

Impact Of Unified Payments Interface (Upi) On The Growth Of The Cashless Economy In India: An Empirical Analysis A Comprehensive Review of Scopus-Indexed Empirical Literature

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ABSTRACT

The launch of the Unified Payments Interface in April 2016 marked the beginning of one of the most remarkable success stories in the history of financial technology. What the National Payments Corporation of India introduced as an interoperability experiment has since grown into the undisputed backbone of everyday financial exchange for hundreds of millions of Indian citizens — processing an extraordinary fifteen billion transactions every single month in less than a decade. This meteoric rise is a testament to the power of visionary infrastructure, and it is a development that richly deserves the sustained scholarly attention it is, at long last, beginning to receive.

This paper tries to consolidate what the research community has actually found. We draw on roughly forty-five studies, all appearing in Scopus-indexed journals or equivalent peer-reviewed venues published between 2017 and 2024, and ask what they collectively tell us about UPI's role in pushing India toward a less cash-dependent economy. The threads are genuinely varied: some scholars have focused on the psychological and generational determinants of who adopts UPI and why; others have used natural experiments and panel regressions to trace macroeconomic consequences; still others have mapped UPI's uneven penetration into rural India or raised alarms about the fraud problem that has grown alongside the platform's success. Theoretical frameworks from UTAUT and UTAUT2 to Diffusion of Innovation sit alongside more empirically driven approaches. The field has pluralism, which is both its strength and, occasionally, its weakness.

What the synthesis yields is a picture with genuine complexity. Yes, UPI has accelerated India's cashless transition in ways that are measurable and, in some cases, causally identified. Financial literacy has improved, merchant revenues have grown, credit access has expanded into populations that were previously invisible to lenders. But the gains are not distributed evenly, fraud is accelerating, rural penetration remains patchy, and the research base itself has blind spots — particularly the near-complete absence of longitudinal studies. This paper maps all of that, and closes by pointing toward where future empirical work is most needed..

Keywords *Unified Payments Interface (UPI); Cashless Economy; Digital Payments; Financial Inclusion; India; FinTech; NPCI; Economic Development; Technology Adoption; Demonetization*

INTRODUCTION:

There is a sentence that appears in various forms across several recent reports on India's digital economy: 'India now accounts for more real-time digital transactions than the rest of the world combined.' It is probably an overstatement, but it is not far off. By 2022, India's share of global real-time transactions was around 46 per cent, exceeding the combined volumes of China, Brazil, South Korea, and Thailand (Dev, Gupta & Kumar, 2024; Cornelli et al., 2024). The infrastructure responsible for most of that volume is the Unified Payments Interface — a system that barely existed seven years earlier.

UPI was designed by NPCI to do something deceptively simple: let people move money between any two bank accounts using a mobile phone, in real time, at any hour, without paying a fee. In practice the design involved enormous complexity — interoperability standards, virtual payment addresses, QR code protocols, a multi-bank settlement architecture — but the user experience was meant to feel frictionless. The pitch worked. Between April 2016 and late 2024, monthly transaction volumes crossed fifteen billion, with 641 participating banks (NPCI, 2025). These are not incremental gains. They represent a structural shift in how a 1.4 billion-person economy conducts its financial life.

Disentangling UPI's story from its broader policy setting is, frankly, impossible. The November 2016

demonetisation — the government's withdrawal of 500- and 1,000-rupee notes from circulation, just months after UPI launched — created an acute liquidity shock that forced a large chunk of the population onto digital alternatives out of sheer necessity. Chodorow-Reich et al. (2020) and Crouzet, Gupta & Mezzanotti (2023) have since shown that this forced adoption left durable habits. Meanwhile, the Digital India programme, the Pradhan Mantri Jan Dhan Yojana financial inclusion scheme, and the JAM (Jan Dhan-Aadhaar-Mobile) infrastructure were all operating simultaneously, each expanding the population of people who could plausibly use UPI. The result was a kind of compounding effect: each enabling force reinforced the others, and UPI grew faster than anyone's early projections.

The academic literature on UPI has expanded accordingly — but not always in coordinated ways. Researchers in information systems have asked about adoption behaviour; economists have studied macroeconomic effects; management scholars have looked at merchant integration; cybersecurity experts have mapped the fraud surface. These conversations have mostly proceeded in parallel, with limited cross-pollination. This paper is an attempt at cross-pollination. We draw on approximately forty-five studies from Scopus-indexed journals, organising their findings around six thematic areas: technology adoption and behaviour; macroeconomic and GDP-level effects; financial inclusion and the rural-urban gap; merchant and MSME development; fraud, cybersecurity, and trust; and international comparisons with policy implications. The review methodology is described in Section 2, the thematic synthesis occupies Section 3, cross-cutting theoretical conclusions are drawn in Section 4, limitations and future agenda are addressed in Section 5, and Section 6 concludes.

2. Review Methodology and Scope

The review is structured rather than formally systematic in the Cochrane or PRISMA sense — there is no PRISMA flow chart, and we have not attempted a statistical meta-analysis. What we have done is impose principled selection criteria and organise the resulting corpus around genuine thematic coherence. The primary inclusion requirement was publication in a Scopus-indexed journal. We also admitted a small number of studies from high-

authority institutional sources (BIS working papers, RBI annual reports, ACM conference proceedings indexed in Scopus) where the institutional credibility and methodological quality warranted it. Around forty-five works published between 2017 and 2024 met these criteria. We selected across methodological traditions deliberately — we did not want the synthesis to simply reflect whatever method happened to dominate one particular sub-field.

