DIGITAL PAYMENTS AND CASH USAGE IN INDIA: HAS UPI CHANGED CONSUMERS' SPENDING PATTERNS? (2016-2025)

A secondary-data based study on UPI Vs Cash Usage

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ABSTRACT

This study investigates the empirical impact of the Unified Payments Interface (UPI) on physical cash usage and private consumer spending in India between 2016 and 2025. Despite UPI processing over 21.6 billion monthly transactions worth ₹28 lakh crore by late 2025, currency held with the public continued to expand from ₹1.6 lakh crore to nearly ₹4.0 lakh crore, highlighting a persistent "currency demand paradox". Using monthly secondary data from the RBI, NPCI, and MoSPI (2018-2026), growth-rate Ordinary Least Squares (OLS) models with Newey-West standard errors were estimated alongside quarterly Private Final Consumption Expenditure (PFCE) intensity tracking.

The econometric results reveal positive cumulative short-run elasticities between monthly UPI growth and both currency with public and ATM cash withdrawals, indicating that broad economic activity drives both payment channels simultaneously in monthly dynamics. However, a structural divergence appears in consumer spending habits. Monthly ATM withdrawal volumes declined after late 2023, and a pivotal crossover occurred in June 2020 relative to household consumption. By 2025, UPI turnover surged past 140% of nominal PFCE, while ATM withdrawals contracted from over 30% to roughly 15% of PFCE. These findings show that while cash persists as an informal store of value, UPI has managed to substitute cash withdrawals for everyday retail consumption.

***Keywords**: UPI, Cash Demand, ATM Withdrawals, Private Final Consumption Expenditure, Payment Substitution.*

1. INTRODUCTION

1.1. Background of Study

Digitalisation has fundamentally reshaped industries worldwide, from the exponential growth of e-commerce to the transformation of digital payments. India's digital payment landscape began with the introduction of National Electronic Fund Transfer (NEFT) in 2005, followed by IMPS in 2010, RuPay cards in 2012, and finally the Unified Payments Interface (UPI) in 2016 (Reserve Bank of India [RBI], 2021b). However, when India first introduced digital payments, it faced heavy scrutiny, and the public was cynical and wary. According to the RBI, in 2005-2006, paper-based instruments accounted for 81.9% of retail payment volume, while digital retail transactions accounted for only 1.3% (RBI, 2024).

However, over the next 20 years, the financial payments landscape has completely changed. UPI accounted for 79.6% of retail payment volume and 25.3% of retail payment value in FY 2023-2024, compared with 2.4% in FY 2018-2019 (RBI, 2024). Paper-based instruments

accounted for only approximately 0.4% of retail payment volume, compared with 81.9% in 2005-2006 (RBI, 2024).

The year 2016 can be considered a turning point in the history of the Indian economy, marked by two monumental events: the introduction of the Unified Payment Interface (UPI) and the implementation of demonetisation after 38 years. Together, these two events altered the financial landscape of the Indian economy. Demonetisation abruptly invalidated 86% of the currency in circulation, and UPI, launched by the National Payments Corporation of India (NPCI), became the quick, convenient alternative (RBI, 2024). The RBI reported a 162.5% year-on-year growth in e-money transaction volume in 2016, followed by 76%, 33%, and 15% growth in the following financial years, FY 2017-2018, FY 2018-2019, and FY 2019-2020 (RBI, 2021b). This effect of UPI was immediate; according to the RBI report in April- October 2016, the year-on-year growth in retail electronic payments was around 37%, which increased to 70% in November and further increased to 123% in December (RBI, 2021b).

The COVID-19 pandemic of 2020 created a second inflection point. While demonetisation pushed people towards a cashless economy by invalidating currency in circulation, the pandemic did so through health risks and limited mobility. Lockdowns, social distancing, and fear of infection spreading through physical currency made digital payments the safer option. Furthermore, remote schooling, work from home, online delivery, and direct payment transfers increased the need for smartphones, and many first-time users adopted digital payments out of necessity rather than choice. While the digital payment ecosystem expanded during COVID, the currency in circulation also increased. The RBI reported that banknotes in circulation grew by 16.8% in value in 2020-2021, against 14.7% in 2019-2020 (RBI, 2021a). This can be attributed to the rise in the precautionary motive for demand for money, as people hoard cash for unforeseen contingencies such as job loss, income uncertainty, and health emergencies (RBI, 2021a).

The current study restricts itself to UPI, not all forms of digital payments, as the Unified Payment Interface has become a monumental success in India, driving one of the largest financial migrations of the decade, if not human history (Ministry of Finance, 2026). This study examines UPI and cash usage in India over 2018-2025 using multiple measures of cash, to establish whether UPI has significantly affected and displaced cash in terms of private consumer spending in India.

1.2. Statement of Problem

India's digital payment system has grown at an extraordinary pace since the launch of the Unified Payments Interface (UPI) in 2016, handling billions of transactions each month. Usually, when a convenient digital payment method expands so quickly, the need for physical cash should decline. However, currency held by the public has continued to rise in India.

