



UPI, Financial Inclusion, and the Architecture of a Digital Economy: Evidence, Gaps, and the Road Ahead for India

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Abstract. India's Unified Payments Interface (UPI) has emerged as the most consequential financial technology experiments in modern economic history, processing over 131 billion transactions worth ₹199.8 trillion in the fiscal year 2023–24 alone. Built on the India Stack — a layered digital public infrastructure comprising Aadhaar-based identity, eKYC, and the Account Aggregator framework — UPI has dramatically accelerated financial inclusion, bringing formal financial services to hundreds of millions of previously unbanked citizens. This paper offers a comprehensive analysis of UPI's architecture and its role in reshaping the Indian fintech landscape. It examines the interplay between regulatory enablement and private-sector innovation, quantifies inclusion gains across income, geography, and gender dimensions, and critically evaluates persistent structural barriers, including the digital divide, cybersecurity vulnerabilities, and gender-based dormancy. Drawing on data from the Reserve Bank of India, National Payments Corporation of India, World Bank Global Findex surveys, and peer-reviewed literature, the paper contends that while India has constructed a world-class payment rail, translating payment access into holistic financial inclusion — encompassing credit, insurance, and wealth creation — demands a second-generation policy agenda anchored in targeted digital literacy, AI-enabled risk assessment, and adaptive regulation.

Keywords: UPI, India Stack, Neo banking

1 Introduction

On August 25, 2016, the National Payments Corporation of India (NPCI) launched the Unified Payments Interface, a real-time payment protocol built atop the Immediate Payment Service (IMPS) infrastructure. Few observers at the time anticipated that within less than a decade, UPI would process more transactions annually than Visa and Mastercard combined in India, or that it would serve as an archetype for digital public infrastructure across Southeast Asia, the Middle East, and Sub-Saharan Africa [1].

India's fintech story is inseparable from its development challenge. In 2011, fewer than 35% of Indian adults held a formal bank account, and the financial system was profoundly stratified along lines of class, caste, geography, and gender [2]. The Jan Dhan Yojana (PMJDY) programme launched in 2014 drove rapid account opening — by 2024, over 530 million Jan Dhan accounts were opened, but account ownership alone does not guarantee financial inclusion if accounts remain dormant or if access to credit, insurance, and savings products continues to elude the economically marginalised [3]. The Indian government's response was architecturally bold: rather than subsidising incumbent banks to extend their reach, it constructed a suite of open digital infrastructure — Aadhaar biometric identity, the Aadhaar Payment Bridge, the Unified Payments Interface, DigiLocker, and the Account Aggregator network — collectively known as the India Stack. This infrastructure is deliberately designed as a public good: interoperable, API-accessible, and open to any licensed financial-service provider. The result has been an explosion of fintech innovation — neobanks, lending platforms, insurtech companies, and wealthtech startups — built atop a state-owned payment rail [4].

This paper presents three key arguments. First, UPI's adoption curve is not merely a technology story but a story about the co-evolution of infrastructure, regulation, and incentive design. Second, quantitative inclusion gains, while substantial, mask deep structural inequities that a payments-first strategy cannot resolve alone. Third, the next phase of Indian fintech must shift from access to engagement — ensuring that digital payment users also access credit, insurance, and savings at meaningful scale — and this transition requires a qualitatively different policy toolkit.

The remainder of the paper is structured as follows. Section 2 reviews the literature on digital payments and financial inclusion. Section 3 examines the architecture of India Stack and UPI's institutional design. Section 4 presents empirical evidence on inclusion outcomes. Section 5 analyses the competitive dynamics of the Indian fintech ecosystem. Section 6 maps structural challenges and equity concerns. Section 7 offers a policy agenda for the next phase of digital finance. Section 8 concludes.

2 Literature Review

2.1 Digital Payments and Financial Inclusion: Theoretical Foundations

The relationship between digital payment access and financial inclusion is theoretically grounded in transaction cost economics. Demirgüç-Kunt et al. [5] argued that physical distance from formal financial infrastructure represents the most significant barrier to account ownership in low- and middle-income countries, and that mobile money can substitute for branch proximity. Beck, Demirgüç-Kunt, and Martinez Peria [6] demonstrate that account ownership correlates positively with household savings behaviour and income smoothing, though the direction of causality is contested.