Searches were run across Scopus, Google Scholar, ScienceDirect, and Emerald Insight. Terms included 'Unified Payments Interface,' 'UPI,' 'digital payment India,' 'cashless economy India,' 'financial inclusion UPI,' 'FinTech India,' 'demonetisation digital payment,' and 'NPCI,' used individually and in combination. Studies that could not be confirmed as Scopus-indexed, or that dealt with digital payments generically without substantive engagement with the Indian context or UPI specifically, were excluded.

2.1 Methodological Diversity in the Literature

The methodological range of this corpus is worth pausing on, because it says something about the field's genuinely interdisciplinary character. Structural equation modelling — both PLS-SEM and covariance-based CB-SEM — appears most frequently: Rastogi et al. (2021) use PLS-SEM to trace the causal chain from UPI adoption through financial literacy to economic development; the 2024 meta-UTAUT study in ScienceDirect uses CB-SEM on 894 respondents; Sinha & Singh (2022) apply SEM in a merchant-focused investigation. For questions about macroeconomic causality, the appropriate tools are different: Chodorow-Reich et al. (2020) and Crouzet et al. (2023) use difference-in-differences designs that exploit the demonetisation shock as a natural experiment; Dubey (2023) adds instrumental variable identification. Transaction volume studies by Sahu, Sahu & Patra (2023) and Singh & Singh (2022) rely on time-series regression. And then the security literature — Kumar et al. (2020) using protocol analysis by reverse-engineering live applications, Kaur et al. (2023) using security audit techniques — looks methodologically quite different from everything else. This diversity enables genuine triangulation, even though it also makes direct comparison across studies tricky.

Table 1: Summary of Selected Scopus-Indexed Publications Reviewed

Author(s) & Year	Journal / Source	Methodology	Key Finding
Rastogi et al. (2021)	Universal Journal of Accounting & Finance	PLS-SEM	UPI → Financial Literacy → Inclusion → Economic Development
Barge & Shailesh (2022)	J. of Asian Finance, Economics & Business	Panel Regression (16 Qtrs)	Financial Inclusion drives UPI digitalization; socio-techno ecosystem model
Sreenu (2020)	ACM Transactions on Internet Technology	Regression Analysis	Cashless policies improve transaction efficiency & economic growth

Author(s) & Year	Journal / Source	Methodology	Key Finding
Dev, Gupta & Kumar (2024)	ACM CSCW Conference Proceedings	Survey + HCI Prototyping	75% of users reported increased spending post-UPI adoption
Kumar et al. (2022)	Indian Journal of Finance and Banking	Descriptive + Factor Analysis	Enablers: ease-of-use, interoperability; Inhibitors: connectivity, fraud
Singh, Singh & Singh (2023)	Access Journal	ADM Diffusion Model Fit	UPI transactions to grow manifold in volume and value
Balakrishnan (2023)	Journal of Payments Strategy & Systems	Analytical Review	Policy framework analysis of UPI growth drivers for global replication
Sahu, Sahu & Patra (2023)	Parikalpana-KIIT Journal of Mgmt	Comparative Analysis	Public vs. private bank UPI performance; future possibilities of UPI
Modwel & Trivedi (2024)	Educational Admin: Theory & Practice	Secondary Data Analysis	UPI impact on financial inclusion and economic development
Cornelli et al. (2024)	BIS Papers (Basel)	Policy & Architecture Review	Open architecture & zero-cost model as key UPI success factors
Adoption Study-UTAUT (2024)	ScienceDirect/IIMB	CB-SEM (n=894)	82.7% variance in UPI attitude explained by extended meta-UTAUT
Baby Boomers UPI (2022)	J. of Advances in Mgmt Research (Emerald)	UTAUT-based Survey	Social influence & trust dominant for older-generation UPI adoption
FinTech Gen Y/Z (2024)	Digital Policy, Regulation & Governance (Emerald)	SEM-SmartPLS 4	Customer satisfaction & effort expectancy -> behavioral intention
Shahid (2022)	Digital Business Journal	Diffusion of Innovation	Trust and perceived usefulness as primary UPI adoption determinants
Belanche et al. (2022)	Telematics and Informatics	Quantitative Survey	Perceived risk moderates' P2P mobile payment adoption
Sinha & Singh (2022)	J. of Financial Services Marketing	Mediation Analysis	Perceived experience mediates merchants' UPI adoption intention
Chodorow-Reich et al. (2020)	AER (macro study)	Diff-in-Differences	Demonetization shock accelerated digital payment adoption across districts
Crouzet, Gupta & Mezzanotti (2023)	Review of Financial Studies	DiD + Individual FE	Cash-dependent consumers shifted spending patterns post-demonetization
Kumar et al. (2020)	USENIX Security Symposium	Security Protocol Analysis	Vulnerabilities in UPI apps via reverse-engineering of payment protocol
UPI Rural Inclusion (2025)	ScienceDirect-Finance Research	Case Study-Aligarh District	UPI deepens financial inclusion in rural Uttar Pradesh

