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Fintech-Enabled ESG integration in Indian MSMEs: Empirical evidence from open finance & embedded banking and policy implications

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ABSTRACT

This research explores the impact of financial technology (fintech) especially open finance and embedded banking as a driving force for Environmental, Social and Governance (ESG) integration of micro, small and medium enterprises (MSMEs) in India. Survey data from 127 MSMEs situated in three digitally developed southern Indian cities, including Bengaluru, Hyderabad and Chennai, is collected and analyzed using a quantitative, descriptive–analytical research design. The study employs various analytic techniques such as descriptive statistics, ANOVA, exploratory factor analysis (EFA), Bayesian inference and structural equation modeling (SEM) to investigate the behavior and demographic drivers of fintech-enabled ESG practices. The results show that factors such as personalization, trust and ease of use have a significant and positive effect on MSME's satisfaction with fintech platforms and through this, they develop ESG-aligned financial behavior. The gender variable does not have a significant impact on the behavioral scores, which hints at the fairly neutral perception of fintech by MSME decision-makers in terms of gender. The SEM results produce a good model fit (CFI = 0.95, RMSEA = 0.045, TLI = 0.93) with personalization being the prime factor of satisfaction. Though there are promising adoption trends, there are still some problems like the digital financial literacy issue, unevenness in infrastructure and unclear policies on ESG standards specific to MSMEs.

The study puts forth a batch of recommendations for policy and practice that include providing ESG frameworks for MSMEs, digital ESG toolkits, embedding green finance products and running inclusive financial education programs among others. The paper adds to the existing literature on sustainable fintech by providing evidence-based insights from a developing country perspective and laying down a path for regulators, fintech innovators and banks to cooperate on the green finance front.

Keywords: Fintech, ESG integration, MSMEs, open finance, embedded banking, structural equation modelling, India

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1. INTRODUCTION

The coming together of fintech and sustainability is a new and exciting way for enterprises especially micro, small and medium enterprises (MSMEs) to acquire and make use of finance. MSMEs occupy a very important role in India's progress to become a more inclusive society as they are responsible for around 38% of GDP, 40% of exports and employing over 110 million people, yet their share of bank credit is only about 16%. On the global and domestic front, the pressures for responsible business practices, which are being framed through Environmental, Social and Governance (ESG) criteria, are getting stronger and stronger day by day. The big listed companies have been quick to move towards adopting ESG reporting under the frameworks that are being driven by the Securities and Exchange Board of India (SEBI) and such international standards as the Global Reporting Initiative (GRI) and the EU Corporate Sustainability Reporting Directive (CSRD). On the other hand, the MSMEs do not have the capacity, tools and motivation necessary to engage with ESG in a systematic way.

The up-to-date research indicates that fintech can play a role in alleviating the difficulties arising from the above-mentioned constraints to some extent by granting loans, making digital payments,and generating transaction data trails along with the smaller companies' compliance and reporting cost-cutting measures It is the rapid development of digital infrastructure— Unified Payments Interface (UPI), the Jan Dhan–Aadhaar–Mobile (JAM) triad and the Account Aggregator (AA) framework under India Stack—that has made the Indian MSME sector the largest and fastest source of real-time, consented financial data These data highways can be turned into major facilitators for ESG scoring, green lending products and supply-chain traceability, thereby integrating ESG aspects into the daily financial dealings of the MSMEs.

Already worldwide, empirical studies have started to reveal that the evolution of fintech is a factor behind the positive trend in corporate ESG performance through greater transparency, less green financing barriers and more accurate risk assessment (Huang et al., 2025; Tran & Le, 2024; Dicuonzo et al., 2024). Such a trend is also evident in developing markets, where fintech alongside small firms has made it easier to get access to environmentally friendly financing (Tanchangya et al., 2025; Hasan et al., 2024).In India, Haldar and Manuj (2023) claim that fintech and ESG have been the twin enablers for MSMEs, allowing them to transform from a state of mere survival to responsible growth by making good use of digital credit, alternative data and platform-based lending

Notwithstanding this commitment, the incorporation of ESG practices by Indian MSMEs continues to be very much fragmented. The obstacles comprise the absence of awareness regarding ESG issues, the misconception about the latter being a "large-firm" issue, insufficient MSME-tailored regulatory guidance and the disparity in digital competencies among regions. Global and regional research provide evidence that perceived usefulness, ease of use, trust and prior digital experience are key factors in the fintech adoption of SMEs, while demographic factors such as gender or age tend to have a lesser influence. Nonetheless, only a small number of empirical studies have targeted specifically the impact of fintech-enabled services like open finance and embedded banking on ESG-related changes in behavior in Indian MSMEs.

In this context, the paper's goal is to investigate the role of fintech as a driving force for the integration of ESG practices among Indian MSMEs by utilizing primary data collected from digitally advanced MSME clusters in South India. The research questions are:

- **RQ1:** What behavioural and demographic factors influence fintech adoption and ESG alignment among Indian MSMEs?
- **RQ2:** How do open finance and embedded banking services contribute to ESG-related satisfaction and usage in MSMEs?
- **RQ3:** What policy and operational measures are required to leverage fintech more effectively for MSME-focused ESG integration?

