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Article

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Adoption of UPI among Indian users: Using extended meta-UTAUT model

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ABSTRACT

Unified Payments Interface (UPI) has grown rapidly in recent times. It has increased its user base, volume, and transaction value through a variety of mobile applications. Various models have been used to study the reasons for UPI adoption. Earlier studies neither measured 'Use Behavior' (UB) as the outcome variable nor examined the influence of attitude on UPI adoption behavior. This study fills the gap by integrating UB into the model and using the extended meta-UTAUT model to explore the UPI adoption behavior of Indian urban users. The model included four exogenous and three endogenous variables. The data were collected from 894 UPI urban users using the purposive sampling method. Covariance-Based Structural Equation Modeling (CB-SEM) was applied for hypotheses testing. The study explained 82.7 % and 84.1 % of the variance for attitude and use behavior, respectively. The results of this study found that performance expectancy significantly impacts use behavior; attitude significantly affects behavioral intention; and trust affects the attitude. The results of the study will be useful in improving the features of UPI so as to increase customer base. The findings will help in smoothly introducing Central Bank Digital Currency (CBDC) among urban masses in India. The results provide future research scope for moderation and mediation. A future study can also be carried out on Indian rural users.

1. Introduction

The National Payments Corporation of India has developed the Unified Payments Interface (UPI). In recent time, it has picked up rapid growth with an enhanced user base, high transaction volume, and transaction value (Singh, 2022). The use of UPI is pivotal for mobile phones. Smart phone users prefer digital payment through their mobile phones because of convenience (Singh and Sharma, 2023). It has the potential to transform and popularize digital payments in India (Sharma et al., 2023). UPI incorporates banking characteristics such as continuous funds routing and dealer payments in a single click (Patel et al., 2023). Use of UPI has reduced the footfall of customers for banking transaction purposes at the bank premise (Smith et al., 2023). Paytm, Amazon Pay, Bhim UPI, Google Pay, PhonePe, and others are UPI-supported mobile applications used in India (Sharma et al., 2023). Most of the urban Indians are using UPI for digital payments (Sharma et al., 2023). The insights from UPI adoption can enhance in preparing strategies for the Reserve Bank of India (RBI) to smoothly launch, integrate, and adopt digital currency among Indian citizens (Sharma and

Singh, 2024).

The theory of planned behavior, technology acceptance model, innovation diffusion theory, unified theory of acceptance and use-of-technology (UTAUT), extended UTAUT, meta-UTAUT, and extended meta-UTAUT have been studied to identify the reasons for new technology adoption. Many studies have examined the adoption of UPI in India (Singh and Sharma, 2023). The studies have demonstrated a link between behavioral intention (BI) and use behavior (UB) (Venkatesh et al., 2003). The researchers have reported that behavioral intentions (BI) and use behavior (UB) are the two important dependable variables (Kaur and Arora, 2021). Sharma et al. (2020) have reported that earlier studies on UPI adoption did not account for use behavior and the influence of attitude on use behavior. To fill this research gap, this study chose the model proposed by Patil et al. (2020) with a few modifications as suggested by the researcher.

The studies conducted in India on UPI acceptance have three drawbacks. Firstly, the data were collected only from a particular region. Population diversity in India is the second reason, which poses a hurdle to completely summarizing the findings of such studies (Patel et al.,

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2023). Thirdly, selecting the theory for the research is another limitation (Gomrez et al., 2023). To overcome such constraints, this study focused on urban Indian UPI users and chose the extended meta-UTAUT model as used by Patil et al. (2020). The extended meta-UTAUT model incorporated BI and UB together.

The present study dropped the grievance redressal and path connection between facilitating conditions and effort expectancy. The reason for dropping grievance is as it is a part of trust (Singh and Sharma, 2023). In case of failure in payments, RBI has the rule that the payment comes back within three to seven days (NPCI, 2023), which is already present in the model, i.e., Trust. The novelty of including personal innovativeness is an improvement that influences attitude and behavioral intention (Gomrez et al., 2023).

The research problem is to uncover the factors influencing UPI adoption among urban Indians. The research objective is to examine the key driving factors in UPI adoption. Thus, this present study delves into UPI adoption among urban Indian users, employing the Extended Meta-UTAUT Model as a comprehensive framework for analysis. This study gathers information and insights to help businesses, policymakers, and financial institutions to improve UPI adoption strategies, enhance user experiences, and advance toward a cashless economy in India. Further, the findings of this study will assist RBI in successfully launching Central Bank Digital Currency (CBDC). It would be easy to begin with the urban Indians (Sharma and Singh, 2024).

The paper is organized as follows: Section 2 reviews the related work on UPI adoption. Section 3 discusses the methodology adopted in this study. Section 4 presents the detailed results of this study. Section 5 is devoted to the discussion. Section 6 presents the conclusions, whereas Section 7 deals with the theoretical contribution. Sections 8 and 9 present the managerial implications and future research directions,

respectively.

2. Review of literature

Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use-of-Technology (UTAUT) are two significant theories which are used to examine users' acceptance of mobile technology adoption and online banking services (Chhonker et al., 2018; Razi-ur-Rahim and Uddin, 2021). TAM was criticized for giving less consideration to the users' attributes (Jimenez et al., 2020). The UTAUT model proposed by Venkatesh et al. (2003) integrates elements from Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT) models. The UTAUT model has Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC) as core determinants to explain and predict technology acceptance and use behavior (Venkatesh et al., 2003).

The UTAUT model faced criticism for not using factors like individual differences, attitude, personal innovativeness, anxiety, trust, and grievance redressed (Patil et al., 2020). To address these shortcomings, the researchers reanalyzed the UTAUT model using meta-investigation and structural equation modeling (MASEM) techniques (Tamilmani et al., 2020). Thus, the amended meta-UTAUT model incorporated four exogenous variables as performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC); three endogenous variables: behavioral intentions (BI), attitude (AT), which is a mediating factor, and use behavior (UB).

