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Post-COVID Digital Payment Adoption and Financial Inclusion in India: Empirical Insights and Policy Implications

Dr Syeda Rukhsana Khalid
Associate Professor in Finance Amjad Ali Khan College of Business Administration

Dr Nikhath Sultana
Associate Professor in Finance Amjad Ali Khan College of Business Administration

Purpose:
This study investigates the impact of digital payment adoption—accelerated by the COVID-19 pandemic—on financial inclusion in India. It analyses multi-platform trends across UPI, AEPS, mobile wallets, and FASTag; identifies regional and demographic disparities; and assesses the relationship between digital transaction growth and the Reserve Bank of India's Financial Inclusion Index (FII).

Design/Methodology/Approach:
Adopting a descriptive-analytical approach, the study draws on secondary data from the RBI, NPCI, PMJDY, and the World Bank's Global Findex. It employs indexed trend comparisons (pre- vs. post-COVID), platform-wise growth analysis, and a multiple linear regression model (2021–2024) to evaluate directional linkages between digital payment usage and financial inclusion.

Findings:
The study finds exponential growth in UPI usage (CAGR: 64.6%), stable adoption of mobile wallets, and a plateau in AEPS-assisted services—with FASTag showing steady infrastructure-led growth alongside app-based platforms. Regression results indicate that UPI and wallet transactions positively influence FII scores**,** while AEPS exhibits a negative association, reflecting its declining marginal impact. However, disparities persist across rural–urban, gender, and literacy lines, signaling the need for inclusive design.

Research Limitations:
Given the limited availability of annual FII data (n = 4), the regression findings are directional and exploratory rather than statistically conclusive.

Practical Implications:
The findings underscore the need for targeted interventions, including digital literacy initiatives, strengthened fraud protection, regional-language platforms, and inclusive financial design to ensure equitable digital participation.

Originality/Value:
This paper offers a novel triangulation of descriptive trend analysis, empirical regression, and policy framing to assess post-pandemic digital financial inclusion in a lower-middle-income context. It provides empirical insights and strategic recommendations relevant to scholars, fintech innovators, and policy stakeholders.

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Keywords: Digital Payments; Financial Inclusion; UPI; AEPS; COVID-19; India; RBI; Regression Analysis; PMJDY; Mobile Wallets; FASTag; Global Findex

1. Introduction

Financial inclusion refers to the provision of accessible, affordable, and appropriate financial services—such as savings, credit, insurance, and payments—in a fair and transparent manner. According to the Reserve Bank of India (RBI), inclusion involves integrating underserved and low-income populations into the formal financial system. The World Bank (2023) similarly defines financial inclusion as ensuring that individuals and businesses have access to useful and affordable financial products and services, delivered responsibly and sustainably.

India's financial inclusion efforts began with traditional banking reforms and were substantially expanded through flagship schemes such as the Pradhan Mantri Jan Dhan Yojana (PMJDY), launched in 2014. PMJDY facilitated the opening of over 500 million bank accounts—many for first-time users—and laid the foundation for the Jan Dhan–Aadhaar–Mobile (JAM) trinity, enabling digital identity and mobile-linked access to financial services. However, prior to the COVID-19 pandemic, challenges persisted: account dormancy was high, digital usage was limited, and cash dependence remained prevalent, particularly in rural and informal sectors.

The COVID-19 pandemic acted as a structural accelerator, intensifying the adoption of digital payment platforms across India. With mobility restrictions and disrupted physical banking services, platforms such as the Unified Payments Interface (UPI), Aadhaar-enabled Payment Systems (AEPS), and mobile wallets became critical for both state benefit transfers and everyday transactions. UPI, in particular, emerged as the backbone of real-time, low-cost, cashless transactions. This shift was further supported by scalable digital infrastructure, including India Stack, biometric authentication, and QR code-enabled applications. As a result, fintech solutions witnessed exponential growth and broader acceptance among varied socio-economic groups.

Digital technologies have become central to inclusive development. As emphasized by the World Bank (2024), digitalization now underpins access to essential services in finance, education, healthcare, and governance. Yet, despite India’s digital momentum, socio-economic divides persist. The country remains a lower-middle-income economy as per World Bank classifications, highlighting a dual reality—digital progress alongside infrastructural and institutional gaps. Indicators such as Gross National Income (GNI) per capita underscore this tension between growth and equity.

Against this backdrop, the present study investigates whether India’s rapid digital payment adoption in the post-COVID era has meaningfully advanced financial inclusion. Specifically, it examines the impact of platforms such as UPI, AEPS, FASTag, and mobile wallets not just in expanding access, but also in fostering regular usage, consumer trust, and empowerment across demographic and geographic divides. Drawing on macroeconomic data, institutional reports, and platform-level trends, the study aims to evaluate the extent to which digital transformation has translated into inclusive financial outcomes.

2. Study Rationale and Research Questions

The post-pandemic period has accelerated the global shift toward digital financial services, with India at the forefront of fintech innovation and public digital infrastructure. However, while transaction volumes and platform usage have increased significantly, it remains unclear whether this growth has translated into sustained and equitable financial inclusion—especially among marginalized populations. Much of the existing research has focused on digital readiness or platform adoption, with limited empirical assessment of how specific payment mechanisms contribute to formal inclusion outcomes such as those captured in the Financial Inclusion Index (FII).

This study addresses this empirical gap by integrating descriptive statistics, regression analysis, and thematic interpretation to assess whether digital payment expansion has resulted in deeper financial integration.

The research is guided by the following questions:
RQ1: To what extent have digital payment platforms such as UPI, AEPS, and mobile wallets contributed to India's financial inclusion in the post-COVID period?

RQ2: What patterns emerge across demographic and regional segments in digital payment usage, and how do these influence the equity of financial access?

RQ3: What are the structural and behavioural barriers that continue to limit the inclusive potential of digital finance in India?

RQ4: What policy measures can strengthen the link between digital payment expansion and long-term financial inclusion?

These questions are anchored in a conceptual framework (Figure 1) that outlines the relationships between platform usage, enabling factors, and inclusive financial outcomes.