Author(s) & Year	Journal / Source	Methodology	Key Finding
Mishra & Gupta (2023)	J. of Cybersecurity Studies	Policy Framework	Digital payment fraud prevention strategies in India
Singh & Singh (2022)	International Journal of Research	Time-Series Analysis	Exponential UPI growth driven by internet expansion & mobile penetration
Jha & Kumar (2021)	MuktShabd Journal	Consumer Survey	User-friendliness & technical confidence key adoption factors
Kaur et al. (2023)	International Journal of Raset (IJRASET)	Security Audit	Cybersecurity vulnerabilities via QR, VPA & social engineering
Thirupathi & Akula (2022)	Asian Journal of Economics, Business & Accounting	Descriptive-Chi-Square	Post-graduate students' perceptions toward UPI transactions
Saxena & Tripathi (2021)	International Journal of Management	Qualitative-Risk Framework	Security risks and safety measures in fintech mobile payments
Vidhya & Sankar (2023)	Shanlax International Journal of Economics	Consumer Survey	Cashless economy perceptions with reference to UPI in Tamil Nadu
Shree, Pratap & Saroy (2021)	Journal of Banking & Financial Technology (Springer)	Survey-Empirical	Consumer experience and digital payment adoption patterns in India
Malladi, Soni & Srinivasan (2021)	CSI Transactions on ICT (Springer)	Literature Review + Framework	Digital financial inclusion: challenges and next frontiers
Al-Smadi (2023)	Borsa Istanbul Review (Elsevier)	Panel Data-MENA	Digital finance positively relates to financial inclusion indicators
Upadhyay & Vishwakarma (2023)	Int. J. of Electronic Finance	COVID-19 Natural Experiment	Digital financial transactions mainstreamed during COVID-19 pandemic
Sharma & Changkakati (2022)	Borsa Istanbul Review (Elsevier)	Cross-sectional Regression	Dimensions of global financial inclusion: UN SDG alignment
Kumar, Choudhary et al. (2022)	Indian Journal of Finance & Banking	Mixed Methods	Growth trajectory of UPI-based mobile payments: enablers & inhibitors
RBI Annual Report (2023)	Reserve Bank of India Publications	Official Statistics	UPI transaction data, fraud metrics and payment system regulations
Bansal & Abishek (2024)	International J. of Novel Research & Development	Analytical Review	UPI payments' impact on financial business and inclusion
Banu et al. (2024)	Digital Business & Society	SEM	Smartphone penetration as mediator in digital payment adoption

Author(s) & Year	Journal / Source	Methodology	Key Finding
Sankararaman et al. (2023)	World J. of Management & Economics	Likert Scale Survey	User opinions toward UPI transactions: satisfaction and trust metrics
Jena (2023)	International Journal of Business	Descriptive Analysis	Internet expansion and mobile usage as UPI adoption predictors
Verma et al. (2024)	Journal of Financial Innovation	Regression	UPI as an accessible platform for digital payment transactions
Dubey (2023)	J. of Finance (AFA Working Paper)	Panel Regression + IV	Cashless payments spurred credit access and real economic outcomes
Abbasi et al. (2021)	Technological Forecasting & Social Change (Elsevier)	Regression-GMM	FinTech efficiency and cultural factors in OECD countries
Adhikary et al. (2023)	Electronic Commerce Research (Springer)	Systematic Review	Small businesses and FinTech: payments and financial impact
Maknickiene & Lapkovskaja (2024)	Journal of Infrastructure Policy & Development	Bibliometric + Content	FinTech influence field: digital finance research landscape
Gupta et al. (2022)	J. of Risk & Financial Management (MDPI)	Secondary Data Panel	FinTech and digital literacy in India: poverty as moderator
Kejkar & Uttarwar (2023)	International J. of Commerce & Mgmt	Primary Survey	UPI adoption barriers among semi-urban populations in India

Source: Author compilation from Scopus-indexed databases (2017-2024)

3. Thematic Synthesis of the Literature

3.1 Technology Adoption and Behavioural Determinants

Any survey of UPI adoption research has to reckon with the fact that Venkatesh et al.'s Unified Theory of Acceptance and Use of Technology — UTAUT, and its consumer-oriented extension UTAUT2 — has become the default theoretical starting point for this literature, sometimes productively and sometimes less so. The framework's four original constructs (performance expectancy, effort expectancy, social influence, facilitating conditions) transfer reasonably well to the mobile payments context. Most of the Indian studies reviewed here extend or modify the base model in some way, which is itself revealing: the Indian setting introduces complications — trust deficits, generational digital divides, rural infrastructure gaps, fraud anxiety — that the standard UTAUT architecture does not fully accommodate.

The most technically rigorous adoption study in our sample is a 2024 investigation published via ScienceDirect using CB-SEM on a sample of 894 urban Indian UPI users. The methodological choice that

distinguishes it from earlier work is treating actual use behaviour as the terminal outcome rather than stopping at behavioural intention — a limitation that has plagued much of the prior adoption literature. The results are striking. The model accounts for 82.7 per cent of the variance in attitude and 84.1 per cent in use behaviour, figures that are substantially higher than what earlier UPI-specific studies typically report. Performance expectancy and effort expectancy remain the strongest drivers of intention, but the study's main contribution is demonstrating that attitude mediates the relationship between expectancy constructs and actual behaviour. That mediation step matters: it means you can have a highly motivated user who still does not follow through, and the attitude construct captures why.

Rastogi et al. (2021), whose work in the *Universal Journal of Accounting and Finance* has been cited widely in subsequent financial inclusion studies, come at the question from a different direction entirely. They are not asking what predicts adoption; they are asking what adoption produces — downstream, in people's financial lives. Their PLS-SEM model traces a chain from UPI adoption to financial literacy (path coefficient 0.558, $p < 0.05$), through inclusion, and eventually to economic

development. Two mediating variables complicate the picture: financial stability partially mediates the literacy-to-inclusion link, while trust mediates the inclusion-to-development relationship. The policy implication here is underappreciated. Regardless of the number of users onboarded, if trust is a mediator and not only a moderator, interventions that ignore it cannot reliably translate UPI adoption into development outcomes.

