

Digital Payment Ecosystems and Consumer Trust: A Post-UPI Perspective

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Abstract: The Unified Payments Interface (UPI), launched by India’s National Payments Corporation of India (NPCI) in 2016, has fundamentally transformed the digital payment landscape, evolving from a disruptive innovation to essential financial infrastructure. This research examines how consumer trust dynamics have shifted in the post-UPI era, where UPI processes over 20 billion monthly transactions and accounts for 84% of India’s digital payments [1]. The study integrates Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) constructs with trust theory to develop a comprehensive framework for understanding consumer trust in mature digital payment ecosystems. Key findings reveal that trust determinants have evolved from brand-based considerations to infrastructure-level confidence, encompassing perceived security, data privacy architectures, regulatory oversight, and interoperability. The research identifies an “invisible trust” paradox where ubiquitous infrastructure becomes taken for granted, potentially creating new vulnerabilities. With UPI handling 50% of global real-time digital transactions and expanding internationally, understanding these trust dynamics is crucial for policymakers, platform designers, and financial institutions navigating the post-infrastructure phase of digital payments evolution.

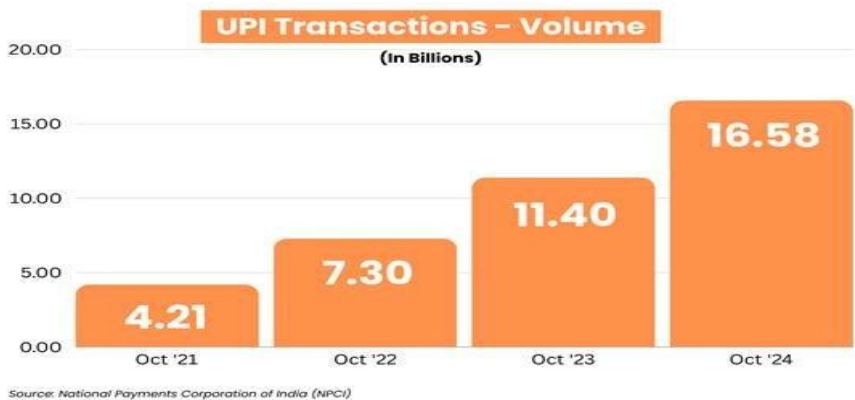
Keywords: Digital payments, UPI, consumer trust, technology acceptance, financial infrastructure, NPCI, digital transformation, payment ecosystems.

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Introduction

The global digital payments landscape has witnessed unprecedented transformation over the past decade, with India emerging as a defining case study through its Unified Payments Interface (UPI) implementation [4]. Launched on April 11, 2016, by the National Payments Corporation of India (NPCI), UPI has evolved from an experimental payment system to the world’s largest real-time payment infrastructure, processing over 640 million transactions daily and surpassing even Visa’s global transaction volumes [4][5].

This transformation represents more than technological advancement; it signifies a fundamental shift in how consumers conceptualize and interact with digital payment systems. In the pre-UPI era, digital payments in India were fragmented across multiple platforms, each requiring separate trust evaluations. Today, UPI accounts for 84% of India’s digital payments, with monthly transaction volumes exceeding 20 billion and annual values reaching \$3.4 trillion [4][16]. The platform’s success has made it a “soft power tool” for India, inspiring similar implementations globally and establishing new benchmarks for real-time payment systems [4].



UPI transaction growth demonstrating India’s digital payment transformation [Source: Press Information Bureau]

The post-UPI landscape presents unique research challenges. When a payment system transitions from innovation to infrastructure, traditional technology acceptance models require reconsideration. The research question emerges: what shapes consumer trust in digital payment ecosystems in the post-UPI era, when UPI has become default infrastructure rather than a new entrant? This inquiry is particularly relevant as UPI's dominance creates new trust dynamics, where consumers must navigate between platform-level trust (PhonePe, Google Pay, Paytm) and infrastructure-level confidence (UPI, NPCI, RBI oversight).

The significance extends beyond India's borders. With UPI expanding to Singapore, UAE, Bhutan, Nepal, and other countries, and handling 49% of global real-time digital payments, understanding these trust mechanisms becomes crucial for international digital payment strategy [6][16]. The post-UPI perspective offers insights into how mature digital payment ecosystems function when infrastructure trust becomes embedded in daily economic activity.

2. Literature Review

Technology Acceptance Models in Digital Payments

The Technology Acceptance Model (TAM), developed by Davis (1989), has been extensively applied to understand digital payment adoption [12][24]. TAM's core constructs—perceived usefulness and perceived ease of use—have proven relevant in payment contexts, with studies consistently showing their influence on behavioral intention [24]. However, the model's limitations become apparent in post-adoption scenarios where technology has achieved ubiquity.

The Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), provides a more comprehensive framework by integrating performance expectancy, effort expectancy, social influence, and facilitating conditions [12]. UTAUT's strength lies in its consideration of moderating factors including age, gender, experience, and voluntariness of use, making it particularly relevant for understanding diverse user populations in mature payment ecosystems.

Figure 1.

