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Digital Financial Inclusion through UPI and Telecom Infrastructure: Opportunities, Challenges and Road Ahead

Dr. Shishir Srivastava[1], Mr. Krishna Kumar Kanoujiya[2]

[1] Assistant Professor, Department of Commerce, Rajkiya Mahila Mahavidyalay, Sitapur Uttar Pradesh, India,
[2]Assistant Professor, Department of Commerce, Maharana Pratap Govt. P.G. College, Hardoi UP, India
[2]Email: *asstprofkrishnakkgdc@gmail.com*

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Abstract

Financial inclusion has long been recognised as a cornerstone of equitable development, yet its realisation at scale remained elusive in India until the convergence of two transformative forces — the Unified Payments Interface (UPI) and the rapid expansion of affordable telecom infrastructure. The proliferation of low-cost mobile internet, catalysed by the telecom disruption of 2016, fundamentally altered the financial access landscape, bringing hundreds of millions of previously unbanked and underbanked citizens within reach of digital payment ecosystems. This paper examines the role of telecom infrastructure as an enabling backbone for UPI-driven financial inclusion in India, analysing the period from FY 2016–17 to FY 2024–25. Drawing upon secondary data from NPCI, RBI, TRAI, and published government reports, the study investigates the relationship between telecom penetration and UPI adoption across rural and urban geographies. The research further assesses the governance framework underpinning Digital Public Infrastructure, identifying systemic gaps in last-mile connectivity, digital literacy, and cybersecurity that constrain inclusive outcomes. The findings underscore that sustainable digital financial inclusion demands an integrated policy approach that treats telecom infrastructure as critical public goods infrastructure aligned with India's SDG commitments.

Keywords: *Digital Financial Inclusion, UPI, Telecom Infrastructure, Digital Public Infrastructure, NPCI, TRAI, Last-Mile Connectivity, SDGs*

1. Introduction

The quest for universal financial inclusion has occupied the centre of India's developmental policy agenda for several decades. Despite numerous initiatives from the nationalisation of commercial banks in 1969 to the Jan Dhan Yojana of 2014 the persistence of a large unbanked population and the structural barriers of geography, literacy, and physical distance from formal financial institutions meant that progress remained uneven and incomplete. It was the conjunction of two transformative technological developments in the mid-2010s that fundamentally altered this trajectory: the launch of the Unified Payments Interface (UPI) by the National Payments Corporation of India (NPCI) in April 2016, and the commercial entry of Reliance Jio Infocomm in September 2016, which unleashed a wave of affordable mobile internet connectivity that reached into towns, villages, and districts previously untouched by digital services.

UPI, in its essential design, is a real-time payment system that enables instant interbank fund transfers through a mobile interface, operating around the clock without the friction of account numbers, branch codes, or physical presence. Its genius lay not merely in its technical architecture but in its compatibility with the feature phones and low-end smartphones that constitute the majority of devices in use across rural and semi-urban India. The dramatic reduction in mobile data prices following Jio's entry from an average of approximately Rs. 250 per GB in 2016 to less than Rs. 10 per GB by 2019 made mobile internet economically accessible to population segments for whom digital connectivity had previously been a

luxury. The synergy between these two developments produced a digital payments revolution of a scale and speed that had few precedents globally.

By March 2025, UPI had processed over 18 billion transactions in a single month, with a cumulative transaction value exceeding Rs. 24 lakh crores annually, involving over 400 million unique users (NPCI, 2025). India's mobile broadband subscriber base crossed 850 million, with rural internet users constituting nearly 45 per cent of the total; a share that would have been unimaginable a decade earlier (TRAI, 2025). These numbers speak to a structural transformation in how ordinary Indians access, transact, and engage with the formal financial system.

Yet, the picture is not without its complications. The geographical distribution of digital financial services remains uneven. Last-mile connectivity gaps persist in tribal belts, hilly terrains, and remote rural districts. Digital literacy continues to lag behind digital access, particularly among women, elderly populations, and marginal agricultural communities. Cybersecurity vulnerabilities and UPI-related fraud have emerged as growing concerns. And the governance architecture that underpins this transformation spanning the Department of Telecommunications, the Reserve Bank of India, the Ministry of Finance, and state governments has not always been as integrated or anticipatory as the scale of the challenge demands.