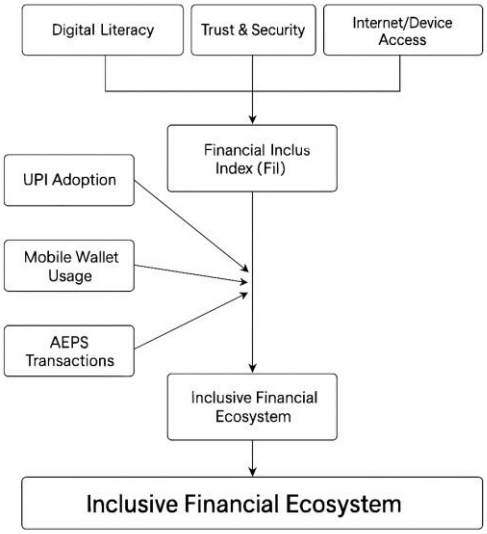

Figure 1. Conceptual Framework: Digital Payment Adoption and Financial Inclusion

This framework illustrates how adoption of UPI, mobile wallets, and AEPS—mediated by factors such as literacy, trust, and connectivity—impacts the Financial Inclusion Index (FII) and drives inclusive digital development. This conceptual framing informs the subsequent literature review and methodological design.

3. Literature Review

3.1 Digital Payments and Financial Inclusion: Conceptual Linkages

The adoption of digital payments has emerged as a transformative force in promoting financial inclusion, particularly within emerging economies such as India. Financial inclusion broadly refers to the extension of affordable and appropriate financial services to underserved populations in a transparent and sustainable manner. As emphasized by the World Bank (2023), digital financial services (DFS) are foundational for enabling individuals and businesses to participate in formal financial systems. Innovations such as the Unified Payments Interface (UPI), mobile wallets, and Aadhaar-enabled Payment Systems (AEPS) have significantly lowered transaction costs and entry barriers (Gomber et al., 2021; Sahay et al., 2022), thereby extending services to previously excluded groups.

Recent literature expands this foundation by examining the socio-economic impacts of DFS. Verma and Chatterjee (2025) argue that digital tools not only enhance access but also build financial resilience through savings, credit, and risk management. Kunal et al. (2025) demonstrate that digital payment systems have empowered informal sector actors—including street vendors and microentrepreneurs—by improving operational efficiency and income stability. Janani et al. (2025) highlight the need to integrate financial literacy with digital deployment strategies, particularly in rural and semi-urban contexts. According to the Global Findex Database (2021), 76% of adults globally—and 71% in developing economies—now own accounts with formal financial institutions or mobile money providers, compared to just 51% globally in 2011, illustrating the growing role of DFS in expanding financial access (World Bank, 2022).

3.2 Post-COVID Digital Acceleration in India

The COVID-19 pandemic acted as a structural accelerator of digital transformation in India's financial sector. Restrictions on physical mobility and banking access positioned digital platforms as critical tools for economic continuity and welfare delivery. Initiatives such as the Pradhan Mantri Jan Dhan Yojana (PMJDY) and Direct Benefit Transfers (DBTs) utilized digital infrastructure to disburse emergency funds (RBI, 2021). Sharma and Dubey (2023) report a surge in UPI transactions during the pandemic, with monthly volumes rising from 2 billion in March 2020 to over 10 billion by late 2023.

Ahmadian (2025) posits that these behavioral changes are not merely reactive but reflect structural shifts in financial habits. Kumar et al. (2025), applying the Stimulus–Organism–Response (S-O-R) model, argue that pandemic-induced behaviors are now embedded in routine financial activity. Rani et al. (2025) compare India's trajectory with emerging MENA economies, noting convergent acceleration trends. The Global Findex (2021) indicates that over 80 million Indian adults made their first digital merchant payment during the pandemic. However, the World Bank (2023)

cautions that a third of the global population remains offline, with limited access to reliable internet and digital devices, exacerbating the digital divide.

3.3 Challenges in the Adoption of Digital Payments

Despite progress, digital payment adoption in India faces several challenges. These include limited digital literacy, low consumer trust, uneven infrastructure, and cybersecurity concerns (Kumar et al., 2022). Demographic divides—especially those related to gender, income, and age—further limit equitable usage. Singh et al. (2023) emphasize that improved access does not necessarily translate to regular usage or financial empowerment.

Jahnavi et al. (2025) identify security and privacy concerns as significant barriers to mobile banking adoption. Achanta and Lepcha (2025) underscore persistent gender gaps, particularly in rural areas. Yadav et al. (2025) argue that perceived risk and low financial confidence inhibit women's sustained engagement with digital platforms. Mathew (2025) attributes limited repeat usage to consumer inertia and low digital confidence among first-time users. These findings highlight the need for trust-building initiatives and targeted capacity development.

3.4 Digital Payment Ecosystem and Policy Interventions

India's digital payment ecosystem has advanced through a combination of regulatory measures, public–private partnerships, and institutional innovation. Frameworks established by the RBI, Ministry of Finance, and National Payments Corporation of India (NPCI) have enabled rapid scaling. Flagship programs such as Digital India, UPI 2.0, and Bharat BillPay have helped normalize digital transactions across sectors (Mehta & Joshi, 2022). However, full ecosystem maturity requires improved grievance redressal, cybersecurity, and financial education.

Agbataekwe-Richmond (2025) calls for adaptive legal frameworks to support fintech growth. Dhamija et al. (2025) emphasize service quality as key to user satisfaction. Aggarwal et al. (2025) highlight how strategic investments—like Facebook's in Jio Platforms—have strengthened digital infrastructure. Simon and Ramesh (2025) use the Paytm case to illustrate tensions between innovation and regulatory compliance in India's fintech space.

3.5 Research Trends, Gaps, and Future Directions

A bibliometric review of post-2020 literature reveals rising scholarly focus on digital payments, financial inclusion, and fintech regulation. Frequently occurring keywords include "UPI," "COVID-19," "digital divide," and "financial resilience." Pizzan-Tomanguillo et al. (2025) emphasize increasing interest in wallet adoption and platform trust. Rašticová et al. (2025) and Panait et al. (2025) raise concerns about new inequalities such as digital fatigue and over-platformisation.