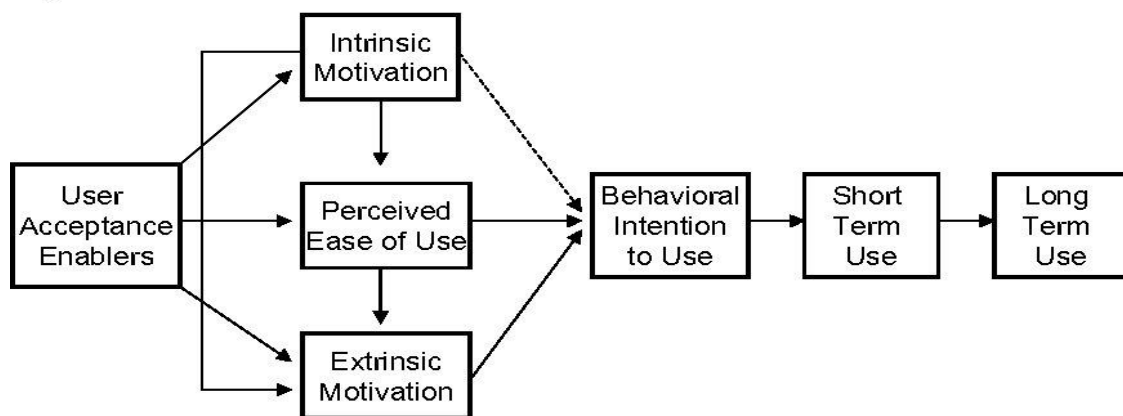


Figure 1. Integrated model (Venkatesh et al. 2002)

Integration of trust constructs with technology acceptance models in payment systems [Source: Semantic Scholar]

Recent studies have extended these models to incorporate trust as a mediating variable [24]. Research by Merhi, Hone, and Tarhini (2019) demonstrated that trust significantly mediates the relationship between UTAUT constructs and behavioral intention in mobile banking contexts [24]. This integration becomes crucial in payment systems where financial risk amplifies the importance of trust considerations.

Trust Theory in E-commerce and Digital Payments

McKnight and Chervany's (2001) trust framework distinguishes between dispositional trust (individual propensity to trust), institutional trust (confidence in structures and regulations), and trusting beliefs about specific entities [25]. This multidimensional approach has been adapted for digital payment contexts, where consumers must simultaneously trust technology platforms, financial institutions, and regulatory frameworks.

Gefen, Karahanna, and Straub (2003) demonstrated that trust acts as both an antecedent to and mediator of technology acceptance in e-commerce environments [25]. Their work established that trust reduces perceived risk and uncertainty, making users more willing to engage with digital systems. In payment contexts, this relationship becomes particularly pronounced due to the financial consequences of trust violations.

Contemporary research has identified several trust antecedents specific to digital payments: perceived security, privacy protection, system reliability, and institutional credibility [23][24]. Studies consistently show that security perceptions strongly influence payment system adoption, with consumers prioritizing platforms that demonstrate robust fraud protection and data safeguarding capabilities [21][23].

Digital Payment Adoption Studies

The literature on digital payment adoption has evolved from early studies focusing on individual technology acceptance to comprehensive ecosystem analyses. Research by Kim et al. (2010) established that security and trust perceptions are primary determinants of e-payment system acceptance, with trust mediating the relationship between security perceptions and usage intention [24].

Recent studies have examined the role of network effects in payment system adoption. As payment platforms achieve critical mass, network externalities become significant drivers of continued usage and ecosystem expansion [19]. This phenomenon is particularly evident in UPI's growth trajectory, where merchant acceptance and user adoption created reinforcing cycles of value creation.

Regulatory Literature and Platform Governance

The Reserve Bank of India's approach to UPI regulation has been characterized by "regulated innovation," balancing technological advancement with consumer protection [8][17]. The RBI's Payment Systems Vision documents and regulatory frameworks have established principles for interoperability, security standards, and dispute resolution mechanisms that underpin consumer trust in the UPI ecosystem [18].

NPCI's governance model, operating as a not-for-profit organization under RBI oversight, represents a unique approach to payment infrastructure management [4]. This institutional structure influences trust dynamics by providing public sector credibility while enabling private sector innovation through third-party payment service providers.

Post-UPI Scholarship (2020-2025)

Recent scholarship has begun examining the implications of UPI's maturation and dominance. Studies highlight the concentration risk, with PhonePe and Google Pay controlling over 80% of UPI transaction volumes [1][2]. This concentration raises questions about market competition and systemic risk, despite the underlying infrastructure remaining open and interoperable.

Research on UPI's international expansion has examined how trust mechanisms translate across regulatory jurisdictions [6][19]. The UPI-PayNow linkage with Singapore and integration with European payment systems demonstrate how infrastructure-level trust can facilitate cross-border payment innovation [17].

The emergence of Central Bank Digital Currency (CBDC) pilots alongside UPI has created new research questions about complementary versus competitive digital payment infrastructures [8]. Early studies suggest that CBDC and UPI serve different trust and functionality requirements, with CBDC emphasizing sovereign backing while UPI focuses on ecosystem convenience.

The Post-UPI Digital Payment Landscape

Ecosystem Architecture and Components

The post-UPI digital payment landscape represents a sophisticated multi-layered ecosystem built upon interoperable infrastructure. At its foundation lies UPI, processing over 21.6 billion transactions monthly as of December 2025, with an average daily volume of 698 million transactions [6]. This infrastructure supports multiple payment modalities including Immediate Payment Service (IMPS), Aadhaar Enabled Payment System (AePS), traditional card networks, digital wallets, and the emerging Central Bank Digital Currency (CBDC) pilot program [4][8].