The literature distinguishes sharply between access and usage. Demirgüç-Kunt and Klapper [7] show that in Sub-Saharan Africa and South Asia, a large fraction of formal bank accounts is used exclusively for government transfer receipt and are otherwise

dormant — a phenomenon Kendall et al. [8] term 'shallow inclusion'. Genuine inclusion, in this framework, requires that individuals use financial services to build assets, manage risk, and invest productively, not merely receive transfers.

Jack and Suri [9] provide what is arguably the most cited empirical study of mobile payments and development outcomes, finding that the availability of M-Pesa in Kenya reduced poverty among female-headed households by 22 percentage points. Their mechanism operates through consumption smoothing: mobile money enables households to receive remittances and insurance transfers rapidly, reducing vulnerability to idiosyncratic income shocks. Subsequent work by Suri and Jack [10] traced long-run occupational shifts: Individuals using M-Pesa were more likely to move out of subsistence farming into retail and business.

India's context differs significantly from Kenya's. Unlike M-Pesa, which operates as a mobile wallet outside the banking system, UPI is a bank-account-linked interface. This design choice reflects both the Indian regulatory preference for bank-intermediated finance and NPCI's ambition to create a universal interoperability layer. Barik and Sharma [11] argue that bank-linkage is both UPI's greatest strength — enabling savings and credit integration — and its greatest weakness, because it excludes the population without bank accounts from direct participation.

2.2 India Stack and the Platform Model of Financial Inclusion

Nandan Nilekani and Viral Shah [12], architects of the India Stack concept, frame digital public infrastructure as a 'programmable foundation' on which markets can build at scale. The key insight is that the state need not deliver financial services directly; it need only provide the identity, consent, and payment layers that reduce the cost of digital financial service delivery to near zero. This is conceptually close to what Rochet and Tirole [13] describe as 'two-sided markets': NPCI operates the platform, banks and fintechs are merchant-and-consumer participants, and network effects drive adoption. Khera et al. [14] of the IMF conduct a cross-country analysis of inclusive digital financial services using a composite index and find that India's trajectory post-2016 — when demonetisation and UPI launched concurrently — represents an outlier among peer economies, suggesting that the supply-side shock of demonetisation combined with a ready digital alternative produced a structural break in payment behaviour. This aligns with Agarwal et al. [15], who use RBI merchant transaction data to show that demonetisation-affected districts exhibited significantly higher post-shock UPI adoption.

2.3 Gender, Geography, the gap in digital access and usage

The financial inclusion literature has increasingly emphasised heterogeneity in outcomes. Holloway et al. [16] synthesised evidence from 33 countries and found that women's account ownership lags men's by approximately 9 percentage points globally, with South Asia showing the widest gap. In India, the World Bank Global Findex 2021 [17] reports that while account ownership gender parity has narrowed, female account dormancy remains significantly higher — approximately 43% of women's accounts show no transactions each year, compared to 27% for men.

Sharma and Kukreja [18] examine rural-urban differences in UPI adoption using NSSO data and find that the rural-urban adoption gap narrowed substantially between 2018 and 2023, but that the nature of usage diverges: rural users predominantly use UPI for P2P transfers and government benefit receipt, while urban users drive merchant payment and financial product subscription. This bifurcation matters for inclusion policy because the financial deepening effects — credit history generation, insurance uptake — are mainly linked to varied transactional behaviour patterns rather than one-time payment activity.

2.4 Fintech Regulation and Innovation

Zetsche et al. [19] propose a taxonomy of fintech regulation approaches ranging from 'wait and see' (United Kingdom pre-2015) to 'regulatory sandbox' (Singapore post-2016) to 'prescriptive control' (China post-2020). India's approach is characterised as 'co-evolutionary': the RBI has progressively expanded the regulatory perimeter to include new fintech categories — Payment Aggregators, Account Aggregators, Prepaid Payment Instruments — while simultaneously creating sandbox mechanisms to test innovations before full licensing.

Philippon [20] argues that fintech has the potential to reduce the 'unit cost' of financial intermediation, which has remained persistently high across advanced economies despite decades of banking technology investment. His analysis suggests that platform-based fintech achieves dramatically lower marginal costs through data network effects and automated underwriting. For India, this implies that effectively designed fintech ecosystems could serve the previously unbanked at commercially viable margins, transforming inclusion from a subsidy-dependent policy goal into a market-driven outcome.

