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Research Article

Factors Influencing Adoption of IoT and Its Impact on CRM in Banks: Examining the Moderating Role of Gender, Age, and Bank Ownership Type

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Internet is becoming a part of our lifestyle; however, the usage rate and application of the Internet are disparate in different parts of the world. In many emerging countries, the Internet is yet to penetrate ordinary households. The present study focuses on how IoT adoption impacts the banks' customer relationship management (CRM) in an emerging market context. Furthermore, the moderating roles of gender, age, and bank ownership type on the relationship between the adoption of IoT and CRM have also been tested. Cost, convenience, social context, and privacy were studied as the predicting variables of IoT adoption, while IoT adoption was investigated as the antecedent of CRM. The CRM variable has been operationalized as a second-order latent construct consisting of three first-order latent variables: responsiveness, satisfaction, and assurance. A cross-sectional, non-probability-based survey was conducted from 467 bank customers of three public and three private sector banks in Aligarh city of India. Two CFA models were run to ensure reliability, validity, and model fit. Hypotheses were tested using structural equation modeling (SEM) on AMOS software, while PROCESS Macro v4.0 by Hayes (2009) was used to test the moderating effect of gender on the relationship between IoT adoption and CRM. The results indicate that cost, convenience, social context, and privacy are positively influencing IoT adoption, which in turn positively affects CRM. Gender and age were found to have a negative moderation effect on the path between IoT adoption and CRM, while bank ownership type positively moderated this link.

1. Introduction

India is one of the world's largest democracies, the second largest populated country after China, and a focal point of competition between business rivals. However, India has been a leader in software, coding, and other virtual service exports. There is still a great need for proper development and implementation of Internet-based services in almost every sector. With the cheap price offering of the 4G network by Reliance Jio in 2016, the scenario was changed entirely for Internet users in India. As of October 2022, India is ranked 2nd globally (after China) in terms of active Internet users (658 millions) sharing approximately 13% of the world's total Internet users (CNBCTV18.COM). Currently, India's 47% population uses Internet, and due to such a large number of Internet users, the scope for the Internet of Things-based services is vast as India is in its initial stage of adoption, development, and implementation of the Internet of Things. Ashton [1] coined the e-term "Internet of Things" (IoT) in 1999. It can be related to connecting objects having a connection antenna and microcomputer chips [2]. IoT extends the benefits obtained from Internet services, data sharing, remote sensing control ability, transfer of real-time data, and many more connecting services and objects [3]. It is a wireless network known as a "wireless body area network" (WBAN) in which two devices can

speak or connect with each other or the same mobile device can collect all the information about the users [4]. It is a broad, growing wireless, connected cloud network [5–8]. According to Cisco's report, over 50 billion connected objects were projected to be interconnected by 2020. This substantial amount of data would undoubtedly assist organizations in delivering personalized service offerings and effectively engaging customers through segmentation and targeted marketing strategies.

As far as the effective utilization of IoT is concerned, almost every sector, like entertainment, health care, railways, or insurance, can be benefitted through real-time customer data. We are facing a fast technological change in daily life in recent decades. The increasing use of smartphones and Internet-connected devices enables banks to access their customers' data on a real-time basis. Now, IoT has become a new tool for managing customer relationships in banks. So the banks are trying to cash this potential of IoT to retain customers by providing them with the real-time services they require [9]. The banking sector is experiencing fast technological change and advancements [10]. Due to e-wallets, online transactions, e-banking, and many more advancements in the banking structure, it is logical to expect another level of banking in the near future because of the increasing usage of IoT services and devices [11]. This technology may help the banks in peer-to-peer lending, know your customer (KYC) upgradation, payment transfers, and fraud reduction [12]. As IoT services can be used anywhere, anytime, no doubt, these devices will fetch a considerable amount of data to be analyzed for a better understanding of customers' needs, and banks will be able to provide the right services to the right customers [13, 14]. With the help of IoT, banks fetch a large amount of customers' information in raw data, which can significantly reduce information asymmetry problems, dampen risk-based pricing, and improve risk management. Furthermore, through proper management and review of collected data, it is quite easy to make predictions of credit risk [15].

Researchers have investigated the role of various aspects of IoT, such as security [16], willingness to pay [17], cybercrime [18], financial technology [19], and blockchain [20] among consumers. Oertzen and Odekerken-Schröder [21] investigated the postadoption of online banking phases in general, while Nayanajith and Damunupola [16] investigated the security aspect of using online banking, and Ali [18] focused on cybercrime related to the use of online banking.

Gao and Bai [7] opined that the banking sector could be benefited from the help of IoT services because of two main reasons; firstly, IoT services save time with the help of technology, and secondly, with the help of real-time information, IoT objects can be collected through which banks can have the information of its customers' profile, investment, and service priorities [22]. With the adaptation of branchless banking through multiple communication channels, it has become easier to provide value-added personalized services to its customers. Although banks are using mobile and online banking, the services will be better and more concerned with IoT adaptation [23]. Awasthi [24] also explained that banks could update their way of marketing and collecting customer data for better CRM through IoT technology. Therefore, the present study points out that this is right to implement IoT services in banks for better CRM. Fu et al. [25] found that online shopping behavior based on the data received from IoT can be used for website designing, e-marketing, etc., to fulfill customers' needs on a real-time basis. The bank can use customers' data to offer them the best-suited services to retain.

Many researchers have explored the adoption aspects of IoT. Yet, few of these studies go beyond the impact of adoption on customer relationship management in general and specifically in the banking sector. It will be an important contribution to the literature to know the influence of factors on IoT adoption in the Indian context to confirm that these factors have the same impact under Indian circumstances. Furthermore, we also considered whether the adoption of IoT would be fruitful to CRM in banks or not. Therefore, we study some of the important factors found through previous literature that are appropriate for the present study on IoT adoption and the impact of IoT adoption on CRM in the banking sector.

