



A Multidimensional Framework of Digital Finance Adoption and Sustainable Outcomes: An Exploratory Factor Analysis Approach

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Abstract: *The study examines a quantitative cross sectional research design to investigate the underlying dimensions of digital financial adoption. A structured 60 item questionnaire with a five-point Likert Scale was used to collect the data from 270 respondents. The technology Acceptance Model is used as the foundation for the instrument development, and which was expanded to incorporate, social inclusion and environmental sustainability perspective. Exploratory Factor Analysis was conducted to determine the latent factor structure using Principal Component Analysis with Varimax rotation, Bartlett's Test of Sphericity (<0.001) and a KMO value of 0.980 indicates the outstanding data suitability. Five different factors with eigen value larger than 1.0 were extracted, collectively accounted for 23.32 of the total variances. These factors include perceived usefulness, trust, and convenience, digital financial knowledge and technical competence, social & financial inclusion results, environmental sustainability and the business. Cronbach's Alpha for all extracted factors demonstrated excellent internal consistency with value ranges from 0.948 to 0.981. The findings suggests that digital finance adoption is a complex multidimensional phenomenon shaped by social technological and environmental aspects. The study provides a validated measurement framework and offers practical insights for policy makers and financial institution to encourage the adoption of sustainable and inclusive digital finance.*

Keywords: *Digital Finance, Adoption, Sustainable Development, Factor Analysis,*

1. Introduction

The global financial landscape is experiencing a seismic transformation, driven by the rapid development of digital technology and an enhanced emphasis on sustainable development. Digital finance consists of wide range of financial services such as internet banking, mobile banking, digital wallets, peer to peer lending and block chain-based transactions. Digital finance is the integration of financial technology, digital payment systems and digital financial products, digital derivatives, digital securities, digital carbon credits, digital currencies and various digital forms of conventional financial products. (Digital finance

Institute, 2015). Understanding the multifaceted elements that drive digital finance adoption is no longer just a technical necessity for digital service provider, but a strategic imperative for policy makers targeting to improve inclusive growth. Fintech usage in India is very attractive with notable rise in the Unified Payments interface from Rs.8.8 trillion in 2018-2019 to Rs. 139.2 trillion in 2022-2023 indicating marvellous development of digital finance as third largest global ecosystem reported by National Payments Corporation of India NPCI in 2023 (CIBIL,2023) Digital finance is the integration of financial technology, digital payment systems and digital financial products, digital derivatives, digital securities, digital carbon credits,



digital currencies and various digital forms of conventional financial products. (Digital finance Institute, 2015). The digital finance revolution gives the stakeholders to make financial transaction more comfortable and efficient and enhancing the financial inclusion by reaching underserved people. (Afjal, 2023). Digital finance is an integration of digital technology and financial services which is also called as Fintech. The usage of digital financial services is the best way to provide financial services to the underserved people in areas where the banking facilities are very low physically. In other words, the digital finance indicates that the usage of digital technologies to provide financial services to make transaction convenient and promote accessibility and speed. (Gartner Finance, 2023). Furthermore, by competing with traditional financial institutions, digital banking enhances the resilience and stability of the financial system. The digital finance brings novel solutions to financial business models. Which are in line with today's fast-moving lifestyle. Robo advisors, digital wallets. Digital currencies, digital payments, digital financial services, digital insurance and digital investments are all becoming more general and extensively utilized, denoting that payments systems are becoming contactless and consumers are going cashless.

In order to empirically map the multifaceted landscape of digital finance adoption, this study employs exploratory factor analysis. Through analysis of 270 survey responses, the study is able to identify and validate the underlying dimension that shape user perception, awareness & knowledge, and sustainability consideration. The resulting framework offers practical insights for creating more effective, inclusive, and sustainable financial services. In addition to advancing theoretical understanding of digital finance adoption.

2. Literature Review

Digital finance is the driving force in the financial sector, revolutionizing the pattern people handle money, make payments and access financial services, in contrast to traditional finance, digital finance is a sophisticated form that skillfully combines technical and financial advancement. (Ozili, 2018; Yin & Yang, 2024; Zou, Liu, Wang, & Yang, 2023).