The meta-UTAUT model has been adopted by researchers in mobile

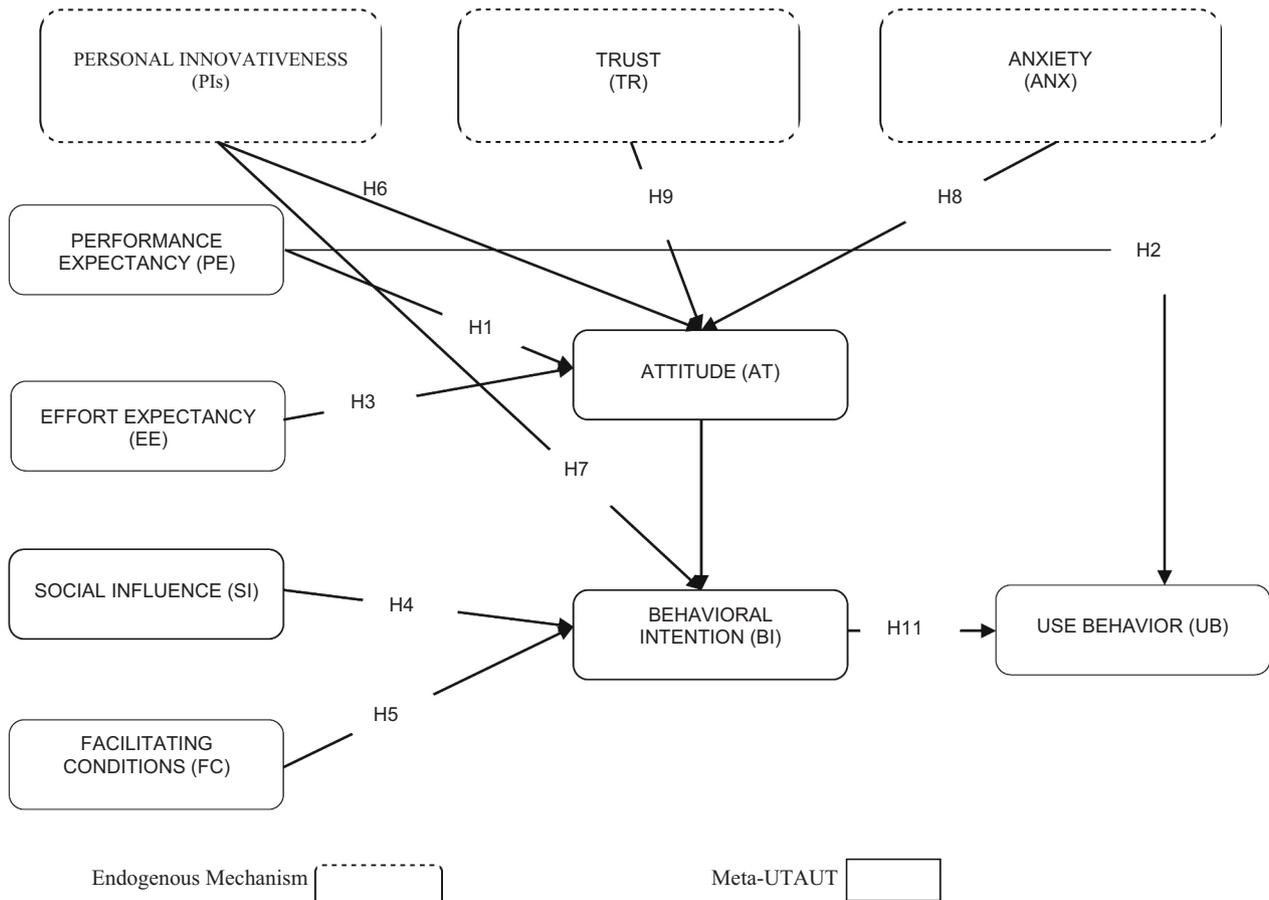


Fig. 1. Conceptual framework for UPI adoption. (Source: Compiled by Authors)

banking (Zhou, 2012), e-learning (Šumak et al., 2011), and healthcare technologies (Venkatesh et al., 2016). The extended Meta-UTAUT model was applied by Ahmed et al. (2024a) and Ahmed et al. (2022). The conceptual framework has been demonstrated in Fig. 1 with the inclusion of personal innovativeness (Gomrez et al., 2023), attitude (Dwivedi et al., 2019), and the relationship between behavioral intention and use behavior (Venkatesh et al., 2003).

2.1. Performance expectancy (PE)

When users benefit from using technology to perform specific tasks, it is called performance expectancy (Liébana-Cabanillas et al., 2018). The practical benefit of UPI payments is the key to shaping customers' positive attitudes toward adoption (Sharma et al., 2023). The study conducted in the USA and Germany by Bailey et al. (2017) and Schierz et al. (2010) reported a positive and significant relationship between PE and consumer attitude toward adopting m-payments. Also, the study in Pakistan by Aslam et al. (2017) found a significant positive effect of PE on customer attitude toward BI in the utilization of m-payments. PE has become a key indicator of Indian customers' attitudes toward mobile payments (Hasan et al., 2024). Consequently, an individual's conviction that utilizing the UPI payment method will lead to a better outcome may impact their inclination to use it. PE is a significant predictor of UB in the context of mobile technology adoption (Venkatesh et al., 2012). Also, the findings of Singh and Sharma (2023), Alaeddin et al. (2018), and supported the significant positive relationship between PE and UB. Thus, the hypotheses are framed as follows:

H1. Performance expectancy positively affects consumer attitudes toward UPI adoption.

H2. Performance expectancy positively affects consumer use behavior in UPI adoption.

2.2. Effort expectancy (EE)

The convenience of using technology is called effort expectation (Venkatesh et al., 2012). Consumers have higher expectations of success when they find the process simple and easy (Gomrez et al., 2023). In the consumer UPI payment domain, EE is a construct that is the same as perceived ease-of-use (Venkatesh et al., 2003). EE is a significant positive predictor of attitude (Chia-Lin Hsu, 2024). The mobile application designs' relevance and ease of use are key elements in shaping users' positive attitudes toward adoption. EE significantly impacts customers' attitudes toward UPI payments (Patel et al., 2023; Shaikh et al., 2018; Singh et al., 2017). However, Aslam et al. (2017) found no significant relationship between the two. This examination contends that the impact of EE on user attitude would be significant in the adoption of UPI. Thus, the hypothesis can be figured out as follows:

H3. Effort expectancy significantly affects attitude in UPI adoption.

2.3. Social influence (SI)

Friends, family, and co-workers influence an individual's behavior (Gupta et al., 2023). SI is the degree to which an individual believes that friends, family, and co-workers influence his/her behavior (Smith et al., 2023). SI predicts BI (Singh and Sharma, 2023). A study in Portugal by Oliveira et al. (2016) confirmed that SI significantly impacts BI in m-payments. The study on India's online PAN (permanent account number) registration system revealed a significant relationship between SI and BI (William et al., 2015). The study on m-payments in the UK by Slade et al. (2015) indicated that SI was the most significant predictor of BI. Also, the findings of Singh and Sharma (2023) in UPI adoption by Indians found a significant positive effect on BI. Thus, based on the above literature review, the following hypothesis is proposed:

H4. SI significantly affects BI in UPI adoption.

2.4. Facilitating conditions (FC)

FC refers to the extent to which an individual accepts technical and organizational infrastructure support for using the system (Venkatesh et al., 2003). FC pertains to sufficient resources and support for individuals to utilize the technology (Sharma et al., 2023). The study by in the USA found that FC significantly influences shoppers' BI to use mobile payments in inns. Sivathanu (2019) and Sharma et al. (2023) reported that FC emphatically affects Indians' BI toward UPI reception. In contrast to these, the study conducted in Portugal by Oliveira et al. (2016) on m-payment adoption reported that the relationship between FC and BI was non-significant. Thus, based on previous studies, the accompanying hypothesis is developed:

H5. Facilitating conditions significantly influence behavioral intentions in UPI adoption.

2.5. Personal innovations (PI)

Innovativeness refers to a person's willingness to try something new and different (Silaen et al., 2021). Liébana-Cabanillas et al. (2014) stated that highly inventive people have new ideas. As a result, they can manage uncertainty, which results in the formation of high intentions toward information technology adoption. PI significantly impacts BI. In India, UPI stands out from other online payment methods. It is widely assumed that customers' PI positively and significantly influences AT toward the use of UPI (Kumar and Sahoo, 2020). The impact of PI on BI is considerable in the context of m-payment (Coward et al., 2008). Abrahão et al.'s (2021) study revealed that adoption readiness is influenced by PI. PI significantly influences attitudes and intentions toward adopting mobile payment services (Thakur and Srivastava, 2014). Consequently, the accompanying hypothesis is planned:

H6. Personal innovativeness significantly affects attitude in UPI adoption.

