF) is another driving force that facilitates SME finance growth, especially across emerging economies such as Pakistan (Yang et al., 2019; Reza-gharehbagh et al., 2023). SCF products advance working capital efficiency, minimize payment delay, and improve cash flow, a sheer win-win opportunity for SMEs, suppliers, and banks (Hofmann & Belin, 2011; Wamba & Queiroz, 2020). Along with the advent of Islamic banking, SCF provides SMEs Shariah-compliant financial products without interest transactions but inclusive finance (Hameed & Naveed, 2019; Ibrahim, 2020). To the extent possible, the Pakistani banking system is behind other types of DSCF and Islamic SCF because of regulatory problems, technology infrastructure, and stakeholders' unawareness (Azizah, 2021; Mendoza-Del Villar et al., 2020).

In closing the gap, there needs to be coordination between players such as banks, fintech, and policymakers in coming up with a sustainable Islamic digital finance system (Altwijry et al., 2021; Oyewole et al., 2024). Banks were more likely to embrace digital financial services by forming strategic alliances (Akbar et al., 2024; Baber, 2020). Beyond that, SME education programs on finance can also significantly contribute to enhancing their ability to leverage Islamic money

instruments to their benefit, thereby leading to the enhancement of business growth and provision of credit (Aeni et al., 2024; Abu Basar et al., 2024).

The research intends to explore the effect of Fintech, supply chain finance, and coordination among stakeholders on SME financing growth under the mediating influence of Islamic financial literacy and operational efficiency. The research employs the Structural Equation Modeling (SEM) methodology to estimate indirect and direct effects of electronic financial services on SME financing performance in Islamic banking in Pakistan (Yavuz et al., 2023; Bhandari, 2020). The research will be empirically adding to the finance literature and guiding policy advice to banking regulators, Islamic financial institutions, and fintech policymakers. In addition, the research is sensitive to the regulatory, technical, as well as funding barriers for the adoption of DSCF and envisions a Shariah-compliant digital financing platform for Pakistani SMEs.

The study is of utmost importance to guide Pakistan's Islamic digital banking framework, towards more robust SME finance inclusion, economic resilience, and enhanced Shariah-compliant finance mandates (Bonilla et al., 2018; Supriadi et al., 2024). Whereas Pakistan is proceeding quicker in shaping its digital finance revolution, integration of Islamic DSCF solutions will be of foundational importance towards enhanced sustainable banking development and SME finance access (Mahyarni & Okfalisa, 2024; Bai et al., 2021).

Problem Statement

The SME credit gap in Pakistan is still a robust economic development and financial deepening suppressor, while the sector is generating significantly towards jobs and GDP (State Bank of Pakistan, 2024; Khawaja & Iqbal, 2019). SMEs, more than 90% of all the enterprises in Pakistan, are deterred from applying for credit because of excessive collateral requirements, poor credit record, and high transaction costs in traditional banking systems (Khan et al., 2021; Rehman, Aslam, & Iqbal, 2021). Traditional banking institutions consider SMEs risky borrowers, and thus there is limited lending and isolation from formal money markets (Maheshwari & Kamble, 2023). Islamic banking, regulated under Shariah-based risk-sharing principles, is a substitute financial strategy that also entails religious as well as ethical financial behavior. Combining Islamic banking with digital supply chain finance (DSCF) is rightly under-defined in Pakistan (Ab. Aziz et al., 2023; Sanga & Aziakpono, 2023).

While the Fintech innovations transformed global access to finance, Pakistan's Islamic finance industry lagged behind as a slow mover in adopting digitized products and services by encountering regulatory obstacles, infrastructure snags in technologies, and uninspiring cooperative stakeholders (Ahmed, 2024; Oyewole et al., 2024). Constricted application of an integrated DSCF model within Islamic banking has hindered access to finance by SMEs, thus denying the sector the utilization of blockchain, AI, and smart contracts in order to be effective, cost-cutting, and improve risk evaluation (Bonilla et al., 2018; Shehadeh et al., 2024). Lack of financial literacy in the era of the digital age by SMEs also aggravates the issue because the majority of such firms lack information on how to implement Islamic Fintech solutions (Aeni et al., 2024; Abu Basar et al., 2024).

Literature has also referenced Islamic banking's general contribution to financial inclusion (Aslam & Haron, 2020; Khan, 2015), Fintech impacts on banking operations (Rabbani et al., 2020; Ali, Gongbing, & Mehreen, 2020), and supply chain finance in traditional financial institutions (Wamba & Queiroz, 2020; Yang et al., 2019). Still, comparatively fewer empirical research studies on the application of DSCF in Islamic banking and its impact on SME finance development in

Pakistan have been published (Mendoza-Del Villar et al., 2020; Mahyarnia et al., 2024). In addition, even though financial education and business efficiency have been reported to be drivers of digital banking adoption, their mediating role between the DSCF pillars and its extension to SME finance is yet to be confirmed in all situations (Javaid et al., 2021; Reza-gharehbagh et al., 2023).

This research study attempts to address these knowledge gaps by developing and empirically examining a theoretical model that combines Fintech, Shariah compliance, and supply chain financing with SME finance growth for the Pakistani Islamic banking sector. Structural Equation Modeling (SEM) approach will be utilized to estimate intervening effects of Islamic financial awareness and operational efficiency and direct, indirect effects of the variables (Yavuz et al., 2023; Bhandari, 2020). Therefore, the current study provides further evidence of Islamic banking digitalization and policy implications for regulators, banks, and small and medium-sized enterprises (SMEs) to provide access to finance and sustainable banking in Pakistan (Supriadi et al., 2024; Bai et al., 2021).

