

The Future of UPI and Digital Payments: Challenges and Opportunities in India

Mehfuza Sultana

(Research Scholar)

Faculty of Commerce and Management

Pacific Academy of Higher Education and Research University, Udaipur, India.

Abstract

The Unified Payments Interface (UPI) has emerged as the cornerstone of India's digital payment ecosystem, transforming the country from a predominantly cash-based economy into a global leader in real-time retail transactions. This paper presents a literature review of the growth, opportunities and challenges associated with UPI and the broader digital payments landscape in India. Drawing on the Technology Acceptance Model, the Diffusion of Innovation framework and financial inclusion theory, the review synthesises findings from recent academic studies, industry reports and government publications. The literature indicates that UPI has substantially advanced financial inclusion, reduced transaction costs and enhanced transparency in the Indian economy, while also facilitating India's emergence as a reference model for real-time payment systems globally. At the same time, the review identifies persistent challenges, including rising cyber fraud, digital and financial literacy gaps in rural areas, infrastructural fragility evidenced by recurring platform outages, and regulatory concerns surrounding market concentration among a small number of third-party application providers. The paper further discusses emerging developments including the Unified Lending Interface (ULI), Central Bank Digital Currency (CBDC) and cross-border UPI linkages that are likely to shape the future trajectory of digital payments in India. The review concludes by identifying gaps in the literature relating to longitudinal fraud-victimisation research, rural adoption dynamics, and the regulatory architecture required to sustain UPI's growth, which together define priorities for future research.

Keywords: *UPI, digital payments, financial inclusion, fintech, cybersecurity, India*

Introduction

India's payment landscape has undergone a profound transformation over the past decade, moving from cash-dominated, branch-based transactions toward an interoperable, mobile-first digital ecosystem anchored by the Unified Payments Interface (UPI). Launched by the National Payments Corporation of India (NPCI) in April 2016, UPI enables instant, 24x7, bank-to-bank fund transfers through a single mobile application and has since become the principal driver of India's digital payments growth, accounting for the overwhelming majority of retail digital transactions in the country (Kuriakose & Sajoy, 2023).

The scale of this transformation is considerable: UPI's share of total digital transactions has grown from a negligible base at launch to a dominant position within less than a decade a trajectory that scholars have described as a genuine digital revolution in Indian retail finance.

This growth has not occurred in isolation. It has been shaped by a confluence of structural enablers the JAM trinity of Jan-Dhan bank accounts, Aadhaar digital identity and mobile connectivity alongside policy interventions such as the 2016 demonetisation, which is widely credited with catalysing the initial shift toward digital transactions (Chodorow-Reich et al., 2020).

Yet as UPI's transaction volumes have scaled into the tens of billions per month the literature has increasingly turned its attention to the risks that accompany this scale: rising incidence of cyber fraud, infrastructural outages, uneven adoption across rural and urban India and unresolved questions about the long-term regulatory architecture needed to govern an increasingly systemically important payment rail (Lonkar et al., 2024).

The purpose of this review is to synthesise this growing body of literature, organising it around three central themes the drivers of UPI's growth the opportunities it presents for India's financial system, and the challenges that must be addressed to sustain its trajectory before identifying gaps that merit further research.

Theoretical Foundations

Research on UPI and digital payments in India draws on several complementary theoretical traditions. The Technology Acceptance Model (TAM) is frequently used to explain individual adoption decisions, positing that perceived usefulness and perceived ease of use jointly determine a user's intention to adopt a new payment technology; UPI's simple, interoperable design requiring only a virtual payment address or QR code has been identified as a key factor underpinning its rapid consumer acceptance (Sahoo et al., 2024).

The Diffusion of Innovation framework has similarly been applied to explain the S-shaped adoption curve observed in UPI penetration data with early urban, tech-literate adopters followed by progressively broader uptake as network effects and merchant acceptance expanded (Kuriakose & Sajoy, 2023).

A second theoretical strand draws on financial inclusion theory which frames digital payment infrastructure as a mechanism for extending formal financial services to previously unbanked or underbanked populations. Within this framework, UPI is theorised not merely as a transaction technology but as a public digital good that lowers the cost of financial access, a perspective that underpins much of the literature examining UPI's contribution to India's broader financial inclusion agenda (Rastogi et al., 2021; Modwel & Trivedi, 2024).

A third strand, more recent and oriented toward the challenges dimension of this review, draws on routine activity theory and victimology frameworks from criminology to explain the rising incidence of digital payment fraud, arguing that the same design features that enable UPI's speed and convenience continuous availability low friction and near-instant settlement simultaneously create opportunities for socially engineered fraud (Lonkar et al., 2024).