The ecosystem's architecture demonstrates remarkable technical sophistication. UPI operates as an open-source API layer above IMPS, enabling 24/7 real-time settlements across 685 participating banks [1][4]. This interoperability extends beyond basic transactions to include advanced features like UPI AutoPay for recurring payments, UPI Lite for offline transactions, and UPI 123PAY for feature phone users, collectively serving over 400 million users across different technological capabilities [4][19].

UPI grows volumes on the back of mobile adoption, RTP demand UPI monthly payment volumes, 2016-2024



Source: FXC Intelligence analysis, NPCI statistics.

FXCintelligence

UPI's expanding international footprint and cross-border payment capabilities [Source: FXC Intelligence]

Recent innovations have expanded the ecosystem's scope significantly. The integration of RuPay credit cards with UPI, launched in September 2022, has doubled monthly credit card spending through UPI to ₹63,826 crore in the first seven months of FY25 [4]. UPI 3.0 features, including conversational voice payments developed with IRCTC and CoRover, demonstrate the platform's evolution toward more accessible and intuitive interfaces [4].

Market Structure and Competitive Dynamics

The post-UPI market structure reveals a fascinating paradox: while the underlying infrastructure remains open and interoperable, the application layer demonstrates significant concentration. PhonePe dominates with 48% market share, processing over 9.4 billion transactions monthly, followed by Google Pay at 35% with 7.16 billion transactions [1][2]. This duopoly controls approximately 83% of UPI transaction volumes,

despite NPCI's 30% volume cap regulation intended to prevent over-concentration [1].

The competitive landscape extends beyond these dominant players to include specialized offerings. Paytm maintains 6.1% market share with 1.52 billion transactions, while emerging platforms like Navi (2.8%), super.money (1.3%), and CRED (0.8%) target specific user segments with differentiated value propositions [1]. These niche players demonstrate how the open UPI infrastructure enables innovation in user experience and service integration, even within a concentrated market structure.

Market dynamics have shifted from user acquisition to ecosystem integration and value-added services. PhonePe's strategy encompasses investments, insurance, and merchant services, while Google Pay leverages Android integration and Google ecosystem synergies [2]. This evolution reflects the maturation from payment-focused applications to comprehensive financial service platforms built on UPI infrastructure.

Transaction Volumes and Growth Patterns

UPI transaction volumes demonstrate sustained exponential growth, with monthly transactions increasing from 1.2 billion in FY18 to over 20 billion in 2025 [1][16]. The year-over-year growth rate of 29.4% in transaction volume and 33% in transaction value indicates continued ecosystem expansion despite achieving massive scale [1]. Daily transaction volumes now exceed 640 million, surpassing Visa's global daily processing capacity and establishing UPI as the world's largest real-time payment system [4][6].

Transaction value patterns reveal interesting usage characteristics. While UPI accounts for 85% of transaction volume, it represents only 9% of total payment value, indicating its dominance in small-ticket, high-frequency transactions [16]. This contrasts with RTGS (Real Time Gross Settlement), which handles 69% of total value despite representing only 0.1% of transaction count, highlighting the ecosystem's ability to serve different payment use cases efficiently [16].

Monthly variation patterns show consistent growth with seasonal fluctuations. October 2025 saw a 9.55% month-over-month increase in transaction value to ₹27.27 lakh crore, driven by festival spending and merchant adoption [1]. This seasonal responsiveness demonstrates the ecosystem's integration into consumer behavior and economic cycles.

Interoperability and Infrastructure Trust

UPI's interoperability represents its most significant innovation, enabling seamless transactions across 685 banks and multiple payment service providers without requiring users to maintain separate relationships with each institution [1][4]. This interoperability creates what can be termed "infrastructure trust"—confidence in the underlying system that transcends individual platform preferences.

The technical implementation of interoperability through standardized APIs and common protocols has eliminated traditional banking silos. Users can initiate transactions from any UPI-enabled application to any bank account, with settlements occurring through NPCI's centralized clearing mechanism [4]. This architecture has fundamentally altered consumer expectations, making seamless cross-institutional payments the default rather than an exception.

Infrastructure trust extends to dispute resolution and grievance redressal mechanisms. NPCI's standardized processes for transaction failures, fraud reporting, and customer complaints create consistent user experiences regardless of the originating payment application [17]. This standardization has been crucial in building confidence in the ecosystem's reliability and fairness.

International Expansion and Cross-Border Integration

UPI's international expansion demonstrates how infrastructure-level trust can facilitate global payment innovation. The UPI-PayNow linkage with Singapore, operational since 2023, enables real-time cross-border remittances between India and Singapore through 19 participating Indian banks [19]. This integration showcases how mature payment infrastructures can interoperate across regulatory jurisdictions while maintaining security and compliance standards.

Recent developments include UPI integration with the Universal Postal Union (UPU) network in the UAE and ongoing work to connect with Europe's TARGET Instant Payment Settlement (TIPS) system [17][19]. These initiatives position UPI not merely as a domestic payment system but as a global payment infrastructure capable of facilitating international commerce and remittances.

The international expansion strategy emphasizes infrastructure-level partnerships rather than application-level competition. By focusing on system interoperability, UPI's global expansion creates opportunities for local payment service providers to leverage India's payment infrastructure while maintaining local market presence and regulatory compliance.