Nevertheless, gaps remain. There is insufficient empirical research on the long-term effects of digital finance on mobility, savings, and credit access. Regional disparities across Indian states are underexplored. Comparatively, countries like Bulgaria, Palau, and Russia have advanced financial inclusion through coordinated investments in digital and human capital (World Bank, 2024). These insights underscore the need for platform-specific studies on digital finance and its role in inclusive

development frameworks. This study aims to address this by focusing on India's post-COVID digital payment platforms and their contribution to financial inclusion.

4. Methodology

4.1 Research Design and Scope

This study employs a descriptive-analytical research design that integrates qualitative and quantitative elements to evaluate the relationship between digital payment adoption and financial inclusion in India during the post-COVID period. The analysis is based on secondary macroeconomic and transaction-level data, supported by policy documentation. A comparative temporal lens is used to contrast pre-COVID (FY 2018–2019) and post-COVID (FY 2020–2025) trends.

4.2 Data Sources

The dataset comprises secondary information obtained from authoritative sources, including:

- National Payments Corporation of India (NPCI) transaction statistics (UPI, FASTag, AEPS)
- Reserve Bank of India (RBI) Financial Inclusion Index
- Pradhan Mantri Jan Dhan Yojana (PMJDY) reports (Ministry of Finance)
- NPCI Retail Payment Statistics (2021–2025)
- World Bank Global Findex (2021)
- RBI's National Strategy for Financial Education (NSFE 2020–2025)

These sources enable analysis of both access and usage dimensions of financial inclusion.

4.3 Descriptive and Visual Analysis

Patterns in digital transaction volumes and values—across UPI, AEPS, mobile wallets, and FASTag—are traced through graphical visualization and descriptive statistics. Metrics such as PMJDY account growth, debit card issuance, cheque usage, and microATM withdrawals are examined to assess system-level changes. Thematic patterns in rural access, platform-specific adoption, and infrastructural shifts are highlighted to contextualize digital usage trends.

4.4 Policy and Innovation Context

To support the empirical narrative, policy measures and fintech innovations are briefly reviewed to contextualize the observed patterns in platform adoption and financial inclusion. These include initiatives such as UPI123Pay, the Zero MDR policy, PMGDISHA, and various fintech-led innovations in user interface design and digital credit. These interventions, summarized in Table 1, formed the institutional foundation for India's rapid digital payment expansion in the post-COVID period.

Table 1. Government and Fintech Interventions Driving Digital Payment Growth in India Post-COVID

Domain	Initiative / Innovation	Strategic Objective	Observed Outcome

Government Policy	Digital India Programme	Expand digital infrastructure and governance	Strengthened foundational tech access, especially in rural areas
	Pradhan Mantri Jan Dhan Yojana (PMJDY)	Universal access to bank accounts	Over 400 million individuals onboarded into the formal banking system
	Direct Benefit Transfers (DBT)	Enable transparent, direct aid disbursement	Boosted public trust and increased usage of UPI for financial transfers
	PMGDISHA (Digital Literacy Mission)	Promote digital literacy among rural populations	Enhanced user confidence and mobile payment adoption
Regulatory Support	Zero MDR Policy (2020)	Eliminate merchant transaction fees	Accelerated adoption among small merchants and vendors
	UPI Lite & UPI123Pay	Improve access for feature phone users and low-bandwidth areas	Expanded financial inclusion in underserved regions
	RBI Regulatory Sandbox	Facilitate responsible fintech experimentation	Encouraged innovation in payment and lending solutions
Fintech Innovations	AI chatbots, vernacular UIs, reward systems	Improve user experience and accessibility	Higher engagement among digitally hesitant populations
	Digital wallets & BNPL services	Simplify digital payments and credit access	Increased usage among youth, small businesses, and informal workers
	QR-based Micro-credit & EMI schemes	Empower unbanked and underbanked communities	Enabled micro-transactions and supported financial resilience

(Source: Compiled by author from RBI, NPCI, PMJDY, and regulatory publications)

4.5 Regression Analysis: Directional Assessment

To complement descriptive insights, a multiple regression model is estimated to assess the directional relationship between digital payment adoption and financial inclusion. The dependent variable is the RBI's Financial Inclusion Index (FII), while the independent variables include UPI, AEPS, and wallet transaction volumes from 2021 to 2024. The model is specified as:

$$FII_t = \beta_0 + \beta_1 \cdot UPI_t + \beta_2 \cdot AEPS_t + \beta_3 \cdot Wallet_t + \varepsilon_t$$

5. Findings and Discussion

This section integrates descriptive analysis with empirical insights to evaluate the impact of digital payment adoption on financial inclusion in India in the post-COVID context. Drawing from data sourced from the Reserve Bank of India (RBI), the National Payments Corporation of India (NPCI), the Pradhan Mantri Jan Dhan Yojana (PMJDY), and the Global Findex Database, the analysis explores adoption patterns, structural challenges, and platform-specific dynamics across UPI, AEPS, FASTag, mobile wallets, and debit cards. The findings are thematically organized and supported by comparative tables and visualizations to offer a comprehensive understanding of India's evolving digital financial ecosystem.

5.1 Pre- vs. Post-COVID Trajectories of Financial Inclusion and Digital Adoption

India's financial inclusion landscape has undergone significant transformation between 2019 and 2025, catalysed by the COVID-19 pandemic and accelerated policy execution. Pre-COVID efforts, as reflected in the RBI's 2019 policy focus, emphasized infrastructure development, SHG integration, and institutional credit delivery, particularly for rural sectors. However, these interventions were predominantly analog in nature.

By contrast, the post-COVID phase reflects a digital pivot. As of 2025, over 550 million Jan Dhan accounts have been opened—50% held by women—with total deposits exceeding ₹2.5 lakh crore. UPI alone accounts for over 83% of India's daily transactions, and more than 500 districts have achieved 100% digital enablement. This shift signals an evolution from access-centric provisioning to widespread digital usage, marking a structural transformation in India's financial inclusion journey.

A comparative summary of key indicators is presented in Table 2.

