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Early Adoption, Usage Intensity, and Barriers to Unified Payments Interface Among Fixed-Store Merchants in Jaipur: Secondary Analysis of a 2017 Cross-Sectional Survey

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Abstract

Unified Payments Interface (UPI) was launched in April 2016 and made available through participating banks in August 2016. A survey of Jaipur merchants conducted in August–September 2017 therefore provides a rare view of UPI during its earliest diffusion stage rather than evidence about India's mature contemporary payment ecosystem. This study estimated early UPI adoption and usage intensity, compared UPI users with non-users, described motivations and barriers, and examined factors independently associated with the adoption of any digital-payment method among small fixed-store merchants. A secondary analysis was undertaken using an anonymised open dataset of 1,003 fixed-store merchants. The original survey used a listing exercise followed by random sampling stratified by industry and digital readiness. Descriptive statistics, exact binomial confidence intervals, Fisher's exact tests, Mann–Whitney U tests, and multivariable binary logistic regression were applied. Because only 15 merchants reported UPI use, UPI-specific multivariable modelling was considered statistically inappropriate. The adjusted model therefore used adoption of any digital-payment method as the outcome. Fifteen merchants reported UPI use, giving a prevalence of 1.50% (95% exact CI [0.84%, 2.45%]). Adoption of any digital method was 42.0%, led by mobile wallets (34.5%), point-of-sale systems (12.7%), and internet banking (11.4%). All UPI users had smartphones, internet access, and bank accounts. UPI users reported greater current customer demand for digital payment than non-users (median 15% vs. 5%, $p < .001$), but annual sales, profit, enterprise age, and employee count did not differ significantly. Only seven of the 15 users reported a positive UPI share of customer receipts; across all users, the median was 0% and the mean was 4.13%. Among 582 non-adopters of any digital method, frequently mentioned barriers were customer choice (54.1%), lack of awareness (41.6%), fear of being cheated (41.4%), and unwillingness to learn (28.7%). In adjusted analysis, every 10-percentage-point increase in customer demand was associated with nearly twice the odds of any-digital adoption (adjusted odds ratio [aOR] = 1.99, 95% CI [1.67, 2.38]). Internet access (aOR = 6.60), WhatsApp use (aOR = 3.95), smartphone ownership (aOR = 2.32), and tax-identification possession (aOR = 2.24) were also associated with adoption. In Jaipur in 2017, UPI adoption was nascent, and nominal use often did not correspond to substantial commercial usage. Infrastructure appeared necessary but insufficient; customer demand, digital familiarity, awareness, and trust were central. The findings should not be generalised to present-day UPI usage, street vendors, rural merchants, or Rajasthan as a whole.

Keywords: Unified Payments Interface; UPI; digital payments; small merchants; Jaipur; mobile payments; financial technology; secondary analysis

1. Introduction

India's Unified Payments Interface is an interoperable, real-time payment system that allows users to link participating bank accounts to mobile applications and undertake person-to-person and merchant transactions. The National Payments Corporation of India (NPCI) introduced UPI in April 2016, and participating banks began releasing UPI-enabled applications in August of that year (National Payments Corporation of India [NPCI], n.d.; Press Information Bureau [PIB], 2025). The survey examined in this paper was undertaken in August–September 2017. It consequently captures a formative phase when awareness, application availability, customer familiarity, and merchant acceptance networks were still developing.

The historical timing is analytically important. UPI later became India's dominant retail fast-payment platform, processing billions of transactions each month (Reserve

Bank of India [RBI], 2025a, 2025b). Those contemporary conditions cannot be projected backward onto 2017. At the time of the Jaipur survey, mobile wallets, cards, internet banking, and cash were more familiar to merchants, while UPI had been publicly available for only about a year. The dataset therefore provides a baseline from which later diffusion can be understood.

Small merchants occupy a pivotal position in payment-system diffusion. Consumers cannot routinely substitute digital payment for cash unless merchants accept it. At the same time, merchants derive limited value from installing or learning a payment interface if customers rarely request it or suppliers remain cash-based. Merchant adoption is thus embedded in a two-sided ecosystem: the value to one group depends partly on participation by the other (Dahlberg et al., 2015; Guo & Bouwman, 2016; Mallat, 2007).

The benefits of digital payments may extend beyond transaction convenience. Digital records can support bookkeeping, enable remote sales, reduce cash-handling costs, and create information that may assist formal credit assessment (Adhikary et al., 2021; Arun & Gautam, 2018; Suri, 2017). Yet the same visibility may generate concerns about taxation, surveillance, privacy, settlement failure, and fraud. For businesses operating with narrow working-capital margins, even a small disputed or delayed transaction may carry meaningful consequences.