4. Theoretical Framework

Integration of TAM/UTAUT with Trust Constructs

The post-UPI digital payment landscape requires a theoretical framework that extends beyond traditional technology acceptance models to incorporate the complex trust dynamics of mature payment ecosystems. This research proposes an integrated framework combining UTAUT constructs with multi-dimensional trust theory, specifically adapted for infrastructure-level payment systems.

Performance expectancy in the post-UPI context transcends individual application features to encompass ecosystem-wide benefits. Users evaluate not just the utility of specific payment apps, but the overall value proposition of participating in an interoperable payment infrastructure [12]. This includes benefits like universal merchant acceptance, instant settlement, and seamless cross-platform transactions that emerge from infrastructure maturity rather than individual application innovation.

Effort expectancy has evolved from initial learning curves to ongoing usability considerations within a standardized interface paradigm. UPI's common interaction patterns across applications have created user expectations for consistent experiences, making effort expectancy more about interface refinement than fundamental usability [12]. The introduction of features like UPI Lite for offline payments and UPI 123PAY for feature phones demonstrates how effort expectancy considerations continue to drive infrastructure evolution.

Social influence operates at multiple levels in the post-UPI ecosystem. Beyond peer adoption pressures, social influence now

includes merchant acceptance networks, institutional endorsements, and cultural integration of digital payments into daily commerce [12]. The ubiquity of UPI QR codes and the social acceptability of digital payments represent evolved forms of social influence that reinforce ecosystem participation.

Facilitating conditions in mature payment ecosystems encompass both technological infrastructure and institutional support systems. This includes network coverage, device compatibility, regulatory frameworks, and dispute resolution mechanisms that enable confident system usage [12]. The reliability of these facilitating conditions becomes crucial for maintaining trust in infrastructure-level systems where individual transaction failures can undermine broader ecosystem confidence.

Multi-Dimensional Trust Framework

Building upon McKnight and Chervany's trust taxonomy, this research proposes a multi-dimensional trust framework specifically adapted for post-UPI payment ecosystems. The framework distinguishes between dispositional trust (individual propensity to trust digital systems), institutional trust (confidence in regulatory and governance structures), technological trust (belief in system security and reliability), platform trust (confidence in specific payment applications), and infrastructure trust (faith in the underlying payment ecosystem).

Dispositional trust influences individual willingness to adopt and continue using digital payment systems, but its impact diminishes as systems achieve ubiquity and social normalization [25]. In post-UPI India, dispositional trust factors become less predictive of usage as digital payments become socially and economically necessary rather than optional.

Institutional trust encompasses confidence in regulatory oversight (RBI), infrastructure governance (NPCI), and legal frameworks supporting digital payments [8][17]. This dimension becomes particularly important in infrastructure-level systems where users must trust institutions they may never directly interact with. The RBI's regulatory approach and NPCI's governance model significantly influence this trust dimension.

Technological trust focuses on perceptions of system security, reliability, and technical competence. In payment contexts, this includes confidence in fraud detection systems, data protection mechanisms, and system uptime [23]. The technical robustness of UPI infrastructure and its ability to handle massive transaction volumes without significant failures has been crucial in building technological trust.

Platform trust relates to confidence in specific payment applications and their operators. Despite using common UPI infrastructure, users maintain distinct trust relationships with PhonePe, Google Pay, Paytm, and other platforms based on their experiences, brand perceptions, and service quality [1][2]. This trust dimension explains continued platform competition despite infrastructure standardization.

Post-UPI Infrastructure Trust Concept

This research introduces "infrastructure trust" as a distinct construct representing confidence in ubiquitous, standardized payment systems that transcend individual platform relationships. Infrastructure trust emerges when payment systems achieve sufficient scale, reliability, and integration that they become taken-

for-granted elements of economic infrastructure, similar to electricity grids or telecommunications networks.

Infrastructure trust differs from traditional technology trust in several key aspects. First, it operates at a system level rather than focusing on individual applications or services. Users develop confidence in the overall payment ecosystem's ability to facilitate commerce, regardless of specific platform choices. Second, infrastructure trust becomes embedded in economic behavior, making it less conscious and more assumed in daily transactions.

The development of infrastructure trust follows a predictable pattern: initial skepticism and careful evaluation, gradual adoption based on positive experiences, habituation through repeated successful usage, and finally, integration into routine economic behavior where the infrastructure becomes invisible and assumed. UPI has progressed through this cycle, with many users now taking instant, interoperable payments for granted.

Infrastructure trust creates both opportunities and vulnerabilities. Positively, it enables ecosystem expansion, reduces transaction friction, and facilitates economic activity. However, it also creates systemic dependencies and potential blind spots where users may not adequately evaluate security risks or alternative options. The "invisible trust" phenomenon can lead to complacency about privacy, security, and market concentration issues.

Trust Antecedents in Mature Payment Ecosystems

The antecedents of trust in post-UPI payment ecosystems operate across multiple levels and time horizons. Immediate trust factors include transaction success rates, system responsiveness, and user interface quality. These factors influence day-to-day usage decisions and platform preferences within the broader UPI ecosystem.

Intermediate trust factors encompass security experiences, customer service quality, and dispute resolution effectiveness. These factors shape longer-term platform loyalty and willingness to engage in higher-value transactions or more complex financial services built on payment infrastructure.

Systemic trust factors include regulatory stability, infrastructure governance, and ecosystem evolution patterns. These factors influence fundamental confidence in the payment system's long-term viability and trustworthiness. Users develop beliefs about whether the system will continue to serve their interests, protect their data, and maintain fair access over time.