Further, the moderation effect of gender on the adoption of IoT has also been tested in the present study as the extensive role of technology in every sector, and the role of women in professional domains is increasing day by day [26]. The organizational mentors or psychologists need to understand gender differences in individuals in adopting technology as they are responsible and always trying for the appropriate organizational change. Since IoT and its adoption in banking services is a relatively new technological phenomenon in India, there is a significant gendered digital divide with $1/3^{rd}$ female users among total Internet users. With only 31% of female bank account holders availing of digital banking services (compared to 69% male account holders), women are less likely to use digital means (IoT-based) of banking services. Thus, these statistics urge us to check for the moderation of gender. Moreover, the rationale for adding the moderation of age is the tendency of the younger generation to be tech-savvy and use digital banking services. As per Statista (2022), 60% of Indian bank customers using digital and Internet banking services are aging 18-26 years, compared to an average of 46% of users aging 27 years and above. With private sector banks adopting emerging technologies to offer more convenient digital means of banking [27], while public sector banks are lagging behind in offering convenient and fast digital banking services [28], private banks' customers are way more forward in using IoT-based digital banking services. Thus, we propose to test the moderation effect of bank ownership type on the link between IoT adoption and CRM. In consistency with the objectives of the study, we explore the following research questions:

RQ1. Do cost, convenience, social context, and privacy concerns significantly influence IoT adoption among bank customers?

RQ2. Does IoT adoption improve customer relationship management in banks?

RQ3. Do gender and age of the customers moderate the relationship between IoT adoption and CRM such that this

relationship is stronger for males (vs. females) and younger customers (vs. older customers?

RQ4. Does bank ownership type moderate the relationship between IoT adoption and CRM such that this relationship is stronger in private banks (vs. public banks)?

2. Theoretical Background and Hypothesis Development

Today, banks in India provide many services to their customers to satisfy their needs and wants. Internet of Things (IoT) is one of the revolutionary add-ons to the banks' services to make their customers acknowledge and aware of their financial transactions, status, and various real-time information. Basically, services include the machine-to-machine connection and conversation. Day by day, various new technologies are introduced under IoT services; although ATM (automated teller machine) has also been a part of IoT services, there are many updated and advanced services are also there to serve the customers in a better and faster way, like digital signature facility, automated payment, real-time asset monitoring, wallet of things, crowd financing, know your customer (KYC), personal finance management, voice-driven communication, fraud detection, and banking chatbots.

Various theories and consumer behavior researchers have uncovered that consumer behavior and perception play a game-changing role in adopting technology [29–33]. The present study explores the factors that influence the adoption of IoT. Four factors have been used for the study: cost, convenience, social context, and privacy. Also, the impact of IoT adoption on CRM services has been checked, so the literature in support of these factors and relations has been reviewed to draw the research gap and, thus, the development of the hypothesis. The moderation effect of gender also needs to be examined to determine the logical relation of the variable on the adoption of IoT based on literature.

2.1. Cost and IoT Adoption. Rayport and Sviokla [34] determined the price factor as one of the most important factors influencing consumer behavior. Cheong and Park [35] explained the IoT cost as a comparison between the sacrifices and the utility of the service. Sathye [36] describes two types of cost; the first one is associated with the use of devices like smartphones, watches, and health care devices, while the second one is related to Internet services. Kim et al. [37] concluded a positive influence of cost on IoT adoption in Taiwan. Similarly, in a survey, Acquity Group Report [38] found "cost" as the most influential factor regarding IoT adoption among consumers. Several studies confirmed cost as a crucial affecting factor for IoT adoption. For instance, Chopdar and Sivakumar [39] also found a positive impact of price on online shopping adoption. Youssef et al. [40] described a relationship between cost and Internet banking. Also, Chang and Wildt [41] mentioned that customers are less interested in adopting IoT if the cost of the service exceeds the benefits. The cost is considered one of the most important factors in deciding on a service purchase. Also, Harper [42] claimed that IoT services should be priced reasonably. He also gave an example where the customers are less interested in adopting online banking due to the high cost of the service.

Furthermore, Hassan et al. [43] confirmed cost as a significant determining factor in consumer decision to use the cellular network. Cho and Sagynov [44] explained that the cost is associated with the consumer attitude regarding adopting new technology. Bajaj et al. [13] also confirmed that cost is one of the most important factors affecting IoT service adoption. Thus, we frame our first hypothesis as follows.

H1. Cost is positively related to IoT adoption such that low cost would increase IoT adoption among bank customers

2.2. Convenience and IoT Adoption. The term "convenience" was introduced in the field of marketing by Copeland [45]. Although the customer of a product explains it differently, it has a special focus on time-saving and time-buying [44, 46]. Johnson and Kaye [47] confirmed convenience as an important factor in IoT adoption. To adopt IoT-based products and services, the customer is required to perceive IoT as an easy-to-use service [7]. This opinion is supported by the Technology Acceptance Model of adopting new technology [33, 48, 49]. Not only for the customers but new technology like online banking also provides service quality and less cost with the requirement of few employees in comparison. Besides, Jannatul [50] explained that the term convenience becomes more important, especially in online services or technology, where accessibility is required 24 hours a day and seven days a week. Due to IoT's transaction and interaction capabilities, easy-to-use concepts have become an essential factor of the service [51].

The UTAUT theory also confirmed that ease of use is crucial in attracting customers to adopt IoT services or products [33]. Easy to use is also associated with the term "ease of learning" as the technology is emerging with newer concepts and updates. Although both terms represent to what extent, the new technology will be easy and effortless [32]. Almugari et al. [52] also added that the "easy-to-use" aspect significantly influences IoT adoption. When we talk about technology adoption, two important aspects, i.e., ease of use and perceived usefulness of the same, play the most important role in analyzing the users' technology adoption behavior and intention [32, 53]. Cooper [54] also supported through his results of research the same as one of three important characteristics for the customer adoption of IoT. Thus, the convenience of easy to use term is associated with saving time, 24×7 accessibility, parking problems, overcrowded banks, etc. Therefore, the second hypothesis has been proposed as follows.