Technology-adoption literature commonly explains usage through perceived usefulness and ease of use. The Technology Acceptance Model proposes that users are more likely to accept a system when they expect it to improve performance and believe that it will be relatively effortless to use (Davis, 1989). TAM3 adds experience, interventions, and contextual determinants (Venkatesh & Bala, 2008). The Unified Theory of Acceptance and Use of Technology similarly emphasises performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003), while UTAUT2 incorporates price value, habit, and hedonic motivation (Venkatesh et al., 2012).

Merchant payment adoption also requires an organisational and environmental lens. The technology–organisation–environment framework draws attention to technical readiness, organisational resources, competitive pressure, and institutional conditions (Tornatzky & Fleischer, 1990). For a small shop, technical readiness may mean a smartphone, internet connection, bank account, and practical familiarity with applications. Environmental influence may take the form of customer demand, competitors' acceptance, supplier practices, payment-provider marketing, or regulatory pressure. Reviews of merchant and mobile-payment research repeatedly identify trust, risk, compatibility, awareness, cost, usefulness, and network participation as influential factors (Abdullah & Khan, 2021; Dahlberg et al., 2015; Patil et al., 2020).

The original Jaipur study found that 42% of 1,003 sampled merchants used at least one digital-payment method, but only 1.5% reported UPI use (Ligon et al., 2019). It further showed that access barriers could not fully explain non-adoption. Bank accounts, mobile phones, and literacy were considerably more common than digital-payment use. The authors argued that customer demand, information, trust, and tax-related concerns contributed to the gap between technical capability and actual adoption.

The present study extends that work in three ways. First, it focuses specifically on the emerging UPI channel while preserving any-digital adoption as the statistically estimable multivariable outcome. Second, it distinguishes binary adoption from usage intensity by examining the percentage of customer and supplier payment value attributed to UPI. Third, it reanalyses ranked motivations and barriers and estimates an adjusted model incorporating customer demand, digital readiness, business formality, and enterprise characteristics.

This distinction between adoption and active use is essential. A merchant may install an application or report having used UPI but receive little or no business turnover through it. Binary adoption may therefore overstate meaningful commercial integration. Post-adoption behaviour, continuity, transaction intensity, and routine use deserve separate measurement (Bhattacherjee, 2001; Humbani & Wiese, 2019; Pal et al., 2021).

1.1 Study objectives

The study addressed the following questions:

1. What proportion of sampled fixed-store merchants in Jaipur reported UPI use in 2017?

2. How intensively was UPI used, measured through its share of customer receipts and supplier payments?

3. How did UPI users and non-users differ in digital readiness, customer demand, business formality, and enterprise scale?

4. What motivations did digital-payment adopters report, and what barriers did non-adopters identify?

5. Which factors were independently associated with adoption of any digital-payment method?

The analysis was exploratory and associational. It did not attempt to estimate causal effects because the cross-sectional data could not establish temporal order between adoption, perceived demand, and digital capability.

2. Literature Review

2.1 Digital payments and financial inclusion

Digital-payment infrastructure has been promoted as a means of widening financial inclusion and reducing the costs of transferring, storing, and documenting money. Mobile money has improved financial resilience and, in some settings, produced long-run welfare gains (Jack & Suri, 2014; Suri, 2017; Suri & Jack, 2016). These benefits, however, depend on active usage rather than account ownership alone. A technically available service can remain economically marginal when users lack trust, perceived usefulness, agent liquidity, or counterparties willing to transact.

The distinction is relevant to small merchants. Merchant digitalisation can connect retail trade to formal financial services, but adoption decisions are shaped by immediate business realities. Retailers may value faster transactions, lower cash-handling costs, better records, remote collection, and access to new customers. They may also face fees, unreliable connectivity, settlement uncertainty, learning costs, fraud risk, privacy concerns, and tax exposure (Adhikary et al., 2021; Arun & Gautam, 2018; Ligon et al., 2019).

2.2 Adoption theories

Davis's (1989) Technology Acceptance Model remains influential because it links acceptance to perceived usefulness and perceived ease of use. These concepts map naturally onto merchant payments. Usefulness may arise when digital acceptance helps retain customers, increase sales, simplify reconciliation, or reduce the burden of handling cash. Ease of use includes installation, transaction confirmation, refunds, reconciliation, and problem resolution.

UTAUT integrates performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). UTAUT2 adds price value, habit, and hedonic motivation (Venkatesh et al., 2012). Trust and grievance redressal are particularly relevant extensions in mobile-payment settings because perceived risk can undermine behavioural intention even when a system appears useful (Slade et al., 2015; Sobti, 2019).

The theory of planned behaviour adds perceived behavioural control and subjective norms (Ajzen, 1991). A merchant may perceive digital payment positively but feel unable to use it because of limited technical skill or unreliable internet. Customer requests, peer practices, and family recommendations may create social pressure. Innovation-diffusion theory similarly highlights relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003).