The interaction between these trust levels creates complex dynamics where positive experiences at one level can compensate for concerns at another, while negative experiences can cascade across levels to undermine overall ecosystem confidence. Understanding these interactions is crucial for maintaining trust in mature payment infrastructures.

5. Determinants of Consumer Trust in the Post-UPI Era

Perceived Security and Fraud Control

Security perceptions remain the foundational determinant of consumer trust in digital payment ecosystems, but the post-UPI era has transformed how consumers evaluate and experience security. The scale of UPI operations—processing over 640 million daily transactions—has necessitated sophisticated fraud detection and prevention systems that operate largely invisibly to users

[4][6]. This invisible security creates a paradox where effective security measures may be taken for granted, potentially reducing conscious security awareness.

The RBI's recent proposal for a "kill switch" mechanism for digital payments represents a significant advancement in fraud control capabilities [13]. This emergency feature would allow banks and payment service providers to instantly suspend compromised accounts or devices when fraud is suspected, potentially stopping fraudulent transactions in real-time rather than relying on post-incident recovery mechanisms. Such proactive security measures enhance consumer confidence by demonstrating institutional commitment to fraud prevention.

However, fraud patterns have evolved alongside the ecosystem's growth. Cybercriminals now target the UPI ecosystem through sophisticated social engineering attacks, mule account networks, and SIM swap frauds [13][14]. The Hyderabad Police's "Operation Octopus" revealed the complexity of modern cybercrime networks, involving hundreds of mule accounts, ghost SIM cards, and allegedly complicit insiders within financial institutions [13]. These evolved threats require consumers to develop new security awareness and trust evaluation capabilities.

Consumer trust in security measures is influenced by both actual security effectiveness and perceived security competence. Studies indicate that 1 in 5 Indians using UPI has faced fraud, yet 51% of victims never report incidents [13]. This underreporting suggests either resignation to fraud as inevitable or lack of confidence in remedial mechanisms, both of which undermine trust in the ecosystem's security effectiveness.

The implementation of two-factor authentication, biometric verification, and transaction limits has created layered security architectures that most users experience as seamless protection [17]. However, the effectiveness of these measures depends on user compliance and understanding, creating ongoing challenges in balancing security with usability in mass-market payment systems.

Data Privacy and Consent Architecture

Data privacy concerns have intensified as digital payment systems accumulate vast amounts of transactional and behavioral data. UPI transactions generate detailed records of consumer spending patterns, merchant relationships, and financial behaviors that have significant commercial and personal value [11][23]. The post-UPI era has seen growing awareness of data privacy issues, influenced by global developments in data protection regulation and high-profile data breaches.

The RBI's recent guidelines on data privacy and consent management reflect regulatory recognition of these concerns [11][17]. The prohibition of "dark patterns" in banking interfaces, effective July 2026, specifically addresses manipulative design practices that trick users into unintended data sharing or service subscriptions [11]. This regulatory intervention demonstrates institutional commitment to protecting consumer privacy rights within digital payment ecosystems.

Consumer understanding of data privacy practices varies significantly across user segments. While technically sophisticated users may actively manage privacy settings and evaluate data sharing policies, mass-market users often accept default settings without fully understanding privacy implications [23]. This knowledge gap creates vulnerabilities where users may

unknowingly compromise their privacy through routine payment system usage.

The implementation of data localization requirements and consent management frameworks has created complex technical and legal architectures that most consumers never directly encounter. Trust in these systems depends largely on institutional credibility and regulatory oversight rather than direct user evaluation of privacy practices [20]. This institutional mediation of privacy protection represents a shift from individual privacy management to systemic privacy governance.

Cross-border data flows associated with UPI's international expansion create additional privacy complexities. As UPI integrates with payment systems in Singapore, UAE, and European countries, consumer data may be subject to different privacy regulations and protection standards [17][19]. Managing these cross-jurisdictional privacy requirements while maintaining user trust presents ongoing challenges for ecosystem governance.

Grievance Redressal and Dispute Resolution

Effective dispute resolution mechanisms are crucial for maintaining consumer trust in high-volume payment systems where individual transaction failures can undermine broader ecosystem confidence. NPCI has implemented standardized grievance redressal processes that operate across all UPI-enabled platforms, creating consistent user experiences regardless of the originating payment application [17].

The RBI's proposed Reserve Bank Ombudsman Scheme 2025 aims to streamline complaint resolution processes and reduce resolution timelines [17]. This initiative reflects recognition that dispute resolution effectiveness directly impacts consumer trust and ecosystem stability. The scheme's emphasis on digital complaint filing and tracking mechanisms aligns with user expectations for efficient, transparent resolution processes.

However, the complexity of multi-party payment ecosystems creates challenges in dispute attribution and resolution. When transactions involve multiple intermediaries—payment apps, banks, merchants, and infrastructure providers—determining responsibility and coordinating resolution can be complex and time-consuming. Users may experience frustration with resolution processes that seem opaque or inefficient, undermining trust in the system's fairness and reliability.

The effectiveness of dispute resolution depends not only on formal mechanisms but also on user awareness and accessibility. Many consumers are unaware of available grievance redressal channels or find them difficult to navigate [14]. This accessibility gap can leave users feeling helpless when problems occur, reducing confidence in the system's ability to protect their interests.

Recent initiatives to integrate artificial intelligence and automated resolution systems aim to improve dispute resolution efficiency and consistency. However, these technological solutions must balance automation benefits with the need for human judgment in complex cases, ensuring that users feel heard and fairly treated in resolution processes.