Shahid (2022) writing in *Digital Business Journal*, prefers Diffusion of Innovation theory to UTAUT, and the different lens brings different insights. Rogers' framework is more sensitive to adoption timing and user typology than UTAUT is, and Shahid exploits this. His key finding is that early adopters and the early majority are not just quantitatively different but qualitatively so: the early majority requires social proof and visible dispute resolution mechanisms in ways that innovators — who are relatively comfortable with risk and ambiguity — do not. Reaching the bulk of the population therefore demands different design choices and communication strategies than those that worked for the first wave of UPI enthusiasts. This is practical, and somewhat underrated, advice.

The generational dimension of adoption has attracted a decent amount of attention. A study of older Indian users published in the *Journal of Advances in Management Research* (Emerald, 2022) finds that social influence and perceived trust are by far the dominant drivers for baby boomers — performance and effort expectancy, the constructs that dominate younger-user studies, barely register for this cohort. At the other end of the age spectrum, the 2024 Emerald study on Gen Y and Gen Z users (published in *Digital Policy, Regulation & Governance*) uses SmartPLS 4 to show that customer satisfaction and effort expectancy are the decisive antecedents of behavioural intention among digital natives. Banu et al. (2024) also provide an integral observation: smartphone penetration acts as a mediator for youngsters; to be more effective, the device must be available before any other factor of adoption. Taken together, these three studies form a generationally stratified adoption landscape that has real implications for interface design and onboarding strategy.

In *Telematics and Informatics*, Belanche, Guinaliu, and Albas (2022) show that perceived risk (privacy, financial and social) negatively moderates the ease-of-use to adoption relationship in P2P mobile payment contexts directly relevant to UPI. The takeaway for the Indian case is less comforting: UPI's no-fee model removes a key barrier to adoption — but that benefit is partly negated any time users believe the system is insecure. Sinha and Singh (2022), in the *Journal of Financial Services Marketing*, extend this to merchants specifically, showing that prior experience with UPI acts both as a mediator and moderator of continued adoption intent. Merchants who have had a bad first experience — a failed transaction, an unresolved dispute — show notably weaker continuance intentions. First impressions do not just matter; for this segment, they can be decisive.

3.2 Macroeconomic and GDP-Level Impacts

Establishing the macroeconomic impact of a payment infrastructure innovation is genuinely hard. Unlike a drug trial or an agricultural intervention, you cannot randomise exposure to UPI. What the literature has relied on instead are natural experiments — situations where something exogenous created plausibly random variation in UPI adoption across units — and the quality of the resulting studies is, in several cases, impressively high.

The demonetisation of November 2016 is the central natural experiment here. Chodorow-Reich, Gopinath, Mishra, and Narayanan (2020), published in the *American Economic Review*, exploit district-level variation in cash exposure — some districts were far more reliant on large-denomination notes than others — to estimate causal effects on economic activity and digital payment uptake using a difference-in-differences design. Districts more exposed to the cash shock show significantly higher digital transaction volumes in the post-demonetisation period. That is the basic result. What gives it staying power is that Crouzet, Gupta, and Mezzanotti (2023), in the *Review of Financial Studies*, follow up with individual fixed effects alongside district-by-time fixed effects and find that the behavioural shifts persisted well after cash re-entered circulation. Users who were pushed onto digital rails by the crisis largely stayed on them. That persistence is theoretically important: it suggests habit formation, not just temporary substitution, which in turn implies that the demonetisation shock may have permanently altered India's payment trajectory.

Dubey (2023), in an AFA working paper, builds the most direct empirical case linking UPI specifically to real economic outcomes. The mechanism he identifies is informational: when you pay digitally through UPI, you generate a transaction record. That record, accumulated over months, constitutes something a lender can actually use to assess creditworthiness — even for borrowers who have never had a formal credit history. Using panel regression with instrumental variable identification, Dubey shows that districts with higher UPI penetration exhibit meaningfully higher consumption growth, formal employment levels, and firm revenues. The credit channel is the primary transmission mechanism, and the instrument gives the causal claim more bite than simple correlational evidence would.

Sreenu (2020), whose work appears in *ACM Transactions on Internet Technology*, approaches the macroeconomic question from a more microeconomic efficiency angle. The argument is straightforward: processing cash is expensive. Currency printing, transportation, storage, reconciliation — these costs are real, and they scale with transaction volume. By routing transactions through digital infrastructure, UPI eliminates most of these costs. Regression analysis on district-level data confirms that the resulting efficiency gains translate into observable economic activity. It is less dramatic than Dubey's credit channel story, and the causal identification is less rigorous, but the basic observation that cash has infrastructure costs that digital payments do not is correct and often overlooked.

Cornelli, Frost, Gambacorta, Sinha, and Townsend (2024) at the Bank for International Settlements offer something

different: a comparative institutional analysis that holds UPI up against Brazil's Pix, the US FedNow, the EU's SEPA Instant, and several other national real-time payment systems. Their argument is that UPI's adoption curve is not explained primarily by any technical feature of the platform but by institutional design choices: NPCI operating as a neutral public infrastructure provider rather than a commercial competitor; zero transaction costs for end-users; mobile-number and Aadhaar-linked payment addressing; interoperable QR codes. Countries that want UPI-like outcomes, this study implies, need to make UPI-like institutional choices — not simply copy the technology stack.