H7. Personal innovativeness significantly affects behavioral intention in UPI adoption.

2.6. Anxiety (ANX)

Anxiety is a person's fear or concern when confronted with the potential of using new technology (Davis et al., 1989). When a person adopts new information technology, they feel the impact of anxiety on attitude, behavioral intent, and the adoption process (Yang et al., 2020). Many studies in this field have demonstrated the importance of anxiety by proving its influence on attitudes (Rana et al., 2017). According to Igbaria (1990), people with high levels of computer anxiety exhibit negative attitudes toward utilizing computers. Anxiety was demonstrated to be quite possibly the main indicator of Indian customer attitude toward UPI payments (Patel et al., 2023). Korobili et al. (2010) discovered a substantial negative relationship between computer anxiety levels and attitudes among Greek undergraduates. It was confirmed by Venkatesh and Bala (2008) in their study on the adoption of new technology that anxiety has a negative influence on attitude. The higher the anxiety, users show less favorable attitude toward UPI adoption (Singh and Srivastava, 2020). Through his study, Senjam (2022) reported that user-friendly technologies and training programs could reduce anxiety. Therefore, the hypothesis is framed as under:

H8. Anxiety has a negative influence on attitude in adoption of UPI.

2.7. Trust (TR)

Trust is the belief that a party will fulfill its duties and handle customers' complaints (Liébana-Cabanillas et al., 2015). Trust is important in electronic monetary transactions when users face greater risks due to nature's unpredictability and lack of control (William et al., 2015).

Transactions carried out through mobile applications are more fragile and unpredictable than those carried out in regular settings, thus posing a larger risk (Lu et al., 2011). In their studies, Patel et al. (2023) and Liébana-Cabanillas et al. (2014) found that if people trust the payment system, they will feel much better about using it. The study conducted by Zhou (2011) on m-payment systems in China found that TR significantly affects AT. The individuals who trust that their transactions are secured and their grievances will be addressed (if any) showed favorable attitudes toward UPI adoption (Zhou, 2011). Limited research has explored how TR in m-payment systems can improve customers' positivity toward mobile transactions. Hence, to confirm the importance of trust in the adoption of UPI, the hypothesis is framed as:

H9. Trust positively affects attitude in adoption of UPI.

2.8. Attitude (AT)

Attitude is how someone feels, positive or negative, about doing a specific thing (Ajzen, 1991). The attitude dimension has appeared in prominent IS/IT adoption theories to assess its impact on behavioral intention (Taylor & Todd, 1995). Its importance was realized in meta-UTAUT and was reinstated in the models that improve variance (Dwivedi et al., 2019). Dwivedi et al. (2019) highlighted that the original UTAUT model did not include attitude as a core construct. Subsequent research, including meta-UTAUT studies, recognized its significance. Attitude strongly influences behavioral intention (Bailey et al., 2017).

Ajzen (1991) seminal work on TPB holds that a person's attitude toward an activity has a substantial impact on their intention to perform that behavior, which in turn affects their actual usage behavior. At the start of adopting new technology, attitude is important in how consumers intend to act in their behaviors (Patel et al., 2023). Given the above discussion and taking into account that UPI payment is at the early stage of adoption among Indians, the following hypothesis is proposed:

H10. A positive attitude significantly influences the intention to adopt UPI.

2.9. Relationship between Behavioral Intentions (BI) and use behavior (UB)

Behavioral intentions are the motivations that drive individual behavior (Ajzen, 1991). If the intentions are strong, there is a greater chance that the particular behavior will be performed. The behavioral intentions affect the usage of the digital payment system (Venkatesh et al., 2012). The UTAUT meta-analysis showed a clear link between behavioral intention and use behavior (Venkatesh et al., 2003). The study on digital payment adoption by Sivathanu (2019) and Patil et al. (2020) highlighted behavioral intentions as the primary relationship in the model regarding use behavior. BI is the mediating variable between UB and AT toward UPI payment (Patel et al., 2023). Plenty of evidence supports the significant impact of behavioral intentions on actual usage when adopting innovations. Thus, to verify the hypothesis, it is planned as follows:

H11. In UPI adoption, consumer behavioral intention significantly and positively impacts use behavior.

3. Methodology

3.1. Research design

This paper investigates the adoption patterns of the Unified Payments Interface (UPI) among urban Indian users by employing an extended version of the Meta-UTAUT model. The paper investigates the specific factors that drive UPI adoption. The study employed

quantitative techniques to achieve the objective of the study. The research approach was deductive, and a single cross-sectional survey questionnaire was used to collect the data. The primary data was gathered from urban Indian UPI users. The data were gathered during August 2023 and January 2024. The current research used a five-point Likert scale, where 1 meant strongly disagree and 5 meant strongly agree, to measure latent constructs indirectly.

3.2. Measurement scaling

The validated scale used by Patil et al. (2020) is readily available to measure the latent constructs from existing UPI payment adoption studies. Further, the additional constructs (anxiety, trust, and personal innovativeness) are validated. The items of the constructs were modified according to the study's objectives. The questionnaire includes 39 items for 10 constructs. The questionnaire was created after reviewing the work of Sivathanu (2019), Venkatesh et al. (2012), Schierz et al. (2010), Lu et al. (2011), Srivastava et al. (2010), Rana et al. (2017), and Agarwal and Prasad (1998), which complied with pre-validated measures (Table 1). The questionnaire was divided into two sections: mobile payment knowledge and demographic identities contained in measurement items.

3.3. Sampling

Due to privacy concerns, data accessibility, and the dynamic nature of UPI users, researchers do not have access to a complete and up-to-date sampling frame (NPCI, 2023). That's why a dependable sampling frame of urban Indian UPI users is not available. In situations where a sampling frame is not available, the researchers use the non-sampling technique to achieve the objective of the research (Sekaran and Bougie, 2016). The researcher uses purposive sampling, which is often used in quantitative research to gather detailed and relevant information from a specific group within the population (Tongco, 2007). From the sample units of this specific group, the researcher gets deeper insights and meaning information related to the research questions. However, the purposive sampling method may introduce selection bias and limit the generalizability of the findings (Teddlie and Yu, 2007). Using a larger sample and the triangulation method of sample collection helps mitigate the effects of selection bias and improve the robustness of findings (Creswell and Plano Clark, 2017).

A large primary data of 916 urban Indian UPI users were collected through electronic media (652 respondents) and in person (264 respondents) using the purposive sampling technique. These respondents reside in Bengaluru and Chennai. The sample collection was being done between August 2023 and January 2024. The large sample size, use of triangulation, and data collection from various cities with different ethnicities, education levels, and experiences helped reduce selection bias and improve the generalizability of the findings. Also, the data was cleaned for any bias present. 22 responses were dropped from the dataset because of fragmented information, resulting in 894 responses used for the analysis. For data adequacy, the sample size should be five to ten times the number of items (Hair et al., 2019). Data was validated through data integrity and validity, and checks were performed before analysis.

