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

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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 is going to introduce UPI-ATM services after successful progress of UPI transaction. While challenges exist, such as limited digital literacy and connectivity issues, several factors have contributed to the adoption of UPI transactions. The present work finds the gap between rural and urban, male and female and technological knowledge and awareness in performing digital transactions. With the help of logit analysis, it has been observed a successful future of UPI-ATM services though there exists 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 growth 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 UPI-based payment apps were launched by banks and private companies, providing users with a variety 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, with the aim of reducing cash usage and increasing financial inclusion. The Reserve Bank of India (RBI) and the National Payments Corporation of India (NPCI) regularly updated the regulatory framework for UPI to ensure its smooth functioning and security. Mobile wallets like Apple Pay, Google Pay, and Samsung Pay store payment card information securely on smart phones. 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 smart phones or computers. UPI is used for various purposes, including bill payments and online shopping. E-commerce platforms enable consumers to make purchases online using various digital payment methods, eliminating the need for physical cash.

The present work concentrates on a state level study to find out the preliminary causes and indicators to improve the growth of UPI transaction in both rural and urban areas. An overall improvement of UPI transaction in grassroots level may lead to motivate the newly introduced UPI-ATM services rapidly.

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 male and female, age, profession, and annual income. Education level plays an important role in the digital payment mode. To understand how the rural consumers perceive mobile payment service and the factors that influence consumers in 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. Majority of the people thinks about the security, complexity and 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 basically demand the usage of plastic money i.e. credit/debit cards, mobile wallets, net banking and more. 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.

They observed that a record rise is seen in the number of online services and payment applications in urban areas while rural area is still crawling and struggling as they suffer due to 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, lack of awareness in cashless transaction are the main issues and challenges faced by 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, basic understanding and overcoming the associated threat. Income and technical soundness is equally important for deeper penetration of digital banking in rural part. For a successful implementation of Digital Financial Inclusion (DFI) and promoting digital payments, the authors propose a conceptual loop model. Behera and Balaji (2019) [2][13][14][15][16][17] 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 area are very compatible with electronic devices especially with mobiles but when it comes to financial transaction through digital method, they prefer to do it manually. Unless people are well educated and trained to use digital payment methods, the dream of digital India will remain as 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. There is inadequate infrastructure ranges from network failure and slow speed of internet and security and privacy issue seem to be one of the major challenges in the development of cashless policy in India. Agarwal K. et al. (2021) [1][12][13] evaluated the factors affecting the consumers to move from one platform to another and the consumer psychology and demographic characteristics to follow up on digital payment mode. They found that the respondents' age group, educational qualification, and marital status displayed a significant difference. In India, every business, even street vendors, or any citizen, whether urban or rural, have 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 businessman's, shopkeepers even those who earn their livelihood through selling of their items using hand carts or 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 majority of the consumers prefer credit/debit card and they are comfortable using digital transactions. Security is found to be the most difficult factor which prevents its usage. Consumer has enough awareness of the information security in cashless transactions.

III. OBJECTIVE

The main objective of this study is to find out the scope and challenges of UPI – ATM transaction system of rural and urban people in the state of West Bengal, India.

- To examine the role of residential advantages experienced a better UPI transaction which helps to introduce UPI-ATM service.
- To examine the role of gender in UPI transaction 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

H_{01}: There is no significant difference is observed by respondents' UPI transaction and the demographic factors.
H_{02}: There is no significant difference is observed by respondents' UPI transaction and the digital awareness.
H_{03}: There is no significant difference is observed by respondents' UPI transaction 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 following Cronbach's Alpha. Two such independent variables are introduced, namely Digital Awareness and Technological Knowledge. The progress or success of UPI Transaction service has been considered as dependent variable, which is a binary response and is assumed to be influenced by demographic factors and the other two factors mentioned earlier.

Let the standard form of dependent and independent variables is

$$(1) \qquad Y_i = \alpha + \beta X_i + U_i$$

In Linear Probability Model (LPM), Y_i 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 $Pr(Y_i = 1|X_i)$. $E(Y_i|X_i)$ is the probability of accepting UPI transaction by an individual given any associated factors. When $E(U_i) = 0$ then,

$$(2) \qquad E(Y_i|X_i) = \alpha + \beta X_i = P_i$$
$$[E(Y_i) = 0(1 - P_i) + 1(P_i)]$$

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),

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

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

Equation (4) is the logistic distribution function.

P_i is the probability of accepting UPI transaction, and $(1 - P_i)$ is the probability of not performing/accepting UPI transaction.