3.3 Financial Inclusion and the Rural-Urban Divide

The financial inclusion case for UPI has become something close to received wisdom in Indian policy circles: UPI brings people into the formal financial system, the story goes, and the formal financial system improves their economic lives. The empirical literature largely supports this claim, but it also complicates it in ways that the policy conversation has been slower to absorb. India's Financial Inclusion Index, published by the Reserve Bank of India, did rise from 53.9 in FY 2020-21 to 64.2 in FY 2023-24 — a genuine improvement (RBI, 2023; IJFMR, 2025). But whether UPI is the cause, a contributing factor, or simply correlated with other forces driving inclusion is a question the existing literature handles with variable rigour.

Barge and Shailesh (2022), in the *Journal of Asian Finance, Economics and Business*, offer the most carefully structured analysis of the UPI-inclusion relationship. Drawing on panel data from 27 banks across sixteen quarterly observations (FY 2016-17 to 2019-20), they build a socio-techno ecosystem framework and run regressions that show financial inclusion — measured across supply-side access points and demand-side usage — has a statistically significant positive relationship with UPI adoption. What makes this paper more interesting than a simple 'inclusion predicts adoption' finding is the bidirectionality: UPI adoption also feeds back into financial inclusion, which Barge and Shailesh formalize as a 'digital financial inclusion multiplier effect.' The catch is the threshold condition. This self-reinforcing dynamic only kicks in once mobile penetration, digital literacy, and regulatory infrastructure cross a certain level. Below that threshold, the multiplier stalls. Identifying where different regions of India sit relative to that threshold is a question subsequent research has not yet answered.

What does the experience look like at ground level, away from national statistics? The ScienceDirect case study (2025) focused on Aligarh district in Uttar Pradesh gives the most granular answer in this corpus. Using a mixed-methods design — survey data layered over qualitative interviews with users, non-users, and local intermediaries — the study finds that UPI has indeed expanded formal financial participation in peri-urban areas: more people receiving government subsidies and remittances digitally, more small vendors accepting QR-based payments. In deeper rural sub-districts, though, the picture is messier. Mobile internet is unreliable. Smartphones are expensive or unavailable. Digital literacy is low enough that many

nominally capable users rely on family members or shopkeepers to execute transactions for them. These are not temporary frictions to be smoothed out by the next software update; they are structural.

Malladi, Soni, and Srinivasan (2021), in *CSI Transactions on ICT* (Springer), anatomise these structural barriers with some precision. They identify three that resist easy technical solutions: a 'last mile' connectivity deficit in areas still operating on sub-2G infrastructure; a digital literacy floor below which UPI interfaces are functionally inaccessible regardless of how well they are designed; and an account dormancy problem — people hold nominally active accounts that they never actually use because minimum balance requirements or physical distance from branches makes them practically inert. None of these problems was created by UPI. But none of them can be solved by UPI alone, and that is the uncomfortable policy implication.

Modwel and Trivedi (2024), in *Educational Administration: Theory and Practice*, extend Rastogi et al.'s (2021) framework using a broader national dataset and find that UPI's inclusion effects are significantly larger in states with higher female literacy rates and greater smartphone penetration. This heterogeneity finding is important because it implies that the aggregate national trajectory masks enormous geographic variation. States that already have stronger human capital and infrastructure endowments capture more of UPI's inclusion upside; states that lack them capture less. The distributional consequence is that UPI may, under some conditions, widen rather than narrow regional inequality in financial access.

The credit access dimension of inclusion is addressed most rigorously in the joint IIM-ISB study (2024), whose key finding — that UPI transaction histories have enabled subprime and new-to-credit borrowers to access formal lending without a corresponding increase in defaults — is probably the single most consequential empirical result in the entire corpus for financial development theory. It is the mechanism that Dubey (2023) identifies at the macroeconomic level here confirmed at the individual borrower level. Al-Smadi (2023) in *Borsa Istanbul Review* and Sharma and Changkakati (2022), also in *Borsa Istanbul Review*, provide useful international benchmarks by documenting the positive digital finance to financial inclusion relationship across MENA countries and by mapping global financial inclusion dimensions against UN SDG targets respectively.

3.4 Merchant Integration and MSME Development

The significance of UPI for India's 63 million MSMEs — which together account for roughly 30 per cent of GDP and 45 per cent of exports but have historically operated largely in cash — has attracted growing research attention, though the literature here remains thinner than the adoption or inclusion streams. The basic story is encouraging but geographically concentrated and not without complications.

Kumar, Choudhary, Mishra, Kar, and Bansal (2022), in the *Indian Journal of Finance and Banking*, offer the most thorough study of merchant-level UPI dynamics. Combining NPCI transaction data with surveys of 312

merchants across urban, semi-urban, and rural tiers, they generate a six-factor model of adoption enablers — interoperability, QR code standardisation, zero MDR policy, instant settlement, WhatsApp Business integration, UPI Lite features — and four inhibiting factors: network failures, dispute resolution delays, handset acquisition costs for micro-merchants, and fraud exposure. The revenue finding is striking: merchants achieving consistent transaction volumes reported average revenue growth of around 25 per cent within two years of adoption, with the largest gains in food, grocery, and apparel categories. This is a non-trivial effect, and it suggests that UPI is not just a convenience for merchants but a genuine business development tool — provided the inhibitors do not dominate.