3.4. Data analysis

The study used SEM-based multivariate modeling, which requires validation of the hypothesized extended UTAUT model through the validation of measurement and structural models. CB-SEM is preferred over PLS-SEM as it aims to confirm theories adopted for the research and where model fit indices are essential. A CB-SEM method is powerful when testing complex models with latent variables (Hair et al., 2019). CB-SEM permits the testing of all relationships among observed and latent factors simultaneously by joining numerous regressions with

Table 1
Survey measurements.

Latent Constructs	Codes	Items	Sources
Use Behavior (UB)	UB1	I am happy using UPI	Sivathanu (2019)
	UB2	I regularly use UPI to pay for purchases	
	UB3	I use UPI to transfer money to my family, friends, or other contacts	
	UB4	I use UPI for online shopping	
Performance Expectancy (PE)	PE1	UPI enables me to complete transactions more swiftly	Venkatesh et al. (2012)
	PE2	Using UPI increases my productivity	
	PE3	Using UPI simplifies my transactions, such as shopping, purchases, and transfers	
	PE4	Using UPI improves my overall payment performance	
Effort Expectancy (EE)	EE1	I find UPI user-friendly	Venkatesh et al. (2012)
	EE2	I find UPI easy to understand and use	
	EE3	I find it easy to become skilled in using UPI	
	EE4	I find UPI flexible to interact with	
	EE5	I find it easy to get UPI to perform the tasks I want it to	
Social Influence (SI)	SI1	People who use UPI around me are seen as more prestigious compared to those who don't	Venkatesh et al. (2012)
	SI2	Among my friends, using UPI is seen as a status symbol	
	SI3	People who influence my behavior think that I should use UPI	
Facilitating Conditions (FC)	FC1	I possess the resources required to utilize UPI	Venkatesh et al. (2012)
	FC2	I have sufficient knowledge to use UPI effectively	
	FC3	I can seek assistance from others when facing challenges using UPI	
	FC4	I have access to specialized instructions on how to use UPI	
Behavioral Intention (BI)	BI1	I will always try to use UPI in my daily life	Venkatesh et al. (2012)
	BI2	I intend to use UPI regularly	
	BI3	I will recommend others to use UPI	
Attitude (AT)	AT1	Using UPI is a wise idea	Schierz et al. (2010)
	AT2	I like the idea of using UPI	
	AT3	Using UPI is pleasant	
	AT4	Using UPI is beneficial	
	AT5	Using UPI is interesting	
Trust (TR)	TR1	I trust UPI to be reliable	Lu et al. (2011): Srivastava et al. (2010)
	TR2	I trust UPI to be secure	
	TR3	I believe UPI to be trustworthy	
Anxiety (ANX)	ANX1	I experience anxiety when using UPI	Rana et al. (2017)
	ANX2	It scares me to think that I can lose personal information by wrongly using UPI	
	ANX3	I am hesitant to use UPI due to the fear of making mistakes I cannot correct	
	ANX4	Using UPI is somewhat scary to me	
Perceived Innovativeness (PIN)	PIN1	I like to experiment while using UPI	Agarwal and Prasad (1998)
	PIN2	I'm typically one of the first among my peers to try new transaction methods through the UPI platform	

Table 1 (continued)

Latent Constructs	Codes	Items	Sources
	PIN3	If I hear about a new transaction mechanism like UPI, I actively seek ways to experiment with it	
	PIN4	Overall, I am not reluctant to try out new UPI platforms	

Source: Compiled by the Authors based on previous studies.

factor analysis and provides overall fit statistics (Iacobucci, 2009). AMOS-25 software was used for analysis purposes, ensuring the study's analytical rigor. The study calculated Cronbach's alpha, factor loadings, composite reliabilities, and average variance extracted to investigate the constructs' convergent validity, discriminant validity, and internal consistency reliability. Herman's common biased test is performed to ensuring the rationale for the test and the implications of the results. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity was performed to examine the suitability of data for factor analysis. The overall fit measurement was examined through Chi-Square, Adjusted Goodness of Fit Index, Comparative Fit Index, Root Mean Square Error of Approximation, and Parsimonious Normed Fit Index (Ahmed et al., 2024b).

4. Results

Table 2 shows that 71 % of males and 29 % of females participated in the survey. 62.9 % of respondents belong to the 15–25 year age group. 54.1 % were students, which is the most common among respondents. 19.6 % of the respondents worked in private-sector employment. PhonePe has the maximum number of users, followed by Paytm, Google Pay, Bhim Pay, and Amazon Pay. The majority of the respondents (66.1 %) have been using UPI for more than a year but less than five years. It indicates that post-COVID-19, an enormous change in UPI adoption has occurred. The demographic insights are crucial for contextualizing the survey results.

4.1. KMO and Bartlett's test of Sphericity and Herman's common biased test

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were

Table 2
Demographic characteristics of UPI users.

Components	Groups	Frequency	% age
Age (Years)	15–25	562	62.9
	26–35	210	23.5
	36–45	80	8.9
	46–55	33	3.7
	56 and above	9	1
Gender	Male	633	70.8
	Female	261	29.2
Occupation	Student	484	54.1
	Private Sector Employee	175	19.6
	Public Sector Employee	87	9.7
UPI App Used	Self Employed	90	10.1
	Unemployed	58	6.5
	Phone Pe	294	32.9
	Paytm	264	29.5
	Google Pay	222	24.8
How long have you been using UPI?	Bhim UPI	70	7.8
	Amazon Pay	44	4.9
	Less Than 1 year	171	19.1
	1–5 years	591	66.1
	More than 5 years	132	14.8

Source: Questionnaire.

used to examine the suitability of data for factor analysis. The KMO test checks sampling adequacy and the extent to which variables share a common variance. Bartlett’s test of Sphericity assesses whether the variables are sufficiently correlated to warrant factor analysis.

Table 3 indicates the Kaiser-Meyer-Olkin (KMO) measure was found to be 0.974, indicating good sampling adequacy. Additionally, Bartlett’s Test of Sphericity was significant ($\chi^2 = 28,158.609, p < 0.000$), suggesting that the correlation matrix is not an identity matrix. These results confirm that the data is appropriate for factor analysis.

Harman’s single-factor test (Table 4) was performed to detect common method bias in this survey research.

The Harman’s single-factor test revealed that the first factor had an eigenvalue of 1, explaining 47.155 % of the total variance. Since the first factor does not account for more than 50 % of the variance, it suggests that common method bias is not a significant concern in the data.

4.2. Measurement model

The measurement model was validated through confirmatory factor analysis (CFA) (Brown, 2015), and the reliability was tested through Cronbach’s alpha. The convergent validity of latent variables is tested through standardized factor loadings, composite reliabilities, and average variance extracted (Fornell and Larcker, 1981). Table 5 presents the results for the constructs’ convergent validity, discriminant validity, and internal consistency reliability.