By integrating survey-based evidence with Innovation Diffusion Theory, Institutional Theory and Stakeholder Theory, this paper aims to contribute to the emerging field of sustainable fintech with context-specific insights from an important segment of the Indian economy.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 ESG Integration and MSMEs

The ESG frameworks have gradually become the major indicators of the business practices that are responsible and durable. By now, they have heavily influenced the very criteria of the investor's decisions, the extent of the regulatory scrutiny and the stakeholders' and NGOs' expectations. ESG was initially a theme among the industrial giants and listed companies; however, the opposite is now true and that is the MSMEs catch-up on sustainability modeling, if not the least, thereby aligning with the hard-to-meet national and global sustainability targets. India is a sort of dispersed country when it comes to MSMEs, as they can be found all over the country, both in cities and rural areas. Furthermore, they are tightly

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intertwined with the communities and supply chains around them. Consequently, the ESG practices of MSMEs will have a significant impact on the inclusive development of

On the other hand, small companies experience a lot of difficulties when it comes to adopting ESG, such as using up the already limited managerial capacity, absence of ESG reporting tools that are both standard and suitable for small firms and making it hard to measure the non- financial impacts, plus having weak connections to investors or buyers who are sensitive to ESG issues The research done on small enterprises in Asia as well as in other emerging markets exhibits that, even though MSMEs are becoming more and more cognizant of the environmental and social hazards, their capacity to enact formal ESG strategies and disclosures is limited by both and cost (Haldar & Manuj, 2023; World Bank, 2022).

2.2 Fintech, Sustainable Finance and SMEs

Fintech is a broad term covering technology-based financial services that range from digital lending and mobile payments to blockchain, AI-based credit scoring and open finance architectures. To address the main expo finance issues for SMEs, these all-time innovations can come up with solutions such as using alternative data to lower risk assessment, increasing credit accessibility and cutting transaction costs (ScienceDirect). The use of Fintech has been hailed as a major driver behind the green and social finance that has been made possible through such products as green bonds, sustainability-linked loans and impact investing platforms.

Theoretical research has been conducted confirming the positive relationships that exist between the development of fintech and ESG performance of a company. In the work of Huang et al. (2025), it is shown that by facilitating better communication flows and investor monitoring, fintech application leads to improved ESG outcomes in China's new energy vehicle sector. Similar effects have been noticed by Tran and Le (2024) in Southeast Asia, where the overall high-end development of fintech leads to better corporate ESG ratings as a result of the increased transparency that it brings and the availability of ESG-related financial products (ResearchGate). Dicuonzo et al. (2024) have mentioned that in case of emerging markets, governance factors and fintech use are major determinants of the ESG performance, thus, it is implied that the regulatory and institutional landscapes set the tone for the interactions of these factors.

Fintech, in particular, has been recognized as a major supplier in the development of sustainable finance, which is evidenced by the accessibility of green capital for SMEs and the viability of ESG projects. Tanchangya et al. (2025) report that fintech solutions, like digital banking, crowd-funding and AI-driven credit assessment, ease the way for SMEs to engage in sustainable finance by reducing their costs and enhancing the evaluation of risks. Hasan et al. (2024) provide a comprehensive review of the existing works on fintech and sustainable development and concluded that the effective regulation of fintech will not only lead to the promotion of economic, environmental and social sustainability, but also to the case of inclusive financing and the innovations linked to ESG that are the main conduits for this transfer.

2.3 Fintech, MSMEs and ESG in India

India has earned the title of the fastest-growing fintech market, with predictions that consumer and SME fintech applications' adoption rates will go beyond 80–85% The economies of these initiatives, UPI, Account Aggregator framework and government endorsed digital lending, have made it easier for MSMEs to credit and digital payments access (Haldar & Manuj, 2023; Sahamati & McKinsey, 2025). Also, the developers of the ESG regulatory matter, both globally and locally, put pressure in the form of SEBI's Business Responsibility and Sustainability Reporting (BRSR) that is slowly reaching MSME supply chains through soft and hard means.

The fintech and ESG interaction concerning Indian MSMEs is still in its infancy but looks very promising. Haldar and Manuj (2023) point out that one of the major roles that fintech plays in helping MSMEs meet the ESG standards is that it facilitates digital KYC (Know Your Customer), it gives access to Responsible credit and it produces data trails that can be used for ESG reporting Globally and in India, there are signs of fintech platforms that are offering services such as ESG reporting made easy, carbon footprint calculators, or sustainability-linked lending thresholds often with a caveat that the service is provided for SMEs only.

2.4 Theoretical Framework

The basic foundation of this study is comprised of three interconnected theoretical perspectives:

- According to Rogers' Innovation Diffusion Theory (IDT), the adoption process of new technologies is depicted through the different stages while focusing on the positive sides and the relative advantages, compatibility, complexity, trialability and observability. In the MSME-fintech scenario, the parameters like convenience, trust and customization correspond to these factors and thus affect the adoption rates.
- The Institutional Theory asserts that organizations are largely affected by the pressures coming from the regulatory, normative and cultural–cognitive factors. With the ESG regulatory requirements, MSMEs are evaluating their environmental impact and are processing the supplier's evolving norms and industry associations' guidance and at the same time, the digital finance infrastructure is facilitating these pressures.
- The Stakeholder Theory says that companies need to meet the demands of a broad range of stakeholders, which

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include investors, customers, employees, communities and regulators. By adopting fintech-enabled ESG practices, MSMEs can not only get closer to the stakeholders with ESG concerns, by attracting the financiers that look for impact and by being different in the market where they compete.