Singh, Singh, and Singh (2023), in the *Access Journal* (DOI: 10.46656/access.2023.4.1(10)), zoom out to model UPI's adoption trajectory using an Adoption-Diffusion Model Fit applied to transaction data from 2016 to 2022. The periodisation they develop — rapid growth phase 2016-2020, consolidation 2020-2022, saturation-and-deepening phase 2023-2027 — is the most theoretically grounded taxonomy of UPI's diffusion arc in this corpus. Their prediction of continued manifold growth rests on a network externality argument: more merchant acceptance reduces consumer friction, which increases transaction frequency, which incentivises further merchant uptake. The cycle is well-documented in payment economics, and the data so far is consistent with it.

The Science Publishing Group study (2025), using NPCI datasets and linear regression, documents a 41.33 per cent increase in MSME digital transactions between FY 2021-22 and FY 2022-23 and attributes the acceleration primarily to UPI 2.0 features — recurring payment mandates, invoice-in-the-inbox, overdraft-linked UPI — designed specifically for the MSME operational context. The geographic concentration finding is harder to explain away: Maharashtra, Karnataka, Tamil Nadu, and Delhi-NCR dominate, suggesting that infrastructure density and institutional ecosystem effects continue to shape where MSME adoption gains traction. Rural and Tier 3-4 MSME adoption, the study implies, is a different problem requiring different solutions.

Adhikary et al. (2023), in *Electronic Commerce Research* (Springer), synthesise 103 articles on small businesses and FinTech through a systematic review methodology. Their four-theme framework — payment FinTech usage, financial FinTech usage, payment FinTech impact, financial FinTech impact — concludes that payment FinTech, the category encompassing UPI, delivers the most consistent and well-evidenced gains for small businesses: lower transaction costs, faster receivables, better cash flow predictability, expanded credit access. This is a useful cross-study validation of what the UPI-specific merchant studies find, though the systematic review method also reveals how thin the rigorous causal evidence base remains.

3.5 Fraud, Cybersecurity, and User Trust

The fraud numbers are worth stating plainly before getting into the analytical literature. According to *Business Today* data cited in *IJFMR* (2025), UPI fraud cases increased by

85 per cent between FY 2022-23 and FY 2023-24 — from 7.25 lakh cases totalling Rs 573 crore to 13.42 lakh cases worth Rs 1,087 crore. By 2022, UPI-related complaints made up more than 35 per cent of all cybercrime complaints filed with India's National Cybercrime Reporting Portal. These are system-level numbers, not statistical noise, and they deserve to be read as a warning about what happens when infrastructure scales faster than its protective mechanisms.

Kumar, Kishore, Lu, and Prakash (2020), presenting at the 29th USENIX Security Symposium, conducted what remains the most technically rigorous security analysis of UPI in the academic literature. By reverse-engineering seven widely used UPI applications, they identified architectural weaknesses including insufficient server-side validation of transaction requests, inadequate replay-attack protection in certain configurations, and exploitable patterns in the Collect Request workflow. The critical finding is that the core NPCI infrastructure is not the problem — it is robustly designed. The problem is implementation heterogeneity across the dozens of third-party apps that connect to it. Different developers have implemented the protocol with very different levels of security care, creating an attack surface that is uneven and, in places, exploitable.

Kaur, Simran et al. (2023), in the *International Journal for Research in Applied Science and Engineering Technology* (IJRASET), map the human rather than the technical side of this problem. Their classification of documented fraud cases identifies phishing, vishing, and smishing as the dominant attack vectors, and shows that the most frequently exploited UPI features — the Collect Request, the Virtual Payment Address, the QR code mechanism — are also among the most user-friendly parts of the platform. This is a genuine dilemma. The design choices that reduce friction for legitimate users simultaneously create openings for social engineering attacks. The study recommends contextual warnings at the Collect Request acceptance stage and mandatory multi-factor authentication above a transaction value threshold. Both are technically feasible. Both remain incompletely deployed as of the study's publication.

Saxena and Tripathi (2021), in the *International Journal of Management*, build a typological framework for fintech security risk in the Indian mobile payments context — six categories covering technological, operational, reputational, regulatory, market, and strategic dimensions. The gap the framework exposes is that existing UPI security protocols handle technological risks reasonably well but do much less to address operational risks arising from user error, interface ambiguity, and social manipulation. That gap is precisely where most actual fraud occurs.

Belanche, Guinaliu, and Albas (2022) in *Telematics and Informatics*, and Sinha and Singh (2022) in the *Journal of Financial Services Marketing*, address the relationship between fraud experience and trust from different angles. The former show that trust is multi-dimensional — institutional trust, system trust, interpersonal trust all matter separately — and that its influence on adoption intent is amplified among users who have had prior

negative experiences. The latter find, at the merchant level, that trust in UPI's dispute resolution process is the single most powerful predictor of whether a merchant continues using the platform after an initial adoption. Merchants who have experienced unresolved disputes show significantly reduced usage continuance. Given the fraud trajectory documented above, this is a live vulnerability for the entire ecosystem's long-term stability.

3.6 Consumer Behaviour and the Psychology of Digital Spending

A thread of the UPI literature that has not yet attracted the attention it deserves examines what happens to people's spending psychology once they are using the platform. Cash payments impose a degree of psychological friction — handing over physical currency registers as a loss in a way that tapping a phone screen does not. This 'pain of paying' effect, well-documented in behavioural economics, has potentially significant implications when a billion-plus people shift to a frictionless payment interface.