The values of Cronbach’s alpha ranging from 0.832 to 0.926 indicate good reliability (Nunnally and Bernstein, 1994; Razi-ur-Rahim et al., 2024). The standard factor loadings varied between 0.642 and 0.904, resulting in the necessary 0.50 cut-off (Gefen et al., 2000). Furthermore, the composite reliability values are greater than 0.70, revealing that the latent constructs were internally consistent (Hair et al., 2019). Finally, average variance extracted (AVE) values varied from 0.557 for facilitating conditions (FC) to 0.7823 for trust (TR), well above the prescribed minimum limit of 0.50 (Fornell and Larcker, 1981). These three tests of the latent construct satisfy the convergent validity with values higher than the specified threshold. The square roots of AVE values are greater than the inter-construct correlations in the factor correlation matrix; hence, the latent constructs pass the discriminant validity test (Fornell and Larcker, 1981). The square root of the AVE values presented in bold across the diagonals is higher than the construct correlations among the corresponding pair of variables (Table 6). It holds for all correlations between the variables in the proposed study model, confirming the discriminant validity of the constructs. The additional constructs (anxiety, trust, and personal innovativeness) meet the necessary reliability and validity criteria (Table 5 and Table 6). The high Cronbach’s Alpha values across these constructs indicate strong internal consistency, while the significant factor loadings and adequate AVE values support both convergent and discriminant validity.

The overall fit measurement model was examined through five standard measures (Ahmed et al., 2024b). For the model to be appropriate, the normed Chi-Square (CMIN/df) should be <5.0 and $p > 0.05$. Adjusted Goodness of Fit Index (AGFI) varies from 0 to 1, with a reading close to 1 (> 0.95) satisfactory fit; Comparative Fit Index (CFI) should be >0.90 acceptable and > 0.95 good fit when Root Mean Square Error of Approximation (RMSEA) values are <0.5 good fit, between 0.05 and 0.10 acceptable and > 0.10 poor fit; and Parsimonious Normed Fit Index (PNFI) should be 0.75 or higher (Ahmed et al., 2024b). The entire measurement model fit indices test yielded a χ^2 value of 2022.516 with

Table 3
KMO and Bartlett’s test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.974
Bartlett’s Test of Sphericity	Approx. Chi-Square	28,158.609
	df	741
	Sig.	0.000

a degree of freedom of 657. The Chi-Square/df value was 3.078. The remaining fit indices, such as AGFI = 0.868, CFI = 0.951, RMSEA = 0.048, and NFI = 0.9294, were within their predicted threshold values, indicating the measurement model’s suitability for subsequent investigation (Table 7).

4.3. Structural model

SEM was performed using AMOS Graphics and SPSS Version 25.0 software. It’s important to establish appropriate model fit indices for the structural model before moving forward with the path analysis. The estimate of structural model fit indices (Table 8) yields appealing and satisfactory findings, with a χ^2 value of 2064.930 and 670 degrees of freedom, resulting in a Chi-square to the degree of freedom ratio of 3.081. A χ^2 /df ratio of 3.081 suggests that the model has a moderately good fit with the data, indicating that the model is reasonably well-specified but may benefit from some minor refinements.

An RMSEA value of 0.075 indicates an acceptable model fit, suggesting that the model aligns reasonably well with the data. Although the fit is not perfect, it is within the acceptable range, showing that the model captures the data structure adequately but may benefit from some improvement. The NFI value of 0.928 suggests that the model fits the data well and provides a significant improvement over the baseline model. It effectively captures the relationships among variables, supporting the model’s validity, though it is slightly below the ideal threshold of 0.95. The CFI value of 0.950 in SEM suggests that the model has an excellent fit with the data. This means that the model is well-specified and effectively captures the relationships among the variables, providing confidence in the model’s accuracy and the validity of the results. And the AGFI value of 0.830 indicates an acceptable fit but is below the ideal threshold for a good fit, suggesting that refining the model could improve its fit.

Table 9 shows that except for H₇ and H₈, all other proposed hypotheses, from H₁ to H₆ and H₉ to H₁₁, were supported in this investigation, and there was a significant positive connection. PE, EE, PIN, and TR constructs were identified as good predictors of the dependent variable AT (verifying H₁, H₃, H₆, and H₉). However, the results did not support H₈, where ANX has an insignificant impact on AT (path coefficient - 0.014 and p -value = 0.561). SI has a direct positive relation with BI (confirming H₄). FC also exhibited a positive link with BI (conforming H₅). Furthermore, PE and BI have significant positive predictors of the ultimate dependent variable, UB. Thus, H₂ and H₁₁ were confirmed, respectively. Regarding significant paths, PE had the highest path coefficient value of 0.699 for UB. This high path coefficient indicates that PE is a significant predictor of UB, showing a relatively strong effect on the behavior being measured. And AT had the highest path coefficient value of 0.553 for BI. It shows that AT has a substantial influence on the intention to perform a particular behavior. It is worth noting that AT, FC, and SI together had the utmost impact on BI, accounting for almost 84.2 % of the variance in the construct. This indicates that these three variables together have a substantial influence on BI, and their combined contribution explains a significant portion of the variance in BI. Similarly, PE, EE, PIN, and TR explain 82.7 % of variance together. Performance Expectancy and Behavioral Intention, when combined, account for a substantial 84.1 % of the variability in Usage Behavior. This indicates a strong and significant relationship between these predictors and the outcome. It demonstrates the model’s effectiveness in explaining usage behavior.

5. Discussion

The model explained a variance of 84.2 % in Indians’ BI toward UPI. This shows the predictive power of the conceptual model. The model has four exogenous variables and three endogenous variables. These are related through eleven path relationships (H₁ to H₁₁). SEM confirmed that nine proposed hypotheses were significant and two were non-

Table 4
Herman's common biased test.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.390	47.155	47.155	18.390	47.155	47.155
2	4.142	10.621	57.776			
3	1.448	3.713	61.489			

Table 5
Measurement model analysis.

Construct	FL	CR	AVE	Cronbach's Alpha
UB		0.8377	0.5635	0.834
UB4	0.735			
UB3	0.734			
UB2	0.756			
UB1	0.777			
PE		0.8915	0.6731	0.888
PE4	0.838			
PE3	0.846			
PE2	0.763			
PE1	0.832			
EE		0.9223	0.7034	0.921
EE5	0.814			
EE4	0.853			
EE3	0.835			
EE2	0.854			
EE1	0.837			
SI		0.8679	0.6868	0.866
SI3	0.831			
SI2	0.86			
SI1	0.794			
FC		0.8333	0.5572	0.832
FC4	0.768			
FC3	0.642			
FC2	0.802			
FC1	0.766			
BI		0.8597	0.6715	0.858
BI3	0.798			
BI2	0.821			
BI1	0.839			
AT		0.9267	0.7165	0.926
AT5	0.834			
AT4	0.838			
AT3	0.865			
AT2	0.862			
AT1	0.833			
PIN		0.8475	0.5829	0.843
PIN4	0.708			
PIN3	0.832			
PIN2	0.806			
PIN1	0.699			
ANX		0.9028	0.6997	0.903
ANX4	0.871			
ANX3	0.882			
ANX2	0.766			
ANX1	0.823			
TR		0.9151	0.7823	0.914
TR3	0.891			
TR2	0.904			
TR1	0.859			

Note: PE = Performance Expectancy; EE = Effort Expectancy; SI=Social Influence; FC=Facilitating Conditions; AT = Attitude; BI=Behavioral Intention; UB=User Behavior; VAR: Variable; TR = Trust; ANX = Anxiety; PIN=Personal Innovativeness.

significant in the UPI adoption. It suggests that the number of urban people in India is adopting UPI.