Interoperability and Switching Costs

UPI's interoperability represents one of its most significant trust-building features, enabling users to transact across different platforms and banks without being locked into specific provider

relationships. This interoperability reduces switching costs and increases user confidence by ensuring that payment capabilities are not dependent on single provider relationships [4][16].

The ability to change payment applications while maintaining access to the same underlying infrastructure and merchant networks provides users with flexibility and reduces concerns about vendor lock-in. Users can experiment with different applications, switch based on feature preferences or service quality, and maintain continuity in their payment capabilities [1][2].

However, interoperability also creates potential trust challenges. When multiple parties are involved in transaction processing, users may be unclear about responsibility for problems or security breaches. The distributed nature of the ecosystem can make it difficult for users to understand who to trust and who to hold accountable for system performance.

Recent NPCI initiatives to enable UPI mandate portability and cross-platform autopay management demonstrate ongoing efforts to enhance interoperability while maintaining security and reliability [17]. These features allow users to transfer recurring payment arrangements between applications, further reducing switching costs and increasing user control over their payment relationships.

The success of interoperability in building trust depends on maintaining consistent user experiences and service quality across different platforms. When interoperability enables seamless functionality, it builds confidence in the ecosystem's robustness and user-centricity. When interoperability creates confusion or inconsistent experiences, it can undermine trust in the system's coherence and reliability.

Network Externalities and Herd Behavior

Network effects play a crucial role in post-UPI trust dynamics, where the value of participation increases with the number of other participants. As UPI achieved critical mass with over 685 participating banks and millions of merchants accepting UPI payments, the network externalities created powerful incentives for continued participation and trust [1][4].

The ubiquity of UPI QR codes and universal merchant acceptance has created a self-reinforcing cycle where consumer confidence grows with ecosystem participation. Users develop trust not only in the technical capabilities of the payment system but also in its social and economic acceptance. This social proof becomes a significant factor in trust formation and maintenance.

Herd behavior influences trust through social validation of payment system usage. When digital payments become socially normal and expected, individual trust evaluation may be influenced more by social conformity than by independent risk assessment [12]. This can create both stability (through widespread acceptance) and vulnerability (through reduced critical evaluation) in trust relationships.

The concentration of market share among leading platforms (PhonePe and Google Pay controlling over 80% of transactions) creates network effects that can reinforce trust through scale and familiarity [1][2]. However, this concentration also raises concerns about market power and systemic risk that may influence long-term trust considerations.

Network externalities extend beyond domestic usage to international acceptance and cross-border functionality. As UPI

expands globally and integrates with international payment systems, the network value increases for users who engage in cross-border commerce or remittances [17][19]. This international network effect enhances trust by demonstrating the system's global viability and acceptance.

User Interface, User Experience, and Friction

The user interface and experience design of payment applications significantly influence trust formation and maintenance in the post-UPI ecosystem. While the underlying UPI infrastructure provides standardized functionality, individual applications differentiate through interface design, feature integration, and user experience optimization [1][2].

Friction in payment processes can undermine trust by creating doubt about system reliability and competence. Users expect instant, seamless transactions, and any delays, failures, or complications can reduce confidence in the system's effectiveness. The post-UPI era has seen continuous refinement of user interfaces to minimize friction while maintaining security and compliance requirements.

The RBI's prohibition of dark patterns in banking interfaces addresses trust concerns related to manipulative design practices [11]. Dark patterns that trick users into unintended actions or subscriptions can severely undermine trust by creating feelings of deception and exploitation. Regulatory intervention in interface design demonstrates recognition that user experience design has trust implications beyond mere usability.

Accessibility considerations have become increasingly important as payment systems serve diverse user populations with varying technical capabilities and physical abilities [20]. The development of UPI 123PAY for feature phone users and voice-based payment interfaces demonstrates efforts to ensure that trust-building user experiences are available across different technological contexts [4].

The balance between security measures and user experience continues to evolve as systems mature. While security requirements may introduce friction through authentication steps and verification processes, users generally accept such friction when they understand its protective purpose and when it is implemented efficiently and transparently.

Regulatory Trust and Institutional Confidence

Trust in regulatory oversight and institutional governance represents a fundamental layer of confidence in digital payment ecosystems. The RBI's role as both regulator and policy architect for digital payments creates institutional credibility that underpins consumer trust in the broader ecosystem [8][17][18].

The establishment of NPCI as a not-for-profit organization under RBI oversight provides institutional structure that balances public interest with private sector innovation. This governance model influences consumer trust by demonstrating that the payment infrastructure operates under public oversight rather than purely commercial interests [4].

Recent regulatory initiatives, including the Framework for Responsible and Ethical Enablement of Artificial Intelligence (FREE-AI) and enhanced cybersecurity requirements, demonstrate proactive regulatory engagement with emerging challenges [20]. Such initiatives build trust by showing that regulatory frameworks

evolve to address new risks and opportunities in the digital payment landscape.

The RBI's approach to "regulated innovation" through initiatives like regulatory sandboxes and controlled pilot programs creates confidence that new payment innovations undergo appropriate evaluation and oversight before mass deployment [20]. This regulatory diligence helps build trust in system safety and reliability.

International recognition of India's payment system innovations and regulatory approaches enhances domestic trust through external validation. When international organizations and other countries adopt UPI-inspired models or seek to integrate with Indian payment systems, it provides social proof of the system's quality and trustworthiness [5][6].