This creates an important question regarding actual consumer spending behavior. While overall cash in the economy keeps growing due to precautionary savings and informal sector needs, it is unclear whether UPI is genuinely replacing cash in daily retail spending. Specifically, there is limited evidence on whether consumers have substituted UPI as a payment method for cash usage.

Clear empirical evidence on how consumers pay helps policymakers and the central bank in currency management and economic planning. Therefore, this study investigates whether UPI has truly displaced cash withdrawals in driving private consumer spending in India.

1.3. Research Questions

1. What has been the impact of UPI on cash in India over 2016-2025?

2. Did UPI substitute cash withdrawals at ATMs in driving retail private consumption in India during the mentioned period?

1.4. Aim of Study

The main aim of this study is to examine how the rapid growth of UPI has influenced cash usage and consumer spending behavior in India between 2016 and 2025. By analyzing monthly trends in currency held by the public and UPI transactions, this research seeks to identify the correlation between UPI and physical money. Furthermore, it aims to determine whether UPI has significantly reduced cash demand or substituted ATM cash withdrawals, and to explore how Indian households have shifted between UPI and cash to meet their daily private consumption needs.

1.5. Objectives of Study

1. To identify the trend of cash in the economy during 2016-2025
2. To identify the trend of UPI transactions during 2016-2025
3. To identify the correlation between cash and UPI
4. To identify whether UPI has a significant impact on cash during 2018-2025.
5. To identify private consumption practices using UPI vs. cash withdrawals

2. LITERATURE REVIEW

2.1. Review of Literature

2.1.1. Theoretical Literature:

The theoretical foundation of money demand can be traced to Keynes' (1936) liquidity preference framework, which identifies three primary motives for holding cash: transactions, precautionary, and speculative. In the context of India's evolving payments landscape, the rapid proliferation of the Unified Payments Interface (UPI) directly addresses the transactional demand for money by providing a frictionless, zero-cost digital medium of exchange. However, physical cash continues to persist primarily to satisfy the precautionary motive, acting as a liquid reserve against emergency needs, systemic downtime, and informal market transactions. Building upon the transaction motive, Baumol's (1952) inventory-theoretic approach posits

that economic agents optimize average cash holdings by trading off the opportunity cost of foregone interest against the fixed transaction and trip costs of converting interest-bearing deposits into cash. While traditionally extended to analyze frequent ATM visits and cash-withdrawal behaviour (Attanasio et al., 2002), the Baumol framework directly explains the post-UPI shift: by eliminating the shoe-leather friction of visiting physical bank branches or ATMs, UPI allows instant point-of-sale settlement directly from bank accounts, thereby reducing the necessity of regular cash replenishment while leaving high-value precautionary cash stocks largely intact.

To understand the rapid migration of retail payments toward digital rails alongside the persistence of cash, behavioral adoption frameworks provide critical micro-foundational insights. The Technology Acceptance Model (TAM), introduced by Davis (1989), posits that individual adoption of new information technology is fundamentally determined by two core constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). In the context of India's retail payments, UPI drastically reduced transactional friction through interoperable phone-number-based routing and instant QR-code scanning, thereby maximizing perceived ease of use and immediate transactional utility relative to physical currency withdrawals.

While classical TAM explains initial system acceptance, consumer payment choices in a developing economy that encompass broader socio-economic and hedonic dimensions are not covered. To address these nuances, Venkatesh, Thong, and Xu (2012) formulated the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2), tailoring adoption models to consumer contexts by integrating Hedonic Motivation, Price Value, and Habit alongside Effort Expectancy and Social Influence. The rapid expansion of UPI has been catalyzed by favorable 'Price Value' driven by the zero Merchant Discount Rate (zero-MDR) mandate, ensuring costless consumer transactions and embedded 'Habit' formation reinforced post-demonetisation and the COVID-19 pandemic mobility restrictions.

Simultaneously, the UTAUT2 framework helps explain the resilience of physical cash through 'Facilitating Conditions' and 'Habit'. While consumers perceive UPI as exceptionally useful for high-frequency, low-ticket daily retail transactions, the lack of ubiquitous digital infrastructure, intermittent server failures, and deeply entrenched habits in the unorganised informal economy might maintain the transactional necessity of cash.

2.1.2. Empirical Literature:

Global and Continental Perspective:

Expanding global trade has pushed payment systems toward innovations that raise the efficiency of fund transfers. Digital wallets now lead worldwide, accounting for 56% of e-commerce value and 33% of point-of-sale (POS) value in 2025, with forecasts of 63% and 42%, respectively, by 2030 (Worldpay, 2026, pp. 38-39). This shift is attributed to technological innovation, evolving consumer spending behaviour, and regulatory frameworks (Dauletova et al., 2025, p. 72). Platforms such as Samsung Pay, Google Pay, PayPal, Apple Pay, WeChat Pay, and Alipay are increasingly the dominant means of consumer settlement (Isamukhamedov, 2026, p. 4).

