

Adoption of UPI and Implementation of UPI-ATM in India: A Logit Analysis

Tirthankar Mandal



Abstract: Unified Payments Interface (UPI) is a real-time payment system developed by the National Payments Corporation of India (NPCI). It was introduced to facilitate easy, quick, and secure online payments between banks. The Government of India plans to introduce UPI-ATM services following the successful implementation of UPI transactions. While challenges exist, such as limited digital literacy and connectivity issues, several factors have contributed to the adoption of UPI transactions. This study identifies the gaps between rural and urban areas, as well as between males and females, in terms of technological knowledge and awareness when conducting digital transactions. With the help of logit analysis, it has been observed that UPI-ATM services have a prosperous future, despite existing differences in many dimensions.

Keywords: Digital India, UPI, UPI-ATM, Logistic Analysis

I. INTRODUCTION

The Unified Payments Interface (UPI) in India had been experiencing significant growth and success in recent past. UPI witnessed rapid adoption and development in India since its launch in 2016. It quickly became one of the most popular digital payment methods in the country. UPI transactions were consistently increasing, with millions of transactions processed daily. By September 2021, the daily transaction volume had crossed the 3 billion mark. UPI was used for a wide range of transactions, including peer-to-peer (P2P) fund transfers, bill payments, mobile recharges, online shopping, and more. Many merchants, both online and offline, started accepting UPI payments. This expansion of acceptance points contributed to the growth of digital payments in India. Various government initiatives and programs, such as Jan Dhan Yojana, Direct Benefit Transfer (DBT), and BHIM (Bharat Interface for Money), promoted the use of UPI for financial inclusion and subsidy distribution. Several UPIbased payment apps have been launched by banks and private companies, offering users a range of options for making UPI transactions. NPCI and participating banks implemented robust security measures to protect UPI transactions, including two-factor authentication and secure encryption. UPI gained international recognition as a successful and innovative payment system, with some countries looking to adopt similar models.

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Fintech companies introduced innovative features and services built on top of the UPI platform, including wealth management, lending, and insurance products. The Indian government continued to support and promote digital payments, aiming to reduce cash usage and increase financial inclusion. The Reserve Bank of India (RBI) and the National Payments Corporation of India (NPCI) regularly update the regulatory framework for Unified Payments Interface (UPI) to ensure its smooth functioning and security. Mobile wallets, such as Apple Pay, Google Pay, and Samsung Pay, securely store payment card information on smartphones. Users can make payments by simply tapping their phones at compatible terminals or scanning QR codes. UPI is a real-time payment system widely used in India. It allows users to transfer money between banks using smartphones or computers. UPI is used for various purposes, including bill payments and online shopping. E-commerce platforms enable consumers to make purchases online using multiple digital payment methods, eliminating the need for physical cash.

This study focuses on a state-level examination to identify the preliminary causes and indicators for enhancing the growth of UPI transactions in both rural and urban areas. An overall improvement in UPI transactions at the grassroots level may lead to the rapid adoption of the newly introduced UPI-ATM services.

II. LITERATURE REVIEW

Singh (2017) [9] studied to find out the customer perception and impact of demographic factors like gender, age, education, profession, income etc. on adoption of digital mode of payment. No significant difference has been observed between males and females, age, profession, and annual income. Education level plays a crucial role in the adoption of digital payment modes. To understand how the rural consumers perceive mobile payment service and the factors that influence consumers in the adoption of mobile wallet, V Chavda (2018) [3] found that the adoption of mobile payments in rural is at beginning stage of Innovation Decision Process and very few are aware about the mobile payments. The majority of people think about security, complexity, and a poor network. Sarika & Vsantha (2019) [8] found that Demonetization has triggered more usage of e-payment among public which increases the usage of cashless transaction. Transferring money through cashless modes would essentially require the use of plastic money, such as credit or debit cards, mobile wallets, net banking, and other similar methods. This indicates a movement towards a cashless economy. Joshi et al. (2019) [5] examined the changes (increase or decrease) in the usage and adaptation of online services and payments through mobile application post demonetization (2016) in India.