3 India Stack and the Architecture of UPI

3.1 The Layered Infrastructure Model

India Stack is best understood as a four-layer architecture. The Presence layer — Aadhaar biometric identity — provides a universal identity number linked to biometrics

for 1.4 billion residents, enabling eKYC at a fraction of the cost of paper-based verification. The Paperless layer — DigiLocker, eSign, and the Digi Dhan Mission — digitises document storage and signing. The Cashless layer — UPI, the BHIM app, the Bharat QR standard, and the Aadhaar Payment Bridge — enables real-time settlement. The Consent layer — the Account Aggregator (AA) framework, launched in 2021 — allows regulated entities to access customer financial data with explicit, revocable, granular consent [21].

These layers interact in ways that generate compounding inclusion benefits. A migrant worker who opens a Jan Dhan account using Aadhaar-eKYC (Presence layer) can receive wages digitally (Cashless layer), build a transaction history stored in a Financial Information Provider (Consent layer), and use that history as a verifiable data asset to secure a micro-loan from a digital lender — all without ever visiting a branch. This is the theoretical pathway from access to engagement that India Stack's architects envisioned.

3.2 UPI's Technical and Institutional Design

UPI operates as an overlay network on the IMPS rail, enabling interoperable account-to-account transfers with virtual payment addresses (VPAs) such as 'name@bank'. The protocol is governed by NPCI — a not-for-profit owned jointly by member banks — under RBI oversight. Key design choices include: zero-charge for consumers, with merchants bearing a Merchant Discount Rate (MDR) that was eliminated for RuPay and UPI transactions on government mandate in 2020; 24x7 real-time settlement; and open API access for Third-Party Application Providers (TPAPs) such as PhonePe, Google Pay, and Paytm [22].

The TPAP model has been transformative. By allowing private technology companies to build consumer-facing applications on NPCI's payment rail, UPI achieved a distribution velocity that the banking system alone could not have matched. PhonePe and Google Pay collectively accounted for approximately 85% of UPI transaction volume in FY2024, illustrating both the success of the open-platform model and the concentration risk it generates [23].

NPCI's response to concentration risk — a 30% market share cap for any single TPAP — has been controversial. Critics argue that the cap impedes network effects and penalises market winners without addressing the underlying competition barriers for smaller fintechs. Proponents contend that interoperability reduces the lock-in that would otherwise make concentration irreversible, and that a dominant private platform controlling a critical payment infrastructure poses systemic risk [24].

3.3 The Account Aggregator Framework

The Account Aggregator (AA) framework, operationalised in 2021, represents arguably the most structurally significant innovation in the India Stack since UPI itself. AA enables users to share verified financial data — bank statements, tax returns, insurance records, investment portfolios — with any consented financial entity in a machine-readable, standardised format. This collapses the information asymmetry that has historically excluded thin-file borrowers from formal credit [25].

For a daily-wage labourer with no credit history, the AA framework creates the possibility of using verified income flows visible in a Jan Dhan account as a creditworthiness signal. For a small retailer, six months of UPI merchant transaction data constitutes a verifiable revenue record that a lender can assess algorithmically in seconds. The RBI's Unified Lending Interface (ULI), announced in 2023 as a sister infrastructure to UPI, aims to extend this logic to the credit market — creating a 'public credit rail' that mirrors the payment rail's interoperability [26].

4 Empirical Evidence on Financial Inclusion Outcomes

4.1 Payment Adoption: Scale and Velocity

Table 1 presents the pattern of UPI adoption across the period 2019–2024, drawing on NPCI monthly bulletin data and RBI Annual Reports.

Table 1. UPI Transaction Growth, FY2019–20 to FY2023–24.

<i>Year</i>	<i>Transactions (Bn).</i>	<i>Value (₹ Trillion).</i>	<i>Registered Users (Mn).</i>
FY 2019–20	12.5	21.3	125
FY 2020–21	22.3	41.0	210
FY 2021–22	46.0	84.2	325
FY 2022–23	83.7	139.1	430
FY 2023–24	131.0	199.8	500

Sources: NPCI Monthly Bulletins; RBI Annual Report 2024.