Table 2: Comparative Financial Inclusion Indicators – Pre vs. Post COVID

Indicator	Pre-COVID (2018–2019)	Post-COVID (2020–2024)
UPI Monthly Txn Volume	~800 million	12,000–18,000 million
Wallet Usage	Limited (manual KYC barriers)	App-based adoption, PPI growth
AEPS Monthly Withdrawals	< 250 million	~293–320 million
PMJDY Accounts	350 million	500 million+
RBI Policy Focus	SHG, BC outreach	Digital trust, grievance redress

(Source: RBI, NPCI, PMJDY, compiled by author)

This comparison reveals a decisive shift in both usage intensity and policy framing of financial inclusion, indicating the structural role of digital payments in India's post-pandemic financial ecosystem.

5.2 Platform-wise Digital Growth: UPI, AEPS, Wallets, FASTag

To evaluate the multi-platform evolution of digital payments post-COVID, Table 3 presents annual transaction volumes for UPI, AEPS, mobile wallets, and FASTag between 2021 and 2025. The

data reveal distinct usage trajectories across platforms, reflecting variations in accessibility, user familiarity, and policy support.

Table 3 indicates that UPI has maintained exponential growth, increasing from 4,566 crore transactions in 2021 to over 18,677 crore by May 2025. Wallet transactions also exhibit sustained growth, rising from 212 crore to 740 crore over the same period. In contrast, AEPS usage has remained relatively stagnant since 2021, with transaction volumes plateauing around 293 crore annually. FASTag transactions demonstrate steady, linear growth—reaching 404 crore by early 2025—highlighting continued adoption within transit and toll payment ecosystems. In terms of value, FASTag transactions rose from ₹2,397.84 crore in January 2021 to ₹6,613.72 crore by January 2025, underscoring its growing role in infrastructure-linked digital finance.

Table 3: Platform-wise Digital Payment Growth in India (2021–2025)

Year	UPI Transactions (Cr)	AEPS Transactions (Cr)	Wallet Transactions (Cr)	FASTag Transactions (Cr)
2021	4,566	296	212	148.56
2022	7,829	303	310	380.32
2023	12,020	293	420	381.98
2024	16,730	293	700	382.58
2025	18,677 (YTD May)	293	740	404.43

(Source: NPCI Retail Statistics, RBI Reports, compiled by author)

UPI's rapid expansion is further illustrated in Figure 1, which shows monthly transaction volumes increasing from 4,566 million in May 2021 to 18,677 million in May 2025. This trend underscores the platform's integration into routine financial behaviour, supported by real-time settlements, QR interoperability, and wide merchant acceptance.

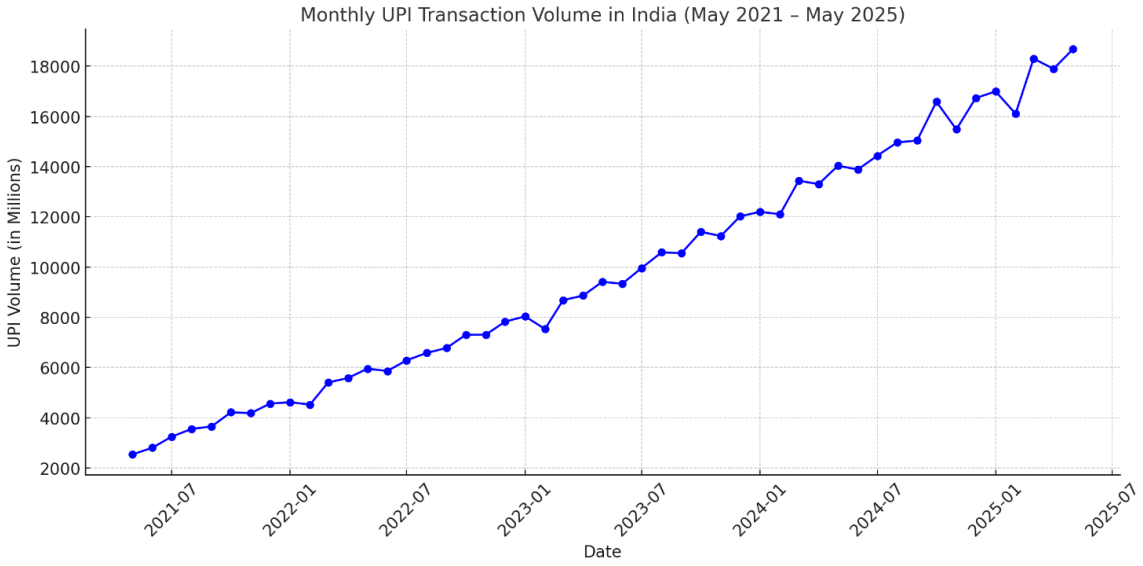

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Figure 2*:* Monthly UPI Transaction Volumes in India (May 2021 – May 2025)
(Source: RBI, NPCI data compiled by author)

Figure 2 confirms the deep integration of UPI into everyday financial behaviour across both retail and P2P transactions.
Figure **3** displays the growth of FASTag transactions between January 2021 and January 2025. The trend is linear, suggesting sustained utility but limited network effects outside the mobility sector. FASTag's infrastructure-led growth complements app-based platforms like UPI, contributing to a diverse digital ecosystem—with FASTag showing steady infrastructure-led growth alongside app-based platforms—where mobility-linked payments increasingly reinforce daily digital habits.