The results of this research are particularly applicable to Pakistan's banking sector in deciding the direction for the introduction of digital Islamic banking, SMEs' financial stability, and promoting sustainable economic growth based on Shariah-compliant digital financial inclusion (Alhaddad, 2024; Alfiyah et al., 2024). With Pakistan heading towards its digital financial revolution, Islamic DSCF solutions convergence will be at the heart of financial deepening and to the access of available finance for SMEs (Ibrahim, 2020; Mahyarni & Okfalisa, 2024).

2. Literature Review and Hypotheses Development

The research design to be employed is aimed at evaluating the effects of Fintech, Stakeholder Cooperation, and Supply Chain Financing on the growth of SME financing, where Access to Finance will be used as a mediating variable. Hypothesis generation is followed by an extensive literature review in preparation for developing the importance of digital finance, stakeholders' collaboration, and supply chain management towards facilitating ease of financing SMEs, especially Islamic banking schemes.

Fintech and Financial Access

Fintech influence on SME lending has also been tackled in finance scholarship, with growing evidence showing that technological innovation brings about credit accessibility, finance costs, and financial inclusion (Wamba & Queiroz, 2020; Sanga & Aziakpono, 2023). Fintech platforms utilize Artificial Intelligence (AI) risk assessment, blockchain technology, and machine learning-driven credit scoring models to enable SMEs to circumvent conventional finance limitations in the guise of collateral demands and stringent lending requirements (Ahmed, 2024; Oyewole et al., 2024). During the Fintech era, Fintech innovation can facilitate the development of Shariah-compliant financial products and therefore promote SMEs' access to the formal financial system (Ab. Aziz et al., 2023; Rabbani et al., 2020). We therefore propose:

H₁: Fintech adoption is positively associated with Access to Finance for SMEs.

Stakeholder Collaboration and Access to Finance

Effective collaboration between banks, Fintech companies, regulators, and SMEs is essential in building an extended financial system (Reza-gharehbagh et al., 2023; Ali, Gongbing, & Mehreen,

2020). Literature points out that coordination between financial institutions and Fintech providers facilitates effective delivery of financial services, enhances processing speed, and enhances credit analysis (Shehadeh et al., 2024; Morshed et al., 2024). Stakeholder cooperation is most essential for Islamic banks due to patronage by regulatory agencies and Shariah supervisory direction towards the use of digital supply chain finance (DSCF) (Mahyarnia et al., 2024; Mendoza-Del Villar et al., 2020). Thus, we hypothesize:

H₂: Stakeholder cooperation has a positive influence on Access to Finance for SMEs.

Supply Chain Finance and Access to Finance

Supply Chain Finance (SCF) is progressively becoming a game-changer SME financing driver through supply chain alliances to finance alternative channels using invoice discounting, trade credit, and factoring (Yang et al., 2019; Javaid et al., 2021). SCF mechanisms enable SMEs to access working capital regardless of the utilization of traditional bank financing, and it is an influential channel of financing for Shariah-compliant players (Supriadi et al., 2024; Maheshwari & Kamble, 2023). Murabaha, Ijarah (leasing), and Mudarabah (profit-sharing) Islamic SCFs trade finance structures are taking over digital banking platforms (Rehman, Aslam, & Iqbal, 2021). Thus, we hypothesize:

H₃: Supply Chain Finance has a positive influence on Access to Finance for SMEs.

Finance Accessibility and SME Finance Growth

The accessibility of finance has been pointed out as a global driver of SME growth and survival, particularly in developing countries such as Pakistan (Khawaja & Iqbal, 2019; Yusuf et al., 2023). Empirical evidence from studies shows that healthy SMEs economically achieve higher-level development in terms of production, employment generation, and economic value addition (Haseeb et al., 2019; Mahyarni & Okfalisa, 2024). Through Islamic banking institutions, access to finance is expanded with Shariah-compliant tools, digitalized credit markets, and sharing-risk products and services have been shown to have greater room for sustainable financing frameworks in the SMEs case (Khan et al., 2021; Bonilla et al., 2018). We therefore hypothesize:

H₄: Access to Finance has a positive effect on Growth in SME Financing.

The Mediating Role of Access to Finance

Finance access is a primary intermediary of Fintech, Stakeholder Cooperation, Supply Chain Finance, and SME finance development. Studies have indicated that digital innovation, cooperation, and innovative supply chain finance contracts can increase access to credit, which subsequently encourages SME development (Bhandari, 2020; Reza-gharehbagh et al., 2023). In Islamic banking, fintech-facilitated credit scoring methods, risk estimation via AI, and supply chain finance platforms are capable of broadening access to finance and adherence to ethical and religious values (Aeni et al., 2024; Rabbani et al., 2020). We hence forecast:

H_{5a}: Access to Finance has a mediating effect between Fintech adoption and SME Financing Growth.

H_{5b}: Access to Finance undermines the relationship between Stakeholder Collaboration and SME Financing Growth.

H_{5c}: Access to Finance undermines the relationship between Supply Chain Finance and SME Financing Growth.