Digital finance development starts in the 1980's with the introduction of Automated Teller Machine (ATMs) and Electronic Fund Transfers (ETFs), which is the initial stage of digital financial services. It has drastically changed the financial environment from simple digitalized banking services from complex financial ecosystem. (Puschmann, 2017).

With the emergence of smartphone & mobile works, digital finance has transformed towards user centric solutions, including mobile banking, peer to peer payment systems, and advanced Fintech platforms. (Gomber et al., 2017; Zou et al., 2023). Digital finance business functions encompass digital lending, digital investment services, digital currency, digital payments solutions, digital insurance, and digital financial advisory services. (Al-Smadi, 2023; Dong & Pan, 2024; Gomber et al., 2017; Hsueh, Jiang, & Zhang, 2024). Economic expansion, foreign direct investment, and energy consumption increase emission, hence reinforcing the pollution- haven concept. Conversely inflation and technical advancement positively influence environmental sustainability. (Kumari, D., Giri, A.K. & Malesios, C. 2025).

According to the financial inclusion inquiry, rural Scheduled Tribes had lower perceptions of many service quality characteristics than their urban counterparts. (V. Ramanujam et al, 2020). Digital finance promotes small & medium scale enterprises and sole entrepreneurs to invest in eco-friendly business and low -emission technologies. Digital financial inclusion promotes the adoption of green production processes and efficient resource management by reducing the hindrance to funding, then it can drastically increase the emissions and improve air quality. Moreover, digital platforms enable the customer to make eco-friendly choices by increased financial literacy and access to information, which eventually contributing to decreased pollution level. (Becha, H., Kalai, Houidi, S. et al. 2025) (Md. Mominur Rahman & Nafis Sadik, 2025) Convenience, efficiency, and trust are all included in the digital financial service adoption scale, while job creation, innovation, and financial stability and included in the economic growth scale.

Similar to how the sustainability scale includes indications of social responsibility. Environmental sustainability, and regulatory support, the organizational performance scale incorporates elements like operational effectiveness, financial standing, and social impact.

Carbon credit, carbon pricing, carbon emissions, green financing, environmental protection, environmental regulation, green finance policy development, and green finance instruments are all new areas that require further focus. (Briere, M., & Ramadhani, R. 2022). Financial inclusion is a powerful instrument for promoting global economic expansion. Including low-income urban residents in the formal financial system can increase their discretionary income and help combat poverty. (Demircuk-Kunt, A., et al. 2022).

Perceived usefulness and perceived ease of use are seen to be key factors in determining user acceptance. Usage behaviour is substantially more correlated with usefulness



than with ease of use. Davis, F.D. (1989). The behavioural intention was found to be significantly predicted by price value, trust, hedonic motivation, performance expectancy, and effort expectancy. It was also demonstrated that behavioural intention and favourable circumstances were important predictors of mobile banking uptake. (Alalwan, A.A., et al. 2017)

An emerging area in finance is the application of factor analysis to sustainability aspects. The triple bottom line was criticized in early research by Norman and MacDonald (2004) as a "vague metaphor" rather than a quantifiable concept. But methodological developments have made empirical validation possible

Despite the widespread integration of digital technology, recent literature frequently approaches adoption through a limited lens, primarily focusing on practical features such as ease of use and perceived risk. But environment sustainability (green Finance) and the socioeconomic inequality reduction are major global priorities which is growing intersecting with Technology Acceptance Model. As a result, a more comprehensive framework is essential to understand how digital literacy, social empowerment and environmental consciousness interact to influence user behavior or adoption.

According to Fabrigar and Wegener (2012), "Exploratory factor analysis serves as both a discovery tool and a validation mechanism, allowing researchers to map uncharted psychological territory in emerging fields like digital finance."