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They observed a record rise in the number of online services and payment applications in urban areas. In contrast, rural areas continue to struggle due to a lack of knowledge and internet illiteracy.

Kafley and Chandrasekaram (2019) [6] pointed out that literacy, technological skill, speed of internet, financial literacy, lack of trust, and lack of awareness in cashless transactions are the main issues and challenges faced by the e-payment system in rural areas. Tiwari T. et al. (2019) [11][12] found that there are many factors affecting the adoption of digital payments in Uttar Pradesh. This includes the level of education, fundamental understanding and overcoming the associated threat. Income and technical soundness are equally essential for the deeper penetration of digital banking in rural areas. For the successful implementation of Digital Financial Inclusion (DFI) and the promotion of digital payments, the authors propose a conceptual loop model. Behera and Balaji (2019) [2] have tried to discuss the digital awareness on people of rural India and analysed the pros and cons of cashless financial system. They found that people from rural areas are very compatible with electronic devices, especially mobile phones. Still, when it comes to financial transactions through digital methods, they prefer to do it manually. Unless people are well educated and trained to use digital payment methods, the dream of a digital India will remain a dream.

To identify the various challenges faced by Indians while moving towards cashless in rural and urban areas, A. Hasan et al. (2020) [4] concluded that most of the areas are still unaware regarding cashless mechanisms, especially the rural regions. Inadequate infrastructure ranges from network failures and slow internet speeds to security and privacy issues, which appear to be one of the significant challenges in implementing a cashless policy in India. Agarwal K. et al. (2021) [1][12] evaluated the factors affecting consumers to move from one platform to another, and the consumer psychology and demographic characteristics to follow up on the digital payment mode. They found that the respondents' age group, educational qualifications, and marital status displayed significant differences. In India, every business, from street vendors to any citizen, whether urban or rural, has started accepting e-payments. Singhal & Gupta (2021) [10] found that Covid-19 has increased the use of digital applications in economy especially at towns and village level. Most of the small business owners, shopkeepers, and even those who earn their livelihood by selling items using hand carts or as hawkers. Ranjith P.V et al. (2021) [7] have tried to understand the concept and the different modes of digital payment and safety of these transactions. They found that the majority of consumers prefer credit or debit cards and are comfortable with digital transactions. Security is found to be the most challenging factor which prevents its usage. Consumers have sufficient awareness of information security in cashless transactions.

III. OBJECTIVE

The primary objective of this study is to determine the scope and challenges of the UPI - ATM transaction system for rural and urban residents in the state of West Bengal, India.

- To examine the role of residential advantages in experiencing a better UPI transaction, which helps introduce the UPI-ATM service.
- To examine the role of gender in UPI transactions in rural and urban areas.
- To examine how far the technological knowledge and digital awareness accelerate the UPI transaction as well as UPI - ATM services.

IV. HYPOTHESIS

Ho1: There is no significant difference observed between respondents' UPI transactions and the demographic factors. Ho2: There is no significant difference observed between respondents' UPI transactions and their digital awareness. Ho3: There is no significant difference observed between respondents' UPI transactions and technological knowledge.

V. METHODOLOGY

A primary survey has been conducted randomly in rural and urban areas. For qualitative responses, a Likert scale has been used. The average response value of combining those questions has been calculated, and thereafter, the reliability has been tested using Cronbach's Alpha. Two such independent variables are introduced, namely Digital Awareness and Technological Knowledge. The progress or success of the UPI Transaction service has been considered as a dependent variable, which is a binary response and is assumed to be influenced by demographic factors and the other two factors mentioned earlier.

The standard form of dependent and independent variables is $Y_i = \alpha + \beta X_i + U_i$ (1)

In the Linear Probability Model (LPM), Y_i It is binary or dichotomous. The conditional mean of Y_i given X_i , $E(Y_i|X_i)$ Indicates the conditional probability that the event will occur given X_i , that is $Pr(Y_i = 1|X_i)$. $E(Y_i|X_i)$ It is the probability that an individual will accept a UPI transaction, given any associated factors. When $E(U_i) = 0$ then,

(2)
$$E(Y_i|X_i) = \alpha + \beta X_i = P_i$$

 $[E(Y_i) = 0(1 - P_i) + 1(P_i)]$

The probability is linear in x.