This paper examines these dynamics systematically. It investigates the relationship between telecom infrastructure expansion and UPI adoption, assesses the governance framework of India's Digital Public Infrastructure (DPI), identifies the structural barriers that continue to limit inclusive outcomes, and offers policy recommendations grounded in empirical evidence. The study is anchored in the period FY 2016–17 to FY 2024–25, which captures the full arc of the UPI-telecom co-evolution.

2. Review of Literature

The literature on digital financial inclusion has grown substantially over the past decade, reflecting both the scholarly interest and the policy urgency attached to the subject. Demirguc-Kunt et al. (2022), in the World Bank's Global Findex Database, documented that India achieved one of the fastest expansions in formal financial account ownership globally between 2017 and 2021, with the gender gap in account ownership narrowing significantly — a development they attributed in substantial part to mobile money adoption and government direct benefit transfers. Their analysis, however, cautioned that account ownership does not automatically translate into active usage, a distinction that bears directly on the evaluation of UPI's inclusive impact.

Chakravorti and Mazzotta (2013) had earlier argued that the true measure of financial inclusion lies not in access alone but in the frequency, diversity, and depth of financial services utilised. By this more demanding standard, India's digital inclusion remains a work in progress, even as headline transaction volumes suggest spectacular success. More recent work by Klapper et al. (2022) reinforced this point, finding that mobile payment platforms in emerging markets frequently exhibit a pattern of concentrated usage among urban, educated, and male populations, with rural and female users accounting for a disproportionately small share of transaction volume relative to their numbers.

On the telecom-finance nexus specifically, Asongu and Nwachukwu (2016) examined sub-Saharan Africa and found strong empirical support for the proposition that mobile phone penetration is a statistically significant determinant of financial inclusion, operating both directly and through its reduction of transaction costs for remote populations. While the African context differs from India's in important respects, the underlying mechanism — connectivity as the enabler of financial access — is broadly applicable. In the Indian context, Agarwal and Ghosh (2020) found a significant positive correlation between telecom tower density at the district level and the uptake of digital payments under the Pradhan Mantri Jan Dhan Yojana (PMJDY), providing direct empirical support for the telecom-inclusion linkage.

The governance dimensions of Digital Public Infrastructure have received increasing scholarly attention following the G20's endorsement of India's DPI framework during its 2023 Presidency. Basu and Bhatt (2023) argued that India's stack-based approach — combining Aadhaar-based identity, Jan Dhan bank accounts, and mobile connectivity into a JAM Trinity — represents a novel governance model for inclusive digitalisation, but noted that its success is contingent on last-mile infrastructure reaching the most marginalised communities. Singh and Rao (2021) highlighted the regulatory

fragmentation between telecom and financial services regulators as a structural impediment to seamless digital financial inclusion, calling for more integrated oversight mechanisms.

The extant literature, while rich in identifying the broad contours of the UPI-telecom relationship, leaves several gaps. There is limited longitudinal analysis that tracks the co-evolution of telecom penetration and UPI adoption across geographical tiers over the full post-Jio period. The governance architecture of India's DPI has not been comprehensively assessed in terms of its alignment with SDG targets, particularly SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities). The present paper seeks to contribute to filling these gaps.

3. Research Gap

A careful reading of the existing literature reveals several notable lacunae that this paper seeks to address. These gaps are not merely technical omissions but reflect broader blind spots in how the UPI-telecom-inclusion relationship has been conceptualised and studied.

3.1. Absence of Longitudinal, Post-Jio Analysis

Much of the published research on UPI adoption and telecom penetration predates or only partially covers the post-2016 period — arguably the most consequential phase of India's digital transformation. Studies that do touch on this period often focus on isolated years or aggregate national data, without tracking the co-evolution of telecom and UPI metrics across the full nine-year arc from FY 2016–17 to FY 2024–25.

3.2. Limited Spatial and Demographic Disaggregation

Existing research tends to report headline figures without adequately disaggregating outcomes across rural-urban divides, gender lines, or geographic tiers. While some district-level studies exist, comprehensive tier-wise analysis mapping where inclusion is deepening and where it remains shallow is conspicuously absent from the literature.

3.3. Underexplored Governance Dimensions

The governance architecture of India's DPI has received growing attention following the G20 endorsement in 2023, but comprehensive assessments of how regulatory fragmentation between DoT, RBI, and MeitY affects ground-level inclusion outcomes remain thin. Most governance analyses stay at the level of institutional description rather than examining the operational consequences of coordination failures for marginalised users.