The Paradox of Invisible Trust

The post-UPI era has witnessed the emergence of what can be termed "invisible trust"—a phenomenon where payment infrastructure becomes so embedded in daily economic activity that it transitions from conscious evaluation to unconscious assumption. This invisibility represents both the ultimate success of trust-building and a potential vulnerability in trust maintenance.

When payment systems achieve infrastructure-level integration, users may stop actively evaluating trust factors and instead assume system reliability and safety. This assumption can be beneficial for ecosystem efficiency and user experience, but it may also reduce vigilance about security practices, privacy protection, and market concentration issues.

The invisibility of trust can create complacency about alternative options and competitive dynamics. Users who take UPI's capabilities for granted may not actively evaluate other payment options or consider the implications of market concentration among leading platforms [1][2]. This reduced competition awareness can undermine long-term ecosystem health and innovation.

Infrastructure trust invisibility also affects user responses to problems or failures. When systems are assumed to be reliable, individual failures may be more jarring and trust-damaging than they would be in systems where users maintain active risk awareness. Managing this expectation dynamic becomes crucial for maintaining trust in mature payment ecosystems.

The challenge for ecosystem governance is maintaining appropriate user awareness and engagement without undermining the efficiency benefits of infrastructure-level trust. This requires ongoing communication about system capabilities, limitations, and user responsibilities, while preserving the seamless user experience that makes infrastructure trust possible.

6. Challenges and Risks

Fraud Evolution and Sophisticated Attack Vectors

The post-UPI ecosystem faces increasingly sophisticated fraud challenges that have evolved alongside the system's growth and adoption. Traditional fraud prevention measures designed for smaller-scale payment systems must now contend with industrial-scale cybercrime operations that exploit the ecosystem's scale and complexity [13][14].

Social engineering attacks have become particularly sophisticated, with fraudsters using psychological manipulation to

trick users into authorizing fraudulent transactions. These attacks often involve impersonation of authority figures, creation of false urgency, and exploitation of users' limited understanding of payment system security features [13]. The effectiveness of such attacks demonstrates that technical security measures alone are insufficient without corresponding user education and awareness programs.

Mule account networks represent a significant systemic risk, enabling fraudsters to move stolen funds through multiple accounts to obscure transaction trails and complicate recovery efforts [13]. Operation Octopus revealed networks involving hundreds of mule accounts across multiple states, highlighting the organized nature of contemporary payment fraud. These networks exploit weaknesses in account opening procedures and KYC verification processes, suggesting that fraud prevention requires coordination across multiple institutions and regulatory frameworks.

SIM swap attacks targeting UPI users have become increasingly common, allowing fraudsters to gain control of users' mobile devices and bypass SMS-based authentication mechanisms [13]. These attacks exploit vulnerabilities in telecommunications security and highlight the interdependence between payment system security and broader digital infrastructure security.

The scale of UPI operations creates both opportunities and challenges for fraud detection. While large transaction volumes enable sophisticated pattern analysis and machine learning-based fraud detection, they also provide cover for fraudulent transactions and create challenges in distinguishing legitimate from suspicious activity. The system's real-time nature requires fraud detection systems to operate with minimal latency while maintaining high accuracy rates.

Systemic Risks and Infrastructure Dependencies

UPI's dominance in India's digital payment landscape creates significant systemic risks that extend beyond individual platform failures to potential ecosystem-wide disruptions. The concentration of transaction processing through NPCI's infrastructure means that any significant system failure could impact the entire digital payment ecosystem [1][4].

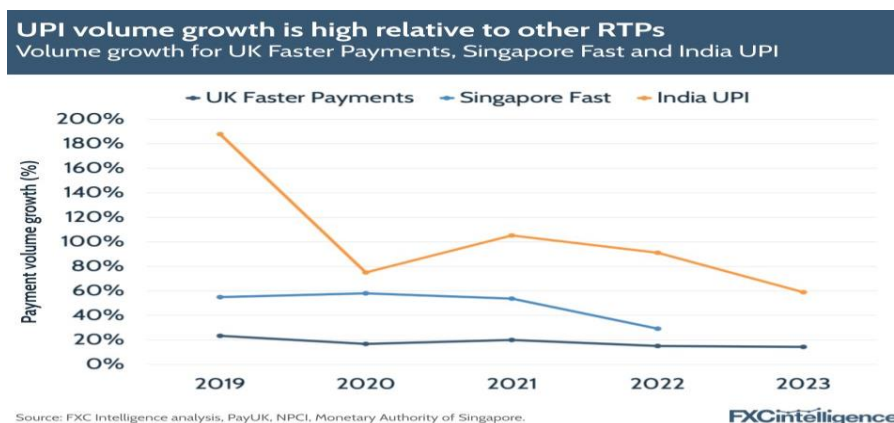
The interdependence between UPI and other critical infrastructure systems, including telecommunications networks, banking systems, and electricity grids, creates cascading risk scenarios where failures in one system can trigger broader disruptions. The COVID-19 pandemic demonstrated how external shocks can rapidly increase digital payment usage, potentially stressing system capacity and revealing infrastructure vulnerabilities.

Concentration risk among payment service providers presents another systemic challenge. With PhonePe and Google Pay controlling over 80% of UPI transaction volumes, the failure or compromise of either platform could significantly disrupt the payment ecosystem [1][2]. While the underlying UPI infrastructure would remain functional, user confidence and system accessibility could be severely impacted.