(V. Ramanujam & S.Muralitharan, 2025), Even though a large portion of Sri Lankans have bank accounts, informal savings techniques are nevertheless common, suggesting a possible lack of confidence in or knowledge of official financial institutions. Despite the widespread use of mobile phones, the uptake of digital financial services, especially mobile Money is scarce, particularly for women, underscoring a stark gender disparity.

3. Methodology

The study focused on a quantitative cross-sectional research design to examine the inherent dimensions of digital finance adoption.

The survey instrument considered of 60 items prepare to measure various aspects of digital finance adoption awareness, perception, social-economic and environment sustainability. each item was measured on 5-point Likert scale (ranging from Strongly Disagree to Strongly Agree) the items were acquired from a synthesis at existing literature on Technology Acceptance Model (TAM) and emerging theories in green finance and social inclusion.

IBM SPSS statistics used for data analysis KMO measure and Bartlett’s test of Sphericity used for factor analysis suitability of the data. Principal Component Analysis was used as extraction technique to reduce the 60 items into a smaller collection of latent variables. Varimax and Kaise Normalization was applied to attain a more interpretable and parsimonious structure. Based on Kaiser’s Criterion (Eigen Values <1.0), factors were kept and visually verified by looking at a scree plot

The study employed a quantitative approach, analysing responses from 270 participants on 60- item questionnaire, an exploratory factor Analysis (EFA) was conducted utilizing Principal Component Analysis with varimax rotation to identify the latent structure of digital finance adoption. For data suitability the primary test confirmed with KMO of 0.980 and a significant Bartlett’s Test (P<0.001)

Items were allocated to factors according to their principal loadings in the rotated Component Matrix, and factors were kept based on, eigen values greater than 1.0 eventually Cronbach’s Alpha coefficients were conducted for internal consistency for each identified factor.

4. Results

01. KMO and Bartlett’s Test

Test	Value
KMO Measure	.980
Bartlett's Test of Sphericity Approx. Chi-Square	28086.528
df	1770
Sig.	.000
Total Item	60
Sample Size	270

Table 01. KMO and Bartlett’s Test

Source: Computed Data

The above table indicates that the dataset is exceptionally suited for factor analysis. The KMO measure of 0.980 is notably high falls into the “Marvelous “category, which indicates that the correlation between the items is very string and there is a substantial amount of underlying variance among the 60 items in the study.

Bartlett’s test of Sphericity (<0.001) is highly significant enabling to reject null hypothesis that the variables are associated. In essence, this verifies that there is enough internal structure in the data matrix to allow for a meaningful reduction into factors.

Moreover the 270-sample size gives a ratio of 6.6 participant per item. Which is slightly below but the high KMO value indicates that the factors are likely to be very stable and well defined regardless.



02. Total Variance Explained

Factor	Eigenvalue	%Variance	Cumulative%
1	36.673	61.122	61.122
2	3.219	5.365	66.488
3	1.818	3.030	69.518
4	1.205	2.008	71.526
5	1.077	1.794	73.320

Table 02. Total Variance Explained
Source: Computed Data

Total Variance explained table suggests that a five-factor solution is highly suitable for data analysis. There are only five factors with eigen value greater than 1.0(Kaiser’s Criterion) the highly significant results are the first factor, which has as eigen value of 36.73 and accounts for 61.12 % of the total variance on its own. Which states that there is a strong primary construct inherent in the items. The cumulative variance explained is 73.32 % thanks to the lesser statistically significant contribution made by the remaining four factors. Only five factors can explain for roughly three quarters of the variance in social science research, which is a very effective and trustable data reduction. this indicates that these factors capture the great bulk of the information found in initial 60 items.