This research confirms the role of PE as a significant indicator of Indians' attitudes (H₁) and conforms to the findings of Schierz et al. (2010), Bailey et al. (2017), Aslam et al. (2017), and Hasan et al. (2024). The consistency across various studies suggests that PE has a strong link with attitudes toward technology adoption, not just in India but

potentially in other contexts too. This alignment strengthens the validity of the current research, supporting the idea that PE is a key factor in shaping attitudes toward adopting technology. The impact on the adoption process appears limited, with a low coefficient of 0.162. It could be due to random chance. The low impact may indicate that although users recognize the benefits, barriers like lack of trust, security concerns, or digital literacy might prevent them from fully adopting the technology. However, this finding differs from the findings of Daştan and Gürler (2016), who reported prominent coefficient values.

PE affects UB with a path value of 0.699 and is the most powerful relationship in the model (H₂). The finding aligns with the results of Alaeddin et al. (2018), Baishya et al. (2020), and Singh and Sharma (2023), who also found a strong relationship between PE and UB in their respective studies. This underscores the importance of users perceiving tangible benefits and efficiency from the system in encouraging actual use. Since PE is so influential, it's important to strategically manage and improve user perceptions of the technology's performance. This could include improving system reliability, speeding up transaction times, and highlighting the system's benefits through targeted marketing.

EE was a significant positive indicator of attitude (H₃), reaffirming this relationship in UPI adoption with the studies of Shaikh et al. (2018), Patel et al. (2023), and Chia-Lin Hsu (2024). Previous research identified EE as a crucial factor among users in the early stages of technology adoption. The positive impact of EE on attitude means that users' attitudes are shaped by how easy they find the technology to use. This matters because attitude often leads to intention to use, so improving EE can indirectly increase actual usage. While EE is significant, there may still be resistance from users who are accustomed to traditional payment methods or who have concerns about security and privacy. Addressing these concerns in conjunction with improving EE can provide a more comprehensive approach to increasing adoption. However, this study also highlights the significance of EE for existing UPI users in maintaining their interest and engagement through an easy-to-use interface.

TR is the most important factor for AT formation as compared to the other five antecedents (H₀). It significantly influences AT, with a path value of 0.42. The literature review also suggested TR as one of the most well-known constructs affecting AT when adopting the UPI payment system (Lu et al., 2011; William et al., 2015). Various investigations have affirmed the critical positive effect of TR on users' AT toward UPI adoption (Daştan and Gürler, 2016; Liébana-Cabanillas et al., 2014; Patil et al., 2020). It confirms that users' readiness to engage with technology is a key factor in their attitudes. Supported by multiple studies, this means that users who are more technologically ready are more likely to have positive attitudes toward UPI adoption.

The PIN is a factor that positively influences users' attitudes toward adopting UPI (H₆). Our findings are consistent with that of Patel et al. (2023). It suggests that Indians with higher levels of personal innovativeness will likely develop strong beliefs about adopting UPI. Personal innovativeness greatly affects attitudes toward m-payments by promoting early adoption, increasing perceived value, and encouraging active involvement. Larger parts of existing examinations have investigated the critical effect of PIN on BI (H₇). Personal innovativeness (PIN) does not have a significant impact on behavioral intention (BI) to adopt a technology, as indicated by the path value of 0.063 and a p-value greater than 0.05. This finding contradicts previous research by Abrahão et al. (2021) and Cowart et al. (2008). This suggests that the influence of personal innovativeness on UPI adoption might be context-dependent.

Table 6
Discriminant validity – fornell & larcker criterion.

Var	CR	AVE	PE	EE	SI	FC	AT	BI	UB	TR	ANX	PIN
PE	0.892	0.673	0.821									
EE	0.922	0.703	0.605***	0.838								
SI	0.868	0.687	0.421***	0.405***	0.828							
FC	0.833	0.557	0.566***	0.584***	0.473***	0.746						
AT	0.927	0.716	0.548***	0.542***	0.434***	0.543***	0.846					
BI	0.859	0.671	0.523***	0.519***	0.481***	0.541***	0.563***	0.819				
UB	0.837	0.563	0.647***	0.592***	0.435***	0.565***	0.546***	0.566***	0.751			
TR	0.915	0.782	0.535***	0.544***	0.445***	0.544***	0.602***	0.533***	0.545***	0.884		
ANX	0.903	0.699	0.087*	0.093**	0.698***	0.211***	0.142***	0.148***	0.137***	0.161***	0.836	
PIN	0.847	0.583	0.366***	0.365***	0.542***	0.394***	0.401***	0.413***	0.392***	0.455***	0.502***	0.763

[Note: CR = Composite Reliability; AVE = Average Variance Extracted; PE = Performance Expectancy; EE = Effort Expectancy; SI=Social Influence; FC=Facilitating Conditions; AT = Attitude; BI=Behavioral Intention; UB=User Behavior; VAR: Variable; TR = Trust; ANX = Anxiety; PIN=Personal; Innovativeness; $\sqrt{\text{AVE}}$ is shown in italics on the diagonal, $p^* < 0.05$; $p^{**} < 0.01$; $p^{***} < 0.001$].

Table 7
Modified indices.

Goodness of Fit Statistics	Recommended Threshold Values (Ahmed et al., 2024b)	Obtained Values
Degree of Freedom (df)		657
Chi-square (χ^2)		2022.516
Chi-square/df	<5.0	3.078
Root Mean Square Error of Approximation (RMSEA)	< 0.05 good fit, between 0.05 and 0.10 acceptable and > 0.10 poor fit	0.048
Normed Fit Index (NFI)	0 to 1, with values nearer 1 a better model-to-data fit	0.929
Comparative Fit Index (CFI)	>0.90 acceptable and > 0.95 good fit	0.951
Root Mean Square Residual (RMR)	A good fit is indicated by values less than 0.08, a good fit is shown by readings ranges 0.08–0.10, and a poor fit is indicated by readings higher than 0.10	0.058
Goodness of Fit Index (GFI)	Range of 0 to 1, with values around 1 (>0.95) a solid fit	0.888
Adjusted Goodness of Fit Index (AGFI)	AGFI varies from 0 to 1, with a reading close to 1 (>0.95) satisfactory fit	0.868

Source: AMOS 25.

Table 8
Fit indices for - original.

Goodness of Fit Statistics	Recommended Threshold Values (Ahmed et al., 2024b)	Measured Values
Degree of Freedom (df)		670
Chi-square (χ^2)		2064.93
Chi-square/df	<5.0	3.081
Root Mean Square Error of Approximation (RMSEA)	< 0.05 good fit, between 0.05 and 0.10 acceptable and > 0.10 poor fit	0.075
Normed Fit Index (NFI)	0 to 1, with values nearer 1 a better model-to-data fit	0.928
Comparative Fit Index (CFI)	>0.90 acceptable and > 0.95 good fit	0.95
Root Mean Square Residual (RMR)	A good fit is indicated by values less than 0.08, a good fit is shown by readings ranges 0.08–0.10, and a poor fit is indicated by readings higher than 0.10	0.255
Goodness of Fit Index (GFI)	Range of 0 to 1, with values around 1 (>0.95) a solid fit	0.83
Adjusted Goodness of Fit Index (AGFI)	AGFI varies from 0 to 1, with a reading close to 1 (>0.95) satisfactory fit	0.85

Source: AMOS 25.