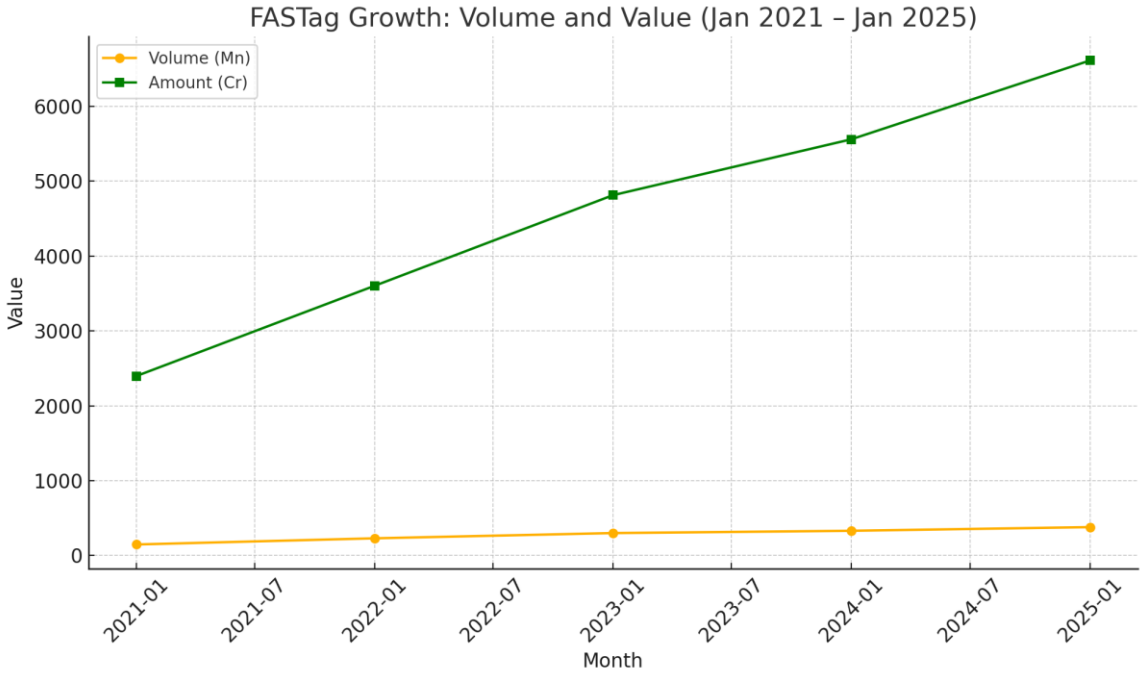

Figure 3*:* FASTag Transaction Volume and Value (Jan 2021 – Jan 2025)
(Source: NPCI Retail Payments Statistics, RBI, May 2025.)

A comparative index analysis, shown in Figure 4, uses 2019 as the base year (Index = 100) to illustrate relative growth across platforms. The indexed trajectories show UPI surging well beyond others, mobile wallets increasing steadily, and AEPS remaining flat post-2021. These patterns suggest a growing preference for autonomous, app-driven systems and a diminishing role for assisted models such as AEPS.

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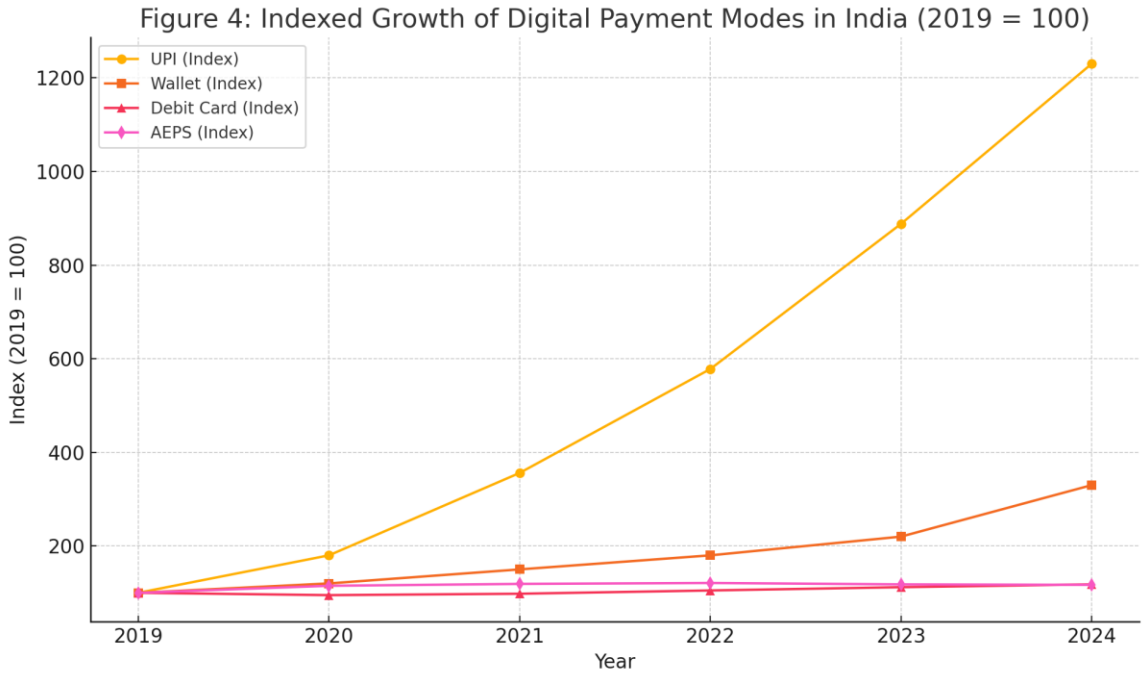

Figure 4: Indexed Growth of Digital Payment Modes in India (2019 = 100) (Source: RBI, NPCI, author's calculations)

Unified Payments Interface (UPI) has witnessed exponential growth, with transaction volumes increasing more than twelvefold during the study period. This surge underscores UPI's emergence as the central pillar of India's digital payment ecosystem, enabled by its interoperability, ease of use, and real-time settlement capabilities. In contrast, mobile wallets have shown moderate but consistent growth, suggesting continued utility among users who prefer prepaid digital options or lack full access to formal banking. Debit card usage displays a slow, linear increase, indicating a relatively static user base and possibly reflecting a transition toward mobile-first platforms. Meanwhile, the Aadhaar Enabled Payment System (AEPS) has exhibited a flat trend since 2021, pointing toward saturation and limited scalability, likely due to its dependence on assisted models and constrained transactional functions. These diverging trajectories highlight UPI's dominant position and also point to the declining marginal utility of legacy and infrastructure-dependent payment systems such as AEPS in an increasingly digitized financial landscape.

5.3 Financial Access & Usage Metrics

India has made considerable strides in expanding formal financial access over the past five years. Table 4 presents key financial inclusion indicators, including account coverage under the Pradhan Mantri Jan Dhan Yojana (PMJDY), debit card issuance, cheque clearances, and micro ATM withdrawals.