3.4. Integrated Policy Framework Deficit

The literature has tended to treat telecom policy and financial inclusion policy as parallel tracks rather than interdependent systems. A synthesised, cross-domain policy framework that treats telecom infrastructure as foundational public goods infrastructure for financial inclusion — and draws that out in terms of concrete institutional design — is largely absent from the existing body of work.

4. Research Objectives

This study set out to develop a grounded understanding of how India's rapid expansion of telecom infrastructure has shaped the trajectory of digital financial inclusion, particularly through the lens of the Unified Payments Interface (UPI). Rather than treating UPI as an isolated fintech success story, the paper approaches it as part of a broader socio-technical ecosystem where connectivity, governance, and economic access are deeply intertwined. The specific objectives guiding the research are as follows:

1. To examine the longitudinal relationship between mobile broadband penetration and UPI adoption across India from FY 2017-18 to FY 2024-25.
2. To evaluate the extent to which UPI-led digital payments have deepened financial inclusion among previously unbanked and underbanked populations, with particular attention to rural geographies, women, and economically marginal communities.
3. To assess the governance framework of India's Digital Public Infrastructure (DPI), identifying structural coordination gaps and regulatory fragmentation that limit inclusive outcomes across the telecom-finance interface.
4. To identify and analyse the structural barriers; including last-mile connectivity deficits, digital literacy gaps, device and language constraints, and cybersecurity vulnerabilities that continue to constrain equitable digital financial access.

5. Research Hypotheses

Based on the objectives and the gaps identified in the existing literature, the study operates with the following four testable propositions. These hypotheses reflect both the empirical and governance dimensions of the research and are evaluated against secondary data and qualitative evidence in the analysis section that follows.

H_1	*There exists a strong positive relationship between the expansion of mobile broadband infrastructure and the growth of UPI transaction volumes across the study period (FY 2016–17 to FY 2024–25).*
H_2	*Despite significant aggregate growth, UPI adoption remains skewed towards urban, male, and economically better-off populations, with rural and female users accounting for a disproportionately small share of active UPI usage relative to their demographic weight.*
H_3	*Regulatory fragmentation across India's DPI governance architecture; specifically the absence of coordinated oversight between DoT, RBI, and MeitY — constitutes a structural impediment to achieving equitable digital financial inclusion outcomes.*
H_4	*Last-mile connectivity gaps, digital literacy deficits, and cybersecurity vulnerabilities together form a reinforcing cluster of structural barriers that disproportionately affect the most marginalised user groups and limit the depth of digital financial inclusion beyond headline metrics.*

6. Research Methodology

The study adopts a descriptive-analytical research design, relying exclusively on secondary data sourced from authoritative national and international repositories. The choice of secondary data is appropriate given that the research questions concern macroeconomic and sector-level trends over an extended period, for which primary data collection would be neither feasible nor methodologically superior to systematic compilation of documented records.

6.1 Data Sources

The principal data sources are: NPCI monthly UPI transaction reports (2016–17 to 2024–25); TRAI Telecom Subscription Data and Performance Indicator Reports (2016–17 to 2024–25); Reserve Bank of India Annual Reports and Payment System Indicators; Ministry of Electronics and Information Technology (MeitY) Digital India progress reports; World Bank Global Findex Database (2017 and 2021 editions); and Government of India Economic Survey editions for the relevant years. These are supplemented by peer-reviewed academic literature and reports from GSMA Intelligence, the International Monetary Fund (IMF), and the G20 Digital Economy Working Group.

6.2 Variables

The study examines the following primary variables: UPI transaction volume and value (monthly and annual); mobile broadband subscriber base (total and rural-urban split) from FY 2017-18 to FY 2024-25.

6.3 Analytical Approach

Trend analysis is applied to trace the co-movement of telecom penetration and UPI adoption over the study period. Descriptive statistics characterise the distribution of key variables. A qualitative governance analysis examines the policy and

regulatory framework of India's DPI ecosystem, using content analysis of official documents and committee reports. Regional and tier-wise disaggregation is used to identify spatial patterns of inclusion and exclusion.

7. Results and Discussion

7.1 Telecom Infrastructure Expansion: A Decade of Transformation

The transformation of India's telecom landscape between 2017 and 2025 is, by any measure, one of the most dramatic infrastructure stories of the twenty-first century. At the time of Jio's commercial launch in September 2016, India had approximately 330 million mobile internet subscribers, with average data consumption of around 1 GB per user per month and average data prices among the highest in the world. By March 2025, India had over 850 million mobile broadband subscribers, average monthly data consumption had risen to approximately 20 GB per user, and data prices had fallen to among the lowest globally; under Rs. 10 per GB on most plans (TRAI, 2025).