03. Scree Plot

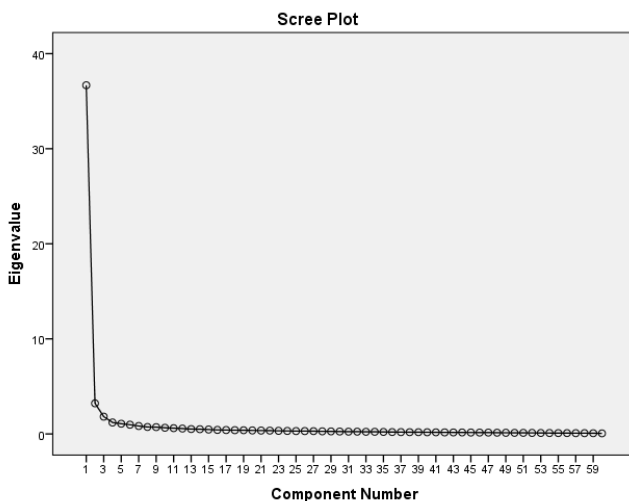


Figure 01: Scree Plot for Factor Reduction
Source: Computed Data

The scree plot gives a visual presentation of elbow test to verify how many factors should be retained by plotting the eigen values in descending order. in the study starting from the initial dominant elements, the plot would display a sharp

vertical drop, followed by a noticeable elbow, or bend as the slop abruptly flattens out.

04. Rotated Component Matrix

Items	F1	F2	F3	F4	F5
I find digital finance services easy to use.	.758				
Digital finance saves me time compared traditional banking.	.737				
I find digital payment methods convenient.	.727				
I believe digital finance is essential for future economic growth.	.712				
I am optimistic about the future of digital finance in my community.	.695				
I prefer digital finance over cash transactions.	.692				
I encourage friends/family to adopt digital financial services.	.674				
I would recommend digital finance services to others in my community.	.671				
I know the benefits of using digital finance over traditional banking.	.654				
Digital finance reduces cash dependency, lowering risks like theft and tax evasion.	.654				
I trust digital finance platforms to securely handle my money	.645				
I prefer using digital finance over traditional banking methods.	.643				
Mobile banking gives the flexibility of banking anywhere.	.642				
I feel secure when making transactions digitally.	.641				
I trust digital finance platforms to securely handle my transactions.	.626				



I am aware of digital finance services (e.g., mobile banking, internet banking, and online payments)	.594				
I believe digital finance can bridge the gap between urban and rural financial inclusion.	.577				
Digital finance supports sustainable business practices (e.g., green bonds, ESG investing)	.576				
Digital finance has reduced the cost of financial transactions for me.	.563				
I use digital finance to manage my savings more effectively.	.555				
I believe digital finance improves financial inclusion.	.553				
Digital finance fosters financial literacy among under-served populations	.536				
Digital finance has improved my access to financial services (e.g., savings, insurance and credit)	.474				
I know how to use digital finance tools for investments.	.790				
I have heard about government initiatives promoting digital finance.	.785				
I understand how digital payments systems works	.751				
I am familiar with security measures in digital finance.	.727				
I follow news or updates about digital finance trends.	.713				
I know how to protect my digital financial accounts from fraud.	.682				
I satisfied with customer support of digital financial services.	.617				

Digital finance has helped me to access credit or loan for my business or personal needs.	.608				
I believe digital finance is essential for the development of the rural communities.	.590				
I am aware of the risks associated with digital finance (e.g., fraud, data breaches).	.589				
I have been able to expand my business or income-generating activities because of digital finance	.538				
I feel confident using digital finance services without assistance	.501				
Digital finance has improved my family's access to healthcare	.708				
Digital finance has helped me support my children's education or other family needs.	.695				
Digital finance has improved my family's financial security	.681				
I use digital finance to contribute to community development initiatives.	.671				
I feel more empowered to make financial decisions because of digital finance	.619				
I feel more financially included because of digital finance services	.611				
Digital finance has improved my ability to save money for emergencies or future needs.	.608				
Digital finance reduces gender disparities in financial services	.604				