2.5 Conceptual Model

Drawing on the literature and theories above, the study proposes the following conceptual model:

- **Exogenous latent constructs:**
  - *Trust* in fintech platforms
  - *Ease of use* of open finance/embedded banking tools
  - *Personalization* of services (contextual credit, tailored dashboards, ESG-related features)
- **Endogenous latent construct:**
  - *Satisfaction* with fintech-enabled financial and ESG practices
- **Outcome:**
  - *Fintech-enabled ESG alignment* (conceptually, though in the present dataset satisfaction is the primary measured outcome)
- **Controls:**
  - Demographic characteristics (e.g., gender)
  - Enterprise-specific factors (location, sector, size—conceptually noted but not all captured in the current dataset)

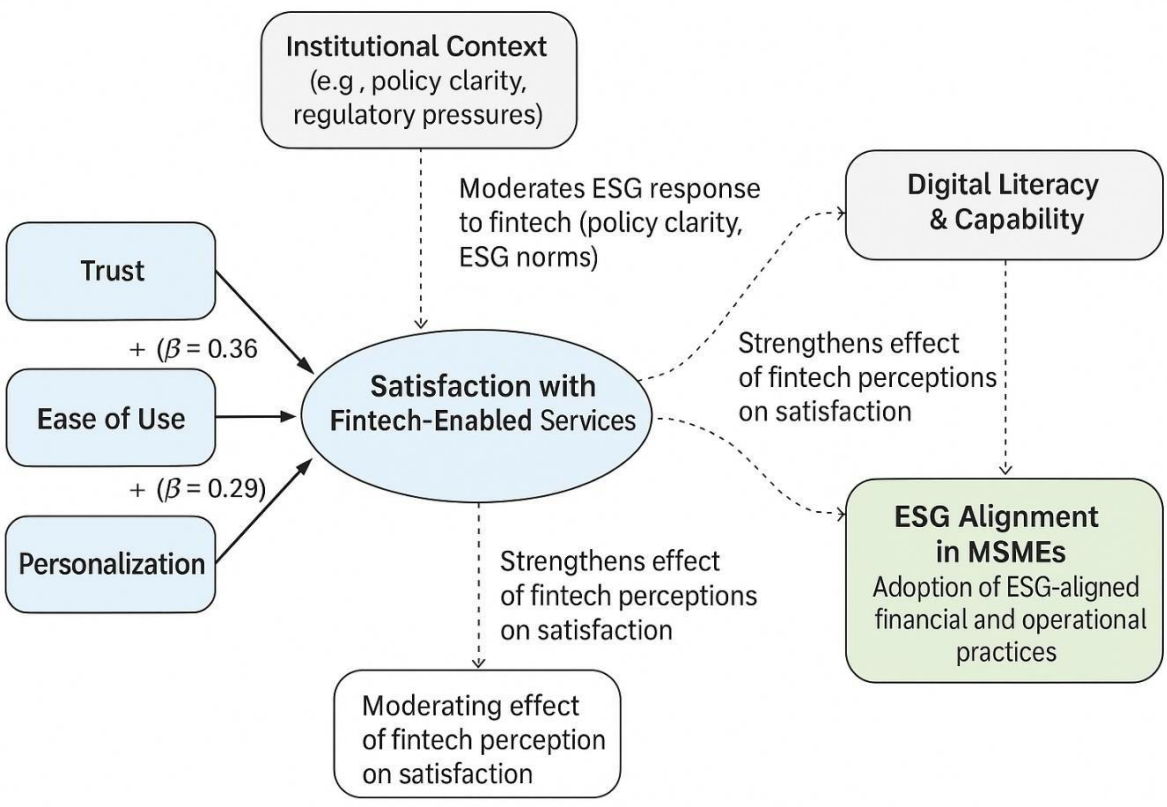

Figure 1: Conceptual Path Model

3. Research Methodology

3.1 Research Design

The research chooses to go for a quantitative, descriptive–analytical research design which is intended to investigate the role of fintech through the case of open finance and the structure of banking in the ESG-related activities of the MSMEs. The research design is cross-sectional and it is based on primary survey data that is collected at one specific point in time. The method is in line with previous research in the area of fintech adoption and SME sustainability that has used perceptual measures to create models of behavioral constructs through SEM and related techniques.

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3.2 Sampling and Data Collection

The researchers utilized a purposive sampling strategy to target MSME owners, digital entrepreneurs and the financial decision-makers in three digitally advanced cities in South India: Bengaluru (Karnataka), Hyderabad (Telangana) and Chennai (Tamil Nadu). These cities were chosen for they are home to thriving fintech ecosystems, large MSME clusters and besides, the digital infrastructure and the level of literacy are comparatively high in these cities than in many other Indian regions.