H2. Convenience of IoT use is positively related to IoT adoption such that higher convenience would increase IoT adoption among bank customers

2.3. Social Context and IoT Adoption. Social context cannot be ignored when deciding to accept or reject a new technological innovation like the Internet of Things. It positively impacts social influence on consumer adoption of the

Internet of Things [7]. Social context plays a leading role when deciding between the adoption of new services or products, particularly in the primary stage of development [55]. Indeed, the social context can be interpreted as users' perception of imitating the behavior of important people in society if they are using these products or services [33]. Furthermore, they define social influence as the personal perception that evolves into a belief that they should also use new technology to follow the trends. Thus, the customers' intention to adopt IoT services or products may be influenced by friends, family members, society, peer groups, and media sources. Social influence plays a significant role in accepting and using innovations. People believe that adopting new technology like IoT will show them as important or updated people in society. It has been found that status significantly affects customer behavior toward adopting IoT products. In a study on the adoption of the smart fridge, Alolayan [56] found that social influence is one of the most affecting factors in the adoption of the product. In another study, AlHogail and AlShahrani [57] also checked social influence as the domain in the acceptance of IoT technology and found a significant role of social influence in encouraging users to adopt the technology. Similarly, Hassan et al. [43] concluded the positive relationship between status and adoption of cellular phone networks. The same relationship was also found significant in the case of the adoption of Internet banking [40]. This notion allows us to frame our third hypothesis as follows.

H3. The social context is positively related to IoT adoption such that a favorable social context would increase IoT adoption among bank customers

2.4. Privacy and IoT Adoption. In this era of technology and innovation, the term privacy received consumer's attention first, especially regarding the security of individuals' financial data. It is one of the essential factors while adopting IoT [58, 59]. Researchers, governments, and institutions pay significant attention to the privacy issue associated with the usage of Internet-related services. For instance, the government can try to get access to the users' data with the help of huge consumer data providers like Amazon and Google to share their data to their servers. This privacy term has created a debate among consumers and data providers [60]. As it is understood that IoT data is more vulnerable than other sources like the web, researchers are paying more attention to the privacy of the data. Decker and Stummer [60] reveal that 87 percent of IoT users are interested in the personal information collected through IoT devices and services. Medaglia and Serbanati [61] explained the privacy and security factors as a big challenge before user-oriented services or applications. Similarly, Gungor et al. [62] and Cho [63] found that related risks like privacy concerns always accompany benefits perceived from the Internet or IoT. Besides, Kim and Lennon [64] and Luo et al. [65] confirmed that the underlying risks associated with a service or object draw significant researchers' concerns. Moreover, many researchers have found that the users' beliefs have an important impact on their behavioral intention to use that technology; in this regard, they found that privacy concern plays a vital role in building trust among the customers [66–68]. Yildirim and Ali-Eldin [69] resulted in perceived usefulness and trust regarding privacy issues as the strongest motivation for the users of IoT services.

Furthermore, Hsu and Lin [70] found that payment through IoT is associated with some risk factors like losing personal data or the failure of the transaction. In this way, it can be concluded that IoT services always bear a high risk as the services and data cannot be touched. According to Perera et al. [14], the customer's confidence can be earned only by regulation of strict law regarding the secure deletion of consumer data, protection of consumer privacy, etc. Further, Li et al. [71] added that security in both physical objects and service applications is an important aspect of IoT success. Alaba et al. [72], Jing et al. [73], Sicari et al. [74], Matharu et al. [75], Hassan et al. [76], and many other researchers support privacy and security as one of the most critical factors for the successful adoption of IoT. Therefore, we propose our fourth hypothesis as follows.

H4. Privacy concern is positively related to IoT adoption such that better privacy would increase IoT adoption among bank customers

2.5. IoT Adoption and CRM. Bajaj et al. [22] mentioned that IoT, a new technology for getting real-time data, has become a new frontier for CRM. Customer relationship management can be defined as some dimensions of service excellence that can be managed better with the help of updated customer data. Giannakis-Bompolis and Boutsouki [77] supported that data drawn with the use of social media can be a new source of customers' information. Ghazaleh and Zabadi [78] also confirmed that big data from IoT objects could contribute effectively to managing customer relations. Rizvi [79] revealed that IoT, a new technology for collecting big data, holds much scope for CRM. They added that IoT could transform the customer experience into a joyful and impactful activity. As organizations have real-time data of consumers, they can have better access to their customers. N. Bansal and N. Bansal [80] also support that with the help of IoT services, it can be possible to follow the customer's expenditure habits so that it can be easy to interact with customers individually to offer them more personalized services. Thus, the fifth hypothesis of the study can be framed as follows.

H5. IoT adoption is positively related to CRM such that increased IoT adoption would lead to better CRM among the banks

2.6. Gender as Moderator on the Link between IoT Adoption and CRM. Much research has proved that gender plays a significant role in deciding the adoption of innovation and technology. Park et al. [81] also confirmed that gender moderates the impact of performance, effort expectancy, and social influence. They explained that males are more likely to tend toward performance when accepting new technology. On the other hand, females are more inclined towards the effort expectancy in accepting or rejecting a new technology. Different studies in the area of a variety of techniques have proved the moderating effect of gender, for example,

online shopping [82], e-mail usage [83], and Internet banking [84]. Also, Gefen and Straub [85] found that the nature of men and women differs in their perception. They suggested that the researchers should include gender as a moderating variable in the IT diffusion model. They also raised the point that the same mode of communication can be perceived differently by users of a different gender. Through their longitudinal study, Venkatesh et al. [86] found that men's decision to adopt new technology is influenced by their attitudes, while women are more influenced by the subjective norm and perceived behavioral control. Many pieces of research also supported that the role of gender is significantly moderating the adoption of innovations and technology [81, 82, 87]. Through their research, Riquelme and Rios [88] also suggested that gender plays a vital role in various factors that significantly impact the adoption of IoT and the technology embedded in different services. Alshurideh et al. [89] also found a significant gender moderation on customers' intention to use e-financial services. Furthermore, Ndubisi [90] found gender's role in customer loyalty. Sanchez-Franco et al. [91] also talked about the gender moderation effect on the customer relationships of Internet service users. These results made us postulate our sixth hypothesis as follows.