Peer to peer (P2P) lending supports community based economic growth.			.500		
Digital finance bridges the urban-rural divide in financial services.			.493		
Digital finance contributes to sustainable development in my community			.682		
Digital finance has reduced my need to travel for banking or financial services.			.657		
Digital finance encourages me to adopt environmentally friendly practices			.652		
Digital finance reduces the need for paper-based transactions (e.g., cash, receipts)			.646		
Digital finance has encouraged me to adopt paperless transactions.			.642		
I believe digital finance is an environmentally friendly alternative to traditional banking			.610		
I believe digital finance can contribute to reducing carbon emissions in my community			.588		
Digital lending prioritizes eco-friendly businesses (e.g., solar energy startup)			.504		
I use digital financial services for most of my business transactions.					.605
I feel comfortable making high-value transactions through digital platforms					.552
Digital finance has helped me increase					.530

my income and business revenue.					
I frequently use digital payment methods for transactions					.523
I use digital finance tools to manage my finances					.521
I use digital finance services to send and receive money from families and friends.					.512
Digital finance services are widely available in my community.					.487

Table 03: Factor Rotation Matrix

Source: Computed Data

The rotated Component matrix cleared the underlying structure of the 60-item scale, which divides the variable into five different thematic dimensions, all of which has a substantial factor loading (usually above 50). Factor 01 is the most comprehensive factor, capturing consumer opinion about security, convenience, and overall preference for digital banking versus traditional banking.

Item related to technical expertise, fraud prevention, familiarity with government programs is included in Factor 2. Factor 3 focuses on the real-world benefits of digital banking, such as improved access to gender equality, healthcare, and education. Factor 4 expresses itself as a unique dimension where digital finance is connected to carbon reduction and paperless transactions. Factor 5, on the other hand, focuses on how frequently high-value transfers and corporate business are utilized

The clean distribution of loading, in which the most of items have a strong correlation with just one factor, indicates good construct validity and offers a robust framework for examining the complex adoption of digital finance.

A “one-size fits-all” strategy for digital finance is unlikely to be successful given the development of five unique variables. First, the predominance of factor 1 indicates that as fundamental prerequisites for customer retention, service providers must give top priority on cyber security and user-friendly interfaces. Second, the significance of factor 2 suggests government and financial marketing and fund educational initiatives that focuses on investment knowledge and fraud protection. Third, factor 3 and 4’s distinct separation provides a road map for value-based marketing by emphasizing how digital finance reduces paper waste (carbon footprint) and closes the gender gap in financial access, organization can promote adoption among

socially conscious users, Lastly the creation of factor 5 indicates that high value transactions and small business owners require specialized digital tools, not just simple person to person transfers.

05. Factor Interpretation and Naming

Factor 01: Perception & Perceived Benefit

Ease of use, trust, security, time savings, preference for digital financial and advocacy behavior are all consisted in this factor. its dominance suggests that the primary drivers influencing the adoption of digital finance are perceived security, convenience and general confidence.

Factor 2: Awareness & Knowledge

This factor's items reflect how well-versed users are in digital finance tools, fraud avoidance, government initiatives, self-assurance, investment awareness. This denotes that adoption behavior is significantly influenced by technical expertise and financial literacy.

Factor 3: Social Sustainability

The social impacts of digital finance such as, education, healthcare, improved access, gender equality, financial empowerment, community development, are captured by this factor. The findings indicate consumer view digital finance as a meaning of enhancing their social and economic well-being.

Factor 4: Environmental Sustainability

It includes the items loading of paperless transaction, reduced travel, lower carbon emissions, and ecofriendly banking practices. This suggests how digital finance is becoming more and more essential in enhancing environmental sustainability.

Factor 5: Usage and Business Impact

This factor includes frequent use, high-value transaction, and financial management. It emphasizes how essential digital finance is for users and entrepreneurs engaged in higher value or commercial activity.

06. Scale Reliability

Factor	Cronbach's Alpha	Items
1: Perception & Perceived Benefit	0.981	23
2: Awareness & Knowledge	0.956	12
3: Social Sustainability	0.950	10
4: Environmental Sustainability	0.951	08
5: Usage and Business Impact	0.948	07

Table 04. Reliability of the factors

The Cronbach's Alpha values for five factors and the number of items linked to each of the five extracted factors are shown in the above table. Cronbach's Alpha evaluates each factors' items dependability and internal consistency.