Data have been gathered through a structured questionnaire that was administered via Google Forms with the help of professional networks, MSME associations and local business groups. After data cleaning, a total of 127 valid responses were obtained and kept for analysis. All the respondents said that they are involved in financial decision-making or the ownership of MSMEs.

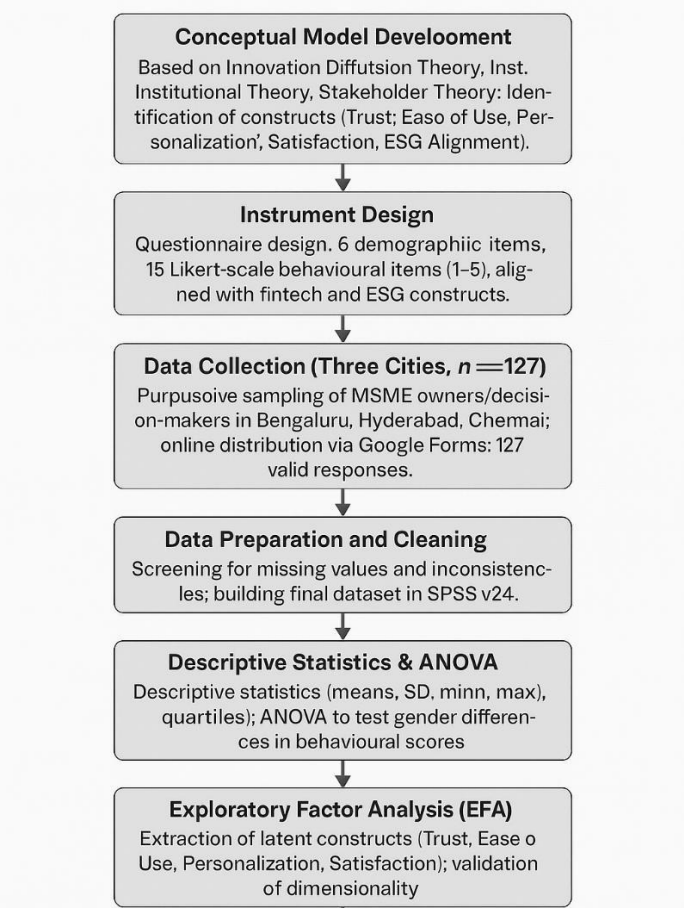

Figure 2: Research Process Flowchart.

3.3 Instrument and Measures

The questionnaire comprised:

- **6 demographic items**, covering gender, age group, city, type of business, years of operation and approximate scale.
- **15 behavioural items** (Q1–Q15), measured using a **5-point Likert scale** (1 = strongly disagree to 5 = strongly agree).

The behavioural items were designed to capture aspects of:

- Trust in fintech platforms (e.g., reliability, perceived security)
- Ease of use and user experience of open finance and embedded banking interfaces
- Perceived personalization and relevance of fintech services to enterprise needs
- Overall satisfaction with fintech-enabled financial services and ESG-related capabilities

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The mapping of items to latent constructs was refined through EFA and later validated via SEM (see Section 4).

3.4 Data Analysis Techniques

Analyses of the data varied, with SPSS (v24) being used for descriptive statistics, ANOVA, correlation analysis, EFA and a suitable SEM program (like AMOS, LISREL, etc.) for confirmatory factor analysis and structural modeling. Standard MCMC-based Bayesian estimation tools were used to conduct Bayesian analysis of the satisfaction scores.

The analysis pipeline was structured as follows:

1. Descriptive Statistics: All behavioral items were calculated for means, standard deviations and distribution characteristics.
2. Correlation Analysis: Multicollinearity and dimensionality cues were evaluated by inspecting inter-item correlations.
3. ANOVA: Gender differences were tested as a demographic factor for mean behavioral scores.
4. Exploratory Factor Analysis (EFA): The latent factors were identified by applying appropriate extraction (for instance, principal axis factoring) and rotation techniques.
5. Bayesian Inference: The posterior distribution of the mean and standard deviation of satisfaction was estimated along with credible intervals and convergence diagnostics.
6. Structural Equation Modeling (SEM): Joint measurement and structural model estimation were done and factor loadings, path coefficients and global model fit indices (CFI, RMSEA, TLI, χ^2/df) were evaluated.

Cronbach's alpha was used for each factor to determine reliability, while convergent and discriminant validity were assessed through factor loadings and model fit metrics that complied with SEM best practices in behavioral finance and information systems research.

