

UPI-Revolution and rapid growth of E-commerce in India-A Comprehensive Analysis

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ABSTRACT

Purpose: The Unified Payments Interface (UPI), introduced by the NPCI in 2016, has emerged as a key factor in the growth of India's e-commerce industry, which has been fuelled by increasing Internet penetration and smartphone adoption. In spite of obstacles like scalability and cybersecurity, UPI's smooth, interoperable, and affordable features have increased transaction efficiency, financial inclusion, and merchant adoption QR codes, driving digital payments from ₹27.31 crores in 2019 to ₹1,830.1 crores in 2025, where UPI holds a 66-78% market share.

Design: This study examines UPI's role of UPI in e-commerce expansion by analysing the correlations between bank participation and transaction volumes, P2M category distributions, UPI's dominance over other payment methods, P2P/P2M trends (2021-2025), and app market shares. Secondary data from the NPCI, RBI, and industry reports underwent correlation, regression, and trend analyses to test five hypotheses on growth patterns and adoption.

Findings: Between 2021 and 2025, the number of banks using UPI grew significantly, rising from 216 to 661. This increase closely followed the growth in UPI usage, showing that as more banks joined the platform, transactions also increased. The analysis shows a strong positive relationship between bank participation and transaction volumes. UPI's growing share of person-to-merchant (P2M) payments reflects how it has become a common method for people to pay for everyday purchases, supported by more merchants accepting it. At the same time, both person-to-person (P2P) and person-to-market (P2M) transactions have expanded rapidly in recent years.

Implications: UPI is making e-commerce more sustainable by reducing transaction costs and expanding digital payment accessibility to broader populations. However, it still faces challenges such as scaling the system to handle growing demand, strengthening cybersecurity, and expanding across borders. To address these issues, policy efforts should focus on improving infrastructure and enhancing security measures. Looking ahead, UPI has strong growth potential, with transaction volumes expected to triple by 2030 through deeper rural adoption, the integration of credit services, and partnerships with other countries. These developments could position UPI as a leading example of digital transformation in emerging markets.

Keywords: UPI, Digital payment, P2P, P2M, Financial inclusion, E-commerce, QR code, E-commerce

I. INTRODUCTION

The Unified Payments Interface (UPI) has emerged as a crucial component of the dramatic transformation that the rapid digitalization of India's financial sector has brought about for both businesses and consumers. UPI, which was introduced in 2016 by the National Payments Corporation of India (NPCI), has revolutionized the process of carrying out financial transactions by offering a reliable, efficient, and accessible digital payment system. In this context, UPI plays a significant role in enhancing customer trust, streamlining the checkout process, and promoting financial inclusivity.

This research investigates the various effects of UPI digital payments on the growth and long-term viability of e-commerce in India. It analyses how

UPI digital payments have impacted the expansion and sustainability of e-commerce by promoting financial inclusion, encouraging merchants to adopt UPI-enabled QR codes, and addressing the challenges tied to UPI integration. This research offers a thorough knowledge of the relationships between the UPI and India's quickly evolving e-commerce industry by looking at data patterns, stakeholder input, and policy changes.

II. LITERATURE REVIEW

Andrew (2021) describes electronic commerce as the process of purchasing and selling products and services via the Internet. It uses various digital devices, including smartphones, computers, and other Internet-enabled devices. These technologies connect consumers with sellers and help present products.

Aathira S Nair and Dr. Kannan (2023) examine UPI and its revolutionary effects on digital payments. The paper highlights its history, key players, and technological advances. It shows how UPI is changing money transactions and specific business practices. The report discusses UPI's wide reach and rapid adoption in the fintech sector. It aims to identify what has driven UPI's success and its ability to boost digital payments.

Sahoo and Kumar (2023) investigated how the 2016 demonetization effort and other factors sped up India's shift to digital payments. This move accelerated the adoption of digital payments, which was aided by the National Payments Corporation of India (NPCI), further propelled by Prime Minister Narendra Modi's support and government initiatives.

The article discusses how digital payments have changed India's economy and society, with UPI being essential for the growth of electronic transactions.