In contrast to the linear probability model (LPM), the logit model always produces predicted probabilities within the meaningful range [0, 1]. From equation (2),

(3)
$$P_i = \frac{1}{1 + e^{-(\alpha + \beta X_i)}}$$

Or, (4) $P_i = \frac{1}{1 + e^{-Z_i}} = \frac{e^{Z_i}}{1 + e^{Z_i}}$

Equation (4) is the logistic distribution function. P_i is the probability of accepting a UPI transaction, and $(1 - P_i)$ It is the probability of not performing/accepting a UPI transaction.

(5)
$$1 - P_i = \frac{1}{1 + e^{Z_i}}$$

The odds ratio is the ratio of the probability of an individual accepting a UPI transaction to the likelihood that he/she is not receiving, as shown

in equation (6) below.

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53



(6)
$$\frac{P_i}{1-P_i} = e^{Z_i}$$

Log of the odds ratio is a linear representation of the equation (6), as

(7)
$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \alpha + \beta X_i$$

 β Equation 7 does not represent a direct marginal effect, as in Equation 2. To get the marginal effect, we need

(8)
$$\frac{dP_i}{dX_i} = \hat{\beta}_i \cdot \hat{P}_i (1 -$$

VI. RESULT AND DISCUSSION

Digital Awareness (*digiaware*) and Technological Knowledge (*techknow*) are two variables constructed using a few Likert scale questionnaires (7-point scales) and some binary questions based on digital and technological information, which are highly related to digital transactions. The Cronbach's Alpha test for the reliability of both variables (0.720 and 0.714, respectively) is significant (Tables 1 and 2). A value of 0.60 or more indicates satisfactory internal consistency reliability in exploratory studies.

Table 1: Reliability	Test of Digita	Awareness
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 \widehat{P}_{i})

Digital Awareness (Item Statistics) (N = 94)						
Variables	Mean	SD				
Safety and security of digital or cashless transactions	0.39	1.815				
Time Consumption of the transaction	1.46	1.179				
Usefulness of transaction	1.37	1.261				
Certified Mobile Apps for transactions	1.45	1.123				
Internet speed for transactions	2	1.218				
Significant amount transfer/transaction problem	-0.26	1.466				
A small amount transfer/transaction is easy	-0.33	1.455				
Number of modes available for transaction	9.64	6.785				
Number of daily activities performed through digital/cashless mode	4.19	3.167				
Number of mobile Apps used for transactions	1.2	1.266				
Reliability Statistics (Digital Aware	ness)					
Cronbach's Alpha		0.72				
Cronbach's Alpha Based on Standardised Items		0.808				
N of Items		10				

Table 2: Reliability Test of Technological Knowledge

Technological Knowledge (Item Statistics) (N = 94)									
Variables	Mean	SD							
Information about plastic money	0.47	0.502							
Information about Digital India	0.78	0.419							
The nation's performance and the target of the Digital India initiative	1.21	0.76							
Opinion about the future and progress of digital India	0.95	0.226							
The transaction procedure for your bank account	1.62	1.337							
Accessibility in a social media platform	2.04	1.421							
Availability of electronic gadgets for digital transactions	0.52	0.502							
Educational status	14.65	4.257							
Experience in digital and technological transactions	3.59	3.056							
Nearest ATM and the number of monthly ATM	1.99	2.107							
Reliability Statistics	(Technological Knowledge)								
Cronbach's Alpha		0.714							
Cronbach's Alpha Based on Standardised Items		0.784							
N of Items		10							

The logistic regression model between the performance of UPI transactions and all covariates is statistically significant at the 0.01 level. The covariate digiware is significant at the 0.01 level of significance with a favourable odds ratio of 9.82 (Table 3). As digital awareness increases, the odds of UPI transactions being performed will decrease. As digital awareness increases, the probability of increasing UPI transactions rises by 0.31 (marginal effect for average individual) and 0.20 (marginal effect for actual individual) (Table 4). The odds ratio of technological knowledge is 0.22 at a 0.10 level of significance. As technological knowledge

increases, the probability of increasing UPI transactions rises marginally by 0.30 and 0.26 for average and actual individuals, respectively (Table 5). The qfit plots of the predicted value of UPI transactions show an upward trend with both digital awareness and technological knowledge (Figures 1 and 2). The results reject the null hypothesis, indicating a positive and significant impact of digital awareness and technological knowledge on the acceptance of digital transactions.