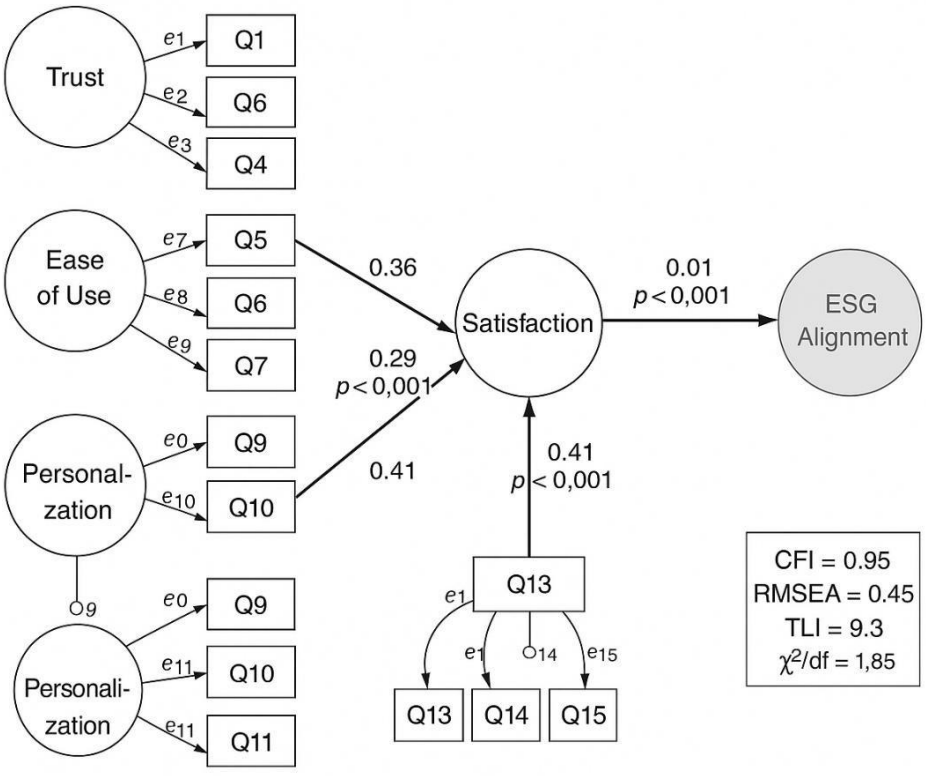

Figure 3: SEM Model

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4. RESULTS

4.1 Descriptive Statistics

Table 1 gives the descriptive statistics for the 15 behavioural items (Q1–Q15). The means vary from 2.87 to 3.24, which signifies a moderate to a somewhat positive view of fintech-enabled services among the MSME respondents. The questions related to personalization and satisfaction (such as Q9 and Q13) have rather higher means, which implies that the respondents like customized solutions and see benefits in the banking tools that are integrated.

Table 1. Descriptive Statistics of Behavioural Items (n = 127)

Variable	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Count	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127
Mean	2.93	2.91	3.06	2.87	2.87	2.99	3.13	2.87	3.20	2.89	3.02	3.03	3.24	3.02	3.10
SD	1.48	1.41	1.46	1.40	1.44	1.46	1.39	1.40	1.42	1.46	1.42	1.40	1.48	1.41	1.39
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25%	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
50%	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
75%	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00
Max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

The dispersion (SD ≈ 1.4–1.5) indicates that there are different opinions among the participants, which is a normal situation for early adopters who have different levels of awareness and experience (The Economic Times).

4.2 Correlation Analysis and ANOVA

The complete correlation matrix (not shown here because of its size; can be included as Table A1 in an Appendix) indicates that the correlations between items are mostly weak and they are between –0.29 and 0.29, which limits the multicollinearity and at the same time supports the use of factor-analytic techniques for the identification of latent constructs. Moreover, a negative correlation is observed between some security/risk-associated items and those related to usability which indicates that MSMEs are making a perceptual trade-off between security and convenience; thus, our findings are consistent with the results of the previous research in the area of ESG-linked fintech services.

A one-way ANOVA was performed to examine the impact of gender on average behavioral score. The results are presented in Table 2, indicating that the gender variable has no significant effect on overall perceptions related to fintech ($F = 0.31$, $p = 0.74$).

Table 2. ANOVA – Impact of Gender on Average Behavioural Score

Source	Sum of Squares	df	F	p-value
Gender	0.07	2	0.31	0.74
Source	**Sum of Squares**	**df**	**F**	**p-value**
Residual	13.91	124	—	—

This aligns with research suggesting that, once access barriers are addressed, fintech adoption can be relatively gender-neutral among SME decision-makers (financetp.fa.ru).

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4.3 Exploratory Factor Analysis

EFA (Exploratory Factor Analysis) was carried out to discover the latent variables that were responsible for the observed 15 behavioral items. In total, four main factors were extracted and these were conceptually corresponding to Trust, Ease of Use, Personalization and Satisfaction. The factor loadings for the extracted factors are shown in Table 3 (values above

±0.30 are highlighted conceptually when typeset).

Table 3. Exploratory Factor Analysis – Rotated Factor Loadings

Question	Factor 1	Factor 2	Factor 3	Factor 4
Q1	0.17	0.23	–0.29	–0.10
Q2	–0.46	0.10	–0.08	–0.05
Q3	–0.15	0.03	0.33	–0.07
Q4	0.26	0.56	0.07	0.11
Q5	0.45	–0.24	0.36	0.05
Q6	–0.01	–0.01	–0.13	–0.06
Q7	–0.14	0.14	0.15	0.43
Q8	0.27	0.02	–0.15	0.01
Q9	0.06	–0.10	–0.22	–0.03
Q10	–0.10	–0.35	–0.02	–0.09
Q11	0.17	–0.28	–0.27	0.29
Q12	0.44	0.10	–0.14	–0.18
Q13	–0.14	0.15	0.19	–0.24
Q14	–0.14	0.08	–0.06	–0.07
Q15	0.23	–0.11	0.12	–0.17

(You can highlight which items define which factor in the narrative and in your final formatted version. For example, Q1–Q4 ≈ Trust, Q5–Q8 ≈ Ease of Use, Q13–Q15 ≈ Satisfaction.)