The regulatory response to concentration risk through NPCI's 30% volume cap has been repeatedly delayed, suggesting challenges in balancing market competition with system stability

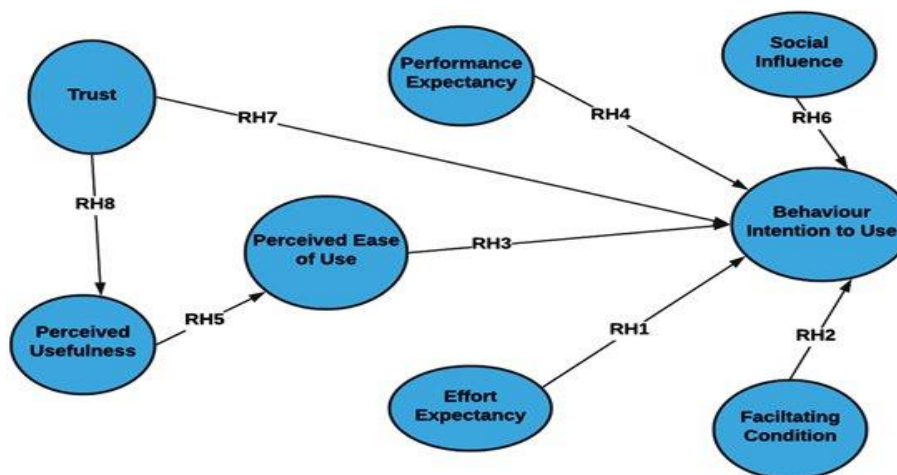
Figures

Figures gathered during research.



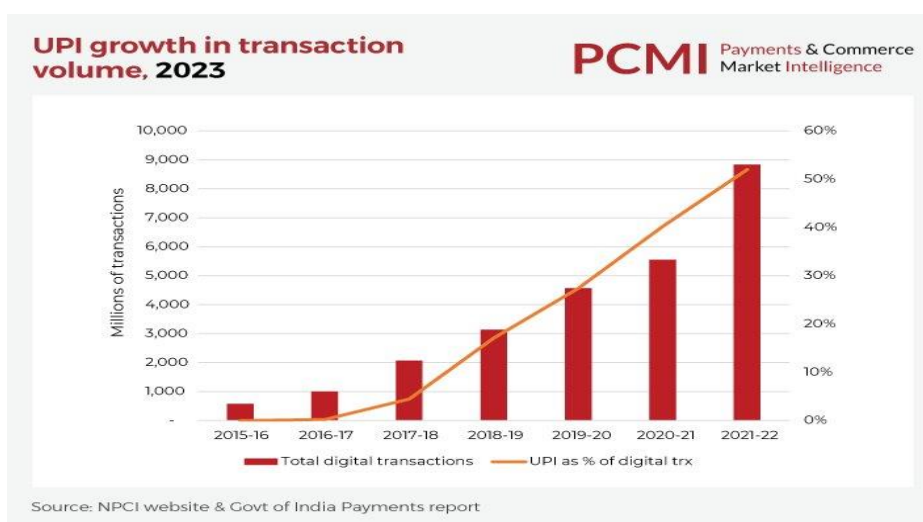
The impact of India's UPI on cross-border payments

The impact of India's UPI on cross-border payments — source: <https://www.fxcintel.com/research/reports/ct-india-upi-cross-border-payments>



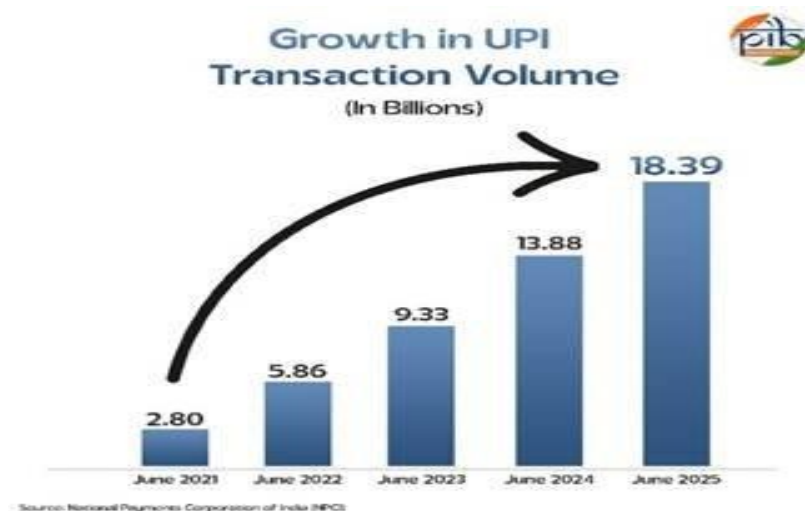
Innovation and Evaluation of Technology Acceptance Model (Tam) in S-Commerce: A Case of Social Media Platforms in Ghana

Innovation and Evaluation of Technology Acceptance Model (Tam) in S-Commerce: A Case of Social Media Platforms in Ghana — source: <https://www.scirp.org/journal/paperinformation?paperid=116214>



Unified Payments Interface (UPI) in India: growth and success in 2023

Unified Payments Interface (UPI) in India: growth and success in 2023 — source: <https://paymentscmi.com/insights/unified-payments-interface-upi-success-lessons/>



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