Factor 01 includes 23 items and Cronbach's Alpha of 0.981 suggesting outstanding internal consistency. This indicates that this factors items measure the same underlying construct with a high degree of consistency. Factor 2 consists of 12 items and Cronbach's Alpha of 0.956 indicating exceptional dependability. Factor 3 has 10 items with Cronbach's Alpha of 0.950 indicating a very high internal consistency. Factor which consists of eight items, has a Cronbach's Alpha of 0.951, suggesting exceptional reliability. Factor 5 has 7 items and Cronbach's Alpha of 0.948 indicating high internal consistency

Overall, all five factors are above the well-recognized threshold of 0.70 demonstrating the excellent reliability of the measurement scales employed in the research. This items within each factor appear to be cohesive and effectively capture their respective constructions based on the consistently high Cronbach's Alpha values.

5. Findings

This study is to identify the underlying factors driving the digital financial adoption using the standardized 60 item measurement scale, the exploratory factor analysis was conducted on data collected from 270 respondents with robust sampling adequacy and reliability measure. The findings indicate exceptional factor analysis suitability, measure of sample the Kaiser Meyer Olkin (KMO) was 0.980, which is in the "Marvelous" category indicates the strong correlations across variable. The output of Bartlett's Test of Sphericity was highly significant ($X^2 = 28086.528$, $P < 0.001$), demonstrating that meaningful factor extraction was not appropriate and the correlation matrix was not an identity matrix. The remarkably high KMO value demonstrates the derived factor structure is dependable and stable. Despite a respondent -t-all-item ratio of 6.6:1.

The five factors were extracted in accordance with Kaiser's criterion (eigen value > 1.0) and through visual inspection of the scree plot by using Principal Component Analysis with Varimax rotation. The five factors together account for 73.23 % of the total variance, which is suggested highly satisfactory in the social science research. Factors account for 61.12 % of the total variance emerged as dominant construct suggesting a prominent core dimension underlying the digital financial adoption. Factors 2 to 5 together capture more behavioural, social, environmental and usage related aspects of the digital finance explained incremental contribution to the explained variance. The five factors answer was powered by the scree plot, which confirmed a different elbow, following the fifth factor.

The five factors based on the rotation matrix reflect distinct and complementary dimensions of adoption of digital finance. The clean factor loading indicates the strong

construct validity and clearly defined latent structure with few cross loadings and most values more than 0.50

Reliability of the measurement scale

All five factors demonstrated remarkably good internal consistency with Cronbach's Alpha value ranging from 0.948 to 0.981. These findings significantly above the commonly accepted criterion of 0.70 confirming that the items within each factor perfectly measure their intended construction. Overall, the measurement instrument suggests good reliability and resilience.

6. Conclusion

The study successfully identified multidimensional structure of adoption digital finance using a thorough exploratory factor analysis. The results suggest that the adoption of digital finance is shaped by five interrelated dimensions: perceived usefulness and trust, digital awareness and competence, financial & social inclusion, green finance, and usage intensity for business and high value transaction.

Perceived usefulness, Security and convenience are the dominance factors remain the fundamental driver of adoption in line with technology acceptance model.

However, the advent of social inclusion and environmental sustainability as distinct elements extends to current theoretical frameworks by suggesting the users, increasingly associated digital finance with larger societal and ecological benefits. This indicates a transition from purely functional adoption motivation to value base and impact-oriented perceptions

The findings practically suggests that a "one-size-fits-all" strategy for digital finance adoption is insufficient. To strengthen confidence, financial service providers should prioritize user-friendly and secure system while governments and regulations should involve in financial literacy, fraud prevention, and digital education initiatives. Furthermore, emphasizing the social and environmental benefits of digital finance can increase, adoption among socially conscious users, while tailored digital solutions are necessary to promote small business and high value transaction customers.

Overall, the study reveals an empirical contribution by offering a validated, reliable and complete measurement framework for digital finance adoption.

The examined factor structure reveals valuable insights for policymakers and institutions, and researcher seeking to improve inclusive, sustainable and widespread adoption of digital financial services.

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