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

The odds ratio is the ratio of probability of an individual accepting UPI transaction to the probability that he/she is not accepting, as shown in equation (6) below.

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

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

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

β in equation 7 does not represent direct marginal effect as like in equation 2. To get the marginal effect we need

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

VI. RESULT AND DISCUSSION

Digital Awareness (*digiaware*) and Technological Knowledge (*techknow*) are two variables that have been constructed by a few Likert scale questionnaires (7 points) 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 the variables (0.720 & 0.714 respectively) is significant (Table 1 & 2). A value of 0.60 or more indicates satisfactory internal consistency reliability in exploratory studies.

Table 1: Reliability Test of Digital Awareness

Digital Awareness (Item Statistics) (N = 94)		
Variables	***Mean***	***SD***
Safety and security of digital or cashless transaction	0.39	1.815
Time Consumption of transaction	1.46	1.179
Usefulness of transaction	1.37	1.261
Certified Mobile Apps for transaction	1.45	1.123
Internet speed for transaction	2	1.218
Large amount transfer/transaction problem	-0.26	1.466
Small amount transfer/transaction 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 transaction	1.2	1.266
Reliability Statistics (Digital Awareness)		
Cronbach's Alpha		0.72
Cronbach's Alpha Based on Standardized 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
Nation's performance and target of digital India initiative	1.21	0.76
Opinion about the future and progress of digital India	0.95	0.226
Transaction procedure of own bank account	1.62	1.337
Accessibility in social media platform	2.04	1.421
Availability of electronic gadgets form digital transaction	0.52	0.502
Educational status	14.65	4.257
Experience on digital and technological transaction	3.59	3.056
Nearest ATM and number of monthly access to ATM	1.99	2.107
Reliability Statistics (Technological Knowledge)		
Cronbach's Alpha		0.714
Cronbach's Alpha Based on Standardized Items		0.784
N of Items		10

The logistic regression model between the performance of UPI transactions with all covariates is significant at 0.01 level of significance. The covariate digiware is significant at 0.01 level of significance with a positive odds ratio of 9.82 (Table 3). As digital awareness increases the odds of UPI transactions performed against not performed will increase. 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. When the technological knowledge increases then 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 are upward rising with both digital awareness and technological knowledge (figure 1 & 2). The results reject the null hypothesis as there is a positive significant impact of digital awareness and technological knowledge over the acceptance of digital transactions.

Table 3: Logistic Regression

Log likelihood = -35.966168	Number of obs =94 LR chi2(4) =55.64 Prob > chi2 =0.0000 Pseudo R2 =0.4362					
tranupi	Odds Ratio	Std. Err.	z	P>z	[95% Conf. 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 4: Marginal Effect of Digi Ware after Logistic Regression

Marginal effects after logistic y = Pr(tranup) (predict) = .34276363							
variable	dy/dx	Std. Err.	z	P>z	[95% C.I.]		X
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% Conf. 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	[95% C.I.]		X
techknow	.3025362	.08672	3.49	0.000	.132575	.472497	1.39628

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

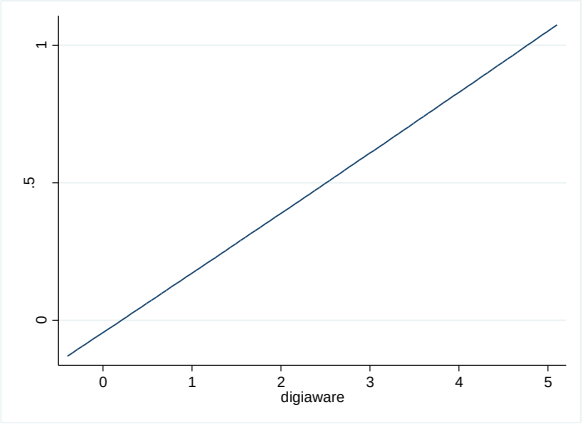

Figure 1: Qfit Plot of Digital Awareness

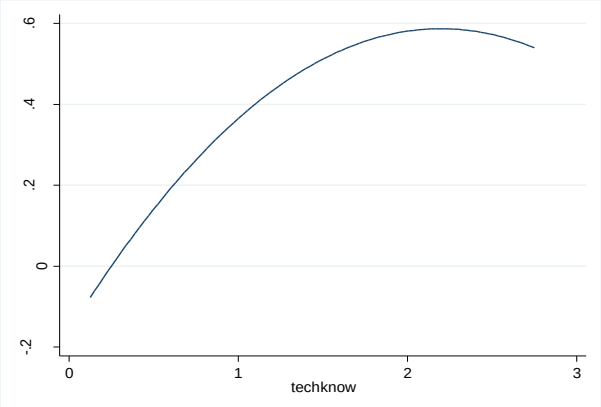

Figure 2: Qfit Plot of Technological Knowledge

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

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Table 6: Prediction with Margins (Residence)