Cash, in contrast, persists largely as an in-store instrument. It represented 14% of global POS value in 2025 and is projected to decline only to 12% by 2030, while cash-based methods account for a small share of online transactions (Worldpay, 2026, p. 39). At the macro level, broad money rose sharply to about 140% of world GDP in 2020 before easing to roughly 136% by 2024 (World Bank, n.d.), although this aggregate includes deposits and is not a direct measure of cash use.

Adoption trajectories differ across regions (Worldpay, 2026). Asia-Pacific leads, with wallets accounting for 77% of regional e-commerce and 63% of POS value in 2025; although China and India dominate the regional figures, adoption is now broad-based (pp. 42-43). In North America, wallets operate largely on top of card spending, reaching 39% of online and 17% of POS value (pp. 146-147). In Europe, strong debit-card networks hold wallets to 18% of POS value, although this is forecast to reach 26% by 2030 (pp. 76–77). In Latin America, wallets compete with account-to-account rails such as Brazil's Pix, and cash accounts for 23% of POS value, against 14% globally, though it is forecast to fall to 18% by 2030 (pp. 114-115).

National Context:

India has witnessed the rapid growth of UPI since it was introduced in 2016; however, cash has continued to coexist alongside UPI. Awasthy et al. (2022) examine the relationship between digital payments and cash demand in India using quarterly data from Q2 2009 to Q2 2022. The authors use descriptive analysis and an autoregressive distributed lag (ARDL) model, considering factors such as income, interest rates, digital payment transactions, and precautionary motives. Their findings show that digital payments are negatively associated with cash demand.

The positive influence of income and precautionary motives helps explain why cash demand remains substantial despite the growth of digital payments. More specifically, Awasthy and Seet (2025) examine the relationship between UPI adoption and cash demand at national and state levels. The national analysis uses quarterly data from Q2 2009 to Q4 2024 and an ARDL model, while the state-level analysis covers 31 states and Union Territories from Q2 2019 to Q1 2025 using fixed-effects panel quantile regression. Cash demand at the state level is measured through currency-chest withdrawals per capita, while PhonePe transactions are used as a proxy for UPI activity. The findings indicate that higher UPI adoption is associated with lower cash demand. However, the relationship is nonlinear, and the strength of substitution varies across state-income groups. Middle-income states exhibit the strongest substitution effect, while the effect moderates as digital adoption matures.

However, substitution does not imply that cash ceases to exist. Tagat et al. (2026) investigate the ‘paradox of cash’ that persists despite the proliferation of alternative payment methods, which have seemingly displaced paper currency as a medium of exchange. The study finds that 94% of the transactions recorded in the payment diary were conducted using cash, with some variation by transaction size and purpose of payment. The underlying reasons for these trends include transaction characteristics, socio-demographic factors and behavioural attitudes. However, their data were collected before UPI’s massive growth. It therefore provides a useful baseline for understanding cash usage, but does not reflect how consumers currently use UPI and cash. Dhamodharan (2026), in Does UPI Adoption Reduce Demand for Physical Currency

in India? An Asymmetric Analysis Using NARDL, found that positive UPI shocks were associated with rising currency use among the public in the long run, suggesting complementarity rather than complete substitution between UPI and cash.

Overall, these studies indicate that digital payments like UPI adoption do not necessarily eliminate cash demand. However, evidence from debit-card transactions and payment diaries collected in 2019 cannot establish whether UPI substitutes for cash or whether both continue to grow. Therefore, the present study examines the relationship between UPI adoption and cash usage in India during 2018–2025.

2.2. Research Gap

Overall, the literature suggests that UPI is reducing the transactional role of cash, but it is not eliminating cash. However, there is limited research connecting the substitution effect of UPI on cash in consumers' everyday payment choices in the post-UPI expansion period. This provides the basis for the present study. Existing research has mostly examined digital payment adoption, financial inclusion and growth effects, behavioural aspects of it while fewer studies test whether UPI has actually displaced cash.

Those that do often rely on short periods, primary survey data, or a single measure of cash. The current study uses secondary data for longer periods. However, usage of monthly data is value addition done by this study where other studies have relied on quarterly data.

3. Methodology

This section outlines the empirical framework and research methodology used to examine the relationship between UPI expansion, currency demand, and private consumer spending in India. It describes the official secondary data sources, analytical software tools, econometric modeling techniques, and variable specifications employed to evaluate whether UPI acts as a substitute or complement to physical cash.

3.1. Sources of Data

The dataset for this study is compiled from official secondary sources published by the Reserve Bank of India (RBI), Ministry of Statistics and Programme Implementation (MoSPI), and the National Payments Corporation of India (NPCI). High-frequency macroeconomic indicators, monetary aggregates, and ATM usage statistics are extracted from the RBI's Database on Indian Economy (DBIE) and its Annual Reports, and from MoSPI, while digital transaction metrics are gathered from NPCI Payment Statistics.