Agrawal and Malik (2021) conducted research titled "Transitioning from Cash to Cashless Economy Towards Digital India." This study explores the various opportunities emerging in the payments sector that support technological growth. The main goal is to move from a cash-dependent system to a cashless economy. Kumar Renuka and Kishore Sreesh (2020) looked into the security of the Unified Payments Interface (UPI) protocol, which supports mobile payment apps in India. Their study uncovers vulnerabilities in the multi-factor authentication design of UPI 1.0. These weaknesses could be exploited by harmful applications and lead to serious security issues.

Pal and Bahasa (2019) point out the significant change in India's reliance on cash and low digital engagement after the government's demonetization initiative in November 2016, which invalidated certain bills and caused a financial crisis. During this cash shortage, the country, previously slow to adopt mobile payment solutions, had to shift towards digital payment methods.

III.OBJECTIVES

- 1) To examine the relationship between transaction volumes and the number of banks

that use UPI, emphasizing synchronized infrastructure and usage growth.

- 2) To investigate the distribution of UPI Person-to-Merchant (P2M) transactions across key e-commerce categories.
- 3) To assess the relative shares of UPI alongside other digital payment methods (e.g. cards, wallets) in 2024, identifying UPI's dominant position.
- 4) To evaluate the trends in UPI P2P and P2M transaction volumes and values from 2021 to 2025, quantifying the shift toward cashless economies.
- 5) To determine the market shares of major UPI apps (e.g. PhonePe, Google Pay, Paytm) and their impact.

IV.METHODOLOGY

The research strategy employed in this study, include the techniques for data collection and analysis. The study's data sources are discussed, including secondary data from publications, reports, and internet sources. The statistical techniques employed to examine the data, include trend analysis and regression analysis,

The following steps are part of the methodology used in this study:

Data Collection: A variety of sources, including reports, periodicals, scholarly articles, and internet platforms, were used to gather data. Government publications, reliable financial news sources, the Reserve Bank of India (RBI), and the National Payments Corporation of India (NPCI) are the main sources of data.

Data Analysis: Correlation analysis was used to thoroughly examine the collected data in order to investigate trends, growth patterns, and the relationships between UPI transactions, online transactions, and other relevant factors. Trend analysis was used to see how e-commerce through UPI transactions has grown over time.

Interpretation and Results:

Significant findings and insights on UPI's impact on India's digital payments ecosystem and its role in the growth of e-commerce in the nation were drawn

from the analysis of the data. These are meant to improve India's digital payment environment by using UPI's advantages and resolving its shortcomings.

V.GROWTH TRENDS OF UPI ADOPTION

India witnessed a remarkable surge in digital payment transactions, climbing from ₹27.31 crores in 2019 to an estimated ₹1,830.1 crores by 2025. This significant increase was largely fuelled by the widespread acceptance of UPI, which accounted for 66% of all transaction volumes by 2025. Table (1) illustrates this expansion of digital transaction volumes in India spanning seven years, from 2019 through 2025. The data presented in the table demonstrates how quickly people embraced digital payment systems and shows the growing shift toward cashless transactions throughout the nation.

**TABLE I
THE UPI GROWTH AND TREND ANALYSIS**

Year	No. of Banks live on UPI	Volume (In Mn.)
2021	216	2731.68
2022	314	5409.65
2023	399	8685.3
2024	572	13,440
2025	661	18,301

Source: NPCI UPI ecosystem statistics.

The data clearly demonstrates a strong positive relationship between the growth of UPI infrastructure in terms of both participating banks and transaction volume.

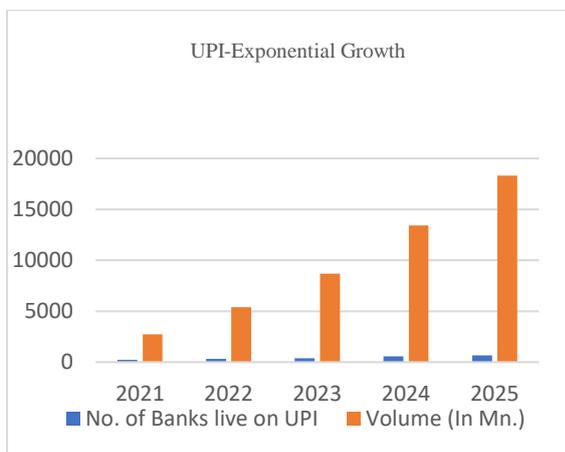


Figure 1: The UPI Growth and Trend Analysis

H1: The number of banks that use UPI and the amount of UPI transactions (measured in million/crore units) between 2021 and 2025 have a statistically significant positive correlation.