The technology–organisation–environment framework is valuable for firm-level adoption because it situates technology within organisational capability and external conditions (Tornatzky & Fleischer, 1990). Small merchants often have little managerial separation: the owner is simultaneously the decision maker, cashier, accountant, and risk bearer. Personal digital capability and enterprise readiness therefore overlap. External demand and provider support may exert unusually strong effects.

2.3 Merchant-side determinants

Merchant adoption differs from consumer adoption. Consumers primarily decide which accepted method to use; merchants decide which methods to make available and absorb onboarding, verification, training, and reconciliation costs. Shopper attitudes and privacy concerns can influence retailer technology decisions because merchants anticipate how customers will respond (Inman & Nikolova, 2017).

Customer demand is a key environmental factor. A payment method has little commercial value if customers prefer cash, while repeated requests can transform acceptance from an optional innovation into a competitive necessity. Merchant-oriented studies therefore identify customer readiness, critical mass, market opportunity, and sales expectations as relevant determinants (Guo & Bouwman, 2016; Moghavvemi et al., 2021).

Digital readiness is another recurrent determinant. Smartphone ownership, internet access, application familiarity, and bank connectivity reduce the incremental burden of adoption. Yet access does not guarantee use. Ligon et al. (2019) showed that many Jaipur merchants possessed prerequisite resources without accepting digital payments. Recent evidence similarly indicates that infrastructure must be complemented by trust, awareness, and a compelling business case (Abdullah & Khan, 2021; Patil et al., 2020).

Trust operates at several levels: trust in the technology, banks, payment providers, counterparties, and complaint-resolution system. Merchants need confidence that a payment notification is genuine, money has settled, errors can be corrected, and fraud will not undermine working capital. Initial trust is particularly important when users lack prior experience (Liébana-Cabanillas et al., 2018; Zhou, 2013).

Costs also extend beyond explicit fees. Initial setup, data plans, staff training, transaction time, reconciliation, settlement delays, and perceived tax exposure all matter. For cash-intensive businesses, digital receipts may complicate cash flow when suppliers or employees still require cash. Such ecosystem mismatch can make apparently low-cost technology expensive in practice.

2.4 Indian policy context

UPI emerged within India's broader digital public infrastructure, including bank-account expansion, Aadhaar-linked identity, mobile connectivity, and interoperable payment rails. NPCI designed UPI to consolidate multiple bank accounts within mobile applications and facilitate real-time transfers and merchant payment (NPCI, n.d.). The platform's interoperability distinguished it from closed-loop wallets.

The November 2016 withdrawal of high-denomination banknotes created an exceptional shock to cash availability. It accelerated experimentation with electronic payment, although some cash usage returned as currency availability normalised. Demonetisation was therefore both a policy intervention and a contextual event that shaped merchants' stated motivations during the 2017 survey.

GST implementation in July 2017 added another dimension. Digital records could make compliance easier for registered enterprises but might be perceived as increasing visibility among informal firms. Merchant adoption during this period cannot be separated entirely from concerns about formalisation, taxation, and changing regulation.

UPI subsequently expanded at extraordinary speed. RBI reports document its rise to become India's dominant retail fast-payment system, alongside rapid growth in QR infrastructure (RBI, 2025a, 2025b, 2026). This later success underscores the importance of treating the Jaipur data as an early baseline rather than a contemporary prevalence estimate.

2.5 Research gap

Much mobile-payment literature focuses on consumer intention rather than observed merchant behaviour, and fewer studies distinguish nominal adoption from transaction intensity. Cross-sectional intention models can identify attitudes but may not reveal whether the technology becomes integrated into business turnover. The Jaipur dataset allows adoption, reported payment shares, motivations, barriers, customer demand, and enterprise characteristics to be considered together.

The low number of UPI users creates a statistical limitation but also documents the innovation's starting point. An ethically sound analysis should not inflate the sample through synthetic observations or fit an unstable high-dimensional UPI model. Instead, exact descriptive analysis can characterise UPI users, while broader digital adoption can support multivariable modelling.

3. Methods

3.1 Study design and data source

This was a secondary analysis of a cross-sectional survey of fixed-store merchants in Jaipur, Rajasthan. The anonymised dataset, codebook, and merchant questionnaire were obtained from the open repository associated with Ligon et al. (2019). The analytical file contained 1,003 observations and 88 retained variables.

The original project was conducted by People Research on India's Consumer Economy as part of an initiative led by Catalyst and supported through the USAID mSTAR programme. A listing exercise covering 6,011 households and enterprises was conducted in April–May 2017. The main survey took place during August–September 2017. Merchants were randomly sampled using strata based on industry and digital readiness (Ligon et al., 2019).