Table 4: Key Financial Inclusion Indicators in India (2021–2025)

Year	PMJDY Accounts (Cr)	Debit Cards in Circulation (Cr)	Cheque Clearances (Lakhs)	Micro ATM Withdrawals (Monthly Cr)
2021	44.6	92.4	640.96	2.90
2022	46.8	95.1	648.73	2.93
2023	48.9	97.7	652.11	2.96
2024	50.1	98.5	645.00	2.95
2025	50.3 (Mar)	99.1	645.00 (Apr)	2.95

(Source: RBI, PMJDY Dashboard, NPCI Retail Payments Statistics)

The data indicate consistent growth in both PMJDY account ownership and debit card circulation, with account holders increasing by nearly 6 crore and card issuance rising by over 6.7 crore between 2021 and 2025. This reflects broadening financial access, largely supported by regulatory reforms and account-linkage mandates.

However, traditional instruments continue to persist. Despite digital advances, cheque clearances have remained persistently high (~64–65 lakh/month), suggesting continued reliance among senior citizens and rural users lacking digital confidence. Similarly, micro ATM withdrawals have remained constant at approximately 2.9 crore per month, pointing to the sustained need for cash-based transactions, particularly in rural and low-connectivity regions.

By March 2025, over 990 million debit cards were in circulation. While card issuance has expanded, usage has also evolved: debit card transactions increased from 661,000 transactions worth ₹3,499 crore in December 2021 to significantly higher volumes in subsequent years. Mobile wallet transactions grew from 212,000 (₹5,661 crore) to 2.12 million (₹7,008 crore) in FY 2023–24, driven by the ease of app-based interfaces and Prepaid Payment Instrument (PPI) regulation enhancements.

AEPS continues to play a pivotal role in rural financial access. As illustrated in Figure 5, AEPS-enabled micro ATM withdrawals remained within the range of 290–320 million per month between January 2021 and January 2025, with transaction values increasing from ₹7,641 crore to ₹8,896 crore. This pattern underscores AEPS's ongoing relevance as an assisted service, particularly for beneficiaries in remote or cash-dependent areas.

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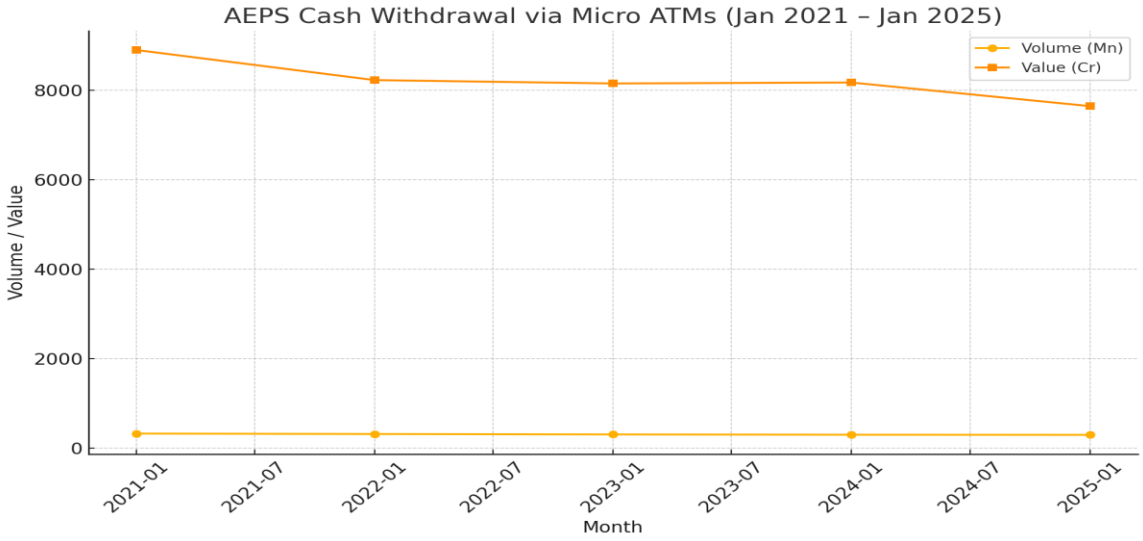

(Source: NPCI Retail Payments Statistics, May 2025)

Figure 5: AEPS Cash Withdrawals via Micro ATMs (Jan 2021 – Jan 2025)

These findings suggest that while digital adoption is expanding through cards and wallets, legacy instruments such as cheques and assisted services like AEPS remain crucial for specific user groups. The coexistence of digital and analog modes reinforces the importance of maintaining a hybrid financial infrastructure to ensure inclusion across demographic and technological divides. Cheque clearances remain persistent, especially among elderly and rural populations, reflecting analog resilience.

5.4 Demographic Disparities: Urban–Rural and Gender Gaps

Despite progress, digital financial inclusion remains uneven. Urban areas account for the majority of transaction volumes due to better infrastructure, higher smartphone penetration, and greater digital literacy. Rural India continues to face challenges of erratic connectivity, limited device access, and low levels of digital confidence.

According to the Global Findex Database (2021), the gender gap in account ownership in developing economies narrowed from 9% to 6%, yet persists. Additionally, nearly one-third of mobile money users in Sub-Saharan Africa—a proxy for rural India's conditions—required assistance for basic transactions. This emphasizes the ongoing need for regional language interfaces, handholding mechanisms, and digital literacy programs in underserved areas.

5.5 Structural Challenges: Frauds, Trust, and Risk Mitigation

As digital adoption accelerates, risks associated with cyber fraud and data misuse rise proportionally. Data from the RBI's Central Payments Fraud Registry reported digital fraud losses of ₹1.21 lakh crore in March 2025 alone, with over 291 reported incidents. Since mid-2024, monthly fraud cases have consistently exceeded 300, highlighting growing vulnerabilities in the financial ecosystem.

These threats erode trust—especially among digitally inexperienced users, senior citizens, and rural populations—undermining sustained adoption. Robust consumer protection laws, secure authentication protocols, and efficient grievance redress mechanisms are essential to mitigate these risks and safeguard user confidence.

5.6 Is Digital Equal to Inclusive?

While India's digital infrastructure has expanded rapidly, the journey toward full financial inclusion remains incomplete. Access alone does not guarantee empowerment. Meaningful inclusion requires users to engage with digital platforms for savings, credit, insurance, and investment—not merely for fund transfers.