H6. Gender moderates the relationship between IoT adoption and CRM such that this relationship is weaker for females (vs. males)

2.7. Age as a Moderator on the Link between IoT Adoption and CRM. The researchers found a good number of researches that resulted in a significant role of age of the customers in the adoption of technology. As the present study is related to the adoption of recently adopted technology, i.e., IoT, it can be relevant to check the moderating effect of the variable. Zhao et al. [92] have confirmed through their research that different age groups have specific moderating effects on mobile health service adoption. They found that technology adoption is more convenient for young and middle-aged users than older users. Chawla and Joshi [93] also explained that the age of the customers moderates between attitude and intention to use technology and confirmed that it is more impactful for younger customers than older customers. This research investigated age differences in individual adoption and sustained usage of technology in the workplace using the theory of planned behavior. Morris and Venkatesh [86] also support that younger employees are more influenced by the attitude and intention of technology adoption than older employees. People from the older generation may face some difficulties in learning new technologies or inventions; on the other hand, the younger generation may accept it easily [94]. Thus, we postulate the seventh hypothesis as follows.

H7. Age moderates the relationship between IoT adoption and CRM such that this relationship is stronger for younger customers (vs. older customers)

2.8. Bank Type (Public vs. Private) as a Moderator on the Link between IoT Adoption and CRM. Public banks working structure and strategies may vary from a private bank. Private banks are now adopting new technologies to fetch customers' real-time data to provide them best services to retain them to last longer and increase their customer life cycle compared to public sector banks which already have the customers' faith due to the government's security. Li et al. [95] also stated that ownership type plays the role of a significant moderator of the effects of customer orientation and competitor orientation in technology-based businesses. Turner et al. [96] found that each ownership type has its managerial skills, control, risks, decision-making skills, and financial expenditure decisions, so it can play a game-changing role while implementing new technology in the company and impact customers' acceptance perception. The absence of bureaucracy and restricted marketing policies makes private banks more influencing in case of technology adoption [97]; thus, we propose our eighth hypothesis as follows.

H8. Bank type moderates the relationship between IoT adoption and CRM such that this relationship is stronger for private banks (vs. public banks)

3. Methodology

In the present manuscript, the researchers have tested a hypothesized model (see Figure 1) to establish causal relationships between cost, convenience, social context, and privacy factors on IoT adoption and then also testified the influence of the adoption of IoT on customer relationship management (CRM) that was formed using second-order construct approach taking responsiveness, satisfaction, and assurance, while the focal point was to moderate the relationship between the adoption of IoT and CRM with gender. Using the cross-sectional design, data were taken from three public banks, viz., State Bank of India, Punjab National Bank, and Bank of Baroda, and three private banks, viz., ICICI Bank, HDFC Bank, and Axis Bank, in Aligarh district. For data collection, the authors used the convenience sampling technique as it was the appropriate method for the study and had been used in many similar studies previously, providing sound and valid results [22, 52, 98–100]. A self-developed structured questionnaire was used to collect the data comprising 31 measurement items, excluding demographic variables. A final sample size of 467 respondents was retrieved, combining 256 male and 211 female respondents (see Table 1).

3.1. Development of Data Collection Instrument. The study adopts the measurement scales from published studies and modifies them as per the study's context to capture the focal constructs. After the development of the instrument, it was tested for piloting with a sample of 20 IoT users to analyze their experience while filling in the information. Their comments were used to improve the clarity of the statements. The questionnaire, comprising 31 measurement items, was designed on a seven-point Likert-type scale to measure the factors and their impact on CRM in bank services based on previous research. The items under the scales named cost have been adopted from Shin [101]. The convenience was measured with the scale items adopted from Davis [102] and Gefen and Straub [83]. Items assessing social context

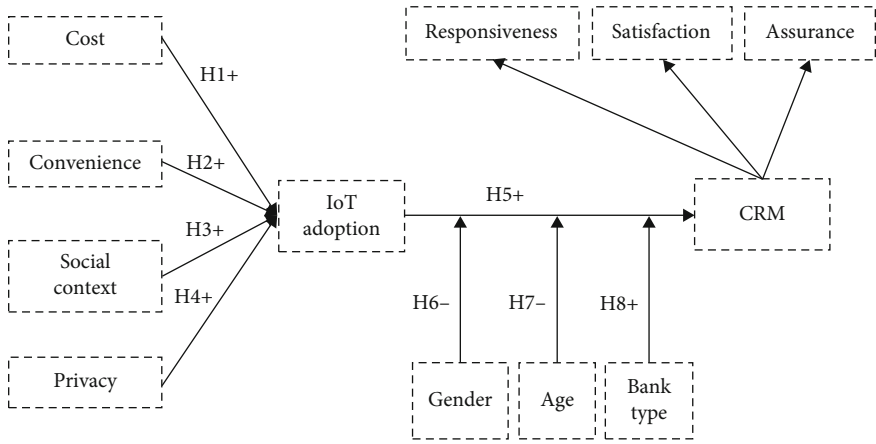


Figure 1: Hypothesized conceptual framework.

Table 1: Respondents' demographic profiles ($N = 467$).

Demographic variable	Frequency	Percentage (%)
Gender		
Male	256	54.80
Female	211	45.20
Age		
18-30 years	221	47.30
31-45 years	211	45.20
Above 45 years	35	7.50
Bank ownership type		
Public	261	55.90
Private	206	44.10

were adopted from Mathieson [103], while for privacy, the scale was adopted from Lee [104] and Featherman and Pavlou [105]. These scales were used to check the impact of these variables on the adoption of IoT on CRM, which is a second-order construct formed by taking responsiveness, satisfaction, and assurance. Measurement items for responsiveness, satisfaction, and assurance were borrowed from Parasuraman et al. [106].