Growth and Evolution of UPI in India

The empirical literature documents UPI's growth trajectory in considerable detail. Early studies used polynomial trendline projections on NPCI and Reserve Bank of India (RBI) data to forecast that the platform could plausibly reach one billion transactions per day, a target that appeared ambitious at the time of writing but has since been substantially validated by subsequent transaction data (Kuriakose & Sajoy, 2023).

Complementary analysis has traced UPI's contribution to India's broader digital payment growth since the platform's inception, situating it within the longer history of India's payment infrastructure development, including the earlier introduction of RTGS and IMPS (Balakrishnan, 2023).

A particularly important structural driver identified in the literature is the 2016 demonetisation of high-value currency notes, which is shown to have significantly accelerated the shift toward digital and formal financial transactions across the Indian economy, even though its effects on cash usage were found to be more complex and less uniformly persistent than initial policy narratives suggested (Chodorow-Reich et al., 2020).

Building on this foundation, subsequent literature reviews synthesising the peer-reviewed evidence published since UPI's launch confirm a consistent pattern: UPI's growth has been driven jointly by government-led digital infrastructure investment, expanding smartphone and internet penetration, and the interoperability that distinguishes UPI from earlier closed-loop mobile wallet systems (Sahoo et al., 2024).

Opportunities Presented by UPI and Digital Payments

Financial Inclusion and Economic Transparency

The most consistently reported opportunity in the literature is UPI's contribution to financial inclusion. By enabling low-cost, real-time transfers without dependence on physical banking infrastructure, UPI is found to extend formal financial services to individuals and small businesses in rural and semi-urban areas where traditional banking access has historically been limited (Rastogi et al., 2021).

Using logistic regression on primary survey data from rural Aligarh district, Haque, Azeez and Akhtar (2025) identify younger age, higher education and specific occupational categories as significant predictors of UPI adoption, while finding that caste, religion and prior Jan-Dhan account holding are not significant, suggesting that targeted financial-literacy and youth-engagement interventions are more effective levers for expanding inclusion than broad demographic targeting alone.

This expanded access is further linked to broader economic development outcomes, with studies reporting that UPI adoption is associated with improved transaction transparency, reduced reliance on informal cash-based exchange and greater integration of small and medium enterprises into the formal economy (Modwel & Trivedi, 2024).

Cost Efficiency and Merchant Adoption

UPI's zero or near-zero merchant discount rate for peer-to-merchant transactions is repeatedly identified as a key factor distinguishing it from card-based payment systems, substantially lowering the cost of digital payment acceptance for small merchants and thereby accelerating point-of-sale digitisation across both urban and semi-urban markets (Kuriakose & Sajoy, 2023). This cost advantage is theorised to be central to UPI's ability to displace cash even in low-value, high-frequency transaction contexts that earlier digital payment systems struggled to penetrate.

Global Expansion and India's Fintech Leadership

A growing strand of literature examines UPI's international expansion, noting its adoption in countries such as Bhutan, Nepal, Sri Lanka, Singapore, France and the UAE and its emergence as a reference model that other developing economies are studying as they design their own instant-payment infrastructures (Balakrishnan, 2023). This international dimension positions UPI not merely as a domestic payment rail but as an instrument of India's broader digital public infrastructure diplomacy, with scholars noting parallels between UPI and other national real-time payment systems such as Brazil's Pix.

Emerging Innovations: ULI and CBDC

The literature increasingly frames UPI's future within a wider ecosystem of complementary digital financial infrastructure. The Unified Lending Interface (ULI), designed to extend UPI's interoperability principles to credit delivery is identified as having the potential to facilitate access to formal credit even in areas with limited internet connectivity, while the Reserve Bank of India's Central Bank Digital Currency (CBDC) or digital rupee, is discussed as a further evolution that could redefine the technological and regulatory foundations of India's currency system (Prajapati & Kumar, 2025).

Industry analysis of the RBI's phased retail and wholesale CBDC pilots, launched in late 2022, similarly frames the digital rupee as a complementary rather than competing instrument to UPI with potential integration between the two systems expected to enhance offline accessibility and cross-border remittance efficiency (India Brand Equity Foundation, 2025).

Together, these developments suggest that UPI is best understood not as a terminal technology but as the foundation for a continuously evolving digital financial stack.

Challenges Facing UPI and Digital Payments in India

Cybersecurity Risks and Rising Fraud

The most extensively documented challenge in the recent literature is the escalation of cyber fraud associated with UPI's growing transaction volumes. Empirical security analyses have identified specific architectural vulnerabilities in UPI applications, including weaknesses in early authentication protocols that were subsequently addressed in later protocol versions (Kumar et al., 2020).