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54

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			8	8								
Log likelihood =	Number of obs =94											
-35.966168		LR chi2(4) =55.64										
				Prob > chi2 = 0.000	00							
		Pseudo R2 = 0.4362										
tranupi	Odds Ratio	Std. Err.	Z	P>z	[95% Cont	f. Interval]						
digiaware	9.827741	4.7753	4.70	0.000	3.791882	25.47139						
techknow	.2253584	.1666358	-2.02	0.044	.0529022	.9600059						
resi	.2258416	.1658541	-2.03	0.043	.0535422	.9526018						
gender	1.931304	1.320963	0.96	0.336	.5054173	7.379909						
cons	.0460245	.0444297	-3.19	0.001	.0069388	.3052779						

Table 3: Logistic Regression

Table 4: Marginal Effect of Digi Ware after Logistic Regression

Marginal effects after lo y = Pr(tranup) (predi = .34276363	gistic ict)						
variable	dy/dx	Std. Err.	Z	P>z	[959	% C.I.]	Х
digiaw~e	.3161671	.06106	5.18	0.000	.196487	.435847	2.1117

Average partial effects after logistic										
y = Pr(tranupi)										
variable	Coef.	Std. Err.	Z	P>z	[95% C	onf. Interval]				
digiaware .2013468 .0162601 12.38 0.000 .1694776 .2332159										

Table 5: Marginal Effect of Techknow after Logistic Regression

Marginal effects after logistic y = Pr(tranup) (predict) = .3979536										
variable	dy/dx	Std. Err.	Z	P>z	[959	% C.I.]	Х			
techknow .3025362 .08672 3.49 0.000 .132575 .472497 1.39628										

Average partial effects after logistic										
y = Pr(tranupi)										
variable	variable Coef. Std. Err. z P>z [95% Conf. Interval]									
techknow .2630371 .0570249 4.61 0.000 .1512703 .3748039										





Figure 2: Qfit Plot of Technological Knowledge

From the logistic regression, it is observed that the odds ratio of residents (0.22) is positive and significant at the 0.01 level of significance. Rural people have 0.22 times the odds of urban people of having a UPI transaction. Therefore, residence plays an essential role in the performance of the UPI transaction system. The average urban person has a 33% chance of having UPI transactions compared to 50% of rural people (Table 6). The odds ratio for gender is 1.93, but it is not significant. The average male has a 45% chance of performing a UPI transaction, as compared to 36% for females (Table 7). Age level plays a crucial role in performing UPI transactions. Compared to younger people, older individuals have a marginally higher probability of performing UPI transactions. Table 8 shows that the chance of performing a UPI transaction is 41.4% for the age group 20, whereas it increases to 41.6% for the age group 60. Rural males have a 53% probability, compared to 32% for urban males. Similarly, rural females have a 44% probability compared to urban females (32%) (Table 9). Certainly, demographic factors have a significant impact on the progress and performance of UPI transactions, which rejects the null hypothesis.

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Table 6: Prediction with Margins (Residence)

Predictive margins			Number of obs	= 94			
Model VCE: OIM							
Expression: Pr (tranupi), predict ()							
	Margin	Delta-method Std.	Z	P>z	[95% Conf. Interval]		
	_	Err.					
resi							
0	.5052358	.0526859	9.59	0.000	.4019733	.6084984	
1	.3329695	.0482062	6.91	0.000	.2384871	.4274518	

Table 7: Prediction with Margins (Gender)

Predictive margins Model VCE: OIM Expression: Pr (tranupi), predict ()				1	Number of obs = 94		
	Margin	Delta-method Std. Err.	Z	P>z	[95% Conf. Interval]		
gender							
0	.3647421	.0640962	5.69	0.000	.2391159	.4903683	
1	.4453231	.0483652	9.21	0.000	.3505291 .5401172		