3.2. Data Collection and Data Screening. A total of 509 responses were collected using a convenience sampling technique during the data collection process [107–109]. For data collection, customers of three private and three public sector banks in the Aligarh district were approached outside the bank branches during working time. Only customers using any IoT service provided by the bank were asked to fill out the questionnaire. One hundred questionnaires were administered for each bank hence totaling 600 questionnaires. First, the data were processed for screening and cleaning, and out of a total of 509 retrieved responses, 24 were found to contain missing frequencies; hence, they were wiped out of the dataset due to the ampleness of the data despite imputing them using the median replacement technique [110–112]. Furthermore, 14 questionnaires were filled in without paying attention to being engaged; therefore, the authors removed them. The authors also checked for outliers in the dataset through Cook's distance method and found that only four responses were showing Cook's statistics above the threshold of 1; thus, those four responses were also removed, and the final data sample was left with 467 responses which are large enough to generalize the finding for a population over a million [113]. The data sample is also appropriate to use confirmatory factor analysis (CFA) as it fulfills the assumption of having ten responses for each observed item, i.e., 310 responses for 31 observed items in the case of the present study [112]. As we used AMOS 20.0 for CFA and SEM models, it assumes multivariate normality of the data; therefore, to fulfill this assumption, measures of skewness and kurtosis were used. A dataset tends to possess multivariate normality if statistics for skewness and kurtosis range between -2 and +2 [112].

For the present study, the data were collected using a cross-sectional approach at a particular time; hence, it might suffer from method biases. To ensure that the data is not suffering from common method variance, the authors used Harman's one-factor test suggested by Podsakoff and Organ [114]. All 31 measurement items were forced to converge under one single factor using the principal component analysis method. The results revealed that the factor that emerged during the process could explain the variance of 31.181% (refer to Table 2) hence not explaining the majority of the variance, i.e., 50% [114], and confirming that the data is not suffering from any common method biases.

4. Results

4.1. Measurement Model: Fit Indices, Reliability, and Validity. The authors used confirmatory factor analysis to ensure the data's quality, validity, and reliability [115]. Primarily, the first-order CFA model was run taking all eight latent constructs, namely, cost, convenience, social status, privacy, adoption of IoT, responsiveness, satisfaction, and assurance, and fit indices for the same were found as follows: CMIN/DF = 2.140, GFI = 0.934, AGFI = 0.904, NFI = 0.958, CFI = 0.967, and RMSEA = 0.046 with factor loading (convergence) of each observed item with its respective latent

Table 2: Total variance explained (Harman's single factor test).

Component	Extraction sums of squared loadings		
	Total	% of variance	Cumulative %
1	8.546	31.180	31.180

Extraction method: principal component analysis. Rotation method: varimax.

construct above 0.70. Furthermore, the second-order CFA model was also run as the outcome variable "CRM" is a second-order construct. Variables, viz., responsiveness, satisfaction, and assurance, were used to form CRM through second-order CFA, and fit indices for the same were found as follows: CMIN/DF = 2.218, GFI = 0.918, AGFI = 0.894, NFI = 0.939, CFI = 0.954, and RMSEA = 0.051 thereby confirming that fit indices for both CFA models fall under excellent category (see Table 3).

In addition to model fit indices, convergent and divergent validities were taken into consideration, and it was found that (see Table 4) average factor loading (convergence) of each measurement item to its respective latent variable was well above 0.70 to explain the majority of variance [120]. AVE was computed, making the squares of average loadings for each construct and was found above the recommended threshold of 0.50 [120], thereby ensuring the convergent validity of each construct. Moreover, the authors also computed Cronbach's alpha reliability and composite reliability (CR), and values for them were also found above the suggested limit of 0.70 [120, 121].

Divergent validity refers to the excess convergence of observed variables to their respective latent variables rather than the correlations of latent variables [122]. Therefore, the square roots of AVE (average loadings) of each construct were compared to their correlations with other constructs, and it is evident from Table 5 that AVE values (shown on diagonals in bold) are greater than the correlation values below, thereby meeting the criterion of divergent validity [122].

4.2. Hypothesis Testing (Direct Effect). To assess the direct effects of cost, convenience, social status, and privacy on IoT adoption, authors postulated hypotheses H1, H2, H3, and H4, respectively, while for testing the influence of the adoption of IoT on CRM, hypothesis H5 was proposed. Results reported in Table 6 testify that cost, convenience, social context, and privacy significantly and positively influence IoT adoption, with standardized estimates of 0.351, 0.267, 0.121, and 0.294, respectively. Moreover, the structural path drawn between the adoption of IoT and CRM was also found to be significant, and the adoption of IoT showed a significant positive coefficient of 0.395 (refer to Table 6). Explanatory power, i.e., R^2 for outcome variables, IoT adoption and CRM, was, respectively, found to be 34.50% and 22.80%.

4.3. Moderation Analysis (Interaction Effect). Hypotheses H6, H7, and H8 were postulated to assess whether the gender and age of the customers and bank ownership type moderate the relationship between the adoption of IoT and CRM. Model-1 in PROCESS Macro v3.0 by Hayes [123] was used with bootstrapping at 5000 and centering mean for product method to measure the interaction effect (moderation) of gender, age, and bank ownership type. Results from Table 6 revealed that customers' gender ($\beta = -0.149$, BootSE = 0.074, and CIs = −0.160, -0.138) and age ($\beta = -0.171$, BootSE = 0.056, and CIs = −0.181, -0.161) negatively moderate the relationship between the adoption of IoT and CRM such that the influence of the adoption of IoT on CRM dampens for female and older customers, hence, leading to acceptance of hypotheses H6 and H7, respectively (see Figures 2 and 3). Further, results also affirm that bank ownership type positively moderates "IoT adoption ➔ CRM" link ($\beta = 0.154$, BootSE = 0.072, and CIs = 0.143, 0.165) such that it gets stronger in private banks than public banks, thereby supporting H8 (see Figure 4).