More recent survey-based research measuring consumer preparedness against digital payment fraud finds that awareness, protective behaviour and responsiveness to fraud vary considerably across the Indian consumer base and proposes a structured framework for assessing and improving consumer resilience to fraud (Lonkar et al., 2024).

This growing fraud burden is not merely a technical problem: because UPI's design prioritises speed and low-friction transactions, the same features that drive adoption also reduce the window for fraud detection and reversal a tension that the literature identifies as a fundamental design trade-off rather than an incidental flaw.

Digital and Financial Literacy Gaps

A second recurring theme concerns uneven digital literacy, particularly among rural, elderly and first-time digital users. Studies applying financial inclusion theory to UPI adoption note that while access to UPI-enabled smartphones has expanded rapidly, actual usage competence and awareness of security practices lag behind access, leaving certain user segments disproportionately vulnerable to both non-adoption and paradoxically, fraud victimisation once they do adopt the technology (Modwel & Trivedi, 2024).

Comparing rural and urban adoption directly, Malik, Gargi, Gahlyan, and Singh (2025) identify a triad of barriers moderating rural UPI adoption persistent digital and financial illiteracy, inadequate last-mile internet and power infrastructure, and a deep-seated trust deficit in digital transaction systems and argue that a uniform, one-size-fits-all policy approach is insufficient to close this gap, calling instead for context-sensitive interventions including vernacular-language grievance redressal systems. This literacy gap is identified as a key constraint on UPI's ability to deliver on its financial inclusion potential in the country's most underserved regions.

Infrastructural Fragility and Platform Outages

As UPI has scaled to become systemically important within India's payment ecosystem, recurring technical outages have drawn scholarly and regulatory attention. Analyses of these disruptions highlight the risks associated with the concentration of transaction volumes on a small number of infrastructure providers and argue that greater redundancy, fallback mechanisms and technological diversification are necessary to preserve the reliability that underpins consumer and merchant trust in the platform (Kuriakose & Sajoy, 2023). The economic costs of such outages, though typically short-lived, are found to fall disproportionately on small retailers and vendors who lack alternative point-of-sale payment options.

Regulatory and Market Concentration Concerns

Finally, the literature raises concerns about market concentration among third-party UPI application providers, with a small number of applications accounting for the large majority of transaction volume.

This concentration is theorised to create systemic risk since a technical failure at a dominant provider could disrupt a disproportionate share of national transaction volume and has prompted regulatory discussion of measures to cap individual providers' market share and encourage a more diversified ecosystem of payment applications (Prajapati & Kumar, 2025).

Alongside this, the literature notes unresolved questions about data governance, cross-border regulatory harmonisation as UPI expands internationally and the evolving liability framework for fraud losses between banks, payment applications, and consumers.

Discussion: Toward the Future of UPI

Synthesising the reviewed literature, UPI's trajectory can be understood as a case of rapid, infrastructure-led financial digitisation whose benefits financial inclusion, transaction cost reduction, and global fintech leadership have consistently outpaced the maturation of the safeguards required to manage its risks. The opportunities identified in the literature (Sections 4.1-4.4) and the challenges documented (Sections 5.1-5.4) are not independent developments but two faces of the same underlying design logic: the very features that have made UPI a global model for instant, low-friction interoperable payments are the features that generate fraud exposure, infrastructural concentration risk, and literacy-driven exclusion at the margins.

The literature broadly agrees that UPI's future encompassing its integration with the Unified Lending Interface, the digital rupee, and cross-border payment corridors will depend on whether India's regulatory and technological institutions can extend the same innovation that built UPI's adoption curve to the governance architecture required to sustain it at even greater scale.

Research Gaps and Directions for Future Research

Despite the breadth of literature reviewed, several gaps warrant further investigation. First, longitudinal research tracking fraud victimisation and consumer trust over time remains scarce; most existing studies are cross-sectional, limiting the field's ability to assess whether consumer resilience to fraud is improving as awareness campaigns and regulatory interventions mature (Lonkar et al., 2024).

Second, while comparative rural-urban studies have begun to emerge (Haque et al., 2025; Malik et al., 2025), most remain confined to single districts or states, limiting generalisability nationally representative, multi-region studies of rural adoption dynamics remain scarce despite rural and semi-urban India representing the segment with the greatest untapped financial inclusion potential and the greatest literacy-related vulnerability (Modwel & Trivedi, 2024).