This transformation was not merely quantitative but qualitative. The widespread adoption of smartphones driven by prices falling below Rs. 5,000 for entry-level 4G handsets; meant that mobile internet became the primary means of digital access for a large proportion of India's population. Rural internet subscriber growth outpaced urban growth in proportional terms from FY 2020–21 onwards, indicating a genuine geographical diffusion of connectivity that went beyond metro and tier-1 city markets.

Table 1: Growth of Mobile Broadband Subscribers and UPI Transactions in India (FY 2017–18 to FY 2024–25)

Financial Year	Mobile Broadband Subscribers (Mn)	Rural Internet Share (%)	UPI Transactions (Mn)	UPI Value (Rs. Lakh Cr.)
FY 2017-18	394	22%	920	1.10
FY 2018-19	643	28%	5,350	8.77
FY 2019-20	668	33%	12,520	21.32
FY 2020-21	755	37%	22,330	41.04
FY 2021-22	760	40%	46,030	84.17
FY 2022-23	762	42%	83,750	139.20
FY 2023-24	820	43%	1,31,000	199.89
FY 2024-25	898	44%	1,85,000	240.00

Source: TRAI Performance Indicator Reports; NPCI UPI Transaction Data.

Table 1 illustrates the near-simultaneous and mutually reinforcing growth of mobile broadband penetration and UPI adoption. The near-zero UPI volumes of FY 2017-18 gave way to exponential growth as smartphone penetration deepened, merchant onboarding accelerated, and consumer trust in digital payments increased. The correlation between mobile broadband subscriber growth and UPI transaction volumes is visually and statistically pronounced, underscoring the telecom infrastructure's role as the foundational enabler of digital financial inclusion.

7.2 Statistical Analysis: Correlation Results

To formally test the hypothesised relationships, the study applies Pearson’s correlation analysis and year-on-year growth rate comparison.

Table 2: Summary of Statistical Tests — Mobile Broadband Subscribers vs UPI Metrics

Test / Statistic	MBB vs UPI Volume	MBB vs UPI Value	Rural Share vs UPI Vol	Interpretation
Pearson r	0.7645	0.7905	0.7967	Strong positive correlation
p-value (Pearson)	0.0272*	0.0195*	0.0179*	Statistically significant ($p<0.05$)

Source: Computed by authors using M.S. Excel.

*Note: *p < 0.05*

7.2.1. Pearson Correlation

The Pearson correlation between MBB subscribers and UPI transaction volume is r = 0.7645 (p = 0.027), indicating a strong and statistically significant positive linear relationship. For UPI value, r = 0.7905 (p = 0.020) - marginally stronger, suggesting that as connectivity deepens, users engage in progressively higher-value transactions, not merely higher-frequency ones. Rural internet share shows an equally strong correlation with UPI volume (r = 0.797, p = 0.018), confirming that geographic diffusion of connectivity not merely aggregate subscriber growth is driving inclusive payment adoption.

7.2.2. Year-on-Year Growth Rate Analysis

Table 3: Year-on-Year Growth Rates - Mobile Broadband Subscribers vs UPI Transaction Volume

Financial Year	MBB Growth (%)	UPI Volume Growth (%)	Interpretation
2018–19	+63.2%	+481.5%	Jio effect: mass subscriber onboarding drives UPI surge
2019–20	+3.9%	+134.0%	Maturation — quality & affordability deepen usage
2020–21	+13.0%	+78.4%	COVID-19 accelerates contactless payment adoption
2021–22	+0.7%	+106.1%	Merchant onboarding boom; UPI decouples from MBB growth
2022–23	+0.3%	+81.9%	UPI ecosystem matures; growth self-sustaining
2023–24	+7.6%	+56.4%	Subscriber base broadens; rural uptake consolidates
2024–25	+9.5%	+41.2%	Incremental expansion; deepening rural penetration

Source: Computed from TRAI and NPCI data by authors using M.S. Excel.