Predictive margins Model VCE: OIM Expression: Pr (tranupi), predict ()			Number of obs = 94			
	Margin	Delta-method Std. Err.	z	P>z	[95% Conf. Interval]	
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 ()			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 Model VCE: OIM Expression: Pr (tranupi), predict ()			Number of obs = 94			
1. _at: age = 20 2. _at: age = 30 3. _at: age = 40 4. _at: age = 50 5. _at: age = 60						
variable	Margin	Delta-method Std. Err.	z	P>z	[95% Conf. Interval]	
_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 Model VCE: OIM Expression: Pr (tranupi), predict ()			Number of obs = 94			
	Margin	Delta-method Std. Err.	z	P>z	[95% Conf. 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 true 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 which indicates a better performance.

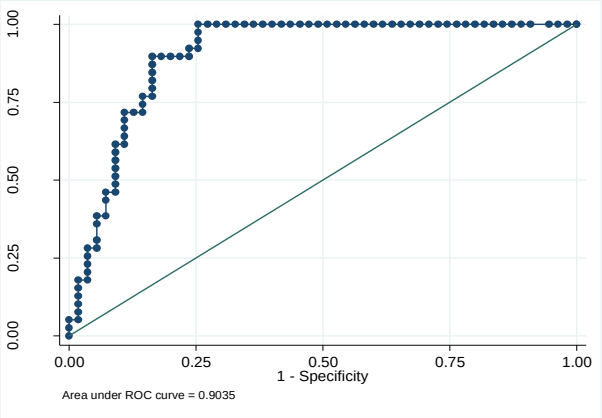

Figure 3: ROC Curve Analysis

Most interestingly rural area of the state West Bengal is performing better UPI transaction compare to urban area, which indicates a successful digital transaction all over the state and nation also. The acceleration of UPI transaction will definitely lead to a successful UPI-ATM services in every part of the nation. Male people are performing higher UPI transaction than female in rural area. This is very true fact that most of the females in rural area are engaged in household activities and they have very less opportunity to transact than male people. But this is not same for urban female people. In urban area both male and female are almost equally performing digital transaction through UPI.

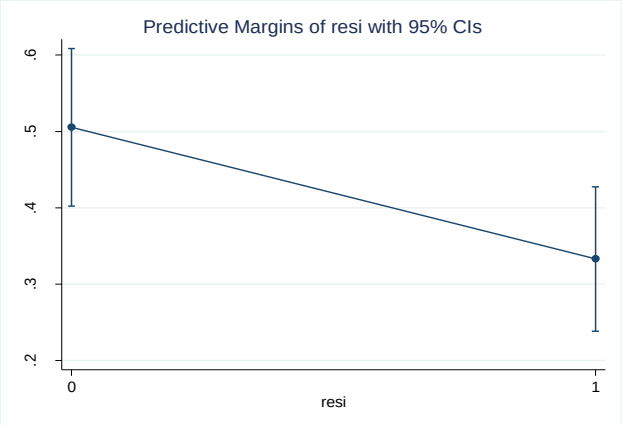

Figure 4: Margins Plot (Residence)

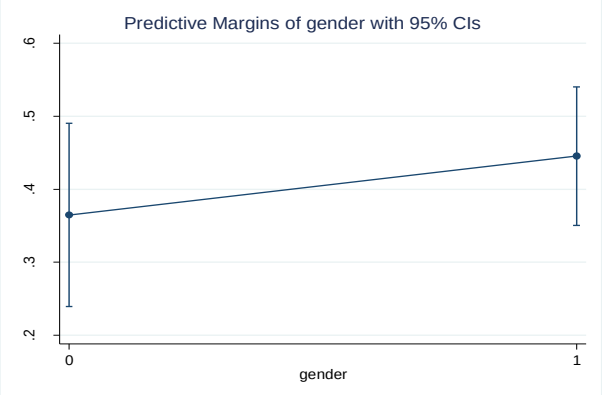

Figure 5: Margins Plot (Gender)