Correlation Analysis:

Correlation between Volume of transactions and no of banks in UPI payment

Volume of transactions (in crores)	Volume of transactions (in crores)	No of Banks on UPI
Pearson correlation	1	.993**
Sig.(2-tailed)		.000
N		5
Pearson correlation	.993**	1
Sig.(2-tailed)	.000	
N	5	5

**The correlation is significant at the two-tailed 0.01 level.

There is a very strong positive Pearson correlation ($r \approx 0.99$) between the number of banks live on UPI and UPI transaction volume. As transaction volume increases, more banks join the UPI ecosystem, indicating synchronised growth of infrastructure and usage.

V.EXPANSION OF E-COMMERCE

A Narrow Merchant Bandwidth-Use of UPI in E-commerce:

The Unified Payments Interface (UPI) has revolutionised E-commerce in India by enabling seamless, instant digital transactions. People nationwide have embraced it, pulling more folks into the formal financial system, fuelling economic growth, and setting the stage for how Indians will handle payments and business in the years to come (15). The UPI ecosystem is expansive, including key players like Google Pay, Phone Pay, Amazon Pay and BHIM. A statistical survey of P2M was analysed among Indian consumers towards payment purposes.

**TABLE II
P2M CATEGORIES OF E-PAYMENTS-UPI**

S.NO	Categories	Vol (Mn)	% Vol	% Value
1	Groceries and supermarket	2848.11	24.3	9.3
2	Fast food restaurants	1144.14	9.8	2
3	Hotels	1102.1	9.4	2.7
4	Telecommunication services	843.97	7.2	2.9

5	Service stations (fuel etc)	591.24	5	5.3
6	Digital goods (games)	332.94	2.8	1.4
7	Cigar shops and Petty shops	294.96	2.5	0.3
8	Bakeries	260.34	2.2	0.6
9	drug stores and pharmacies	255.66	2.2	1.5
10	Utility services (Electricity, water etc.)	171.01	1.5	3.3

Source: NPCI UPI ecosystem statistics.

H2: The share of P2M transactions in total UPI volume has increased significantly over time, indicating rising merchant-side adoption.

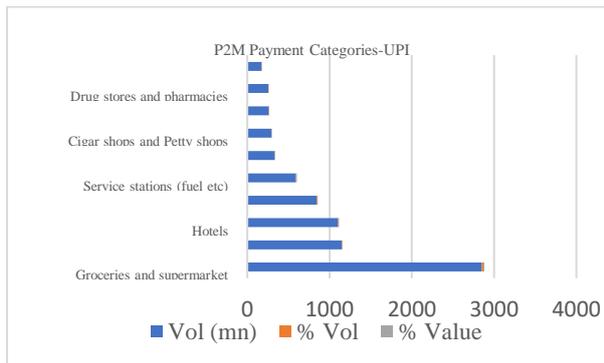


Figure 2: P2M Payment Categories-UPI

VI. DISTRIBUTED DIGITAL PAYMENTS

India's digital payments industry has seen a significant shift, moving from traditional banking transactions to digital ones (Hussain & Bhardwaj, 2024). The distribution of different digital payment methods in 2024 is shown in the table below, with the Unified Payments Interface (UPI) holding a commanding 78%. This is followed by digital wallets, debit and credit cards, and other payment methods. The pie chart below provides a graphical representation of the relative contributions of these payment methods to the digital payment's ecosystem in 2024.

TABLE III
DISTRIBUTION OF DIGITAL PAYMENT METHODS (2024)

No.	Sources	% of distribution
1	UPI	78
2	Debit/credit card	7
3	Digital wallets	12
4	Others	3

Source: NPCI UPI ecosystem statistics.