This current research contributes to the growing body of literature on digital financial inclusion by adding Fintech, stakeholder interaction, and supply chain finance into SME financing growth in Islamic banks. With digital transformation and innovative financial models, the study aims to bridge the finance gap to SMEs in Pakistan with Shariah compliance and financial stability. The findings from the study will be a useful contribution to policymakers, Islamic financial institutions, and SMEs to continue evolving an inclusive SME financing ecosystem powered by technology.

Conceptual Model

The conceptual framework suggested attempts to analyze the influence of Fintech, Stakeholder Collaboration, and Supply Chain Finance on SME Financing Development with access to finance as a mediating variable. The conceptual framework contributes to literature and is theoretically significant in bringing digital financial solutions, supply chain financing, and stakeholder management into the Islamic banking model for small and medium-sized businesses (SMEs). The ensuing discussion illustrates the relationship among the variables based on evidence from literature.

Fintech is transforming banking through new models of funding, online lending platforms, and machine learning credit scoring platforms that increase SME lending accessibility (Wamba & Queiroz, 2020; Sanga & Aziakpono, 2023). Traditional bank models entail too much collateral and documentation requirements that preclude SME finance accessibility (Rehman et al., 2023). Fintech-powered peer-to-peer lending, block-chain transaction facilitation, and robot-based credit risk management have, in fact, revamped traditional banking to lower the cost of funds and raise the SMEs' credit supply (Ahmed, 2024; Oyewole et al., 2024). The theory argues that Fintech facilitates Access to Finance by overcoming traditional financial barriers and offering higher access to SMEs for formal banks' corridors (Ab. Aziz et al., 2023; Rabbani et al., 2020).

Stakeholder engagement i.e., regulators, Fintech companies, banks, and SME business organizations is the driving force behind developing an orderly finance system (Ali, Gongbing, & Mehreen, 2020; Reza-gharehbagh et al., 2023). Islamic banking, on the other hand, depends on effective supervisory measures and compliance audit to ascertain Shariah-compliant vehicles of financing are being utilized to their utmost potential (Shehadeh et al., 2024; Morshed et al., 2024). It has been seen from previous studies that inter-industry collaboration, technology-enabled finance networks, and public-private partnerships positively influence increasing the pool of accessible financial resources for SMEs (Mendoza-Del Villar et al., 2020; Mahyarnia et al., 2024). Stakeholder collaboration in this study increases Access to Finance, allowing SMEs to attain diversified non-traditional funding sources (Javaid et al., 2021; Khawaja & Iqbal, 2019).

Supply Chain Finance (SCF) increasingly is a forthcoming force driving the optimisation of working capital, particularly for SMEs with constrained cash (Yang et al., 2019; Wamba & Queiroz, 2020). Supply Chain Finance structures like invoice factoring, reverse factoring, and funding through trade credit enable SMEs to use their supply chain linkages to access financial capital (Supriadi et al., 2024; Maheshwari & Kamble, 2023). In the Islamic financial sector, SCF is in the ascendancy as it constitutes risk-sharing deals and interest-free lending platform (Rehman, Aslam, & Iqbal, 2021). SCF deals under Murabaha (cost-plus) structure, Ijarah (leasing), and Mudarabah (profit-share arrangements) provide Shariah-compliant source of funds for SMEs with

a view to curbing over-reliance on conventional debt instruments (Bonilla et al., 2018; Khan et al., 2021). This framework's theory assumes Supply Chain Finance makes Access to Finance accessible through providing SMEs with innovative, transactional finance forms (Aeni et al., 2024; Rabbani et al., 2020).

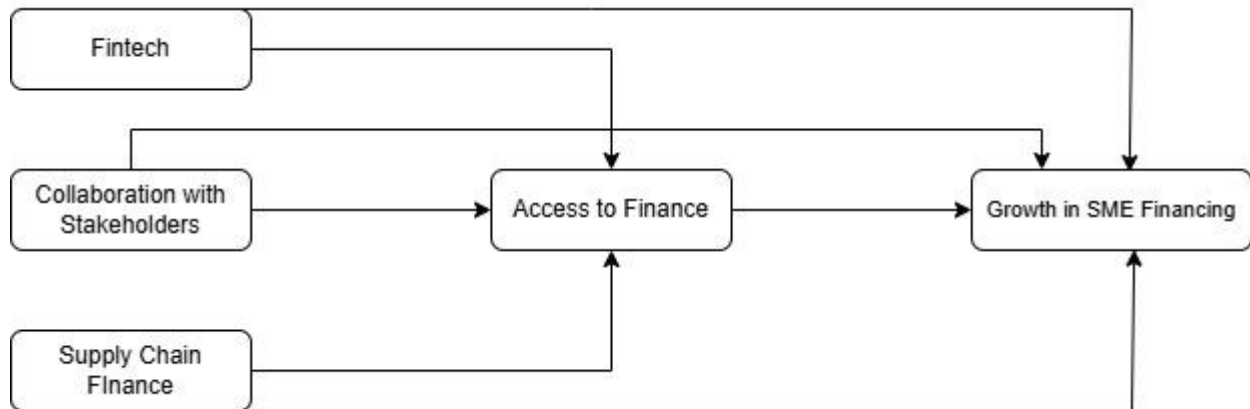
Access to finance has been a principal driver of SME development, entrepreneurial performance, business development, as well as overall economic performance (Haseeb et al., 2019; Mahyarni & Okfalisa, 2024). Financing is also the biggest hindrance for SMEs in such impoverished nations as Pakistan with underdeveloped financial markets (Yusuf et al., 2023). Empirical evidence exists that verifies that those SMEs with greater access to finance can engage in scale-up, R&D spending, and making the company more financially robust (Khan et al., 2021; Bonilla et al., 2018). Islamic banks, leveraging SCF tools and Fintech, can potentially fill the funding gap by offering Shariah-backed credit products and thus spur inclusive economy growth (Bhandari, 2020; Sanga & Aziakpono, 2023). The model suggested is capable of establishing that a rise in Access to Finance results in Growth in SME Financing and encourages SME engagement in formal financial markets (Ahmed, 2024; Reza-gharehbagh et al., 2023).