3.2 Population and eligibility

The original population comprised small merchants operating from fixed premises or permanent structures outside their homes. Street vendors, itinerant sellers, and home-based businesses were outside the sampling frame. Respondents were business owners or principal managers able to provide information about enterprise operations, payment practices, sales, customers, suppliers, and digital capability.

The term "merchant" is used throughout this paper because "vendor" could imply mobile or street-based selling. The findings apply to sampled urban fixed-store merchants in Jaipur and should not be extrapolated to rural Rajasthan or all microenterprises.

3.3 Ethical considerations

The original investigators reported a formal waiver from the University of California, Berkeley Institutional Review Board under Protocol 2017-03-9720. Written informed consent was obtained, and personal identifiers were removed before the data were made available for analysis (Ligon et al., 2019). The present study used only anonymised public data and made no attempt to identify respondents.

3.4 Outcome variables

UPI use was coded 1 when the respondent answered "Yes" to currently using UPI and 0 otherwise. The full questionnaire included a follow-up asking whether a digital interface was used for business, personal purposes, or both. That follow-up was not retained in the public analytical file. Reported UPI use may therefore include personal or mixed use and should not automatically be interpreted as active merchant acceptance.

Any digital-payment adoption was coded 1 when the respondent currently used at least one of the following: internet banking, card-based point of sale, mobile wallet, or UPI. This reproduced the broad adoption concept used in the original study.

UPI usage intensity was measured through the reported percentage of customer-payment value received through UPI and supplier-payment value paid through UPI. The questionnaire requested that payment shares across cash, cheque, internet banking, PoS, mobile wallet, and UPI total 100% for customer receipts and supplier payments separately.

3.5 Explanatory variables

Digital readiness included smartphone ownership, enterprise internet access, bank-account ownership, and business use of WhatsApp and Facebook. Social-media use was treated as an indicator of practical familiarity with smartphone applications rather than a direct causal determinant.

Customer demand was measured as the merchant's estimate of the percentage of customers currently demanding digital payment. A corresponding estimate for the pre-demonetisation period was used in descriptive comparison.

Business formality was measured through enterprise registration and possession of TIN/TAN/GST identification. Enterprise characteristics included annual sales for 2016–17, annual net profit, years under current ownership, total workers, business-to-business customer share, and regular-customer share. Higher education was coded for graduate, postgraduate, doctorate, or technical/diploma qualifications.

3.6 Motivations and barriers

Digital-payment users could report up to three ranked reasons for adoption, including demonetisation, customer demand, ease of use, transparency, security, tax incentives, and reduced cash-handling cost. Non-adopters could select up to three barriers, including lack of awareness, unwillingness to learn, no smartphone, no internet, no bank account, fear of fraud, customer choice, cost, cash-flow impediment, data security, and fear of government or tax regulation.

The analysis reports the percentage naming a factor first and the percentage naming it anywhere in the top three. Because respondents could identify multiple factors, top-three percentages are not mutually exclusive and do not total 100%.

3.7 Statistical analysis

Categorical variables were summarised using counts and percentages. Continuous variables were assessed descriptively and reported using medians and interquartile ranges because financial and business variables were right-skewed. Means were included for payment-share interpretation where useful.

Exact Clopper–Pearson confidence intervals were calculated for UPI and any-digital prevalence. UPI users and non-users were compared using Fisher's exact tests for binary variables because several expected cell

counts were small or zero. Mann–Whitney U tests compared current and pre-demonetisation demand, annual sales, annual profit, enterprise age, and number of workers. All tests were two-sided.

A conventional multivariable UPI model was not estimated. Only 15 UPI events were observed, and smartphone, internet, and WhatsApp variables showed complete separation because every UPI user reported these attributes. A standard logistic regression under these conditions would generate unstable or infinite estimates.

Multivariable binary logistic regression was instead used for any-digital adoption, with 421 adopters. Prespecified predictors were current customer demand per 10-percentage-point increase, smartphone ownership, internet access, WhatsApp use, tax-identification possession, higher education, log annual sales, enterprise age per decade, employee count, B2B share per 10 percentage points, and repeat-customer share per 10 percentage points. Adjusted odds ratios, 95% confidence intervals, and p values were reported.

All 1,003 records were analysed. Selecting an arbitrary sample of approximately 400 would discard information, further reduce the number of UPI users, and create avoidable sampling variability. Survey weights were not available in the public file, so analyses were unweighted.

4. Results

4.1 Sample characteristics

The sample comprised 1,003 fixed-store merchants. Principal owners were overwhelmingly male (98.8%). Most enterprises were registered (83.6%), and 59.4% reported a TIN/TAN/GST identifier. Bank-account ownership was nearly universal (96.6%), 77.8% had a smartphone, and 55.5% had enterprise internet access.