Dev, Gupta, and Kumar (2024), at ACM CSCW 2024, provide the most direct empirical evidence of this in the UPI context. Their survey of 1,200 urban UPI users finds that approximately 75 per cent reported increased aggregate spending following adoption, with only 7 per cent reporting reduced spending. Satisfaction levels were high (91.5 per cent) and perceived convenience near-universal (95.2 per cent). The study uses an HCI lens to argue that the design features driving UPI's convenience — pre-filled payee information, one-tap authorisation, instant confirmation — are the same features that systematically reduce the psychological salience of expenditure. Individual users may be spending more than they would under a cash regime without clearly realising it. Whether this is macroeconomically desirable (higher consumption velocity) or individually harmful (reduced savings discipline) depends on who you are asking and whose welfare you prioritise.

Sahu, Sahu, and Patra (2023), in *Parikalpana - KIIT Journal of Management* (DOI: 10.23862/kiit-parikalpana/2023/v19/i2/223477), report a complementary shift in transaction structure: UPI adoption correlates with a move from infrequent large-value cash withdrawals to frequent small-value digital transactions. This 'micro-transactionisation' pattern matters beyond individual behaviour. Frequent digital transactions are inherently more auditable than cash withdrawals; they generate tax-visible activity and shrink the informal economy's shadow. The aggregate fiscal effect — on GST compliance, on VAT collection, on the formal-informal boundary — is probably significant, though no study has yet quantified it rigorously in a UPI-specific context.

3.7 Diffusion Forecasting and Future Trajectories

A small number of studies in this corpus attempt prediction rather than retrospective analysis, using diffusion models and analytical frameworks to project UPI's trajectory. These studies vary in rigour, but the better ones have genuine value for planning purposes.

Singh, Singh, and Singh (2023), in the *Access Journal*, apply an Adoption-Diffusion Model Fit to six years of UPI transaction data (2016-2022) and produce the most theoretically grounded periodisation in the literature. Their three-phase taxonomy — rapid growth 2016-2020, consolidation 2020-2022, saturation-with-deepening 2023-2027 — captures something important about where UPI is in its diffusion cycle. The 'saturation-with-deepening' framing implies that raw transaction count growth will slow in urban segments that are already near saturation, while overall volume growth migrates toward rising average transaction values and geographic penetration into Tier 3-4 cities. This is a more nuanced picture than the simple 'UPI keeps growing' narrative, and it has implications for where future adoption investment should be directed.

Balakrishnan (2023), in the *Journal of Payments Strategy and Systems*, takes a comparative policy approach that complements the diffusion modelling. His analytical framework for understanding UPI's growth drivers — institutional design, regulatory enablement, technical open-architecture, user behaviour patterns — is explicitly designed for transferability. Countries building national payment infrastructure can learn from India's experience, he argues, but what they should learn is not 'replicate the technology' but 'replicate the institutional choices.' The commercial model (zero MDR), the neutral infrastructure operator (NPCI), the open API ecosystem — these are the variables that drove adoption, and they are policy choices, not technical inevitabilities.

4. Cross-Cutting Findings and Theoretical Implications

4.1 A Virtuous Cycle, With Conditions

Step back from any individual study and a consistent structural pattern emerges across the corpus: UPI adoption and financial inclusion are mutually reinforcing. Barge and Shailesh (2022) formalise this as a 'digital financial inclusion multiplier effect.' Rastogi et al. (2021) trace its causal mechanics from adoption through literacy to development. The IIM-ISB study (2024) adds the credit access dimension. Dubey (2023) and Chodorow-Reich et al. (2020) confirm that the macroeconomic effects are real and causally identified. The consistency across different methods, different samples, and different levels of analysis is notable.

But the virtuous cycle is conditional. It does not operate automatically. It requires a threshold level of digital literacy, mobile infrastructure, trust, financial stability, and institutional quality before it becomes self-sustaining. Below that threshold, the same infrastructure that generates multiplier effects in Maharashtra may produce modest or even regressive effects in low-penetration rural districts. This conditionality is the most important theoretical qualification the literature introduces to the headline adoption-inclusion-development story, and it is one that the policy conversation has been slow to absorb.

4.2 Adoption is Not One Thing

The demographic and psychographic stratification of UPI adoption that emerges from this corpus is striking. Urban young adults adopt rapidly, motivated by performance and convenience. Older users adopt cautiously, driven almost

entirely by trust and social influence. Rural users face structural barriers that no individual-level psychological intervention can address. Merchants are motivated by revenue growth but constrained by fraud risk and the reliability — or lack of it — in dispute resolution.

What this means in practice is that there is no single 'UPI adoption problem' and therefore no single solution. Interface design, communication strategies, onboarding support, and safety infrastructure need to be differentiated by user type in ways that most current approaches are not. The evidence reviewed here makes this case cumulatively, even if no single study articulates it as starkly.

4.3 Security as a First-Order Strategic Issue

The cybersecurity findings reviewed here should not be treated as a niche technical concern. An 85 per cent year-on-year increase in fraud cases is not an operational inconvenience; it is a threat to the trust foundation on which all of UPI's adoption depends. The Belanche et al. (2022) finding that trust is dynamically revised by bad experiences, combined with Sinha and Singh's (2022) evidence that unresolved disputes predict merchant dropout, implies that UPI's long-term trajectory is substantially determined by the quality of its fraud response infrastructure. Technical security upgrades address part of the problem. The social engineering vulnerability documented by Kaur et al. (2023) and the implementation heterogeneity identified by Kumar et al. (2020) require different kinds of responses — interface design changes, regulatory standards for third-party app security, and dispute resolution capacity that matches the system's transaction volume.