3.2. Tools used for Data Analysis

Microsoft Excel was employed for initial data collation, structuring, and tabular transformations. Python was utilized for time-series cleaning, statistical diagnostics, econometric estimation, and generating analytical trend visualizations.

3.3. Variables Specification

- *Currency with Public (CWP):* The portion of Currency in Circulation held outside the banking system by households, firms, and businesses (calculated as CIC minus cash reserves held by commercial banks).
- *UPI Volume:* The aggregate count or total frequency of payment transactions successfully processed through the Unified Payments Interface during a specific monthly period.
- *UPI Value:* The total nominal gross monetary amount (turnover in INR) settled across all transactions completed via the Unified Payments Interface over a given period.
- *ATM Withdrawals (Value and Volume):* The monthly total count (volume) and aggregate nominal worth (value) of cash withdrawn by consumers through Automated Teller Machines, capturing primary cash-access transactions.
- *Policy Repo Rate / Consolidated Deposit Rate:* The benchmark lending interest rate fixed by the RBI Monetary Policy Committee, representing prevailing monetary stance and the opportunity cost of holding non-interest-bearing cash balances.
- *Inflation Rate (CPI):* The annualized percentage change in the Consumer Price Index (General), capturing overall retail price movement and eroding the purchasing power of cash holdings.
- *Private Final Consumption Expenditure(PFCE):* The total expenditure incurred by resident households and non-profit institutions serving households on final consumption of goods and services.
- *Index of Industrial Production (IIP):* An index that tracks the monthly volume of physical production across mining, manufacturing, and electricity sectors, serving as a high-frequency monthly proxy for real economic output and income.
- *Gross Domestic Product (GDP):* The total monetary or market value of all finished goods and services produced within the country during a specific period, used as the primary benchmark for overall national economic size and growth.

4. Data Analysis & Interpretations

This chapter presents the empirical findings and statistical evaluations structured around the study's five core objectives. First, descriptive time-series trend analysis tracks the patterns of physical cash (Currency with the Public and ATM cash withdrawals) alongside monthly UPI volume and turnover value (Objectives 1 and 2). Second, a bivariate correlation matrix measures the statistical associations between cash growth, digital payments, and economic controls (Objective 3). Third, to determine whether UPI significantly displaces cash, growth-rate Ordinary Least Squares (OLS) regressions with Newey-West standard errors are estimated across multiple cash indicators following Augmented Dickey-Fuller (ADF) stationarity tests (Objective 4). Finally, shifting payment habits in private consumption are evaluated by plotting

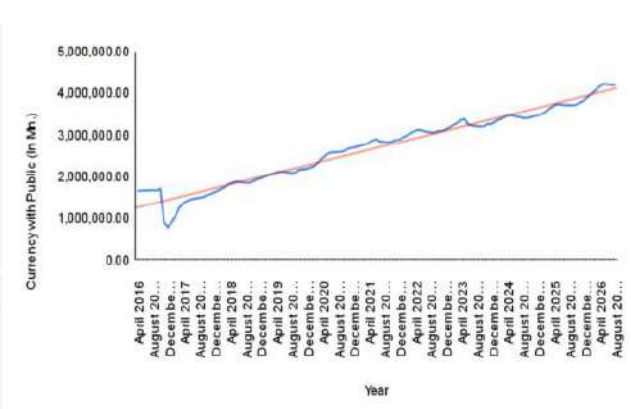
UPI transaction value and ATM withdrawals against quarterly Private Final Consumption Expenditure (PFCE) to observe structural substitution trends (Objective 5).

4.1. Result for Objective 1

Currency with the public exhibited an overall upward trend between 2016 and 2025, despite the increasing adoption of digital payment systems. As shown in Figure 1, currency with the public increased from approximately 1.6 million in 2016 to around 3.8-4.0 million by 2025, based on the values displayed in the chart. The trend was interrupted by a sharp decline in late 2016, coinciding with demonetisation, followed by a gradual recovery. Thereafter, currency with the public continued to increase, although with some fluctuations. This sustained rise indicates that the expansion of digital payments has not been accompanied by a sustained decline in the stock of currency held by the public. Rather, physical currency has continued to remain an important component of the Indian payment landscape.

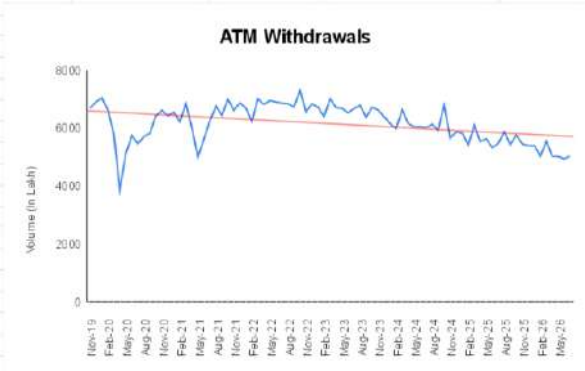
While currency with the public continued to rise, ATM withdrawal volumes exhibited a different pattern. As illustrated in Figure 2, withdrawals fluctuated considerably from November 2019 onwards, with a sharp decline in early 2020 followed by a recovery. However, the series began to weaken from late 2023, with withdrawal volumes declining from approximately 6,000–6,500 lakh to around 5,000 lakh by May 2026. This downward movement may indicate a change in the way consumers access cash, potentially reflecting the growing availability and convenience of digital payment alternatives such as UPI. Nevertheless, ATM withdrawals represent only one channel of cash access, and their decline does not necessarily imply an equivalent reduction in overall cash usage.