The World Bank's 2024 classification continues to list India as a lower-middle-income country, reflecting developmental challenges that coexist with digital advancements. Cross-national comparisons with countries like Iran and Ukraine, which recently transitioned to upper-middle-income status, suggest that digital adoption must be matched with institutional reforms.

India's path forward must combine digital expansion with universal literacy efforts, regional-language user interfaces, affordable data and devices, and strong consumer data protection legislation. Only then can India ensure that its digital transformation truly bridges, rather than widens, socioeconomic divides.

To support the regression analysis in Section 5.7, Table 5 presents the Reserve Bank of India's official Financial Inclusion Index (FII) scores for the years 2021 to 2024. The FII is a composite measure that captures the extent of financial inclusion across access, usage, and quality dimensions, scaled from 0 to 100. The steady upward trend in FII values—from 53.9 in FY2021 to 64.2 in FY2024—reflects the cumulative impact of policy interventions, infrastructure improvements, and expanding digital financial services during the post-COVID period. These values form the dependent variable for the multiple linear regression model used to assess the directional influence of digital payment platforms such as UPI, AEPS, and mobile wallets on financial inclusion outcomes.

Table 5. RBI Financial Inclusion Index (FII), FY 2021–2024

Financial Year (ending March)	FII Value
2021	53.9
2022	56.4
2023	60.1
2024	64.2

(Source: Reserve Bank of India (2021–2024), Financial Inclusion Index Press Release)

5.7 Regression Results – Digital Payments and Financial Inclusion

To evaluate the directional relationship between digital payment adoption and financial inclusion, a multiple linear regression model was employed. The dependent variable was the Reserve Bank of India's Financial Inclusion Index (FII), while the independent variables included annual transaction volumes for UPI, AEPS, and mobile wallets for the period 2021–2024.

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http://eelet.org.uk

Regression equation:

$$FII=58.03+0.0008\cdot UPI-0.0271\cdot AEPS+0.0016\cdot Wallet$$

The regression output indicates the following directional associations:

- **UPI**: Exhibits a **positive coefficient**, suggesting that increased UPI usage is associated with improvements in the Financial Inclusion Index (FII). This aligns with its widespread adoption, real-time functionality, and deep integration into India's digital economy.
- **AEPS**: Shows a **negative coefficient**, implying an inverse relationship with FII. This may reflect usage saturation or its limited functionality as a largely withdrawal-centric platform in rural contexts.
- **Wallets**: Present a **positive marginal effect**, indicating that higher wallet usage is directionally associated with increased financial inclusion. This likely reflects the growing preference for app-based, autonomous platforms among younger and semi-urban populations.

Given the limited number of annual observations (n = 4), the regression model is not statistically significant and must be interpreted with caution. Nonetheless, the directional patterns are consistent with the descriptive and thematic findings discussed earlier. The results reinforce the argument that digitally native, app-driven payment platforms contribute more meaningfully to financial inclusion outcomes than infrastructure-dependent or assisted service models.

The coefficient values, interpretation, and diagnostics from the regression model are presented in Table 6 below

Table 6: Multiple Linear Regression Results: Digital Payment Variables and Financial Inclusion Index (2021–2024)

Dependent Variable: Financial Inclusion Index (FII)

Variable	Coefficient (β)	Standard Error	p-value	Interpretation
Intercept	58.03	∞	NaN	Base FII level without digital transactions
UPI Volume	0.0008	∞	NaN	Positive impact; higher UPI adoption increases FII
AEPS Volume	–0.0271	∞	NaN	Negative sign; suggests saturation of AEPS
Wallet Volume	0.0016	∞	NaN	Strong marginal influence; app-driven adoption has high impact
R^2	1.000	—	—	Perfect fit (overfitted due to n = 4)
Observations	4	—	—	Annual data from 2021–2024

(Source: Author's calculation based on NPCI and RBI data)

Note: *Due to the small number of annual data points (n = 4), standard errors and p-values are undefined. The results are interpreted directionally and support descriptive insights.*

The regression model yields an R^2 value of 1.000, indicating an exact fit to the dataset. However, this result stems from a statistical artifact rather than true model strength. With the number of explanatory variables equal to the number of annual observations (n = 4), the model has zero

degrees of freedom, leading to infinite standard errors and undefined p-values. As such, the coefficients should be interpreted as exploratory and directional rather than statistically conclusive.

Nevertheless, the estimated relationships offer useful preliminary insights. The positive coefficients for UPI and mobile wallet volumes suggest a favourable association with improvements in the Financial Inclusion Index, whereas the slightly negative coefficient for AEPS reflects potential saturation. These directional patterns will be further substantiated in the subsequent visual analysis section, which illustrates the correlation and linear trends between platform-specific transaction volumes and the FII.

5.8 Correlation and Visual Analysis

To support the regression results, a Pearson correlation matrix was generated (Figure 6). The findings reveal a very strong positive correlation between UPI transactions and the Financial Inclusion Index (FII), underscoring UPI's pivotal role in promoting digital financial access. Mobile wallet usage also demonstrates a strong positive correlation with FII, reflecting growing adoption among youth and informal workers. In contrast, AEPS transactions exhibit a moderate negative correlation, possibly indicating saturation in biometric-based systems or a shift toward more user-friendly digital platforms. These results reinforce the significance of app-based innovations in driving financial inclusion post-COVID.