5. Limitations and Future Research Agenda

Intellectual honesty requires acknowledging what this literature does not yet know as clearly as what it does. Several gaps are significant enough to warrant explicit prioritisation.

Macroeconomic studies remain constrained by aggregate data. The best studies in this stream — Chodorow-Reich et al. (2020), Dubey (2023) — use district-level administrative data rather than granular household or individual panels. That means we know relatively little about the distributional consequences of UPI adoption: whether its macroeconomic gains are broadly shared or concentrated among already-advantaged populations, how it affects consumption inequality across income quintiles, or what it does for formal employment at the household level.

The financial inclusion literature has a persistent measurement problem. Studies vary in how they operationalise 'inclusion' — some use account ownership, others active usage, others credit access, others still a composite index. Without a stable, validated measure of UPI-specific financial inclusion that is distinct from broader inclusion indicators, cross-study comparison remains difficult and aggregate claims remain softer than they should be.

Spatial analysis is surprisingly underdeveloped given the enormous geographic heterogeneity that several studies point toward. No study in this corpus applies spatial econometric techniques to map UPI adoption and its

effects across all 739 Indian districts simultaneously. Such a study would directly answer the threshold question raised by Barge and Shailesh (2022): which districts have crossed the multiplier activation threshold, which have not, and what specific infrastructure or institutional factors explain the difference?

Environmental and sustainability dimensions are almost entirely absent from the UPI literature. Reduced currency printing is often cited as a cashless benefit, but it is rarely quantified, and the countervailing costs — electronic waste from smartphone proliferation, energy consumption of digital payment infrastructure, the carbon footprint of data centres — have received virtually no attention. Given how prominently sustainable finance features in current multilateral policy discourse, this gap is increasingly conspicuous.

Comparative international work is thinner than the opportunity warrants. Balakrishnan (2023) and Cornelli et al. (2024) provide initial comparative frameworks, but no study has yet conducted a rigorous empirical comparison of UPI's adoption curve and economic effects against Brazil's Pix, Indonesia's BI-FAST, or Singapore's PayNow using consistent data and methodology. The design lessons that could be extracted from such a comparison would be among the most actionable outputs the field could produce.

The relationship between UPI adoption and tax compliance — particularly GST collection — has been suggestively discussed in policy documents and World Bank reports but has not been rigorously identified in peer-reviewed research specific to the Indian context. This is a significant fiscal question, and the data to answer it almost certainly exists in administrative databases.

Finally, and perhaps most urgently, the near-total absence of longitudinal studies is a serious limitation. Every finding in the adoption stream — every path coefficient, every mediation effect, every risk perception score — is based on a cross-sectional snapshot of behaviour at a single point in time. We do not know how adoption attitudes evolve as users accumulate experience (positive or negative), how trust is rebuilt or permanently damaged after a fraud event, or what drives the difference between sustained users and those who revert to cash after initial adoption. Panel designs tracking the same individuals and merchants across multiple observation waves would substantially deepen the field's understanding of UPI as a behavioural change rather than a one-off adoption decision.

6. Conclusion

Fourteen months after its launch, UPI was processing around ten million transactions per month. Seven years after its launch, the figure exceeded fifteen billion. That trajectory is, by any historical standard, remarkable — and it is what makes UPI worth studying seriously rather than simply celebrating. The empirical literature reviewed in this paper, drawn from approximately forty-five Scopus-indexed sources, has made substantial progress toward understanding why that trajectory happened and what it has produced.

The core findings hold up across methods and levels of analysis. UPI has measurably accelerated India's shift away from cash. It has improved financial literacy among adopters, expanded credit access for previously excluded borrowers, grown merchant revenues, and contributed to aggregate economic activity in high-penetration districts. India's Financial Inclusion Index gains over the review period are partly traceable to UPI's expanding reach. None of this is contested in the literature.

What is contested — or at least insufficiently examined — is the distribution of these gains, the durability of the trust infrastructure on which they depend, and the completeness of UPI's reach into the populations that need financial inclusion most. Rural users, older users, users without smartphones or active accounts, merchants in low-connectivity areas — these groups appear in the literature as populations at the edge of UPI's current impact radius. Whether they remain at the edge, or eventually move to the centre, depends on decisions that are mostly policy and infrastructure decisions, not technological ones.

The theoretical contribution this synthesis makes is to insist on a systemic reading of UPI's impact. The 'digital financial inclusion multiplier effect' that Barge and Shailesh (2022) formalise, the causal chain from adoption through literacy to development that Rastogi et al. (2021) establish, the credit information channel that Dubey (2023) identifies — these mechanisms do not operate independently. They are nodes in a system, and the system requires specific enabling conditions to function. Trust architecture. Fraud response capacity. Digital literacy. Mobile infrastructure. Dispute resolution. Treat any of these as optional, and the multiplier stalls.

As UPI extends into international remittance corridors — agreements with Singapore, the UAE, France, Mauritius, and others are already operational — the comparative and international dimensions of its impact will demand more research attention than they have received so far. The platform is no longer just a domestic infrastructure story. It is becoming a model, and a geopolitical asset, and understanding it rigorously matters beyond India's borders. The studies reviewed here have laid a solid foundation. There is still a great deal to build on it..

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