The contrasting movements of these two indicators are particularly relevant to understanding the changing role of cash in India. An increase in currency with the public alongside a decline in ATM withdrawals suggests that the stock of cash held by the public and the frequency with which cash is withdrawn do not necessarily move in the same direction. Although the expansion of UPI may reduce the need to withdraw cash for certain transactions, the continued rise in currency with the public indicates that physical currency remains in demand. These trends therefore suggest that the growth of digital payments may be changing the way cash is accessed and used rather than simply replacing it.



***(Source**: RBI DBIE)*

Fig 1: Currency With Public



***(Source**: RBI DBIE)*

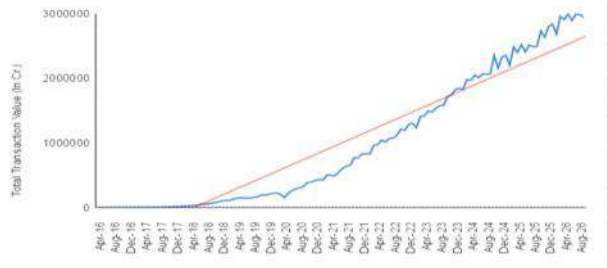
Fig 2: ATM Cash Withdrawals

4.2. Result for Objective 2

UPI has witnessed substantial growth in both transaction volume and value since its introduction in 2016, indicating its increasing role in India's digital payment ecosystem. As shown in Figure 3, transaction volume remained relatively low during the initial years but began to rise from 2018 onwards, with growth accelerating after 2020. The upward trajectory became particularly pronounced from 2022, reaching approximately 21,600 million transactions per month by

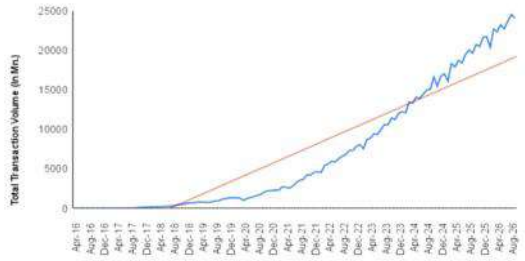
December 2025, compared with around 2,200 million in December 2020. This represents an increase of nearly 882 per cent over the five years, highlighting the rapid expansion of UPI usage. Figure 4 indicates the increase in transaction volume was accompanied by a substantial rise in transaction value, which grew from approximately ₹4.2 lakh crore per month in December 2020 to around ₹28 lakh crore by December 2025, an increase of roughly 567 per cent. Although both indicators recorded strong growth, transaction volume increased at a faster rate than transaction value during this period. This pattern suggests that the expansion of UPI was characterised not only by an increase in the total amount transferred but also by a substantial rise in the frequency of digital transactions. The simultaneous growth in these indicators highlights the strengthening role of UPI in facilitating everyday payments.

The sustained expansion of UPI provides an important context for understanding changes in cash demand. While the increasing volume and value of digital transactions indicate a growing preference for digital payment channels, the continued rise in currency with the public, observed in the preceding analysis, presents a contrasting trend.



(Source: NPCI Payment Statistics)

Fig 3: UPI Transaction Value Trend



(Source: NPCI Payment Statistics)

Fig 4: UPI Transaction Volume Trend

This suggests that the growth of UPI has not necessarily translated into a corresponding decline in the overall stock of cash. Rather, digital payments may be replacing cash for certain transactions while physical currency continues to serve other payment and liquidity needs. The relationship between these trends therefore warrants further examination to understand the extent to which UPI substitutes for cash or coexists with it in India's changing payment landscape.

4.3. Results for Objective 3 & 4

India's payments have moved rapidly from cash to UPI, yet currency in circulation kept rising, the "currency demand paradox" studied in an RBI paper (Awasthy, Misra and Dhal). This paper tests whether faster UPI growth goes with slower cash growth.

This study tests whether the growth of digital payments, proxied by UPI, has displaced cash in the Indian economy. It uses monthly data from January 2018 to August 2026, beginning after UPI's 2017 rollout, which gives 101 observations once differencing and lags are applied. Following the RBI's currency-demand framework, cash growth is regressed on income, prices, the interest rate, digital payments, and a set of shock dummies, estimated as a growth-rate OLS with Newey-West standard errors to correct for autocorrelation and heteroskedasticity. The main hypothesis concerns the cumulative UPI effect, defined as the sum of the coefficients on contemporaneous UPI growth and its two lags. Under the null (H0), this total effect on cash growth is zero. Under the alternative (H1), it is negative, indicating substitution away from cash.