The compound annual growth rate (CAGR) of UPI transactions between FY2020 and FY2024 stands at approximately 79%, one of the fastest adoption curves ever recorded for a payment system. By comparison, Brazil's PIX — the closest global analogue, launched in 2020 — reached 40 billion annual transactions by 2023 [27]. India's volume advantage reflects population scale, but also the network effects generated by UPI's merchant ecosystem: as of March 2024, over 50 million merchants accepted UPI, including approximately 12 million in rural and semi-urban locations [28].

4.2 Financial Inclusion Metrics

Table 2 synthesizes key inclusion indicators across three time periods, drawing on World Bank Global Findex data and RBI Financial Inclusion reports.

Table 2: Financial Inclusion Indicators, India, 2015–2024.

Indicator.	2015	2021	2024 (Est.)
Bank Account Ownership (%)	53%	78%	87%
Digital Payment Users (Mn)	40	350	600+
Mobile Wallet Penetration (%)	2%	19%	38%
Formal Credit Access, Rural (%)	15%	27%	36%
Insurance Penetration (%)	3.4%	4.2%	5.1%

Sources: World Bank Global Findex 2021; RBI Financial Inclusion Index Reports 2022–2024.

The inclusion gains are substantial across all dimensions. Bank account ownership rose from 53% in 2015 to an estimated 87% in 2024, the most rapid trajectory among G20 economies. Digital payment user counts grew fifteenfold over the decade. However, formal credit access in rural areas — at 36% in 2024 — remains significantly below the 60% threshold associated with substantive economic participation in the development economics literature [29]. Insurance penetration, at 5.1%, trails the OECD average of 9.2% by a wide margin [30].

4.3 The Credit Gap

The most consequential remaining gap is in credit. The Reserve Bank of India estimates that the formal credit demand-supply gap for micro, small, and medium enterprises (MSMEs) alone stood at approximately ₹25 trillion in 2023 [31]. This gap has historically been addressed only partially and at a high cost — by informal moneylenders charging annual interest rates of 24–48%, compared to the 12–18% range of regulated digital lenders.

Digital lenders using UPI transaction data and AA-shared financial information have begun to address this gap. TransUnion CIBIL data shows that the number of new-to-credit borrowers receiving digital loans grew from 8.5 million in FY2020 to 28.3 million in FY2023, with new-to-credit borrowers from rural areas growing at twice the urban rate [32]. The average ticket size of MSME digital loans fell from ₹4.2 lakh in 2020 to ₹1.8 lakh in 2024, reflecting lenders' improved ability to underwrite smaller, riskier loans using richer data inputs.

4.4 Gender-Disaggregated Outcomes

Gender-disaggregated data reveals a more complex picture than aggregate statistics suggest. While the Jan Dhan programme achieved near-parity in account ownership (52% of PMJDY accounts are held by women), the World Bank Findex 2021 reports a 16-percentage-point gap in active digital payment use between men and women in India [17]. Field surveys by Microsave Consulting [33] identify four structural barriers: (1) low smartphone ownership among women; (2) dependence on male family members for device access; (3) social norms restricting independent financial decision-making; and (4) product design that does not reflect women's financial behaviour patterns, such as rotating savings groups and informal risk-pooling.

Promising interventions include the RBI's initiative to integrate Women Self-Help Groups (SHGs) into the digital payment ecosystem — over 12 million SHG members had received digital literacy training under the PMJDY framework by 2024 — and neobank products specifically designed for women, such as those offered by Niyu Solutions and Fi Money [34].

5 The Indian Fintech Ecosystem: Competitive Dynamics

5.1 Sectoral Overview

India's fintech ecosystem, with over 10,000 registered companies as of 2024, is the world's third largest by funding volume after the United States and China [35]. The ecosystem is organised across five principal verticals: digital payments (PhonePe, Google Pay, Paytm), digital lending (Lendingkart, Faircent, KreditBee, Slice), insurtech (Acko, Digit Insurance, Riskcovry), wealthtech (Zerodha, Groww, Smallcase), and neobanking (Jupiter, Fi Money, Open, Niyu). Cross-sectoral convergence is accelerating: payment companies are acquiring lending licenses, lending platforms are adding insurance distribution, and wealth platforms are integrating credit products.