Table 3 reveals the most analytically interesting dimension of the telecom-UPI relationship. In FY 2018–19, a 63 per cent surge in MBB subscribers driven by Jio's mass-market penetration triggered a staggering 482 per cent increase in UPI transactions. This disproportionate amplification is the hallmark of network effect dynamics: the Jio disruption did not merely add users; it crossed a tipping point that made UPI viable at scale for ordinary commerce. In subsequent years, MBB growth slowed dramatically to under 1 per cent in FY 2021-22 and FY 2022–23; while UPI volumes continued to grow at

80-106 per cent annually. This 'decoupling' phase reflects UPI's graduation from infrastructure-dependence to ecosystem self-sufficiency: once users and merchants are onboarded, usage deepens through habit, feature expansion, and network spillovers even without proportional connectivity growth. By FY 2024-25, both series are on more comparable growth trajectories, suggesting a maturing market where incremental subscriber gains translate into incremental transaction gains rather than exponential amplification.

7.2. UPI and Financial Inclusion: Progress and Patterns

The expansion of UPI has produced measurable gains in financial inclusion across multiple dimensions. The number of active PMJDY account holders crossed 530 million by March 2025, with over 67 per cent of accounts showing transactions in the preceding three months a significant improvement from the dormancy rates that characterised early Jan Dhan accounts (Ministry of Finance, 2025). Direct Benefit Transfer (DBT) disbursements, routed through the JAM Trinity infrastructure, reached over Rs. 7 lakh crores in FY 2024-25, indicating that digital financial infrastructure is now a substantive channel for welfare delivery, not merely a payment convenience.

However, disaggregated data reveal important patterns of uneven inclusion. Urban residents account for approximately 62 per cent of UPI transaction volume, despite constituting only 35 per cent of India's population. Women users, while growing, continue to account for a disproportionately small share of high-value UPI transactions. Among rural users, UPI adoption is concentrated in peri-urban villages and district headquarters, with remote and tribal hamlets still largely outside the active digital payment's ecosystem. This spatial and demographic unevenness points to structural barriers that connectivity expansion alone has not dissolved.

7.3. Governance Architecture of India's Digital Public Infrastructure

India's DPI framework often described through the metaphor of a technology stack rests on three foundational layers: identity (Aadhaar), bank accounts (PMJDY), and mobile connectivity (broadly enabled by telecom liberalisation). Above these foundational layers sit application-level services including UPI, the Aadhaar-enabled Payment System (AePS), and the Open Credit Enablement Network (OCEN). This architecture, endorsed by the G20 under India's 2023 Presidency as a model for developing nations, represents a genuinely innovative approach to state-facilitated financial inclusion (Ministry of Finance, Government of India, 2023).

The governance of this stack, however, is distributed across multiple regulators and ministries whose mandates do not always align seamlessly. The Department of Telecommunications (DoT) and TRAI govern the telecom layer; the RBI governs the payment systems layer; MeitY oversees digital identity and data infrastructure; and state governments are responsible for last-mile service delivery. The absence of a unified DPI governance authority has, in practice, led to coordination gaps particularly visible in the delayed rollout of mobile connectivity to underserved areas, the incomplete integration of offline payment solutions for low-connectivity zones, and the uneven implementation of cybersecurity standards across payment service providers.

The National Cyber Security Policy and the RBI's guidelines on digital payment fraud have partially addressed the security dimension, but the incidence of UPI-related fraud which crossed Rs. 1,087 crores in FY 2023-24 according to RBI data remains a concern that disproportionately affects less digitally literate users, eroding trust precisely among the populations whose inclusion is most needed (RBI, 2024).

7.4. Structural Barriers to Inclusive Digital Finance

Despite the impressive headline numbers, four structural barriers continue to constrain the depth and equity of digital financial inclusion in India:

- Last-Mile Connectivity Gaps: While India's aggregate telecom coverage has improved dramatically, approximately 25,000 villages remain without 4G connectivity as of 2024, concentrated in the North-East, hilly states, and tribal districts (DoT, 2024). BharatNet, the government's flagship rural broadband programme, has faced implementation delays and quality shortfalls that have limited its impact on genuinely remote communities.
- Digital Literacy Deficit: The Internet and Mobile Association of India (IAMAI) estimates that while internet access has expanded rapidly, active and purposive digital usage — including the ability to safely conduct financial

transactions, recognise phishing attempts, and use digital grievance redress mechanisms — remains limited among first-generation internet users, particularly rural women and elderly populations.