Third, the regulatory and competition-policy dimensions of UPI's market structure particularly the implications of market-share concentration among third-party applications remain more often discussed in policy commentary than examined through rigorous empirical or comparative regulatory analysis (Prajapati & Kumar, 2025).

Finally, as UPI expands across borders, comparative research examining how UPI's interoperability model translates into different regulatory and banking environments abroad is only beginning to emerge leaving open important questions about the scalability of India's digital public infrastructure model to other national contexts (Balakrishnan, 2023).

These gaps collectively define a research agenda for scholars seeking to understand not only how UPI has grown, but how its growth can be sustained responsibly as India's digital payment ecosystem continues to evolve.

Conclusion

This review has traced the literature documenting UPI's emergence as the backbone of India's digital payment ecosystem examining the theoretical foundations, growth drivers, opportunities and challenges that define current scholarship on the platform.

The evidence reviewed suggests that UPI has delivered substantial gains in financial inclusion, transaction efficiency, and international fintech leadership while simultaneously exposing the Indian payment system to new forms of cyber risk, infrastructural fragility and regulatory complexity.

As UPI's future increasingly intersects with complementary innovations such as the Unified Lending Interface and the Central Bank Digital Currency, the literature suggested that sustaining UPI's success will require continueinnovation not only in payment technology but in the governance, literacy, and security frameworks that surround it.

References

- Balakrishnan, M. (2023). The Unified Payment Interface and the growth of digital payments in India: An analysis. *Journal of Payments Strategy & Systems*, 17(3), 250–270.
- Chodorow-Reich, G., Gopinath, G., Mishra, P., & Narayanan, A. (2020). Cash and the economy: Evidence from India's demonetization. *The Quarterly Journal of Economics*, 135(1), 57–103. <https://doi.org/10.1093/qje/qjz027>
- Haque, M. I., Azeez, A., & Akhtar, S. M. J. (2025). UPI and financial inclusion in rural India: A case study. ScienceDirect. <https://doi.org/10.1016/j.dajour.2025.100162>
- India Brand Equity Foundation. (2025). Digital rupee: Exploring the future of India's Central Bank Digital Currency (CBDC). IBEF. <https://www.ibef.org>
- Kumar, R., Kishore, S., Lu, H., & Prakash, A. (2020). Security analysis of Unified Payments Interface and payment apps in India. *Proceedings of the 29th USENIX Security Symposium*, 1499–1516.
- Kuriakose, A., & Sajoy, P. B. (2023). Strategies and challenges of Unified Payment Interface: Towards facilitating a digital payments system in India. *Journal of Telecommunications and the Digital Economy*, 11(4), 33–47. <https://doi.org/10.18080/jtde.v11n4.651>
- Lonkar, A., Dharmadhikari, S., Dharurkar, N., Patil, K., & Phadke, R. A. (2024). Tackling digital payment frauds: A study of consumer preparedness in India. *Journal of Financial Crime*, 32(2), 257–278. <https://doi.org/10.1108/JFC-01-2024-0029>
- Malik, R., Gargi, Gahlyan, A., & Singh, N. (2025). A comparative study of UPI digital payment adoption and its economic impact in rural and urban India. *SSRN Electronic Journal*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5667430
- Modwel, G., & Trivedi, M. (2024). The impact of Unified Payment Interface (UPI) on financial inclusion and economic development. *Educational Administration: Theory and Practice*, 30(5), 8351–8360. <https://doi.org/10.53555/kuey.v30i5.3494>
- National Payments Corporation of India. (2025). UPI product statistics. NPCI. <https://www.npci.org.in>
- Prajapati, S., & Kumar, S. (2025). Indian digitally payment systems: UPI, ULI, CBDC – Challenges, opportunities, and prospects. *Advances in Consumer Research*, 2(4), 4864–4867.
- Press Information Bureau. (2025). Digital payment transactions surge with over 18,000 crore transactions in 2024–25. Government of India, Ministry of Finance. <https://www.pib.gov.in>

Rastogi, S., Panse, C., Sharma, A., & Bhimavarapu, V. M. (2021). Unified Payment Interface (UPI): A digital innovation and its impact on financial inclusion and economic development. *Universal Journal of Accounting and Finance*, 9(3), 518–530. <https://doi.org/10.13189/ujaf.2021.090326>

Reserve Bank of India. (2024). Annual report 2023–24. RBI. <https://www.rbi.org.in>

Sahoo, D. K., Patnaik, B. C. M., & Satpathy, I. (2024). Adoption of Unified Payment Interface (UPI): A literature review. *Journal of the Oriental Institute*, 73(2), 141–152. <https://doi.org/10.8224/journaloi.v73i2.141>