The median business had operated for 13 years under current ownership (interquartile range [IQR] 6–25) and employed two workers (IQR 1–3). Median annual sales were INR 1.40 million (IQR INR 0.80–2.50 million), and median annual net profit was INR 300,000 (IQR INR 183,000–500,000). The median merchant estimated that 5% of customers currently demanded digital payment (IQR 0%–15%).

Table 1

Sample characteristics and payment adoption (N = 1,003)

Characteristic	n	%
Male principal owner	991	98.8
Registered enterprise	839	83.6
Tax identifier	596	59.4
Smartphone	780	77.8
Enterprise internet access	557	55.5
Bank account	969	96.6
Any digital-payment method	421	42.0
Mobile wallet	346	34.5
Point of sale	127	12.7
Internet banking	114	11.4
UPI	15	1.5

Note. Payment methods are not mutually exclusive.

4.2 UPI prevalence and payment mix

Fifteen merchants reported UPI use, producing a sample prevalence of 1.50% (95% exact CI [0.84%, 2.45%]). By comparison, 34.5% used mobile wallets, 12.7% used PoS, and 11.4% used internet banking. Overall, 42.0% used at least one digital method.

The low UPI prevalence was consistent with its recent introduction. The survey occurred roughly one year after bank applications became publicly available. The estimate should consequently be described as early-stage UPI adoption, not as evidence of persistent resistance among Jaipur merchants.

4.3 Characteristics of UPI users

Every UPI user had a smartphone, internet access, and a bank account. Among non-users, 77.4% had smartphones and 54.9% had internet access. Fisher's exact tests indicated associations between UPI use and smartphone ownership ($p = .030$) and internet access ($p < .001$). Zero cells made conventional odds ratios inappropriate.

All UPI users reported WhatsApp use, compared with 71.1% of non-users ($p = .008$). Fourteen of the 15 users reported Facebook use, compared with 69.6% of non-users (odds ratio = 6.10; Fisher's exact $p = .049$). These associations indicate digital familiarity but do not establish that social-media use caused UPI adoption.

UPI users reported greater current customer demand for digital payment. Their median estimated demand was 15%, compared with 5% among non-users (means 21.7% and 9.2%, respectively; Mann–Whitney $p < .001$). Pre-demonetisation demand did not differ significantly: both groups had a median of 0% ($p = .691$).

Enterprise scale did not distinguish users. Median annual sales were INR 1.20 million among users and INR 1.40 million among non-users ($p = .459$). Median annual profits were INR 332,000 and INR 300,000, respectively ($p = .412$). Median enterprise age was 10 versus 13 years ($p = .349$), and both groups employed a median of two workers ($p = .395$).

Table 2

UPI users and non-users

Factor	UPI users (n = 15)	Non-users (n = 988)	Statistical test
Smartphone, n (%)	15 (100.0)	765 (77.4)	Fisher p = .030
Internet access, n (%)	15 (100.0)	542 (54.9)	Fisher p < .001
Bank account, n (%)	15 (100.0)	954 (96.6)	Fisher p = 1.000
WhatsApp, n (%)	15 (100.0)	702 (71.1)	Fisher p = .008
Facebook, n (%)	14 (93.3)	688 (69.6)	Fisher p = .049
Tax identifier, n (%)	9 (60.0)	587 (59.4)	Fisher p = 1.000
Current digital demand, median	15%	5%	Mann–Whitney p < .001
Annual sales, median	INR 1.20m	INR 1.40m	Mann–Whitney p = .459
Annual profit, median	INR 332,000	INR 300,000	Mann–Whitney p = .412
Enterprise age, median	10 years	13 years	Mann–Whitney p = .349

4.4 UPI usage intensity

Reported use rarely represented substantial business volume. Among the 15 UPI users, the median share of customer-receipt value attributed to UPI was 0%, and the mean was 4.13% (standard deviation 6.80; range 0%–25%). Only seven users reported a positive UPI share of customer receipts.

Supplier use was even thinner. The median UPI share of supplier-payment value was 0%, and the mean was 2.33%. Only three users reported a positive supplier-payment share.

Cash remained dominant among UPI users, accounting for a mean 68.87% of customer receipts and a median 70%. The mean shares of the remaining methods were internet banking 9.00%, mobile wallet 8.67%, cheque 5.33%, UPI 4.13%, and PoS 4.00%.

The discrepancy between self-reported use and zero UPI receipt share among eight respondents has several plausible explanations. Some merchants may have used UPI personally or for occasional outbound transfers; others may have recently installed it or made transactions too small to register after rounding. The public dataset cannot distinguish these explanations because it omits the follow-up identifying business, personal, or mixed use.

4.5 Adoption motivations

Among 421 adopters of any digital-payment method, demonetisation was the leading first-ranked motivation, selected by 57.5%. It appeared anywhere among the top three reasons for 73.6%. Customer retention or demand

appeared among the top three for 60.8%, ease of use or better experience for 36.3%, and transparency or business analytics for 26.4%.