Understanding that personal innovativeness may not uniformly impact behavioral intention across all user groups.

The very weak link between anxiety and users’ attitudes toward

using UPI (with a path value of -0.014 and a p -value of 0.561) means that anxiety did not have a significant effect on how users feel about using UPI (H_8). In contrast, other studies within IS/IT support the negative influence of ANX on individuals’ attitudes toward new technology adoption. This study disconfirms the findings of Korobili et al. (2010) and Venkatesh and Bala (2008). The finding that anxiety doesn’t significantly affect attitudes toward UPI adoption might be specific to this study’s context. UPI is a specific type of payment technology, and users’ attitudes toward it may be influenced by different factors compared to other technologies studied previously. This difference shows we need to look more into what affects user attitudes toward UPI adoption and highlights its importance.

BI is the core mediating variable of individual UB toward UPI adoption (Patel et al., 2023). BI had four antecedents: AT, SI, PIN, and FC. The three antecedents, AT, FC, and SI, have significant and positive indicators of Indians’ BI toward UPI adoption. SI has a path value of 0.078 , the second lowest impact on BI after FC (H_4). These results support the findings of Slade et al. (2015), Fahad and Shahid (2022), and Singh and Sharma (2023). It suggests that personal preferences and direct experiences with the technology are more important. Therefore, adoption strategies should highlight UPI’s benefits and focus on educating users rather than relying on social influence.

FC has a crucial role in shaping consumer BI. In this study, the path coefficient from FC to BI is 0.316 , and it’s statistically significant ($p < 0.001$) (H_5). It satisfies the findings of Moroson & De Franco, 2016, Sivathanu (2019), and Sharma et al. (2023). This significant impact means that when users feel they have enough resources, support, and infrastructure, they are more likely to intend to use the technology (UPI). Facilitating conditions like access to technology, technical support, and easy-to-use interfaces help users be more willing to adopt and use the technology. However, the study contradicts Oliveira et al.’s (2016) findings, who observed this relationship as non-significant. This contradiction suggests that the impact of facilitating conditions might vary depending on the context, technology, or sample used in the research.

AT is the most grounded indicator in deciding Indians’ BI toward UPI adoption (H_{10}). $AT \rightarrow BI$ has a path value of 0.553 (p -esteem < 0.001). The study supports the findings of Patel et al. (2023) and Bailey et al. (2017). It confirms the importance of including attitude (AT) in comprehending UPI adoption. This means that how users feel about UPI strongly affects their decision to start using it. Attitudes encompass users’ evaluations of the technology, which can affect their behavioral intentions. Including AT in the proposed research model aligns with the TRA (Fishbein and Ajzen, 1975) and the TPB (Ajzen, 1991). This shows that attitudes should be included in research models and adoption strategies. AT has likewise been utilized as an intervening variable between PE and EE across a few examinations (Patel et al., 2023; Rana et al., 2017) involving UTAUT as a fundamental model. This means that users’ attitudes can affect how performance expectancy influences effort

Table 9
Hypotheses test results.

Hypotheses	Independent Constructs	Dependent Constructs	r ²	Path Coeff.	p-value	Results
H ₁	PE	AT	0.827	0.162	0.026	Supported
H ₃	EE	AT		0.331	0.001	Supported
H ₆	PIN	AT		0.085	0.026	Supported
H ₈	ANX	AT	0.842	-0.014	0.561	Not Supported
H ₉	TR	AT		0.42	0.001	Supported
H ₄	SI	BI		0.078	0.012	Supported
H ₅	FC	BI		0.316	0.001	Supported
H ₇	PIN	BI		0.063	0.072	Not Supported
H ₁₀	AT	BI		0.553	0.001	Supported
H ₂	PE	UB	0.841	0.699	0.001	Supported
H ₁₁	BI	UB		0.257	0.001	Supported

expectancy.

Use behavior has two antecedents, PE and BI. As examined prior, PE is the most grounded indicator of UB, with a path value of 0.699 (*p*-esteem <0.001). In the meantime, BI is the most frequently involved intermediary variable for UB (H₁₁). BI is a major predictor with a path of 0.257 (*p*-esteem <0.001). The findings corroborate with those of [Fahad and Shahid \(2022\)](#), [Sivathanu \(2019\)](#), and [Patil et al. \(2020\)](#), who studied the influence of BI on UB in technology and digital adoption. Given the significant impact of BI on UB, efforts to enhance user intentions through targeted marketing, user education, and support can effectively increase technology adoption rates.

6. Conclusions

India is the second biggest mobile phone market, with 616 million users ([Ravi et al., 2024](#)). Post-Covid-19 has initiated the use of digital currency. UPI is one of the mobile apps used to transfer digital money. It is simple to use. It is beneficial to both the individual and the government. In line with its simplicity to use and to overcome crypto-currency challenges, the Indian government is planning to introduce CBDC. The study on the adoption of UPI among urban Indian users can help formulate and implement its digital currency successfully. Importantly, it would be easy to start in urban Indian cities as most of the urban Indian citizens are educated. Thus, this research focused on urban Indians using the UPI. The study employed an extended meta-UTAUT model as a theoretical framework with a few modifications. The applicability of the extended meta-UTAUT model was confirmed in the context of this research by the earlier researchers.

The influence of PE on AT showed that its usefulness and practical use highly influence Indians’ willingness to adopt UPI. PE is the most grounded UB indicator and features UPI’s utilitarian worth. It shows that experienced consumers’ perception of practical benefits directly influences how they use UPI payment systems. It confirms that users value the benefits of the UPI system, particularly its ease of use. It is concluded that the strong influence of PE on AT underscores that Indian consumers prioritize UPI’s practical benefits and ease of use, making it a decisive factor in their adoption and usage behavior.

The outcomes uncovered AT, FC, and SI add to 84.2 % of the variance on BI. It is concluded that resources, technical support, and institutional assistance foster behavioral intention toward adopting UPI. Technical support for UPI use and user-friendly applications must be developed to attract new users. Thus, the applications should be simple to use by all segments of customers. Providing reliable assistance and ensuring the apps are easy to navigate will encourage more people to use UPI. It will establish trust in UPI services, ultimately encouraging users to positively consider adopting the UPI payment system. This approach can help to overcome any initial difficulties users might face and make the overall experience more pleasant and accessible. The user-centric designs, effective communication, and incentives will drive user behavior toward UPI adoption.

The educational qualifications, security features, and increased

familiarity with digital technologies enhance understanding and reduce anxiety. The study findings revealed that users among young and educated users are highly likely to accept the UPI payment system. The findings state that UPI app-creating organizations should target these categories of users. The public authority, in association with the private players, ought to guarantee that internet connectivity is accessible in all places of the country to assist with advancing the utilization of UPI services.