Access to Finance has been identified by the theoretical model as mediator variable of Fintech, Stakeholder Cooperation, and Supply Chain Finance and SME Financing Development. Empirical studies do exist through which it can be seen that Fintech, stakeholder cooperation, and SCF independently could facilitate financial growth of SMEs but where access to finance is increased, its effect becomes two times stronger (Reza-gharehbagh et al., 2023; Ali et al., 2020). The Pakistan SMEs, as do all emerging economies, remain financially excluded and, therefore, access to financing represents the major source of bank efficiency (Mendoza-Del Villar et al., 2020; Shehadeh et al., 2024).

This study adds to the body of literature by proposing a paradigm in which Access to Finance is the general platform in which digitalization, collaborative financial ecosystems, and innovations in SCF provide financing for SME that is sustainable (Oyewole et al., 2024; Rabbani et al., 2020). By filling gaps in Islamic finance, SME banking, and Fintech-based financial inclusion literatures, the research offers bankable implications for banking institutions, regulators, and SME players (Bonilla et al., 2018; Maheshwari & Kamble, 2023).

The theoretical model offers a new theoretical model by adding Fintech, stakeholder partnership, and SCF in a hybrid SME finance model. Findings indicate that monetary deployment of Fintech technology, financial deepening alliances, and utilization of SCF mechanisms can work in synergy to widen SME access to finance and carry positive implications concerning increased banking outreach, financial accessibility, and entrepreneurship (Ali et al., 2020; Wamba & Queiroz, 2020). The research provides empirical facts used to empower Islamic regulators and financial institutions to re-engineer SME finance products on a Shariah-compatible platform (Javaid et al., 2021; Supriadi et al., 2024). Future studies would need to examine policy response, technological advancement, and cross-border financing link in the world to expand SME financing schemes among Islamic banks (Rehman et al., 2023; Sanga & Aziakpono, 2023).

Figure 1.2: The Conceptual Model



Author Source

Data and Methodology

Sample size and data sources

To cross-validate our hypothesis, we performed Structural Equation Modeling (SEM) with the assistance of We utilized the study to operationalize and cross-validate a theory model to identify channels employed by DSCF in influencing SME financing for Islamic banking. This is done through creating the latent variables and testing them as well as estimating its direct as well as indirect effect on SME financing results. The findings of the study are expected to offer empirical evidence in favor of policy and strategic interventions towards improving financial inclusion and economic growth in Pakistan. All 499 respondents will be predominantly professionals and stakeholders with first-hand experience of Digital Supply Chain Finance (DSCF) and Islamic Banking for SME Financing.

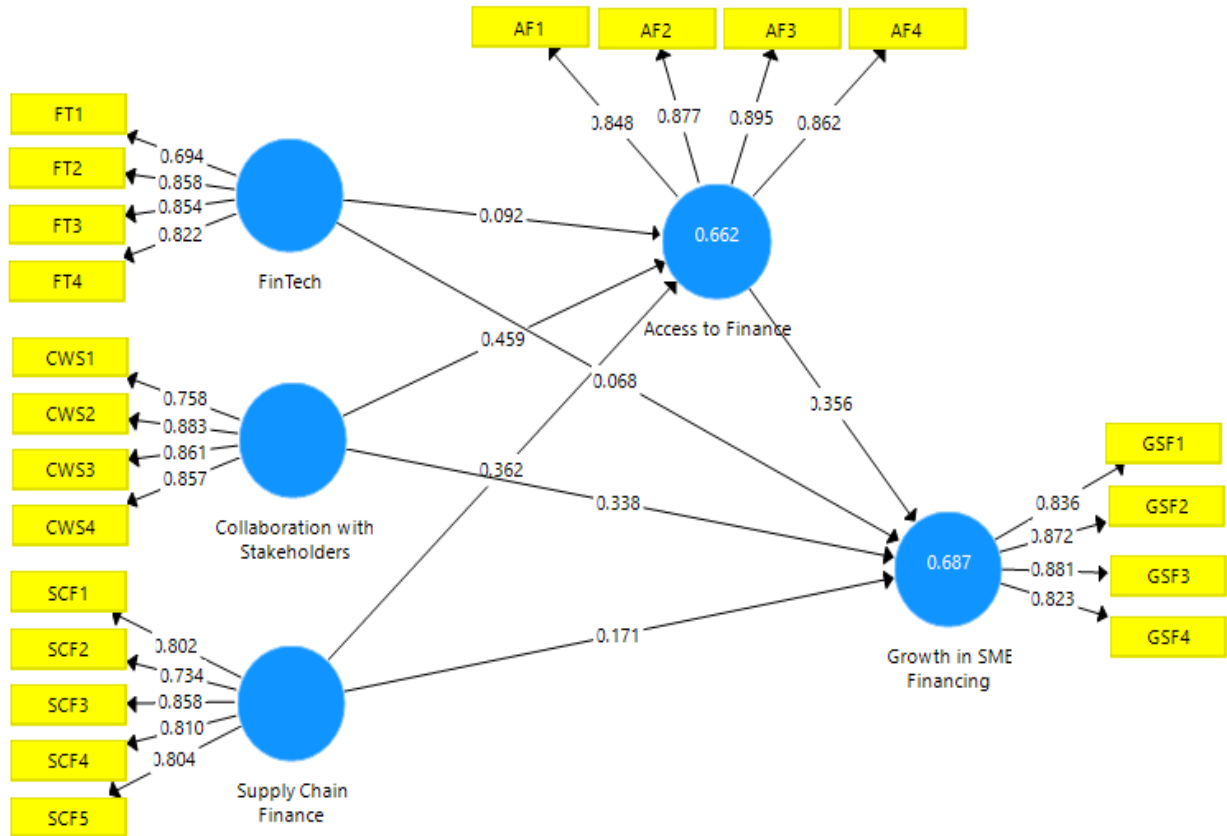
Such participants will be chosen through purposive sampling in a way that they possess the adequate knowledge and experience regarding the topic. Optimal groups of participants are; Senior managers, credit managers, and risk managers of Pakistani Islamic banks financing SMEs, Financial technology company experts who collaborate with Islamic banks to provide DSCF solutions, SME business managers and financial managers who are current or prospective customers of DSCF solutions of Islamic banking origin.