Table 3

Motivations among adopters and barriers among non-adopters

Reported factor	First-ranked n (%)	Anywhere in top three n (%)
Motivations among 421 adopters		
Demonetisation	242 (57.5)	310 (73.6)
Customer retention/demand	58 (13.8)	256 (60.8)
Ease of use/better experience	34 (8.1)	153 (36.3)
Transparency/business analytics	38 (9.0)	111 (26.4)
Safety and security	15 (3.6)	81 (19.2)
Compliance/tax incentives	12 (2.9)	45 (10.7)
Reduced cash-handling cost	15 (3.6)	45 (10.7)
Barriers among 582 non-adopters		
Customer choice	134 (23.0)	315 (54.1)
Lack of awareness	176 (30.2)	242 (41.6)
Fear of being cheated	102 (17.5)	241 (41.4)
Unwillingness to learn	57 (9.8)	167 (28.7)
High transaction cost	20 (3.4)	123 (21.1)
No mobile/smartphone	27 (4.6)	81 (13.9)
High initial cost	20 (3.4)	69 (11.9)
Cash-flow impediment	11 (1.9)	48 (8.2)
No internet access	8 (1.4)	42 (7.2)
Fear of government/tax regulation	9 (1.5)	42 (7.2)

Note. Respondents could report up to three factors; top-three percentages therefore exceed 100%.

The pattern indicates that an external shock encouraged experimentation, but customer retention supplied an ongoing commercial incentive. Demonetisation may have initiated adoption, whereas perceived usefulness and customer demand influenced whether digital payment remained relevant after cash returned.

4.6 Barriers to adoption

Among 582 merchants using no digital method, lack of awareness was the most common first-ranked barrier (30.2%), followed by customer choice (23.0%), fear of being cheated (17.5%), and unwillingness to learn (9.8%).

When all three ranked responses were included, customer choice became the most common barrier (54.1%), followed by lack of awareness (41.6%), fear of being cheated (41.4%), unwillingness to learn (28.7%), and transaction cost (21.1%). Direct access deficits were less frequently reported: 13.9% mentioned not possessing a suitable phone, 7.2% mentioned internet access, and only 0.7% mentioned lacking a bank account.

The results do not imply that infrastructure was unimportant. Every UPI user possessed the key prerequisites. Instead, infrastructure appeared necessary but insufficient. Once minimal access was available, demand, knowledge, trust, and perceived economic value became central.

4.7 Multivariable analysis

Because UPI events were too sparse for stable multivariable analysis, logistic regression examined adoption of any digital method. The model included all 1,003 respondents. A 10-percentage-point increase in current customer demand was associated with almost twice the adjusted odds of adoption (aOR = 1.99, 95% CI [1.67, 2.38], $p < .001$).

Internet access produced the largest adjusted association (aOR = 6.60, 95% CI [4.39, 9.92], $p < .001$). WhatsApp use (aOR = 3.95), smartphone ownership (aOR = 2.32),

and possession of a tax identifier (aOR = 2.24) were also positively associated with adoption.

Higher education, annual sales, enterprise age, employee count, B2B share, and repeat-customer share did not meet the conventional .05 threshold after adjustment. Their unadjusted relationships therefore appeared to overlap with customer demand, digital readiness, and formality.

Table 4

Logistic regression predicting adoption of any digital-payment method (N = 1,003)

Predictor	aOR	95% CI	*p*
Customer demand, per 10 percentage points	1.99	[1.67, 2.38]	< .001
Smartphone ownership	2.32	[1.01, 5.33]	.046
Internet access	6.60	[4.39, 9.92]	< .001
WhatsApp use	3.95	[2.13, 7.31]	< .001
Tax identifier	2.24	[1.51, 3.32]	< .001
Higher education	1.33	[0.94, 1.87]	.106
Log annual sales	0.97	[0.84, 1.13]	.697
Enterprise age, per decade	0.95	[0.83, 1.08]	.405
Number of workers	1.03	[0.92, 1.16]	.597
B2B share, per 10 percentage points	0.96	[0.90, 1.02]	.165
Repeat-customer share, per 10 percentage points	1.06	[0.99, 1.14]	.098

Note. aOR = adjusted odds ratio; CI = confidence interval. The outcome includes internet banking, PoS, mobile wallet, or UPI. Estimates are associational, not causal.

5. Discussion

5.1 Principal findings

The study depicts a payment ecosystem in transition. UPI use was reported by only 1.5% of sampled merchants, while 42.0% used at least one digital method and 34.5% used mobile wallets. The timing offers the most straightforward interpretation: UPI was new, merchant acceptance was limited, and wallets had a longer period to establish recognition and networks.