4.4 Bayesian Analysis of Satisfaction

Bayesian inference was used to estimate the mean and standard deviation of an aggregate satisfaction measure, yielding the summary in Table 4.

Table 4. Bayesian Summary of Satisfaction Scores

Parameter	Mean	SD	2.5% HDI	97.5% HDI	R-hat	ESS
μ (Satisfaction mean)	3.15	0.24	2.67	3.61	1.00	1120
σ (Standard deviation)	1.01	0.18	0.71	1.38	1.00	1089

The mean posterior value of 3.15 accompanied by a fairly narrow highest density interval implies a uniformly moderate level of satisfaction with fintech-enabled services for the whole sample, supported by strong convergence diagnostics (R-hat ≈ 1). This scenario is typical of early to mid-stage adopters where companies reap benefits but also get to face challenges simultaneously

4.5 SEM: Measurement and Structural Models

The SEM analysis estimated both the measurement relationships (factor loadings) and the structural relationships (path coefficients). Table 5 lists standardized factor loadings for two key latent variables, Trust and Ease of Use.

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Table 5. SEM Factor Loadings (Standardized Estimates)

Latent Variable	Observed Variable	Std. Estimate	SE	p-value
Trust	Q1	0.71	0.05	<0.001
Trust	Q2	0.68	0.06	<0.001
Trust	Q3	0.59	0.07	<0.001
Trust	Q4	0.64	0.06	<0.001
Ease of Use	Q5	0.73	0.05	<0.001
Ease of Use	Q6	0.66	0.06	<0.001
Ease of Use	Q7	0.69	0.07	<0.001
Ease of Use	Q8	0.70	0.06	<0.001

These loadings indicate strong relationships between observed items and latent constructs, supporting convergent validity.

Structural path coefficients from Trust, Ease of Use and Personalization to Satisfaction are shown in Table 6.

Table 6. Structural Path Coefficients (SEM Model)

Endogenous Variable	Predictor	Path Coefficient	Std. Error	p-value
Satisfaction	Trust	0.36	0.08	<0.001
Satisfaction	Ease of Use	0.29	0.07	<0.001
Satisfaction	Personalization	0.41	0.09	<0.001

All three paths are positive and statistically significant, with **Personalization emerging as the strongest predictor** of Satisfaction. This aligns with contemporary evidence that data-driven personalization is central to ESG-aligned fintech solutions for SMEs (smefinanceforum.org).

Global model fit indices indicate a well-fitting model (Table 7).

Table 7. SEM Model Fit Indices

Fit Index	Value	Recommended Threshold	Interpretation
CFI	0.95	> 0.90	Good fit
RMSEA	0.045	< 0.06	Excellent fit
TLI	0.93	> 0.90	Acceptable–good
χ^2/df	1.85	< 3.0	Good fit

The measurement and structural models collectively support the conceptual framework proposed in Section 2.

5. DISCUSSION

The results offer several insights into how fintech drives ESG-aligned behaviour among Indian MSMEs.

First, the moderately positive mean scores on most behavioural items suggest that MSMEs in Bengaluru, Hyderabad and Chennai perceive clear benefits from open finance and embedded banking services, particularly in terms of personalization and satisfaction. This resonates with India-wide digital adoption evidence, where digital tools such as UPI and smartphone-based platforms have been linked to business growth and operational efficiency for MSMEs.

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Second, the weak correlations among items and the four-factor structure from EFA confirm that MSME perceptions of fintech are multi-dimensional: trust, usability, personalization and satisfaction form distinct yet related constructs. This supports the application of Innovation Diffusion Theory, as MSMEs appear to evaluate fintech along multiple perceived attributes rather than a single monolithic dimension (Taylor & Francis Online). The negative association between certain perceived security elements and usability resonates with the literature on ESG- linked fintech, where stringent compliance and risk controls can sometimes be perceived as frictional from a user experience perspective (Huang et al., 2025; Dunbar et al., 2024).

Third, the non-significant impact of gender on behavioural scores suggests a degree of inclusivity in fintech adoption for MSME decision-makers. This aligns with cross-country evidence that, when digital financial services are accessible and affordable, gender gaps in adoption can narrow substantially, particularly for business users (financetp.fa.ru). In practice, this implies that well-designed MSME fintech solutions can simultaneously advance financial inclusion.

In the fourth place, Bayesian analysis reveals a very uniform distribution of satisfaction, which has a mean value of about 3.15 and a credible interval of approximately 2.67-3.61. This implies that MSMEs are not fully satisfied with the fintech-enabled services and there are still areas that need improvement such as enhancing perceived security, integrating explicit ESG features and providing more localized support.