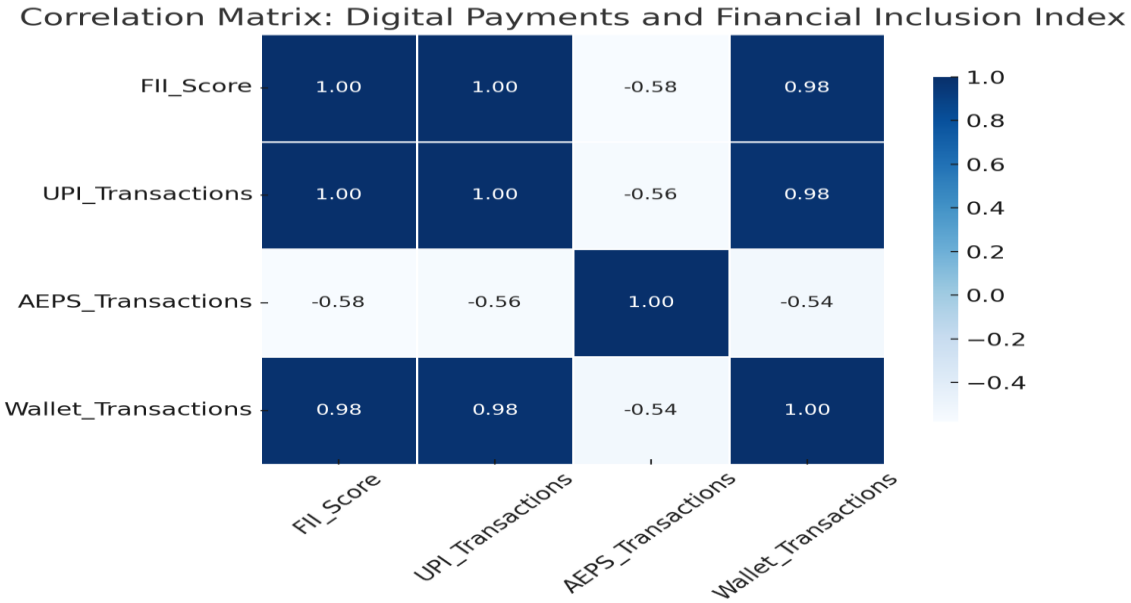

Figure 6: Correlation Matrix among UPI, Wallet, AEPS Transactions and Financial Inclusion Index (2021–2024)

Further, Figure 7 presents scatter plots with linear trendlines depicting the relationship between each digital payment mode and the Financial Inclusion Index (FII). The UPI-FII plot reveals a steep upward slope, indicating a robust positive association between increased UPI usage and higher levels of financial inclusion. Mobile wallet transactions show a moderate upward trend, suggesting a supportive, though less pronounced, contribution to inclusion. In contrast, the AEPS-FII plot is nearly flat, reflecting a weak or negligible linear relationship. These visual patterns visually

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corroborate the regression and correlation results, emphasizing UPI's central role in India's post-COVID digital financial ecosystem.

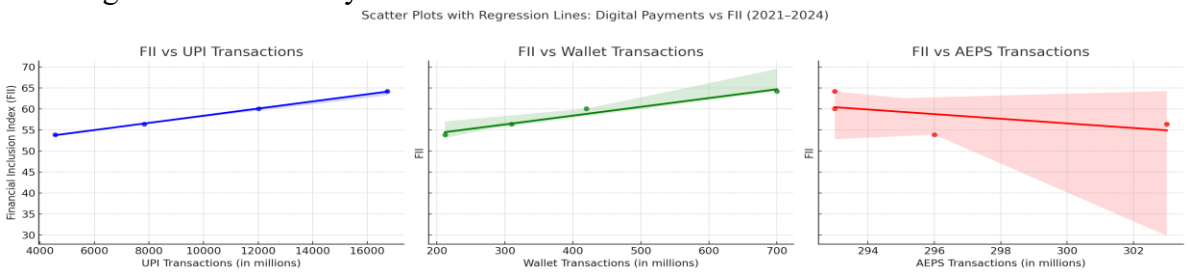

Figure 7: Scatter Plots with Trendlines: UPI, Wallet, and AEPS Transactions vs. Financial Inclusion Index

6. Conclusion and Policy Implications

The post-COVID surge in digital payments has structurally reshaped India's financial inclusion landscape. This study establishes that digital platforms such as UPI and mobile wallets exhibit a strong positive association with financial inclusion outcomes, whereas infrastructure-heavy and assisted models like AEPS are approaching a saturation point. However, despite these advancements, the benefits of digitalization remain unevenly distributed across socio-economic and geographic segments. Rural populations, women, elderly individuals, and low-income groups continue to face persistent barriers, including limited access, low digital confidence, inadequate literacy, and affordability constraints.

The evidence highlights the need to move beyond infrastructure deployment and toward fostering meaningful and equitable usage. While digital access is foundational, it is not sufficient for inclusive financial empowerment. The regression results specifically show that UPI and mobile wallets are positively associated with improvements in the Financial Inclusion Index (FII), indicating their growing role in promoting digital engagement and access. In contrast, AEPS exhibits a negative coefficient, suggesting its effectiveness may be declining—possibly due to usage saturation or its limited transactional scope. These insights align with the descriptive trends observed and reinforce the need to prioritize scalable, app-based systems for inclusive financial development.

From a policy perspective, several strategic imperatives emerge:

- **Promote Inclusive Digital and Financial Literacy**: Implement regionally tailored education campaigns targeting digitally marginalized populations, particularly in rural and semi-urban areas.
- **Enhance Trust and Consumer Protection**: Strengthen cybersecurity awareness, fraud mitigation systems, and responsive grievance redress mechanisms to build sustained trust in digital platforms.
- **Facilitate Affordable and Equitable Access**: Introduce policies that subsidise smartphones, expand UPI123Pay and other voice-enabled services, and support last-mile connectivity in low-bandwidth zones.
- **Integrate Digital Finance into Welfare Delivery**: Embed digital payment interfaces into government schemes (e.g., credit, insurance, pensions) to promote habitual usage and increase financial empowerment.

- **Enable Data-Driven Policymaking**: Ensure regular publication of disaggregated financial inclusion data (by gender, region, and platform) to support evidence-based, targeted interventions.
- **Foster Scalable and Inclusive Fintech Innovation**: Encourage responsible experimentation through regulatory sandboxes and public–private partnerships to ensure inclusive, secure, and future-ready digital finance ecosystems.

India now stands at a pivotal juncture. The goal must evolve from digitization for its own sake to the democratization of digital financial participation. A truly inclusive digital economy will require not only technological progress but also socially responsive policy frameworks—ensuring that digital transformation becomes a sustainable and equitable driver of national development.

Conflict of Interest Statement: The authors declare no conflicts of interest related to this study.

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