5.2 Buy Now Pay Later: Growth and Risks

Buy Now Pay Later (BNPL) deserves particular attention as the fastest-growing — and most contested — fintech vertical. BNPL credit disbursements in India grew from ₹14,000 crore in FY2021 to approximately ₹1.1 lakh crore in FY2024 [36]. BNPL provides instant credit at the point of purchase without a traditional credit card, appealing particularly to the 'credit-card-less' middle class and aspirational rural consumers. Fintech companies, including ZestMoney, LazyPay, Simpl, and Amazon Pay Later, have driven this growth.

Regulatory ambivalence has shaped BNPL's trajectory sharply. The RBI's 2022 circular on prepaid payment instruments effectively prohibited loading BNPL credit onto wallets, forcing a structural shift toward bank-partnered models. ZestMoney's closure in

2023 illustrated the fragility of BNPL business models that lack direct banking partnerships and robust underwriting [37]. The RBI has signalled intent to bring BNPL under the Non-Banking Financial Company (NBFC) framework, which would impose capital adequacy and collection-practice standards — a development the industry broadly welcomes as providing regulatory clarity at the cost of compliance overhead.

5.3 Neobanks: The Regulatory Constraint

India's neobank segment is uniquely constrained relative to global peers. In the United Kingdom, Germany, and Brazil, neobanks can obtain independent banking licences and hold deposits directly. In India, the RBI has not issued new universal banking licences since 2015 and has not created a 'digital banking licence' category, though the committee chaired by Sudarshan Sen recommended such a framework in 2022 [38]. Consequently, Indian neobanks operate as technology layers atop partner banks — a model that limits product autonomy, creates margin pressure, and concentrates risk within partner institutions.

The Bank's caution is understandable given the failure of several cooperative banks in recent years. However, regulatory path dependency may be impeding competition: incumbent banks, insulated from direct neobank competition, have limited incentive to improve the quality of digital services for low-income segments. A tiered digital banking licence — permitting limited deposit-taking up to a defined threshold — could introduce competitive pressure while ring-fencing systemic risk.

5.4 Cross-Border Payments: UPI's Global Ambition

NPCI International, established in 2020, has accelerated UPI's internationalisation. By 2024, UPI payment acceptance had been enabled in Singapore, the UAE, France, the UK, Bhutan, Nepal, Sri Lanka, and Mauritius [39]. The linkage of UPI with Singapore's PayNow in 2023 — enabling real-time, low-cost remittances between India and Singapore — represents a bilateral template that NPCI is actively replicating. India received approximately \$120 billion in remittances in 2023, the world's largest inflow, and reducing the 5–7% average cost of international transfers to the sub-1% level achievable via interlinked real-time payment systems represents a significant welfare improvement for the diaspora and recipient households alike.

6 Structural Challenges and Equity Concerns

6.1 The Persistent Digital Divide

India's digital payment ecosystem has achieved extraordinary reach in absolute terms, but relative penetration masks stark geographic stratification. TRAI data for 2024

shows smartphone penetration at 73% in urban areas versus 42% in rural areas, with meaningful differences within rural geographies between irrigated, commercially active regions and rain-fed, tribal, or mountainous zones [40]. Internet connectivity, the prerequisite for UPI, remains intermittent across approximately 200,000 villages despite the BharatNet infrastructure programme, which has experienced repeated delays and implementation shortfalls.

Offline payment modes — UPI Lite (allowing cached-balance transactions below ₹500 without internet), *99# USSD payments on basic feature phones, and the Aadhaar-enabled Payment System (AePS) for biometric withdrawals — partially address connectivity constraints. However, UPI Lite transaction volumes remain modest, and AePS fraud — cloned fingerprints used for unauthorised withdrawals — has become a significant rural crime vector, undermining trust precisely among the most vulnerable new entrants to the financial system [41].

6.2 Cybersecurity and Fraud

Digital payment fraud has grown in tandem with transaction volumes. RBI data shows that UPI-related frauds totalled ₹1,087 crore in FY2023–24, representing approximately 50,000 individual fraud incidents [42]. Social engineering — where fraudsters impersonate bank officials, government agents, or e-commerce delivery personnel to obtain OTPs or UPI PINs — accounts for the majority of cases. The concentration of fraud in the UPI layer is structurally concerning because, unlike credit card fraud which has chargeback protections, UPI transactions are push payments that are largely irrevocable.