- Device and Language Barriers: A significant proportion of rural internet users access the web on shared devices, limiting the personal and habitual use of digital payment applications. The predominance of English-language interfaces on financial applications, despite regulatory nudges for vernacular support, continues to create friction for non-English-speaking users.
- Regulatory Fragmentation: The multi-regulator governance structure of India's DPI creates coordination inefficiencies. Gaps in data portability, interoperability standards, and cross-platform fraud reporting have slowed the maturation of the digital financial ecosystem, particularly for rural and informal sector users.

8. Analysis of Hypotheses

The following section evaluates each hypothesis against the empirical evidence and governance findings presented in the study. The analysis draws on secondary data from NPCI, TRAI, RBI, and government reports, interpreted through the analytical framework described in the methodology.

8.1. H1: Telecom Expansion and UPI Growth

The data presented in Table 1 provide compelling support for H1. Mobile broadband subscribers grew from approximately 394 million in FY 2017–18 to 898 million in FY 2024–25 — a more than twofold increase. Over the same period, UPI transaction volumes grew from 920 million to 185 billion transactions, an increase of two orders of magnitude. The temporal correlation between subscriber growth and UPI uptake is directionally consistent across every year of the study period.

What is particularly telling is the pattern of acceleration: the steepest growth in both telecom penetration and UPI volumes occurs in the FY 2019–20 to FY 2022–23 window, precisely when rural internet subscriber growth began outpacing urban growth in proportional terms. As affordable mobile internet reached second and third-tier geographies, UPI usage expanded beyond its early urban-educated user base. The fall in mobile data prices — from approximately Rs. 250 per GB in 2016 to under Rs. 10 per GB by 2019 — is a critical intervening variable: it was the affordability shift, not simply subscriber numbers, that enabled lower-income, rural populations to sustain active mobile internet usage and, by extension, access UPI. H1 is therefore supported, with the relationship best understood as one mediated by affordability.

8.2. H2: Uneven Adoption Across Demographics

H2 receives strong empirical support from the disaggregated data examined in the study. Despite 400 million unique UPI users as of March 2025, urban residents account for approximately 62 per cent of UPI transaction volume while constituting only 35 per cent of India's population. This urban concentration is even more pronounced in high-value transactions. The gender dimension is similarly supported: the broader literature consistently finds that women's share of mobile payment transactions in emerging markets is significantly below their population share, and India is not an exception to this pattern.

The analysis adds an important spatial nuance to H2: rural UPI adoption is not uniformly low — peri-urban villages and district headquarters have seen meaningful uptake, while remote and tribal areas remain largely outside the active digital payments ecosystem. This geographic layering within the rural category is a refinement that headline rural-urban binary comparisons tend to obscure. H2 is therefore supported, with the qualification that unevenness reflects a complex spatial hierarchy of digital financial access rather than a simple urban-rural binary.

8.3. H3: Governance Fragmentation as Structural Barrier

H3 is supported by the governance analysis, though the evidence is largely qualitative in nature given the inherent difficulty of quantifying coordination failures. The study documents several concrete manifestations of regulatory fragmentation: BharatNet's implementation delays and quality shortfalls, attributed in part to insufficient coordination between DoT's infrastructure mandate and MeitY's digital service delivery responsibilities; the absence of a unified cybersecurity certification standard for UPI service providers; and the incomplete integration of offline payment solutions for low-connectivity zones.

The UPI fraud figure of Rs. 1,087 crores in FY 2023–24 is a particularly telling indicator — growing at a pace that reflects uneven security implementation across payment service providers, a direct consequence of the absence of mandatory, standardised cybersecurity requirements that a unified governance authority might have enforced. That these losses disproportionately affect less digitally literate users compounds the equity concern: the populations most in need of inclusion are bearing the largest trust costs of governance fragmentation. H3 is therefore well-supported, and the policy recommendation for a statutory DPI Governance Board flows directly from this finding.

8.4. H4: Reinforcing Cluster of Structural Barriers

H4 is the most conceptually ambitious of the four hypotheses, and it is supported most directly by the pattern of findings across the other three. The study identifies four structural barriers: last-mile connectivity gaps affecting approximately 25,000 villages; digital literacy deficits that limit purposive and safe usage even among users with internet access; device and language constraints; and regulatory fragmentation that slows grievance redress and erodes trust.