H3: UPI's share in total digital payment methods (UPI vs cards vs wallets vs others) is significantly greater than the combined share of other methods in 2024.

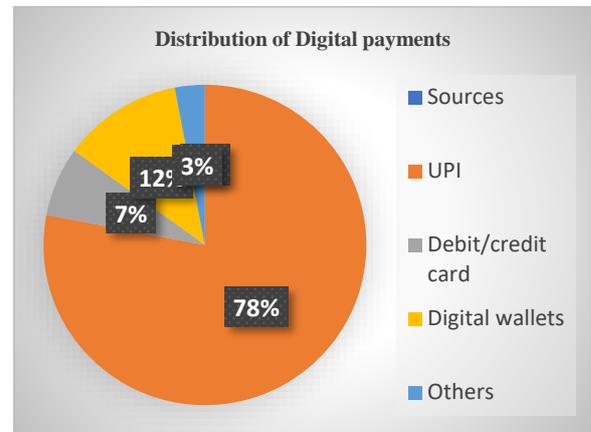


Figure 3: Distribution of Digital payment methods (2024)

VII. UPI IN INDIA'S DIGITAL PAYMENT ECOSYSTEM

As a design framework with a set of common Application Programming Interfaces (APIs) that make integration simple, UPI has emerged as a key player in India's digital economy. With its full seamless operation, it has handled more than 75% of the nation's retail digital payments, improving financial access and ensuring quick money transfers. offers a variety of use scenarios including request-to-pay, UPI on delivery, standing instructions, person-to-person (P2P), and person-to-merchant (P2M) [16]. The transaction trends are displayed in the table below.

TABLE IV
UPI-P2P AND P2M TRANSACTIONS TRENDS (2021-2025)

Month	UPI P2P and P2M Transactions		
	Total	P2P	P2M
	Vol (Mn)	Vol (Mn)	Vol (Mn)
Oct 25	19,633.4	7,266.4	12,366.97
Oct 24	16,584.9	6,281.7	10,303.18
Oct 23	11,408.7	4,689.4	6,719.37
Oct 22	7,305.4	3,436.6	3,868.76
Oct 21	4,218.6	2507.1	1,711.53

H4: There is a significant difference between UPI P2P and P2M transaction volumes across the years 2021–2025.

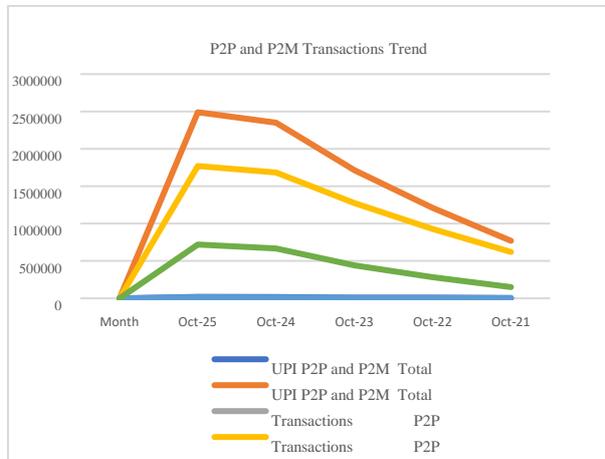


Figure 4: UPI-P2P and P2M Transaction trends (2021-2025)

In conclusion, throughout the last five years, the UPI ecosystem in India has experienced incredible expansion and change. The growing confidence and dependence on digital payments is reflected in the increased transaction volumes and values.

TABLE V

UPI APPS IN INDIA WITH THEIR MARKET SHARE

App name	Vol (Mn)	Value (Cr)	Market share
Phone pe	3519.12	620121.97	50%
Google Pay	2639.55	42442.48	34.20%
Paytm Payments	1027.97	116864.36	10.80%
Amazon pay	47.80	8981.82	3.50%
BHIM	23.21	7158.37	1.50%

Source: <https://www.npci.org.in/what-we-do/upi/product-statistics>

H 5: There is a significant difference in transaction volumes and values among major UPI apps (PhonePe, Google Pay, Paytm, Amazon Pay, BHIM), with PhonePe holding the largest market share.