The Indians are very sensitive toward their social circles. The social circle recommendations impact the decision to adopt any new technology. Early users demonstrate positive/negative experiences with the new technology adopted in their circles. Thus, new technology’s perceived value, safety, and security must be validated before wider adoption among the masses. A positive attitude toward UPI increases users’ likelihood of adopting and using the system in their financial transactions. A positive attitude toward UPI will contribute significantly to adopting digitalized Indian currency. UPI adoption among Indians reflects a significant shift toward digital payments, driven by factors like convenience, security, government support, and competitive offerings from various service providers. In conclusion, continued efforts to address challenges and enhance user experiences will further drive UPI adoption and usage in India, contributing to easy CBDC adoption. In conclusion, UPI’s success in India’s digital landscape is driven by its ease of use, practical benefits, and strong social influence, making it a pivotal tool for future CBDC adoption, especially among young, educated users in urban areas.

7. Theoretical contribution

This study clarifies the extended meta-UTAUT model using a cross-context hypothesizing framework with attributes well-defined for Indian culture. None of the current studies on IS/IT adoption overall and on versatile UPI adoption have validated the extended meta-UTAUT model. Experimentally testing this model is the theoretical commitment to research in general, particularly on UPI adoption by urban Indians.

The comprehensive assessment of the literature review on the UPI adoption process reveals that earlier studies should have considered the impact of BI on UB. Also, the suggested extended meta-UTAUT model lacks context-specific external components. These would have better captured the potential characteristics of UPI adoption by Indian users. Recognizing this, the study included PIN as an additional construct alongside the meta-UTAUT model proposed by [Patil et al. \(2020\)](#). ANX, TR, and PIN highlight the relationship with AT, BI, and UB.

This research presented a new relationship between existing meta-UTAUT model factors. Today, UPI is turning into another developed examination field. The current observational research must still incorporate the utilization conduct built to determine UPI adoption. This examination goes above and beyond in adding to the current UPI adoption literature by including the UB as variable. As a result, the model is approved by gathering suitable information from the adopters

of the UPI frameworks concerning India.

8. Managerial implications

The research model presented in this investigation offers a thorough grasp of different drivers and inhibitors that present Indian urban users' adoption of UPI. It suggests several thoughts for managers to use in practice. The significant effect of PE on AT and UB demonstrates that, on account of focusing on Indians, special promotions like publicizing messages ought to address the usefulness of UPI payments (Bailey et al., 2017). For stakeholders, it's crucial to make sure the system is seen as useful and meets users' needs to boost its adoption. Organizations must exhibit areas of strength to ensure a successful UPI adoption and meet user expectations, particularly in the realm of technology enthusiasm. Organizations are encouraged to push app developers to enhance UPI applications based on user experiences and exceed their expectations.

Given the significant influence of EE on AT, application developers should create simple UPI applications to increase user confidence in integrating them into UPI adoption. Improving the convenience, simplicity, ease of use, and security of UPI apps will attract more users to adopt these payment systems. Critical social effect on behavioral intentions demonstrates that UPI app providers ought to assign resources and endeavor toward more dynamic utilization of cultural impact to propel users' BI. UPI App provider organizations need to enhance their utilization of virtual entertainment to boost social interaction and encourage users to use mobile applications. The FC has a positive impact on BI. UPI service provider organizations ought to provide training and support programs that will increase the understanding and usage of UPI application users. UPI service providers can assign training and customer engagement resources to familiarize users with the mobile payment system.

PIN significantly impacts consumer attitude. It indicates that UPI service providers should focus on the characteristics of innovative applications. Co-operatives of UPI service providers should encourage innovative Indian users to adopt UPI, thereby reducing the risk for other users through their social networks. The tremendous impact of TR on disposition shows that UPI applications and trade organizations ought to advance trust by introducing clear return and security approaches. It ought to be conceivable by dispatching visual introductions of security and quality declarations. Trust-building exercises explicitly concern better approaches for UPI. It will additionally assist with diminishing users' views of risk. There's a chance to improve trust among users by providing education, addressing concerns, and making the system more user-friendly. Improving trust can help create more positive attitudes toward UPI.

Understanding user behavior, designing targeted interventions, and enhancing user experiences in UPI adoption can significantly influence real-world strategies. Organizations can create more effective approaches to encourage adoption and usage by gaining insights into how users interact with UPI systems. Tailored interventions can address specific user needs and barriers, while improved user experiences can lead to higher satisfaction and engagement. These efforts can drive the success of UPI payment systems in the market. It includes addressing user challenges, improving satisfaction and usability, and customizing marketing approaches for different user groups. All these are aimed at boosting UPI adoption rates. This study has shown that TR in UPI adoption is crucial. CBDC can leverage similar strategies. By studying UPI adoption, CBDC designers and implementers can gain insights to increase the likelihood of success.

9. Limitations and future research directions

Like other research, this study too has some limitations. The literature review was done through research papers published in Scopus, which can be extended to open sources also. This study summarizes and broadens the information based on urban Indians' users of the UPI but

does not include the rural population. It does not capture the unique factors affecting UPI adoption in rural areas. Future studies may focus on rural Indians using UPI. The quantitative methodology is another limitation of the study. The reliance on quantitative methodology in the study may limit the depth and contextual understanding of the research topic, focusing primarily on numerical data and statistical analysis. Using mixed methods could address these limitations by combining quantitative data with qualitative insights. The study involves data only from two metropolitan cities in India. As there is a vast diversity of urban population in India, other urban-class cities could be included for better results. The present research is based on the sample, not the population; the inherent limitations of the sampling will exist. Besides, a more extensive scope of databases can be utilized.

This paper has practical limitations, which could be the study for future research. Firstly, this skewed distribution in gender distribution might reflect a gender bias in the survey or could indicate differences in accessibility or willingness to participate in the survey across genders. Secondly, the age distribution is concentrated within the younger demographic. It suggests that the survey largely captured the opinions and behaviors of younger individuals and lacked insights from other age groups. Thirdly, the survey was particularly effective in reaching an educational audience, which could influence the overall findings, especially concerning attitudes and behaviors typical of the student demographic. And last but not least, the dominance of younger individuals and students. In future research, these limitations could be overcome.

In this research, non-probability purposive sampling was applied to gather the data that could have different findings relative to probability-based sampling. In the future, data can be accumulated by a probability-based sampling technique that permits people from different dialects and education levels to participate. There is a need to carry out the groundwork on non-adopters and look at results using the model proposed in this research paper. Future assessments can utilize a mixed-method approach for additional comprehension. Future research should investigate the moderating (age, income, or education level) and mediating impact. Further, reviewing the rustic pieces of the country would also be intriguing.

In future studies, qualitative research can be conducted to understand significant results and analyze the implications of non-significant findings. Using longitudinal studies in future research can offer valuable insights into the dynamic evolution of UPI adoption and usage patterns over time. This approach provides a detailed understanding of research outcomes and monitors shifts in adoption trends, enhancing our perspective on UPI's evolving landscape.

CRedit authorship contribution statement

Mohammad Razi-ur-Rahim: Writing – review & editing, Writing – original draft, Software, Data curation, Conceptualization. **Mustafa Raza Rabbani:** Writing – original draft, Supervision, Methodology, Conceptualization. **Furquan Uddin:** Writing – review & editing, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Zakir Hossen Shaikh:** Writing – review & editing, Visualization, Validation, Funding acquisition, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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