5. Discussion and Conclusion

The present study contributes an integrated model measuring the influencing factors to the adoption of IoT and the position of adoption of IoT on CRM in banks' services to the existing literature on IoT and its adoption in different sectors, especially the sectors that provide the financial services like banking and insurance. The study also gives an image of the moderating role of gender on IoT adoption and its impact on CRM in banks. Although many pieces of research related to technology adoption have been found in the field of banks, no such study was found measuring the factors that influence IoT adoption and predicting the role of IoT adoption on CRM in banks. Very few studies have explored IoT adoption in the Indian context, especially consumer behavior. The study model consists of two levels. First is the influence of cost, convenience, social context, and privacy on IoT adoption. IoT in Indian banks is still in its initial stage and not so widespread; thus, the cost associated with the services and cost of IoT devices are a big concern to attract people to use these services so as the convenient aspects of making people comfortable to use these services. Furthermore, since the IoT is a technological phenomenon and its use and retaining the customers' data be vulnerable or hacked due to technical glitches, thus, privacy concerns are also one of the most sensitive factors that influence IoT adoption.

One more factor is "social context," which is also very important to check consumer behavior regarding the adoption of IoT in Indian banks as it plays a significant role in stimulating the customers to use IoT services provided by banks. Therefore, considering these factors, we created a model to check their impact on IoT adoption. In the second level, an SEM model was created to measure CRM through IoT implementation in banks. Since both males and females have different attitudes towards the services of IoT and CRM, thus we have also checked the moderating effect of gender on the adoption of IoT and CRM in banks (see Figure 5).

There is a significant impact of cost, convenience, social context, and privacy on IoT adoption. The cost has been found to influence IoT adoption the most among all four

Table 3: CFA model fit indices.

Model	CMIN/DF	GFI	AGFI	NFI	CFI	RMSEA
Recommended value	Acceptable 1-4	≥0.90	≥0.85	≥0.90	≥0.90	<0.07
	Wheaton et al. [116]	Shevlin and Miles [117]	Shevlin and Miles [117]	Hu and Bentler [118]	Hu and Bentler [118]	MacCallum et al. [119]
Model fit indices (first-order CFA)						
Study model-1 (first order)	2.148	0.934	0.904	0.958	0.967	0.046
Model fit indices (second-order CFA)						
Study model-2 (second order)	2.218	0.918	0.894	0.939	0.954	0.051

Table 4: CFA loadings, Cronbach's alpha, CR, and AVE.

Construct name	Variable name	No. of items	Average CFA loading	Alpha	CR	AVE
Cost		3	0.734	0.791	0.808	0.539
IoT adoption		4	0.825	0.921	0.928	0.681
Convenience		4	0.781	0.895	0.904	0.610
Status		3	0.794	0.846	0.855	0.630
Privacy		3	0.824	0.821	0.833	0.679
Customer relationship management *(second-order construct)*	*Responsiveness*	5	0.810	0.935	0.940	0.728
	Satisfaction	4	0.798			
	Assurance	5	0.740			

Table 5: Correlations, divergent validity, and descriptive statistics.

	1	2	3	4	5	6
Cost	**(0.734)**					
IoT adoption	0.464	**(0.825)**				
Convenience	0.519	0.384	**(0.781)**			
Social status	0.198	0.227	0.217	**(0.794)**		
Privacy	0.258	0.365	0.172	0.137	**(0.824)**	
Customer relationship management	0.249	0.526	0.337	0.254	0.159	**(0.853)**
Mean	4.844	5.240	5.359	4.671	5.152	5.248
Standard deviation	0.865	1.145	1.028	0.904	1.052	1.208
Skewness	-1.154	-1.204	0.869	0.675	1.118	0.824
Kurtosis	0.865	-1.256	0.907	-1.265	0.552	0.667

Note: bold diagonal values within parentheses are the squared root of AVE.

significant variables. Since India is a developing country and the average per capita income is also low, most Indians are more concerned about the cost of IoT services banks provide. We know that adopting new technology will be successfully implemented if more people can use and test it. Hence, there is a positive relationship between the cost and adoption of IoT, which confirms that lower or reasonable costs of IoT services would encourage the banks' customers to adopt the IoT services more in their daily lives. Therefore, banks need to ensure that they charge a low amount for using interbased banking activities to motivate the customer to use the same.

The second variable having a high association with the adoption of IoT is privacy which positively affects the adoption of IoT services in banks as banking services have been connected with customers' financial data that is highly confidential. Thus, the results suggest that the adoption of IoT services will be increased if the privacy measures provide better facilities to reduce hacking, phishing, card cloning, etc. If the bank successfully assures its customer about the privacy of their information, they are more likely to adopt IoT banking services. Another variable, convenience, has also been found to be a positive predictor of IoT banking services since IoT-based services provide ease of use to the

Table 6: Standardized direct and interaction (moderation) effects.

Dependent variable		Independent variable	Std. estimate
Direct effects			
IoT adoption	←	Cost	0.351***
IoT adoption	←	Convenience	0.267***
IoT adoption	←	Status	0.121***
IoT adoption	←	Privacy	0.294***
Customer relationship management	←	IoT adoption	0.395***
Interaction effect (moderation effect)			
Customer relationship management	←	IoT adoption*gender	-0.149**
Customer relationship management	←	IoT adoption*age	-0.171**
Customer relationship management	←	IoT adoption*bank type	0.154**

Note: direct paths have been found significant at 1% level of significance, i.e., *** p value < 0.01. The interaction effects have been found significant at a 5% level of significance, i.e., ** $p < 0.05$, with bootstrapping at 5000.