The RBI's establishment of a Central Payment Fraud Information Registry (CPFIR) and NPCI's introduction of machine-learning-based fraud pattern detection have begun to yield results: the fraud-to-transaction ratio (by value) fell from 0.0012% in FY22 to 0.00054% in FY24 [43]. However, absolute fraud values continue to rise with transaction volumes, and the disproportionate victimisation of low-literacy, newly banked individuals raises equity concerns — those who have most recently been included are most exposed to predatory fraud.

6.3 Data Governance and Privacy

The Digital Personal Data Protection (DPDP) Act 2023, India's first comprehensive data protection legislation, establishes rights of data principal consent, correction, and erasure. For the fintech sector, the Act's implications are profound: the Account Aggregator framework, which rests on data sharing with consent, must adapt to DPDP's consent architecture; digital lenders using alternative data for credit scoring must ensure that data minimisation principles do not impede the very data richness that enables thin-file lending; and payment data — the most granular record of individual behaviour

available — must be managed under explicit retention and cross-border transfer restrictions [44].

The interaction between DPDP, the AA framework, and the Credit Information Companies Regulation Act creates a complex, partially overlapping regulatory landscape that increases compliance costs for fintech startups relative to incumbent banks with dedicated legal and compliance departments. Harmonisation of consent frameworks across these instruments is a regulatory priority that remains unaddressed.

6.4 Summary of Challenges and Proposed Interventions

Table 3: Structural Challenges in Indian Fintech — Issues and Proposed Interventions.

Challenge Domain	Key Issues	Potential Interventions
Digital Literacy	Low smartphone adoption in rural areas; language barriers	Vernacular UPI interfaces; PMGDISHA programme expansion
Cybersecurity	Rising UPI fraud (₹1,087 Cr in FY24); phishing attacks	AI-based fraud detection; RBI Fraud Registry
Infrastructure	Intermittent connectivity in Tier 3+ cities	BharatNet Phase II; satellite broadband rollout
Gender Gap	Women's account dormancy (~43%); social norms	Women-focused fintech products; SHG digital integration
Regulatory Lag	Slow policy response to neo-banks, crypto, BNPL	Sandbox-first regulation; DPDP Act enforcement

Source: Authors' synthesis from RBI, NASSCOM, and academic literature.

7 A Second-Generation Policy Agenda

7.1 From Payment Access to Financial Engagement

The first generation of Indian fintech policy was correctly focused on access infrastructure — building the identity, payment, and consent rails, opening bank accounts at scale, and enabling private innovation atop public infrastructure. This agenda has largely succeeded: the rails exist, accounts exist, and a vibrant private ecosystem exists. The second-generation challenge is fundamentally different: it is a question of engagement, trust, and product design.

Financial engagement requires users not merely hold accounts and occasionally receive transfers, but actively use a portfolio of financial services — savings, credit, insurance, investments — in ways that build economic resilience and intergenerational wealth. The empirical evidence reviewed in Section 4 demonstrates that India remains

far from this goal, particularly for rural, female, and low-income users. The policy interventions required are correspondingly more nuanced than the infrastructure mandates of the first generation.

7.2 Digital Literacy at Scale

Digital literacy programmes — the PMGDISHA scheme, RBI's Financial Education Programme, and NPCI's BHIM training initiatives — have reached approximately 60 million individuals since 2017. However, literacy training that does not reach individuals now of their first digital payment transaction, or that is delivered in languages and formats inaccessible to low-literacy users, produces limited behaviour change. Research by the Consultative Group to Assist the Poor (CGAP) [45] demonstrates that 'just-in-time' financial education — delivered via SMS or IVR at the point of first product use — is significantly more effective than classroom training.

Operationally, this suggests a mandate that TPAPs and banks include behavioural literacy nudges — in local languages, using voice interfaces for low-literacy users — within the UPI application layer itself. The inclusion of fraud awareness training in onboarding flows, currently voluntary, should be made compulsory for new users transacting below defined income thresholds.

7.3 Regulatory Innovation: Adaptive Frameworks for Neobanks and BNPL

India's regulatory framework for digital banking is approaching an inflection point. The persistence of a bank-partnership-only model for neobanks is increasingly difficult to justify given the maturity of the ecosystem and the demonstrated capacity of NPCI to manage systemic risk. A tiered licensing framework — permitting neobanks to hold deposits up to ₹5 lakh per customer with ringfenced capital — would introduce competition, preserve systemic stability, and align India with global best practice [46].