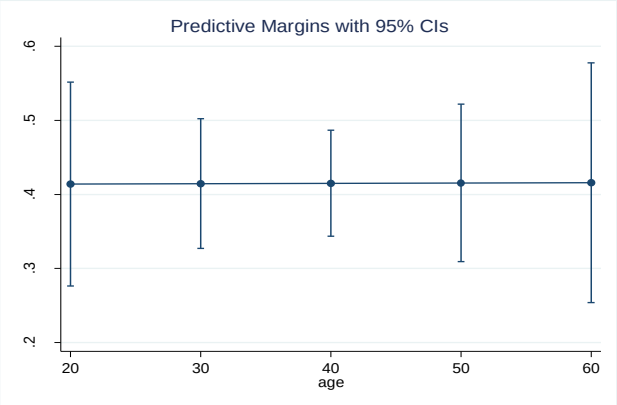

Figure 6: Margins Plot (Age)

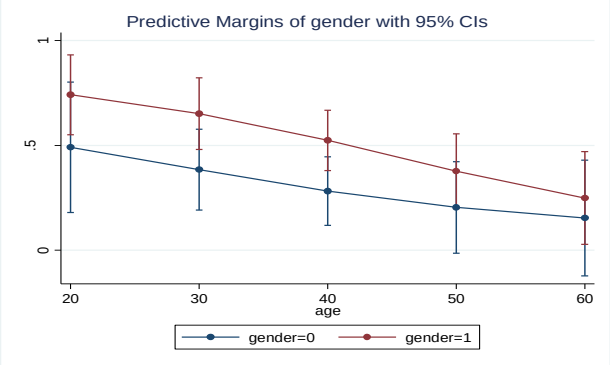

Figure 7: Margins Plot of Interaction (Gender & Age)

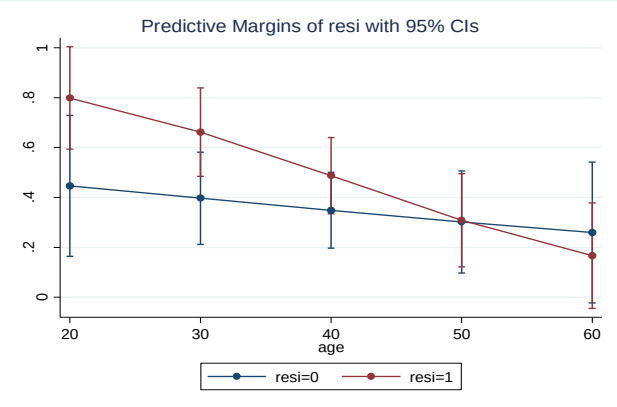

Figure 8: Margins Plot of Interaction (Residence & Age)

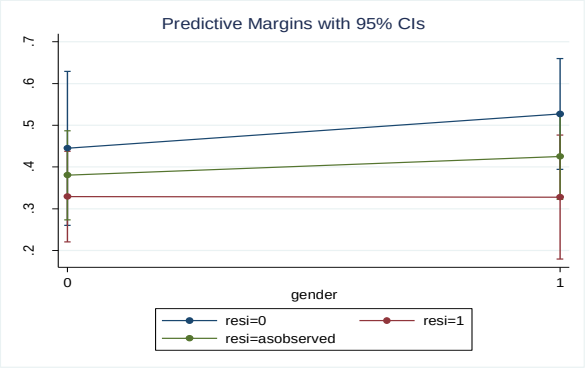

Figure 9: Margins Plot of Interaction (Gender & Residence)

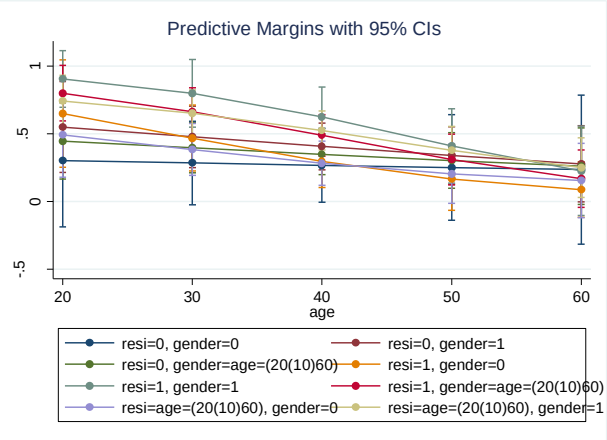

Figure 10: Margins Plot of Interaction (Residence, Gender & Age)

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 not be familiar with digital technology or may 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 important concerns. Overall, while challenges persist, the increasing adoption of UPI transactions in rural India is contributing to financial inclusion and improving access to essential services for rural communities. Continued efforts to address these challenges and expand digital infrastructure like UPI-ATM service will further drive the growth of digital transactions in every corner of nation.

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Authors Contributions	I am only the sole author of the article

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