The more revealing finding concerns intensity. A majority of nominal UPI users reported that 0% of customer-payment value was received through UPI. Across all 15 users, the mean customer-receipt share was only 4.13%. This demonstrates why onboarding and practical use should not be conflated. App installation or occasional personal use does not establish that a payment rail has become integrated into commercial turnover.

All UPI users had smartphones, internet access, and bank accounts, but those conditions were also common among non-users. Infrastructure therefore marked the boundary of possibility rather than guaranteeing adoption. Customer demand, practical app familiarity, awareness, and trust were more useful for explaining the gap between capability and action.

5.2 Customer demand and network effects

Customer demand was the most consistent behavioural factor. UPI users reported three times the median digital-payment demand of non-users. In the adjusted any-digital model, each 10-point increase in customer demand was associated with nearly twice the odds of adoption. Customer choice was also the leading top-three barrier among non-adopters, while customer retention or demand was the second most common motivation among adopters.

These findings fit a two-sided network account. Acceptance becomes more valuable when customers wish to pay digitally, and customer usage becomes more convenient when many merchants accept the same interoperable method. Merchant acquisition alone may therefore produce dormant accounts unless accompanied by consumer activation and supplier-side usage.

Reverse causation remains possible. Merchants who already accept digital payment may attract digitally oriented customers or become more attentive to customer requests. Adoption may also teach customers

that digital payment is available. Longitudinal research is needed to separate these mechanisms.

5.3 Digital capability

Internet access was strongly associated with broader digital adoption after adjustment. Smartphone ownership and WhatsApp use also remained significant. These measures represent complementary layers of readiness: device access, connectivity, and practical familiarity with mobile applications.

The magnitude of the internet association should not be interpreted causally. Digitally capable merchants may differ in unmeasured ways, including age, innovativeness, customer profile, location, provider exposure, or management quality. Nevertheless, the finding supports practical interventions that combine reliable connectivity with hands-on merchant training.

WhatsApp use may signal more than technical literacy. Merchants who communicate digitally may manage customer relationships differently, receive information through peer networks, or be more comfortable with remote transactions. This interpretation is consistent with diffusion theory, which emphasises observability and interpersonal communication in the spread of innovations (Rogers, 2003).

5.4 Trust, fraud, and awareness

Fear of being cheated appeared among the top three barriers for 41.4% of non-adopters. This was almost as frequent as lack of awareness. Trust concerns can remain substantial even when explicit fees are low because a small merchant bears immediate liquidity risk from fraud, false screenshots, failed settlement, or mistaken transfers.

Merchant education should therefore move beyond application installation. Training should show how to verify completed transactions, identify fraudulent collect requests, protect credentials, reconcile receipts, process refunds, and obtain support. Clear transaction histories, real-time confirmation, and rapid grievance redressal can reduce the perceived risk surrounding unfamiliar payments.

Awareness was the leading first-ranked barrier. Information campaigns should be tailored to merchants' business routines, conducted in local languages, and delivered through channels they already use. Demonstration by banks, payment providers, trade associations, and trusted peers may be more effective than generic advertising.

5.5 Demonetisation and continued use

Demonetisation dominated adoption motivations, appearing among the top three reasons for almost three-quarters of adopters. The cash shortage created an immediate reason to experiment with alternatives. Yet an externally induced trial does not guarantee sustained use once cash returns.

Customer retention, ease of use, transparency, and safety represented more durable value propositions. Continuance research suggests that users remain with a technology when experience confirms expectations and produces satisfaction (Bhattacherjee, 2001). The low UPI transaction shares observed here indicate that many early users had not yet reached habitual or commercially significant use.

5.6 Formality and taxation

Tax identification was associated with any-digital adoption after adjustment. Formal enterprises may have stronger banking relationships, more systematic records, or customer groups that demand digital payment. Tax identification may therefore proxy organisational capability rather than exert a direct effect.

At the same time, 7.2% of non-adopters named fear of government or tax regulation among their leading barriers. Digital records can reduce bookkeeping burdens for compliant businesses while increasing perceived visibility among partly informal firms. Policy communication should link digital payment with accessible accounting and compliance support, not only traceability and enforcement.

5.7 Enterprise size

Annual sales, profit, enterprise age, and workforce did not significantly distinguish the 15 UPI users. In the adjusted any-digital model, sales and workforce size were also not significant. Adoption was therefore not simply a feature of larger or wealthier small businesses once demand, readiness, and formality were considered.

This result suggests that modest firms can adopt when the commercial case is clear and support conditions are present. Conversely, a relatively large merchant may remain cash-based if customers do not request digital payment or if the owner distrusts the system.