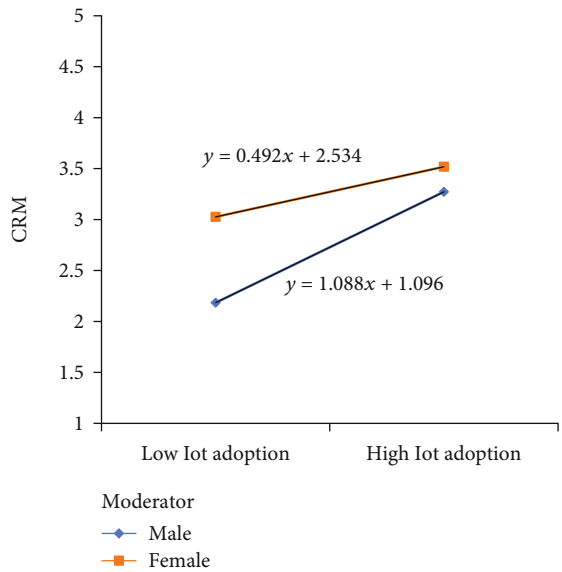


Figure 2: Moderation effect of gender on "IoT adoption ➔ CRM" link.

customers in their routine banking tasks without hassle like 24*7 banking facility, anytime, anywhere functionality, quick actions, and many more. Thus, convenience and ease of using IoT-based banking services increase the likelihood of adopting IoT-based banking services. This notion suggests that banks' ease and hassle-free usage of IoT services would attract customers to opt for IoT-based banking services more frequently, thereby smoothening the functionality of bank services. One more predictor, named social context, also has a positive relationship with the adoption of IoT, which shows that the opinion of society, friends, and family usually influences people's choice of opting for IoT-based banking services. It delineates that people show a greater inclination towards these services if the decision to adopt is approved by the influence group, i.e., friends, family, and relatives.

Furthermore, the authors also tested the impact of IoT on CRM in banks in the second model. The result of the SEM model predicts a significant positive relationship between the adoption of IoT banking services and the customer relationship management of banks. As it has been proved, if IoT banking services are implemented with good privacy measures for the confidentiality of the customers' data at an affordable cost, it will surely lead to convenience for the customer in their routine banking work. It will not only lessen the rush load at the bank branches but also create real-time data about the customers. The IoT services provide the banks with a vast amount of data related to their customers, and the same data can be used to serve the customers in a better way. Personalized banking and offers can be enhanced with IoT. In this way, banks can detect their most profitable customers and retain them for long. Banks, with the use of real-time data of their customers, can manage the different products in a better way as they can be customized as per customers' requirements. The customers will benefit from the most relevant offers and products and the most convenient, time-saving, and pocket-friendly services at their place. Many services are being provided on this line, like mobile banking, ATM, SMS banking, smart banking, money deposit machines, and home banking. Now the banks know what kind of services an individual customer wants through IoT services. Banks have all the individual customers' data regarding their usage of transactions, money, or services. In this way, the banks can be resourceful with IoT services, especially in customer relationship management.

It was also a subject of curiosity whether gender, age, and bank ownership type play a significant moderating role in improving or dampening this IoT adoption and CRM relationship. For this purpose, the moderation effects of gender, age, and bank ownership type were checked, and it was found that the gender and age of the customers negatively moderate the relationship between the adoption of IoT and CRM. The results infer that "IoT adoption ➔ CRM" link gets weaker for female and older customers. This finding suggests that banks are less able to maintain a sound relationship with their female customers than male customers.

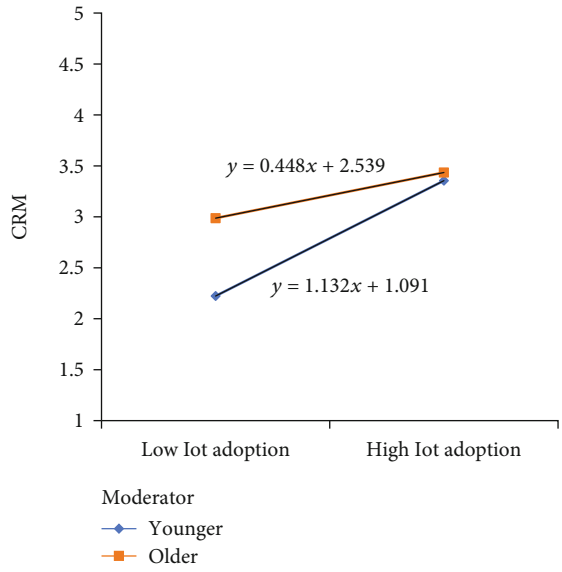


Figure 3: Moderation effect of age on "IoT adoption ➔ CRM" link.

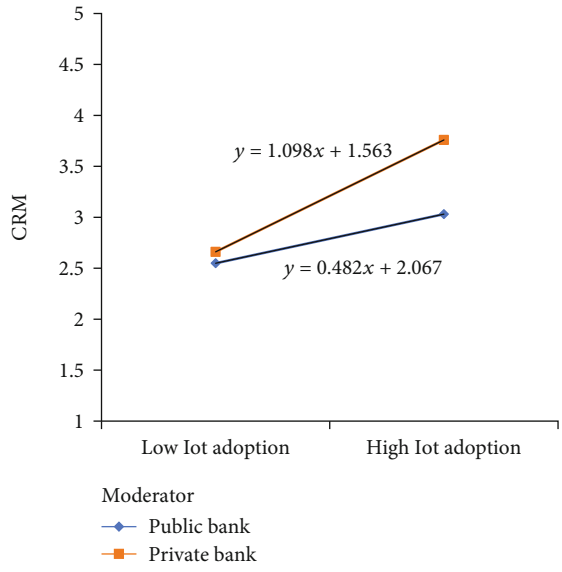


Figure 4: Moderation effect of bank ownership type on "IoT adoption ➔ CRM" link.