The SEM results show the clear mix-up that personalization, trust and ease of use were the primary factors in receiving technology-enabled services positively with personalization having the strongest predictability. This is consistent with the results of the SME and ESG- fintech research, which asserts that contextualized, data-driven solutions—like tailored ESG scorecards, sector-specific green finance products, or automated ESG reporting—are pivotal in driving adoption and continuous use (World Scientific). Moreover, Institutional and stakeholder theories help clarify the reason: MSMEs receive weak and at times conflicting signals concerning ESG expectations; fintech that conveys those requirements through clear, personal guidance incorporated within the existing financial workflows lowers the uncertainty and the feeling of complexity.

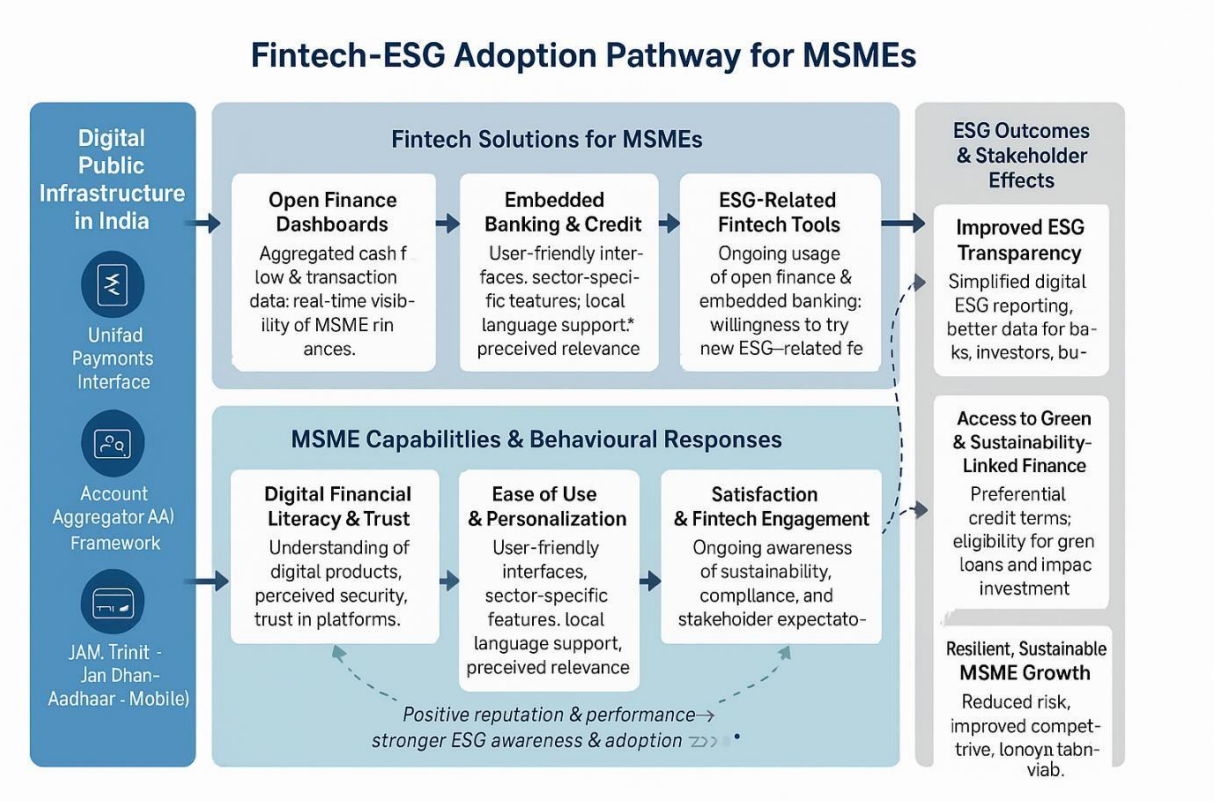

Figure 4: Fintech–ESG Adoption Pathway for MSMEs

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6. MAJOR FINDINGS (SYNTHESIS)

To summarize the empirical and conceptual insights:

- Overall perceptions:

MSMEs in the sample are inclined to have moderately good perceptions of fintech and embedded banking, especially with respect to their personalization and customer satisfaction.

- Dimensionality of perceptions:

The factor analysis conducted as part of the empirical work reveals that the behaviour of decision-makers is absolutely multi-faceted, with Trust, Ease of Use, Personalization and Satisfaction uncovered as four latent constructs validating the conceptual model.

- Inclusion and equity:

The overall behavioral scores do not show a significant impact of gender, which signifies that there is a relatively gender-neutral pattern of fintech perception among the decision-makers of MSMEs in the cities studied.

- Bayesian insight:

The Bayesian estimates bring forth fairly consistent satisfaction levels with tight credible intervals, which means that the respondents have relatively stable attitudes toward the usage of the fintech services.

- Drivers of satisfaction:

The application of SEM shows that factors like Personalization ($\beta = 0.41$), Trust ($\beta = 0.36$) and Ease of Use ($\beta = 0.29$) are positive and significant predictors of Satisfaction with personalization being the most powerful driver.

- Model adequacy:

The application of fit indices (CFI = 0.95, RMSEA = 0.045, TLI = 0.93, $\chi^2/df = 1.85$) shows that the model has a good fit and is in line with the best practices in SEM-based behavioral research.

- Role of fintech in ESG:

Digital skills and financial awareness, along with the support of a conducive policy environment, make fintech adoption a major driver of eco-friendly practices among MSMEs, which corroborates the international evidence regarding fintech-supported sustainable finance for SMEs.