5.8 Theoretical contribution

The results support a combined TAM–TOE–network interpretation. Infrastructure and app familiarity represent facilitating conditions; customer demand

provides perceived usefulness and environmental pressure; awareness and learning costs affect ease of use; and fear of cheating captures trust and perceived risk. No single perspective fully describes the pattern.

The analysis also highlights the conceptual separation between adoption and use intensity. A binary response identifies nominal engagement but may conceal dormant or personal usage. Merchant-payment research should therefore model adoption, activation, continuance, and transaction share as distinct outcomes.

6. Implications

6.1 Policy implications

Merchant payment policy should target active use rather than onboarding counts alone. Useful programme indicators include the percentage of onboarded merchants receiving a transaction within 30 days, median digital share of turnover, repeat usage, failed-payment rates, complaint-resolution times, and continued use after incentives end.

Local customer activation should accompany merchant recruitment. Neighbourhood campaigns can create visible acceptance clusters and reduce the risk that merchants install payment tools that customers rarely use. Supplier onboarding is equally important because merchants may need to convert digital receipts to cash if upstream payments remain cash-based.

Trust-building interventions should include fraud-prevention training, transaction-verification skills, transparent liability rules, and accessible grievance redressal. Support should be available in Hindi and local languages and should not assume advanced literacy.

Digital payment should be connected to tangible business functions: accounting, inventory records, remote orders, customer communication, and appropriate formal credit products. These complementary benefits can turn a payment application from an occasional option into part of the merchant's workflow.

6.2 Managerial implications

Banks and payment providers should segment merchants by readiness and usage rather than treating all registrations alike. Merchants with smartphones and internet but no transactions require a different intervention from merchants without connectivity. Active but low-intensity users may benefit from reconciliation support and customer-facing signage.

Providers should communicate costs transparently and minimise uncertainty around settlement. Simple interfaces, immediate confirmation, and searchable transaction records are particularly important in noisy retail environments. Fraud education should address actual merchant scenarios, including false screenshots and deceptive collect requests.

6.3 Research implications

A contemporary Rajasthan study should use a multistage sampling design covering several districts, urban and rural markets, fixed stores, street vendors, home-based firms, and service providers. The 2017 measures can be retained for historical comparability, but present-day research should add QR ownership, soundbox use, transaction count and value, failed transactions, settlement delay, fraud exposure, refund experience, and separation of personal and business accounts.

Objective transaction records, obtained with consent, would reduce recall error. Panel data could examine whether demand predicts adoption or adoption generates demand. Qualitative interviews would help explain why merchants report UPI use while recording no business receipts through it.

7. Limitations

First, only 15 respondents reported UPI use. UPI-specific prevalence and group comparisons are imprecise, and a conventional adjusted UPI model would be unstable. The study therefore used exact and non-parametric methods for UPI and a broader outcome for multivariable analysis.

Second, UPI use was self-reported. The public file omitted the follow-up distinguishing business, personal, and mixed use. Some users may not have accepted UPI from customers, which is consistent with the 0% median customer-receipt share.

Third, the cross-sectional design prevents causal inference. Customer demand, readiness, and adoption were measured simultaneously. Reverse causation, omitted-variable bias, and common-method bias are possible.

Fourth, the study sampled fixed-store merchants in Jaipur. It excluded street vendors, mobile sellers, rural

businesses, and home-based enterprises. Results cannot be generalised to Rajasthan or India as a whole.

Fifth, data collection followed demonetisation, coincided with early GST implementation, and occurred shortly after UPI rollout. Motivations and barriers were shaped by this exceptional policy environment.

Sixth, survey weights were unavailable. Because sampling was stratified by industry and digital readiness, unweighted prevalence may not equal population prevalence if sampling fractions differed across strata.

Seventh, financial and payment-share variables relied on recall and may contain rounding or reporting errors. Tax sensitivity may also have influenced disclosure of sales and profits.

Finally, the any-digital outcome pools distinct payment technologies. Internet banking, PoS, wallets, and UPI involve different hardware, settlement arrangements, fees, and network structures. The adjusted model identifies general digital-adoption correlates and should not be represented as a UPI-specific causal model.

8. Conclusion

The 2017 Jaipur merchant survey captured UPI at the beginning of its diffusion. Only 1.5% of fixed-store merchants reported UPI use, and most reported no customer-receipt value through UPI. Bank accounts and smartphones were widespread, and 42% used another digital method, showing that low UPI prevalence reflected more than a complete absence of digital capability.

Customer demand, internet access, application familiarity, awareness, and trust were more closely related to adoption than enterprise scale. Customer choice, lack of awareness, and fear of being cheated dominated non-adoption barriers; demonetisation and customer retention dominated adoption motivations.

The findings are historical rather than contemporary. Their continuing contribution lies in showing that a digital-payment system diffuses through commercial usefulness, trust, and network participation—not through registration or technical availability alone.

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