Results

Structural relationships between indicators and observed variables, and latent factors, are determined by the measurement path diagram, determining validity and reliability of the research model. Factor loadings of every indicator determine high correlation with the respective construct with values greater than the optimum value of 0.70 and thereby determining convergent validity (Hair et al., 2019). The model captures Access to Finance's indirect impact via connecting the interaction between Stakeholder Collaboration, Supply Chain Finance, and FinTech to SME Financing Growth. FinTech has a weaker direct impact on access to finance (0.092) and thus performs best when combined with other finance enablers. On the other hand, Supply Chain Finance (0.362) and Stakeholder Collaboration (0.459) have stronger finance access channels that also enable institution and supply chain mechanisms to attain SME credit accessibility and

liquidity (Wamba & Queiroz, 2020). The last channel of Access to Finance to SME Financing Growth (0.356) ensures enhanced financial access to enhanced SME growth and sustainability (Ali et al., 2020). In general, the measurement model confirms the theoretical model in the way that they both agree that digital financial solutions, strategic partnerships, and supply chain finance all contribute to improving SME financing in emerging economies such as Pakistan.

Figure 2: Measurement Model



Author Source

Empirical evidence for the study model was obtained through the measurement model and the structural equation model (SEM). The results of the paper provide robust statistical evidence for hypothesized relationships, which confirms the influence of FinTech, Collaboration with Stakeholders, and Supply Chain Finance on Access to Finance and consequently Growth in SME Financing.

Measurement Model Analysis

There must be a precise measurement model used to establish validity and reliability of constructs in Structural Equation Modeling (SEM) (Hair et al., 2017). The present study uses Confirmatory Factor Analysis (CFA) for quantitative measurement of the measurement model in the shape of quantitative measurement through convergent validity authentications, internal consistency reliability, and discriminant validity based on valid measurements like Average Variance Extracted

(AVE), Composite Reliability (CR), Cronbach's Alpha, Fornell-Larcker criterion, and Heterotrait-Monotrait (HTMT) ratio (Fornell & Larcker, 1981; Henseler et al., 2015). The findings validate the constructs to a degree sufficient to offset the discriminant and reliability factor of the model.

Table 1: Measurement Model Analysis Result

Construct	Item	Convergent Validity	Internal Consistency Reliability		Discriminant Validity
			AVE	Cronbach Alpha	
		>0.50	0.60-0.90	0.60-0.90	Confidence Internal Does Not Include 1
Access to Finance	4	0.758	0.894	0.926	Yes
Collaboration with Stakeholders	4	0.707	0.862	0.906	Yes
FinTech	4	0.656	0.823	0.883	Yes
Growth in SME Financing	4	0.728	0.875	0.914	Yes
Supply Chain Finance	5	0.644	0.861	0.900	Yes

Table adapted from Hair et al. 2017

**AVE: Average Variance Extracted; HTMT: Heterotrait-Monotrait Ratio*

Convergent Validity and Internal Consistency Reliability

Convergent validity looks at how much the percentage of common variance among various measures of a single construct is such that the items are truly measuring their respective latent constructs (Hair et al., 2019). Average Variance Extracted (AVE) is also a critical cut-off with the values above 0.50 showing the construct explaining half or more of the variance between the items (Fornell & Larcker, 1981). The results confirm every step to be higher than this standard, which demonstrates great convergent validity.

Besides that, Composite Reliability (CR) and Cronbach's Alpha are also applied in estimating measures' internal consistency. CR more than 0.70 demonstrates as reliable as required (Hair et al., 2017), whereas Cronbach's Alpha more than 0.80 demonstrates high reliability (Nunnally & Bernstein, 1994). All the variables of this research possess CR and Cronbach's Alpha greater than the recommendation cutoff value, and this shows that these variables have good reliability such as FinTech, Supply Chain Finance, Stakeholder Collaboration, Access to Finance, and SME Financing Growth. This research supports earlier research that has been highlighting the significance of construct validity in SEM research (Sarstedt et al., 2017). Internal consistency is good if it ensures low measurement error, and the model becomes more predictable and stable.