We model using two cash value indicators: Currency with Public and ATM Cash Withdrawals. Three events are controlled for: the inclusion of micro-ATM cash in RBI data (November 2019), the zero-MDR policy on UPI (January 2020), and the COVID-19 lockdown (March to June 2020). The IIP index value acts as a monthly data proxy for GDP in the model. The table below explains the variables.

Role	**Variable (Δ = monthly change in logs)**	**Source**
Dependent, Model 1	Currency with the public, Δln	RBI
Dependent, Model 2	ATM cash withdrawals (ATM + PoS + Micro-ATM), Δln	RBI (DBIE R612)
Independent	UPI value, Δln, this month and two lags	NPCI
Control	IIP, Δln (activity proxy)	MoSPI
Control	CPI, Δln	MoSPI
Control	Repo rate, change in level	RBI
Dummies	COVID (four monthly pulses), Zero MDR, month dummies	Author's construction based on the events timeline

Table 1: Variables and dummies considered

	ΔCWP	ΔATM	ΔUPI	ΔIIP	ΔCPI
ΔATM	-0.03				
ΔUPI	0.12	0.78			
ΔIIP	-0.12	0.82	0.69		
ΔCPI	-0.21	-0.10	-0.08	-0.25	
ΔRepo	-0.27	-0.02	0.02	0.01	0.09

Source: Author's Calculation

Table 2: Correlation matrix

From Table 2: The ATM growth correlates strongly with UPI (0.78) and IIP (0.82), which correlate at 0.69; currency growth is weakly correlated ($|r| \leq 0.27$).

Ordinary Least Squares Testing

To guard against spurious regression, each variable was tested for a unit root using the Augmented Dickey-Fuller (ADF) test in levels and in first differences. Currency, UPI, CPI, and the repo rate were found to be integrated of order one, I(1), while IIP and ATM withdrawals were stationary in levels. As all first-differenced series were stationary, the models were estimated in growth rates, so that every regressor entering the equations is stationary. Two specifications were then estimated.

In Model 1, growth in currency with the public was regressed on contemporaneous and two lags of UPI growth, along with growth in IIP and CPI, the repo rate, and the event dummies. The cumulative UPI effect was positive and statistically significant (0.053, p = 0.005), driven largely by the same-month coefficient (0.045, p = 0.020). The model had an adjusted R^2 of 0.679 with 101 observations. In Model 2, growth in ATM cash withdrawals was regressed on its own lag in addition to the same regressors. The cumulative UPI effect was again positive and significant (0.369, p = 0.010), with a same-month coefficient of 0.463 (p = 0.001). Lagged ATM growth was negative (-0.267, p = 0.002), and the adjusted R^2 was 0.863 with 101 observations.

Model 1: Currency with the public

$$\ln \mathrm{CWP}_t = \alpha + \sum_{k=0}^{2} \gamma_k \ln \mathrm{UPI}_{t-k} + \gamma_3 \ln \mathrm{IIP}_t + \gamma_4 \ln \mathrm{CPI}_t + \gamma_5 \mathrm{Repo}_t + \boldsymbol{\delta}' \mathbf{D}_t + \varepsilon_t$$

Result: Total UPI effect +0.053 (p = 0.005), from the same month (+0.045, p = 0.020). Adjusted R^2 0.679, n = 101.

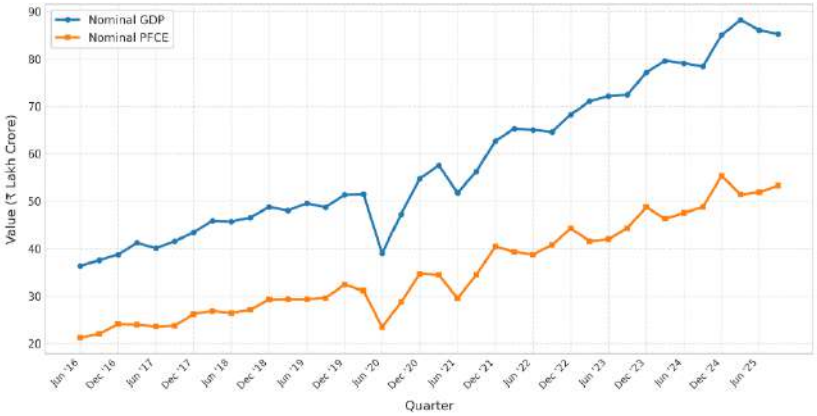
Model 2: ATM cash withdrawals

$$\ln \mathrm{ATM}_t = \alpha + \rho \ln \mathrm{ATM}_{t-1} + \sum_{k=0}^{2} \gamma_k \ln \mathrm{UPI}_{t-k} + \gamma_3 \ln \mathrm{IIP}_t + \gamma_4 \ln \mathrm{CPI}_t + \gamma_5 \mathrm{Repo}_t + \boldsymbol{\delta}' \mathbf{D}_t + \varepsilon_t$$

Result: Total UPI effect +0.369 (p = 0.010), from the same month (+0.463, p = 0.001); lagged ATM growth -0.267 (p = 0.002). Adjusted R^2 0.863, n = 101.