For BNPL, the priority is harmonisation: bringing all credit-at-point-of-sale products under a single NBFC sub-category with standardised disclosure requirements, cooling-off periods for high-value purchases, and collection practice codes. The RBI's existing regulatory stance on BNPL is partially inconsistent — treating identical economic transactions differently depending on the technical mechanism through which credit is extended — and this inconsistency creates arbitrage that disadvantages consumer protection [47].

7.4 AI and Responsible Data Use in Credit

The most consequential emerging regulatory frontier is the use of artificial intelligence in credit underwriting. India's fintech lenders are at the frontier of deploying large language models for loan application assessment, alternative data (social media activity, app usage patterns, geolocation data) for risk scoring, and reinforcement learning for dynamic interest rate setting. These methods significantly expand the creditworthy population but also introduce new risks: algorithmic bias that replicates historical discrimination, opacity that prevents consumers from understanding or contesting adverse decisions, and data security exposure of highly sensitive behavioural profiles [48].

The RBI's 2024 discussion paper on AI in financial services signals awareness of these risks but stops short of prescriptive requirements. A principles-based framework — requiring explainability of adverse credit decisions, regular bias audits of ML models, and privacy-preserving computation (federated learning, differential privacy) for models trained on sensitive personal data — would provide the regulatory certainty that responsible fintechs require while setting a floor beneath which less scrupulous operators cannot fall [49].

7.5 UPI for Agriculture and Rural Livelihoods

Agriculture accounts for 18% of India's GDP and 45% of employment, yet agricultural finance — crop loans, input financing, insurance, commodity price risk management — remains among the least digitised segments of the economy. The NABARD Digital Financial Inclusion Strategy identifies three priority interventions: integrating Kisan Credit Card (KCC) disbursements with UPI; enabling commodity exchange transactions on the eNAM platform via UPI; and linking crop insurance premium collection and claim settlement to Aadhaar-seeded bank accounts with instant UPI disbursements [50].

Pilot programmes in states including Maharashtra, Telangana, and Rajasthan have demonstrated that digital KCC disbursements reduce leakage and administrative costs by approximately 30% relative to branch-based systems. Scaling these pilots nationally — with particular attention to the approximately 85 million marginal and small farmers who currently lack KCC access — represents a high-impact frontier for UPI-enabled inclusion.

8 Conclusion

India's fintech transformation over the past decade constitutes one of the most consequential episodes of state-guided market innovation in modern economic history. The construction of India Stack, the launch and scaling of UPI, and the regulatory co-evolution that enabled a vibrant private ecosystem have together compressed decades of financial infrastructure development into less than ten years. By the metrics of payment

volume, account ownership, and digital user count, the results are unambiguous: India has built a world-class digital financial architecture.

Yet the central argument of this paper is that the payment-first phase of Indian fintech, however successful, is a necessary but not sufficient condition for genuine financial inclusion. The empirical record shows that hundreds of millions of newly banked Indians remain poorly served by formal credit, insurance, and wealth-building products. The digital divide persists along geographic, gender, and income dimensions. Cybersecurity threats disproportionately victimise the most recently included. And a regulatory framework designed for the first generation of fintech is increasingly ill-suited to the second — characterised by neobanks, AI-driven lending, BNPL, and cross-border payment corridors.

The policy agenda for the next decade must be correspondingly more sophisticated: moving from infrastructure mandates to engagement design, from blanket regulation to adaptive licensing frameworks, from aggregate inclusion metrics to disaggregated equity tracking, and from payment-only thinking to a holistic account of the financial lives of the economically marginalised. India has built the rails. The challenge now is to ensure that the trains running on them reach every station.

The global significance of India's experiment should not be understated. The G20's TechSprint on financial inclusion, the World Bank's recognition of India Stack as a global development model, and the rapid adoption of UPI-inspired infrastructure in Southeast Asia and Africa all reflect a growing consensus that India's approach — open, interoperable, state-built rails with private-sector innovation on top — offers a replicable template for the world's unbanked billions. The responsibility that accompanies this template is to resolve, honestly and urgently, the equity failures that remain within India's own borders.

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