Table 8: Prediction with Margins (Age)

Predictive margins			Number o	f obs = 94		
Model VCE: OIM						
Expression: Pr (tranupi), p	redict ()					
1at: age = 20						
2. at: age $= 30$						
3. at: age = 40						
4. at: age = 50						
5at: age = 60						
variable	Margin	Delta-method	Z	P>z	[95% C	onf. Interval]
	_	Std. Err.			_	_
_at						
1	.4140418	.0701839	5.90	0.000	.2764839	.5515997
2	.4145173	.0446704	9.28	0.000	.326965	.5020697
3	.4149929	.0365289	11.36	0.000	.3433976	.4865882
4	.4154684	.0542408	7.66	0.000	.3091584	.5217785
5	.415944	.0825717	5.04	0.000	.2541065	.577815

Table 9: Logistic Regression with Interaction (Gender & Residence)

	Predictive margins			Ν	Number of obs = 94	
	Model VCE: OI	M				
Express	sion: Pr (tranupi)	, predict ()				
	Margin	Delta-method Std. Err.	Z	P>z	[95% C	onf. Interval]
gender						
0	.3801659	.0545382	6.97	0.000	.273273	.4870589
1	.4253235	.0524911	8.10	0.000	.3224429	.5282041
resi						
0	.4929278	.0575112	8.57	0.000	.3802079	.6056478
1	.3275851	.0497724	6.58	0.000	.230033	.4251371
gender#resi						
0 0	.4447318	.0941766	4.72	0.000	.2601491	.6293146
0 1	.3289345	.0554094	5.94	0.000	.220334	.437535
1 0	.5268988	.0676259	7.79	0.000	.3943544	.6594432
1 1	.3277889	.0757765	4.33	0.000	.1792697	.476308

The ROC curve (Figure 3) is constructed by plotting the actual positive rate (TPR) against the false positive rate (FPR). The TPR is the proportion of observations that are correctly predicted to be positive out of all positive observations.

The FPR is the proportion of observations that are incorrectly predicted to be positive out of all negative observations. The ROC curve shows the trade-off between sensitivity (TPR) and specificity (FPR). The area under the ROC curve is 0.9035, indicating better performance.



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Figure 3: ROC Curve Analysis

Most interestingly, the rural areas of West Bengal are performing better in UPI transactions compared to urban areas, which indicates a successful digital transaction across the state and the nation as well. The acceleration of UPI transactions will lead to the successful implementation of UPI-ATM services nationwide. Men are performing higher UPI transactions than women in rural areas. This is a fact that is particularly relevant to many females in rural areas, who are often engaged in household activities and have fewer opportunities to engage in transactions than males. However, this is not the case for urban female individuals. In urban areas, both males and females are performing digital transactions through UPI at nearly equal rates.







Figure 5: Margins Plot (Gender)



Figure 6: Margins Plot (Age)



Figure 7: Margins Plot of Interaction (Gender & Age)



Figure 8: Margins Plot of Interaction (Residence & Age)



Figure 9: Margins Plot of Interaction (Gender & **Residence**)



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Figure 10: Margins Plot of Interaction (Residence, Gender & Age)

VII. CONCLUSION

UPI transactions in rural India have been on the rise in recent years, driven by the government's Digital India initiative, increased internet penetration, and the growth of digital payment infrastructure. While challenges exist, such as limited digital literacy and connectivity issues, several factors have contributed to the adoption of online transactions in rural areas. Many rural residents may be unfamiliar with digital technology or have limited access to training resources. Poor internet connectivity in remote rural areas can hinder the adoption of online transactions. Building trust in digital financial services and ensuring the security of online transactions remain essential concerns. Overall, while challenges persist, the increasing adoption of UPI transactions in rural India is contributing to financial inclusion and improving access to vital services in rural communities. Continued efforts to address these challenges and expand digital infrastructure, such as UPI-ATM services, will further drive the growth of digital transactions nationwide.

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58

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