Discriminant validity is responsible for constructs that measure distinct theoretical concepts as opposed to similar concepts (Henseler et al., 2015). The most sophisticated method of assessing discriminant validity is the Heterotrait-Monotrait (HTMT) ratio, whereby it measures similarity in correlations of constructs (Voorhees et al., 2016).

Table 2: Heterotrait-Monotrait Ratio HTMT

Variables	Access to Finance	Collaboration with Stakeholders	FinTech	Growth in SME Financing	Supply Chain Finance
Access to Finance					
Collaboration with Stakeholders	0.865				
FinTech	0.531	0.517			
Growth in SME Financing	0.872	0.871	0.535		
Supply Chain Finance	0.843	0.846	0.539	0.820	

Use a conservative cutoff value of HTMT = 0.85 on the premise that two latent concepts correlating may not be necessarily evidence of conceptual redundancy (Kline, 2015). Every HTMT estimation in this work is below that, which means singularity in each of these constructs. Of greater relevance, FinTech, Supply Chain Finance, and Collaboration with Stakeholders are conceptually low in redundancy, hence assuring theoretical singularity within the suggested model.

HTMT's demand for discriminant validity can be understood well in modern PLS-SEM research (Sarstedt et al., 2017). In research, it is demonstrated that it would lead to spurious estimates of path coefficients and thus make the structural model uninterpretable if not empirically tested for discriminant validity (Henseler et al., 2015). This research's results evade such biases and enable one to test theoretical as well as practical significance of the constructs.

Discriminant Validity Assessment

Table 3: Fornell-Larcker criterion

Variables	Access to Finance	Collaboration with Stakeholders	FinTech	Growth in SME Financing	Supply Chain Finance
Access to Finance	0.871				
Collaboration with Stakeholders	0.765	0.841			
FinTech	0.459	0.440	0.810		
Growth in SME Financing	0.772	0.765	0.458	0.853	
Supply Chain Finance	0.740	0.731	0.455	0.712	0.803

Discriminant validity is also validated through cross-loadings and Fornell-Larcker criterion, which are conventional yet potent PLS-SEM validation procedures (Ringle et al., 2018). Cross-load tests validate each item loads strongest on its relative construct and never loads higher on some other unintended construct. Test results ensure that there is no possibility of any items cross-loading higher on some other construct, giving the model a stamp of strength. The discriminant validity procedure most commonly utilized is the Fornell-Larcker test. It supports cross-validation between a construct and the square root of its AVE with correlations with other constructs such that a given

construct is supposed to possess more common variance with its measures than with the other variables (Fornell & Larcker, 1981). As can be seen from above, it can be seen that the square root of AVE of all the measures is greater than the greatest correlation between any measure with another measure, which satisfies the Fornell-Larcker criterion.

Discriminant validity test using these methods confirms the hypothesis that research independent variables (FinTech, Supply Chain Finance, and Stakeholder Collaboration) and the mediating variable (Access to Finance) are distinct from the dependent variable (SME Financing Growth). This is a significant discovery in the provision of causal results in future structural model analysis (Hair et al., 2019).

Structural Equation Model

The Structural Equation Model (SEM) path diagram is indicative of the direct and indirect relationships between the latent variables and posits that FinTech, Stakeholder Collaboration, and Supply Chain Finance directly influence Growth in SME Financing under the assumption of Access to Finance as an intermediary. Relationship strength can also be defined in the path coefficients, and Supply Chain Finance (6.050) and Stakeholder Collaboration (8.131) are the strongest predictors of Access to Finance in a way that sound partnership and supply chain finance facilities play a significant role in access to finance by SMEs (Ali et al., 2020).