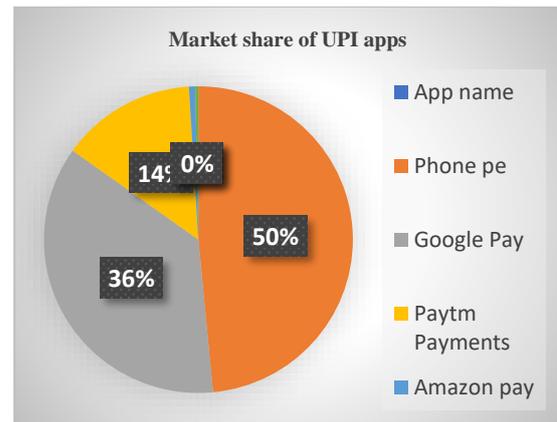


Figure 5: UPI Apps in India with their market share

VIII.FUTURE PROSPECTS

Future trends for the Unified Payment Interface (UPI) are examined in a study by Kumar and Unnisa (2024). The study projects the future of UPI by examining the changing UPI ecosystem and taking into account the factors like data application, digital transactions, and payments fuelling the internet user growth in India. UPI transaction volumes are projected to triple by 2030, reaching over 120 billion annually, supported by a CAGR of around 10.5% for UPI apps from 2024-30. Rural and semi-urban expansion offers untapped potential as internet access and smartphone penetration improve, alongside integration with e-commerce, blockchain, and biometric security to enhance financial inclusion.[14] Person-to-Merchant (P2M) segments will drive revenue growth at 67% year-on-year, fuelled by 30 million+ merchants and government initiatives promoting cashless economies. The future of UPI seems bright, thanks to its growing popularity in rural areas, technological advances, and partnerships with foreign payment networks. Additionally, UPI is expected to integrate with emerging payment methods like the digital rupee, which would increase financial inclusion and lower transaction expenses even more. UPI's influence on business is likely to increase due to continuous innovation in financial technology and cross-border transaction capabilities.

IX.CHALLENGES AND SOLUTIONS

UPI, a considerably agreed and extensively employed system in Indian financial transactions, is one invention that simplifies digital deals.

Scaling infrastructure: Despite its success, UPI faces many obstacles. The lack of infrastructure to

handle the growing number of deals is a major challenge for UPI [17]. Building strong server systems and expanding network capacity can fix these issues.

Expensive: UPI deals can be more costly than cash deals, as they require a smartphone and internet connectivity.

Cybersecurity risks: Users face higher cybersecurity risks from more digital transactions. The rise in online payments has made UPI vulnerable to hackers and scammers, stressing the need for strong security to maintain customer trust. The solution framework can be used to monitor and adapt to these security challenges.

Cross-border expansion: The main challenge for UPI's future is international growth due to integration issues. This can be addressed through political discussions and efforts to standardise UPI as a payment method. Investing in infrastructure and user experience is crucial, focusing on speed, reliability, and security of transactions.

X.CONCLUSION

In India's digital payments ecosystem, the Unified Payments Interface (UPI) has emerged as a revolutionary tool, fuelling unprecedented increases in transaction volumes, financial inclusion, and e-commerce adoption between 2021 and 2025.

The findings highlight UPI's synchronized infrastructure expansion and usage increase, supported by NPCI's ecosystem and government initiatives, which have raised total digital transactions from ₹27.31 crores in 2019 to over ₹1,830 crores in 2025, with UPI accounting for 66% [7]. The move toward cashless economies is clear, especially in e-commerce, where P2M transactions show merchant adoption and consumer trust. UPI's future looks bright, with estimates of tripling volumes to 120 billion by 2030 at a 10.5% CAGR, driven by rural outreach, blockchain integration, and cross-border opportunities [11]. However, challenges such as infrastructure development, cybersecurity threats, transaction costs, and international expansion require proactive solutions, like improved server capacity, biometric security, and policy standardisation. **In summary**, UPI exemplifies digital India's success story, promoting economic resilience and inclusion. Policymakers, regulators, and fintech stakeholders must focus on innovation and safeguards to unlock its full potential, ensuring UPI not only leads in domestic

payments but also positions India as a global fintech leader.

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