4.5. Result for Objective 5

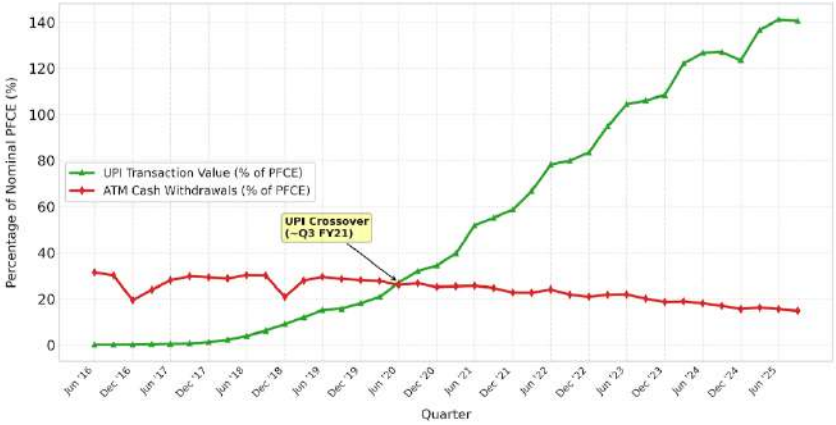
Private Final Consumption Expenditure (PFCE) measures the total expenditure incurred by resident households and non-profit institutions serving households (NPISH) on goods and services for final consumption. It serves as a reliable proxy for consumer demand because it captures actual end-use household spending, spanning daily essentials, healthcare, and discretionary items, hence reflecting real purchasing power and economic confidence.



(Source: MoSPI and RBI)

Fig 5: Nominal GDP Vs Nominal PFCE (Quarterly)

The PFCE vs. GDP line graph shows that private consumption is the Indian economy's foundational growth engine, consistently accounting for over half of total national income and tracking GDP expansion through both growth cycles and post-pandemic recovery phases.



(Source: MoSPI)

Fig 6: Relative Intensity of UPI Value Vs ATM Cash Withdrawals as a % of PFCE (2016 - 2025)

Analysis of UPI transaction Value and ATM cash withdrawals as a percentage of private final consumption indicates ongoing payment substitution, where digital P2P and retail channels rapidly absorbed the major consumer spending growth. Meanwhile, physical cash usage via ATMs transitioned from the dominant baseline medium to a secondary reserve liquidity tool. The structural crossover occurred in June 2020 when UPI officially surpassed ATM withdrawals relative to household consumption, indicating increased preference for UPI payments over cash relative to private final consumption expenditure.

5. Conclusion

5.1. Summary of Findings

This study investigated the empirical relationship between the rapid growth of the Unified Payments Interface (UPI) and physical cash usage in India between 2016 and 2025. Based on the econometric estimation, correlation analysis, and trend comparisons, the key findings are summarized below:

- **Continued Growth of Cash Stock Alongside UPI:** Currency with the Public (CWP) showed a sustained upward trend, increasing from approximately ₹1.6 lakh crore in 2016 to nearly ₹3.8–4.0 lakh crore by 2025. Even though UPI grew massively post-2020 (surpassing 21,600 million monthly transactions and ₹28 lakh crore in value by December 2025), it did not cause a nominal decline in the total cash stock held by the public.
- **Divergence Between Cash Stock and Cash Access:** While aggregate currency with the public expanded, monthly ATM cash withdrawal volumes peaked and began declining after late 2023 (falling from around 6,000–6,500 lakh to roughly 5,000 lakh). This confirms that while the transactional frequency of accessing cash through physical terminals has weakened, overall demand for holding currency remains resilient.
- **Positive Short-Run Co-movement (Complementarity in Growth Rates):** The growth-rate Ordinary Least Squares (OLS) models revealed a statistically significant positive cumulative relationship between monthly UPI growth and cash growth. The cumulative UPI effect was +0.053 ($p=0.005$) on Currency with the Public and +0.369 ($p=0.010$) on ATM cash withdrawals. These positive elasticities indicate that UPI growth does not immediately depress cash demand in monthly time-series dynamics, driven primarily by parallel macroeconomic expansion and general economic activity.
- **Structural Substitution in Household Private Consumption:** Although total cash stock continues to grow, household spending habits show strong digital substitution. UPI transaction value as a percentage of Private Final Consumption Expenditure (PFCE) underwent a decisive structural crossover in June 2020, rising from negligible levels in 2016 to over 140% of quarterly PFCE by 2025. Over the same timeframe, ATM cash withdrawals fell from over 30% of PFCE to around 15%, proving that new incremental consumer consumption is overwhelmingly absorbed by digital UPI rails rather than physical cash.