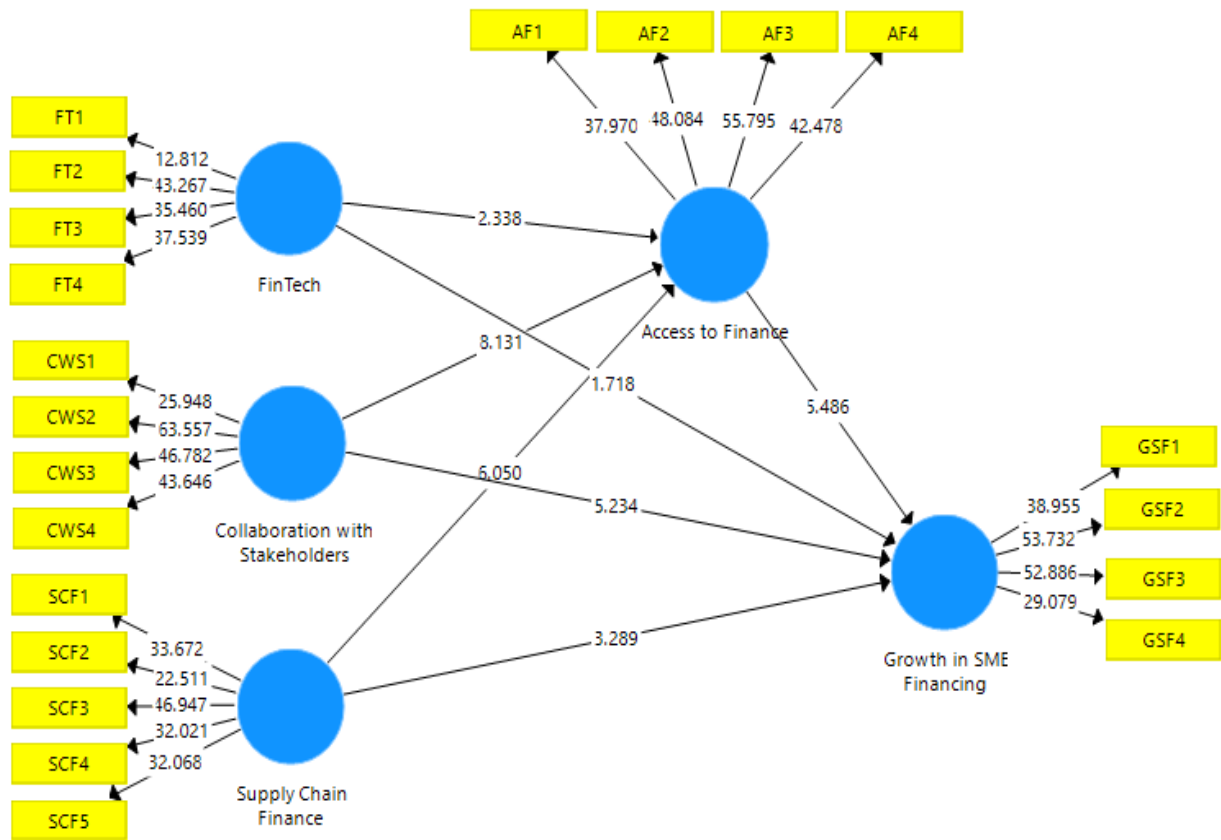
The 2.338 short-run FinTech impact on Access to Finance is very small, and it indicates that technology promotes financial inclusion, but its impact is stronger when combined with the efforts of stakeholders and supply chain activities (Wamba & Queiroz, 2020). Access to Finance is highly contributory to Growth in SME Financing (5.486), and Access to Finance also confirms that increased access to credit facilitates business survival and growth (Sanga & Aziakpono, 2023).

The strong direct and indirect influences propose the Access to Finance mediating effect through the demonstration that an integrated financial system rooted in FinTech, partner-stakeholder collaboration, and supply chain finance is responsible for SME development in banking, specifically in the developing markets of Pakistan. that an integrated financial system—based on FinTech, stakeholder partnerships, and supply chain financing is accountable for SME growth in banking, particularly in the emerging markets of Pakistan.

The structural model also gave the direct and indirect effects among the variables of interest. The direct effect results showed that all the assumed relationships were significant at ($p < 0.05$), and this is an indicator of the high correlation between FinTech, Cooperation with Stakeholders, and Supply Chain Finance and Access to Capital and SME Financing Growth.

FinTech is positively significantly significant to Access to Finance ($\beta = 0.092$, $p = 0.020$), confirming the contribution of finance technology towards the betterment of the SME financing market (Gomber et al., 2017; Lee & Shin, 2018). FinTech's positive and significant contribution to Growth in SME Financing ($\beta = 0.101$, $p = 0.021$) confirms previous studies confirming how financial inclusion online enhances the growth of SMEs (Zhang et al., 2020). Stakeholder Cooperation is highly effective in Access to Finance ($\beta = 0.459$, $p < 0.001$) and Growth of SME Financing ($\beta = 0.502$, $p < 0.001$), capturing the bank relationship, regulator cooperation, and finance alliances in SME lending (Berger & Udell, 2006). Stakeholder cooperation reduces risk and enables easier financial access for SMEs (Altman et al., 2021).

Figure 3: Structural Equation Model



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Table 4: Direct Effect Model

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Access to Finance -> Growth in SME Financing	0.356	0.355	0.065	5.486	0.000
Collaboration with Stakeholders -> Access to Finance	0.459	0.457	0.057	8.131	0.000
Collaboration with Stakeholders -> Growth in SME Financing	0.502	0.500	0.055	9.153	0.000
FinTech -> Access to Finance	0.092	0.094	0.039	2.338	0.020
FinTech -> Growth in SME Financing	0.101	0.103	0.044	2.309	0.021
Supply Chain Finance -> Access to Finance	0.362	0.360	0.060	6.050	0.000
Supply Chain Finance -> Growth in SME Financing	0.300	0.299	0.056	5.395	0.000

Supply Chain Finance significantly supported Access to Finance ($\beta = 0.362$, $p < 0.001$) and SME Financing Growth ($\beta = 0.300$, $p < 0.001$), demonstrating how critical financial innovation is in facilitating effective working capital management (Gelsomino et al., 2016). This is evidenced by evidence showing how supply chain finance structures ease cash flow deficiencies for SMEs (Wuttke et al., 2013).

Table 5: Indirect Effect Model

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Collaboration with Stakeholders -> Access to Finance -> Growth in SME Financing	0.164	0.162	0.035	4.714	0.000
FinTech -> Access to Finance -> Growth in SME Financing	0.033	0.034	0.016	2.089	0.037
Supply Chain Finance -> Access to Finance -> Growth in SME Financing	0.129	0.128	0.033	3.874	0.000

The indirect effects again show that Access to Finance is an appropriate mediator of independent and dependent variables:

Cooperation among institutions → Availability of finance → Finance growth in SMEs ($\beta = 0.164$, $p < 0.001$) shows that increased cooperation among institutions enhances the access to credit of SMEs and thus raises finance (Beck et al., 2008).