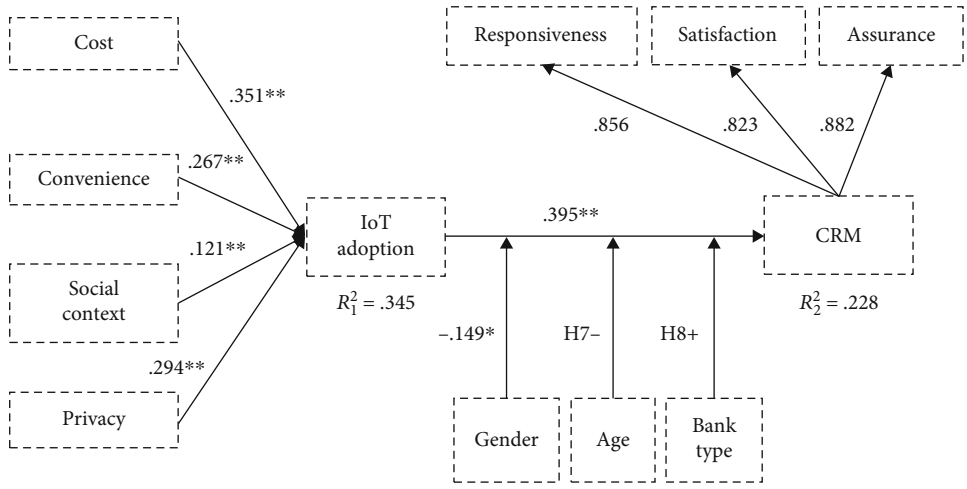
The reason behind this may vary in different banks. However, it can be understood that women are typically more apprehensive about privacy and data security. If they perceive IoT-based banking services as invasive or risky, it could impede their adoption and subsequently impact their level of involvement with CRM initiatives. On the other hand, the adoption of IoT-based banking services may be hindered among older customers due to their relatively lower technological skills and unfamiliarity with IoT devices. To address this challenge, CRM strategies should focus on offering suitable training, support, and user-friendly interfaces. These measures are aimed at bridging the technological gap and enhancing the adoption rates of IoT-based banking services among older customers.

Further, "IoT adoption ➔ CRM" link is found stronger for private banks than public banks. The reason behind the upper hand of private banks in maintaining better CRM might be their greater flexibility and independence in making strategic choices, including the adoption of innovative technologies such as IoT-based banking services. They are capable of swiftly responding to market trends and customer expectations, enabling seamless integration of IoT technology into their range of services. This agility empowers private banks to potentially implement CRM strategies with greater efficiency, customizing them to the distinct requirements and preferences of customers utilizing IoT services. In contrast, public banks encounter difficulties in customizing their CRM strategies due to larger customer bases and resource constraints. Consequently, their adoption of IoT-based banking services often focuses more on improving operational efficiency rather than personalization efforts.

This paper presents a holistic view of the adoption of the Internet of Things in banks, its impact on customer relationship management, and the moderating effect of gender, age, and bank ownership type on the IoT adoption and CRM relationship. The results provide information for the policymakers and product planners for banks and other financial services like insurance and loan agencies, so that they can be aware while providing customized and personalized offers and products to their customers.

6. Practical Implications

Nowadays, the banking sector is implementing newer technologies to attract new customers and retain the present customers by providing real-time services for personalization to maintain long-term relationships with them that can be followed with the help of the present study's results. After confirming the factors influencing the adoption of IoT and its impact on CRM services under the purview of responsiveness, satisfaction, and assurance of the services, the organization can make policies keeping in knowledge about these factors. The findings indicate that when banks promote their IoT-enabled services, the benefits from these services should be emphasized so that customers can be well aware of the advantages and disadvantages of IoT services. The moderation effects of age, gender, and bank type make the work half done for the policymakers as they can use the results for the specific gender and age group. Financial institutions should conduct comprehensive market research and appropriately segment their customer base to successfully handle the influence of gender and age. By gaining a deep understanding of the varied requirements, preferences, and worries of different gender and age demographics, customized CRM strategies can be formulated. These strategies are aimed at cultivating customer engagement and satisfaction, specifically for IoT-based banking services. While private banks may have more agility and customer-centric focus, public banks can leverage their existing trust and stability to foster the adoption of IoT-based banking services and effectively integrate them into CRM efforts. Both ownership types can



Note: Paths have been found significant at 1% and 5% levels of significance, i.e., $^{**}p < 0.01$ and $^{*}p < 0.05$.

Figure 5: Hypothesized conceptual framework.

benefit from embracing IoT technology and designing CRM strategies that align with customer expectations, needs, and preferences in the digital era.

7. Limitations and Scope for Future Research

Like many other studies, this study also suffers from some limitations. The sample size for future research should be expanded for better representativeness and include all user categories, from users to nonusers. This would make the researcher find out the factors for nonusage decisions among various consumer groups. Besides, in future research, more influencing factors that play an important role in adopting IoT should be incorporated. The present study is related to a specific banking sector area and creates future scope for other sectors like tourism, education, and health care. This study is not based on any model; hence, another study could rely on any robust model like the technology acceptance model (TAM), unified theory of acceptance and use of technology (UTAUT), theory of planned behavior (TPB), and innovation diffusion theory (IDT). The present study collects data from only one district of Uttar Pradesh, India, i.e., Aligarh, using a convenience sampling method, hence may not represent India. Future studies may expand geographical coverage by taking more cities from other states of India. The scope for conducting a comparative or cross-culture study is also open across developing neighboring countries like China, Pakistan, Sri Lanka, Bangladesh, and Bhutan. Gender, age, and bank ownership type (public vs. private) have already been checked as moderators on IoT adoption and CRM links, so there is a scope to check the moderation effect of other variables like income, education, or type of employment of the customers.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding authors upon reasonable request.

Ethical Approval

Data was anonymized, even no personal information like contact numbers or/and email addresses was solicited, so this study was exempted for ethical approval by Institutional Ethics Committee of Aligarh Muslim University.

Consent

Informed consent was obtained from all individual participants included in the study.

Conflicts of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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