5.2. Policy Suggestions

The findings demonstrate that while UPI has largely substituted physical cash in driving private retail consumption, aggregate currency stock continues to expand due to informal sector dependence and precautionary motives. Therefore, policy interventions should support this consumer transition while managing dual payment rails:

1. **Focus on Informal Economy Formalisation:** Consumer spending through UPI has crossed baseline consumption levels, but overall cash remains high because the informal sector relies on physical currency for working capital and wages. Policies must focus on providing micro-credit, streamlined compliance, and digital ledger incentives to informal vendors rather than trying to curb cash supply directly.
2. **Maintain Strategic Cash Access Points:** While ATM withdrawals have moderated relative to private consumption, currency with the public continues to rise. Central banks and scheduled commercial banks should avoid aggressive branch or ATM closures, especially in semi-urban and rural centers where physical cash remains essential as a liquidity backstop during system downtimes.
3. **Safeguard Household Retail Payment Rails:** With private household expenditure heavily anchored on UPI, systemic resilience is crucial. Regulatory bodies must enforce stringent uptime standards, enhance zero-liability consumer dispute resolution frameworks, and deploy proactive fraud-detection mechanisms to protect daily retail consumers.

5.3. Assumptions of Study

This empirical analysis relies on the following key assumptions:

1. **Secondary Data Reliability:** The aggregate data published by the Reserve Bank of India (RBI), the National Payments Corporation of India (NPCI), and MoSPI are assumed to be accurate, methodologically consistent, and reflective of actual macro-level transactions and currency movements across India.
2. **High-Frequency Proxy Validity:** The Index of Industrial Production (IIP) is assumed to act as an appropriate monthly activity proxy for real output and income, while quarterly Private Final Consumption Expenditure (PFCE) validly mirrors consumer aggregate spending trends.
3. **Transaction Flow vs. Hoarding Behavior:** It is assumed that Automated Teller Machine (ATM) withdrawals and UPI volume primarily reflect transaction-driven payment needs (flow), whereas Currency with the Public (CWP) and high-denomination note holdings capture broader precautionary liquidity demands (stock).
4. **Exogenous Policy Shocks:** Major systemic interventions, such as Demonetisation (2016), the zero-MDR mandate (2020), COVID-19 mobility curbs (2020), and the withdrawal of the ₹2,000 note (2023) are assumed to act as exogenous structural breaks rather than endogenous changes in organic consumer preferences.

5.4. Limitations of Study

While providing important empirical insights, this study has several limitations:

1. **Aggregate Macro vs. Micro Disaggregation:** The analysis is restricted to national aggregate secondary time-series data. It cannot capture state-level disparities, rural-urban variations, or individual consumer demographic nuances (such as age, gender, education, and household income brackets).
2. **Definitional and Reporting Adjustments:** The cash withdrawal series underwent structural definition shifts over time (for instance, the incorporation of Micro-ATMs from November 2019 onward), creating minor non-homogeneities in high-frequency comparisons.
3. **Unobservable Informal and Shadow Transactions:** Physical cash velocity and peer-to-peer informal cash handoffs cannot be directly recorded in official monetary statistics, limiting precise measurement of actual cash turnover in unorganised markets.
4. **Short-Run Focus of Econometric Estimation:** Due to the relatively young history of UPI (mature data starting from 2018), the OLS model estimates short-run monthly growth elasticities. Exploratory tests found no robust long-run cointegration relationship, restricting findings to immediate monthly dynamics rather than decades-long equilibrium effects.
5. **Limitation of OLS:** OLS statistical analysis measures correlation, not causation. Cash and UPI are both driven by the same underlying factors, such as overall spending, income, and festival demand, so OLS cannot tell whether UPI is replacing cash or whether both are simply rising together.

5.5. Future Scope of Study

1. **State-Level and Sub-National Analysis:** Future research can employ panel data econometrics across different Indian states and Union Territories to test whether digital substitution varies significantly by regional per capita income and banking infrastructure density.
2. **Non-Linear Threshold and Saturation Models:** Further econometric studies could deploy threshold regression models (e.g., Panel Threshold or Smooth Transition Autoregressive models) to identify the exact digital penetration turning point, the threshold beyond which aggregate currency stock begins an irreversible downward shift.
3. **Household-Level Primary Payment Diaries:** Micro-level payment diaries can quantify how digital substitution varies across specific PFCE consumption baskets, such as perishable food items, healthcare, transportation, and consumer durables.
4. **Impact of Central Bank Digital Currency (CBDC):** As the Reserve Bank of India expands its Digital Rupee (e₹) pilot, future empirical research can assess whether sovereign digital cash competes directly with UPI rails or accelerates the displacement

of physical high-denomination banknotes.

Acknowledgement:

We express our sincere gratitude to Pallavi Prasad and Vagisha Goel for their invaluable insights, continuous encouragement, and constructive feedback throughout the development of this research. Their intellectual contributions and thoughtful discussions significantly enhanced the quality and depth of this study.

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