What the analysis reveals is that these barriers do not operate independently. A rural woman with internet access but limited digital literacy is effectively excluded from the active UPI ecosystem even if connectivity infrastructure reaches her. If she does attempt digital payments and encounters fraud with no accessible redress mechanism — a plausible scenario given the governance gaps documented under H3 — the experience reinforces avoidance rather than adoption. This compounding dynamic is precisely what H4 anticipates: the barriers form a mutually reinforcing cluster, not a simple additive list. The policy implication is that interventions targeting any single barrier in isolation will yield less inclusive impact than integrated approaches addressing the cluster simultaneously. H4 is therefore supported, and it provides the synthetic analytical lens through which the study's policy recommendations are best understood.

9. Policy Recommendations

On the basis of the analysis presented, the following evidence-based policy recommendations are offered:

9.1. Establish an Integrated DPI Governance Authority

India should consider establishing a statutory Digital Public Infrastructure Governance Board with cross-ministerial representation from DoT, RBI, MeitY, and the Ministry of Finance, alongside independent technical and civil society members. Such a body would be charged with setting interoperability standards, coordinating last-mile connectivity programmes with financial service delivery, and maintaining a unified DPI roadmap aligned with SDG commitments. The current fragmented oversight model is inadequate for the scale and complexity of the infrastructure being governed.

9.2. Accelerate Targeted Connectivity for Underserved Geographies

BharatNet must be revitalised with time-bound performance targets and independent quality audits. Satellite-based broadband options — including low-earth orbit (LEO) satellite services — should be actively licensed and deployed for the approximately 25,000 villages that remain outside terrestrial 4G coverage. The recently announced revisions to India's satellite communication policy represent a step in the right direction, but implementation pace needs to be significantly faster if the last-mile gap is to be closed within the Viksit Bharat 2047 timeline.

9.3. Invest in Digital and Financial Literacy at Scale

The existing Digital Saksharta Abhiyan and PM-WANI programmes need to be substantially scaled and redesigned to incorporate financial literacy components specifically oriented toward safe digital payments, fraud recognition, and grievance redress. These programmes should be delivered in regional languages and calibrated to the literacy and numeracy levels of target populations, with particular focus on rural women — who represent both the most underserved demographic and the demographic with the highest potential multiplier effect on household financial inclusion.

9.4. Strengthen Cybersecurity Infrastructure for Digital Payments

The RBI and NPCI should develop a mandatory, standardised cyber hygiene certification for all UPI payment service providers, with graduated requirements based on transaction volumes. A dedicated UPI Fraud Redressal Mechanism with guaranteed resolution timelines should be established, modelled on successful precedents in other jurisdictions. Consumer insurance schemes for small-value digital transaction losses should be explored as a policy tool to rebuild trust among first-time digital payment users who have experienced fraud.

9.5. Align Telecom and Financial Inclusion Targets with SDG Monitoring

India's Voluntary National Review (VNR) submissions to the United Nations High-Level Political Forum should incorporate disaggregated digital financial inclusion metrics — rural-urban gaps, gender gaps, and district-level UPI adoption data — as explicit SDG 1, SDG 8, and SDG 10 indicators. This would not only strengthen accountability but also help attract international development finance for last-mile DPI investment.

10. Conclusion

India's digital financial inclusion story is genuinely inspiring in its breadth and speed. The conjunction of UPI and affordable telecom connectivity has created a payments ecosystem that handles transaction volumes rivalling the largest financial markets in the world, while simultaneously serving street vendors, small farmers, and daily wage workers in ways that formal banking could never reach. This is a governance achievement of considerable significance, and it carries important lessons for developing nations navigating their own paths to digital inclusion.

Yet the data also tell a story of unfinished business. Geographic and demographic disparities in UPI adoption, persistent last-mile connectivity gaps, digital literacy deficits, governance fragmentation, and cybersecurity vulnerabilities all represent structural barriers that must be addressed if the promise of universal digital financial inclusion is to be fulfilled rather than merely approximated. The transition from impressive headline numbers to genuinely inclusive outcomes require a second generation of policy interventions that are more targeted, more integrated, and more explicitly aligned with the developmental goals that motivated the DPI project in the first place.

As India moves towards its Viksit Bharat 2047 vision which places digital infrastructure and inclusive prosperity at its centre the imperative is clear: telecom infrastructure must be treated not as a commercial sector alone but as critical public goods infrastructure whose universal provision is a non-negotiable developmental obligation. When that framing takes hold in governance practice as firmly as it has in policy rhetoric, the full transformative potential of UPI and digital financial inclusion will finally be within reach for every Indian, regardless of where they live, what language they speak, or how far they are from the nearest city.

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