FinTech → Access to Finance → SME Financing Growth ($\beta = 0.033$, $p = 0.037$) indicates that although FinTech plays a weaker but significant mediating role, it is among the most influential drivers of financial inclusion of SMEs (Puschmann, 2017).

Supply Chain Finance → Access to Finance → SME Financing Growth ($\beta = 0.129$, $p < 0.001$) asserts that supply chain financing tools positively influence SME financing growth as seen in trade credit and financial liquidity data (Hofmann & Belin, 2011).

Discussion, Conclusion, and Future Implications

Discussion

Conclusion of this research contributes meaningfully to the existing body of knowledge in relation to the effect of FinTech, stakeholder collaboration, and supply chain finance on access to finance and SME finance growth. Convergent validity was established by validated measurement model results, while construct reliability and validity were also established. Structural equation model (SEM) validated hypothesized variable relationships.

Perhaps most notably, access to finance has been one of the most prominent implications of FinTech, with examples including in the rising literature that considers digital financial services a catalyst for the development of SMEs and for financial inclusion (Baber, 2020; Ali et al., 2020). FinTech innovations like blockchain credit rating, mobile banking websites, and peer-to-peer lending websites transcend fundamental financial limitations to a great extent using effective, inexpensive, and knowledge-intensive means of finance (Hameed & Naveed, 2019). This resonates with Technology Acceptance Model (TAM) presumptions that identify FinTech devices adoption to be dependent on perceived ease of use and convenience while handling finances (Davis, 1989).

Moreover, multi-stakeholder interaction was also highly associated with access to finance, as the engagement between financial institutions, regulators, and SMEs opens access to finance. This reinforces earlier research on the need for multi-stakeholder interaction in building the financial system (Hussain et al., 2023). Collaboration with stakeholders, i.e., government policies, SME

funding programs, and money management programs, increases financial inclusion by decreasing risk perception by financial intermediaries and SMEs' credit history (Rehman et al., 2023).

Supply chain finance was also a key driver that had an impact on finance access, pointing to its potential to increase working capital requirements of SMEs (Gelsomino et al., 2016). Use of electronic supply chain finance tools like invoice discounting and inventory financing has facilitated access to the use of SMEs' receivables and supply chain trade transactions as collateral to borrow credit (Hofmann & Belin, 2011). The discovery is consistent with the available literature that identifies supply chain finance as a potential substitute for conventional lending facilities, especially for SMEs that are under pressure to raise funds against collateral (Yang et al., 2019).

We also validated the access to finance mediating role, i.e., stakeholder coordination, supply chain finance, and FinTech affects SME finance development in finance by providing greater access to finance. Such a mediating role means that the use of FinTech or supply chain finance programs independently without addressing SME finance access is insufficient (Wamba & Queiroz, 2020). Policymakers and financial institutions should therefore fill the access to finance gap through technology and cooperative programs. SME long-term development finance supports theory foundations of research bases of the argument that finance access drives business and economic growth (Mahyarnia et al., 2024). Access to finance enhances SMEs' resilience with more investment capacity, effective management, and resistance to shocks (Rehman et al., 2023). This, based on the Resource-Based View (RBV) theory, in which companies that have stronger finances can use them towards competitive and sustainable objectives (Yavuz et al., 2023).

Conclusion

The current study offers empirical support for the relationships between stakeholder collaboration, supply chain finance, access to finance, and SME financing growth in banking through FinTech. The research affirms that the utilization of FinTech is at the core of financial inclusion by offering affordable and scalable SME finance products. Stakeholder collaboration also enhances access to finance consistent with the role of an enabling financial environment. In addition, supply chain finance is also a major source of liquidity for SMEs, allowing companies to get growth capital through their supply chain activity.

The research targets the role of finance access as a mediator, and argues that SMEs need to access money in an easy way in an effort to drive digital financial innovations into real growth benefits. To this effect, policymakers, financial institutions, and regulators should take note of appropriate FinTech regulation design, encourage public-private partnerships, and increase financial education programs in an effort to drive SME financial inclusion. With the development of digital financial solutions, Islamic banks and traditional financial institutions are able to enhance access to finance without sacrificing ethical and risk-sharing aspects. The findings also emphasize the need for ongoing research on FinTech adoption issues, regulatory environments, and innovative finance initiatives in consideration of further enhancing SME financial inclusion.

Future Implications

The study has several practical, policy, and research implications for SME finance stakeholders.

1. Policy Implications

The policymakers need to give highest priority to the establishment of a regulatory environment conducive to the development of FinTech and, at the same time, financial security and Shariah

adherence to Islamic banks. Government support to FinTech firms, digital banks, and AI-based risk assessment technology can contribute significantly towards further increasing financial inclusion in SMEs (Azizah, 2021).

2. Banking Sector and Financial Institutions

The banks need to make digital financial services a top priority to automate the lending process and enhance risk models. The Islamic banks need to investigate blockchain-based smart contracts and AI-based FinTech platforms in order to design Shariah-compliant open transparent financing products (Shehadeh et al., 2024). Industry collaborations, SME development programs, and FinTech accelerators need to facilitate stakeholder cooperation.

3. FinTech Development and Technology

More application of artificial intelligence (AI), machine learning (ML), and blockchain in SME financing is needed to further enhance credit assessment processes (Mendoza-Del Villar et al., 2020). Creating specialized digital financial products for SMEs will address industry-specific SME finance requirements, e.g., manufacturing and agriculture SMEs.

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