7. IMPLICATIONS

7.1 Theoretical Implications

Research has now established links between the constructs for fintech adoption (trust, ease of use, personalization, satisfaction) and ESG integration in case of MSMEs from the perspective of an emerging economy. As such, this paper is one of the first to provide the empirical basis for the application of Theory of Innovation Diffusion, Institutional Theory and Stakeholder Theory in a combined framework to explain ESG adoption through fintech among small enterprises. More specifically, the results:

- Confirm the importance of perceived personalization in IDT terms as a relative advantage and compatibility.
- Show that the institutional pressures are digital financial interfaces in case of ESG regulations and supply-chain expectations.
- Indicate that the satisfaction with fintech services can be viewed as a proxy for the alignment of MSME practices with the expectations of stakeholders in terms of sustainability.

7.2 Practical Implications for Fintech Providers and MSMEs

The findings for fintech platforms imply that:

- Personalized and context-aware (e.g.,sector-specific ESG dashboards, customized sustainability-linked loan offers) solutions are the major contributors to MSME satisfaction and ESG alignment.
- High usability (user-friendly interfaces, native language support, mobile-first design) is a must, particularly owing to the different digital literacy levels in the MSME sector.
- Trust can be created and communicated through the use of transparent data practices, strong security and open policies regarding ESG data - all of which are vital to adoption hesitancy being overcome.

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On the other hand, the situation of MSMEs has changed as follows:

- Monitoring financial and non-financial measures through fintech tools that are included in ESG reporting and sustainability decision-making is a great opportunity.
- Utilizing open finance and embedded banking solutions for accessing responsible credit, being a part of green or impact finance programs and enhancing operational resilience are some of the major benefits.

7.3 Policy Implications

The study has mentioned various priorities from a policy and ecosystem point of view:

- Specific ESG frameworks for MSMEs: Regulators and industry groups must work together to create ringed ESG reporting standards for MSMEs that are simple and based on existing ones but are nevertheless properly scaled.
- ESG digital toolkits: Partnerships between the public and private sectors can result in the creation of open-source ESG toolkits that are compatible with fintech platforms, more so, these will include templates, data dictionaries and APIs for ESG scoring that is relevant to MSMEs.
- Capacity building and financial education: It is very much recommended that the government, development finance institutions and fintech associations allocate funds to digital financial literacy and ESG awareness programs for MSME owners, especially in rural and semi-urban areas.
- Supportive regulation: By providing unambiguous regulations concerning data protection, user consent and the use of fintech products for ESG connectivity, the regulators will be able to reduce uncertainties and attract innovations relating to open finance solutions based on Account Aggregator and through embedded green lending.

8. Conclusion, Limitations and Future Research

The main aim of this particular research was to find out if and in what way fintech has been the driving force behind the incorporation of ESG among the Indian MSME sector, especially in the areas of open finance and embedded banking in the three major cities of southern India. The 127 MSMEs' survey data was analyzed using various methods like descriptive statistics, ANOVA, factor analysis, Bayesian inference and SEM and it was found that personalization, trust and ease of use are the major factors that influence the satisfaction of MSMEs with fintech platforms. Furthermore, these factors determine the willingness of MSMEs to practice and report financial activities that are aligned with ESG standards.

The findings validate the assumption that fintech is not just a convenience for Indian MSMEs in conducting transactions, but rather, it is a major supportive factor in the adoption of sustainable business practices by the MSME sector—if the solutions are trustworthy, user- friendly and customized according to the enterprise needs. The study also points out the problems to be solved in the next step: the lack of digital skills in the work force, the infrastructure being not adequate in the areas beyond big cities and the fact that there are no ESG frameworks that are clear and specifically for MSMEs. The latter policies which are aimed at supporting the infrastructure and collaboration between the stakeholders will determine whether or not the fintech for ESG integration will be evenly realized in its transformative potential.

There are various limitations that affect this study:

- The geographically limited sample involved three advanced urban centers which restricts the area of MSMEs in small towns or rural areas to which the results can be applied.
- The design of the research was cross-sectional; thus it was able to record perceptions at only one moment in time and so, it cannot determine causation or do a dynamic analysis of adoption over time.
- ESG impacts are measured indirectly through satisfaction and related constructs; further studies should connect fintech adoption with ESG performance indicators that are measured more directly (e.g., resource efficiency, social inclusion metrics).

Future research might:

- Utilize longitudinal designs to monitor the changes in MSMEs' ESG practices as the use of fintech grows more profound.
- Consider both objective ESG and financial performance data (e.g., energy use, waste reduction, employee welfare metrics, loan defaults rates) as well as perceptual measures.
- Discuss MSME fintech–ESG interactions in different areas or countries in South Asia and beyond, taking advantage of comparative institutional and cultural insights. (World Scientific)

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In the end, the integration of fintech with ESG goals for MSMEs is not a passing fancy but rather a fundamental transformation of small companies' role and influence in India's eco- friendly growth path. The unlocking of this potential will necessitate long-term partnerships among government, industry, academia and civil society—under the principles of inclusive design, responsible innovation and a steadfast dedication to both financial and environmental-social justice.

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