Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2022.vol9.no9.0191

Financial Inclusion - An Impetus to the Digitalization of Payment Services (UPI) in India

Arpita SHARMA[1], Venkata Mrudula BHIMAVARAPU[2], Jagjeevan KANOUJIYA[3], Prashant BARGE[4], Shailesh RASTOGI[5]

Received: June 30, 2022 Revised: September 18, 2022 Accepted: September 30, 2022

Abstract

The ecosystem for digital payments in India has expanded quickly during the last decade. A synthesis of technical advancements and progressive governmental laws and regulations has fuelled this expansion. Particularly, the UPI system has assisted India in transitioning from a nation heavily reliant on cash for daily transactions to one with fewer cash transactions. The study attempted to determine how Financial Inclusion (FI) through a socio-techno-ecosystem impacts digital payment systems. FI involves ensuring financial services, products, and an adequate amount of credit without discrimination against the weaker section of society. The study has established that FI impacts the UPI. The finance infrastructure thus helps to develop an ecosystem where financial access and the awareness level help people to transit to new channels of payment. We have used secondary data of 27 banks for sixteen quarters and four years, i.e., for the financial years 2016–17 to 2019–20. It is observed from the current study that the offsite_ATM plays a significant role in the value creation of the UPI. Our study implies that it will help retailers, individuals, and business houses to use UPI platforms for swift payments without hassle. Also helpful for industries that are still not digitally disrupted and industry-specific UPI transactions.

Keywords: Financial Inclusion, UPI, Digital Payments, Panel Data Analysis, India

JEL Classification Code: G21, G28, G29

1. Introduction

In 2010, G 20 (GPFI, 2021) developed innovative financial inclusion principles emphasizing poverty reduction in emerging economies. An increase in the importance of digital finance in improving financial inclusion is thus observed. This leads to poverty reduction and economic development, but to achieve the stable growth of the economy, accessibility to financial services through financial innovation and digital finance is necessary. The Indian government, in its 2022 budget, focused on digital finance and the fintech sector to ensure that these financial services should be reaching every nook and corner and work towards financial inclusion. Financial inclusion thus requires an inclusive ecosystem with social and technological combinations.

The socio-techno ecosystem consists of society and technology that will have a symbiotic relationship and create a mutual value. The technology involves digital artifacts like ATMs, chips, and card payments integrating emerging

[1]First Author. Assistant Professor, Symbiosis Institute of Business Management, Symbiosis International (Deemed) University, India. Email: arpita.sharma85@gmail.com
[2]Corresponding Author. Assistant Professor, School of Commerce and Management, D Y Patil International University, India. [Postal Address: Sector 29, Nigdi Pradhikaran, Akurdi, Pune, Maharashtra, 411044, India] Email: mrudulabhimavarapu@gmail.com
[3]Ph.D. Scholar, Symbiosis Institute of Business Management, Symbiosis International (Deemed) University, India. Email: jagjeevan24288@yahoo.co.in
[4]Assistant Professor, Symbiosis Institute of Business Management, Symbiosis International (Deemed) University, India. Email: bargep@gmail.com.
[5]Professor, Symbiosis Institute of Business Management, Symbiosis International (Deemed) University, India. Email: krishnasgdas@gmail.com

applications. The social actors are payment banks, internet banking, financial services providers, and regulators.

The Indian government has initiated a program called Indian Stack (Sanmath, 2018). 'A 'stack' includes all of the technologies required to run an application, including computer languages, architecture, libraries, servers, user interfaces, experiences, and software – the apps themselves – as well as developer tools such as APIs, which connect databases and software' (DIGFIN, 2020). This will help the Indian sub-continent to become a modernized fintech pioneer. To modernize the retail payments and the settlement system National Payments Corporation of India took over the ATM network. The Unique Identification Authority of India tackles the unique identification of the individual through biometrics and the Aadhar card. These infrastructure units started a project on Unified Payments Interface (UPI). Post demonetization, the UPI and wallet-based payments got to see a boost in the economy. In June 2020, UPI transactions were noted as 1.3 billion, but the Indian government wants to revamp the stack so that UPI usage reaches 1 billion transactions per day (DIGFIN, 2020). The Indian Stack is built on the discourse of transparent financial inclusion. Thus, knowing how financial inclusion can influence UPI transactions is essential.

The current study contributes to understanding how the financial inclusion socio-tech ecosystem will impact the digital payments systems. The study will define the financial inclusion socio-tech ecosystem and will study its various components.

The next section of the paper shows how the Unified Payment Interface 'UPI' has become a game-changer in the story. This is followed by section three, which presents the conceptual framework, literature review, and hypothesis formulation. Section four explains the research methodology and data used in the study. After that, section five explains the empirical findings, and sections six and seven discuss the results and the concluding observation, respectively.

2. UPI: A Game-Changer

Post demonetization, the Indian government has made efforts to push the digital economy (Maken & Shekhar, 2017). The government has taken many policy initiatives to shift to the cashless economy, with increased use of ATMs, Banking cards, e-wallets, and net – banking (Cashless India 2021). The introduction of the UPI has acted as a game-changer to enable a gradual shift to the digital payment system (Rastogi et al., 2022; Rakesh et al., 2018; Vishnoi & Bishla, 2021). The Unified Payments Interface (UPI) is a real-time payment system developed by the National Payments Corporation of India (NPCI) that allows for inter-bank peer-to-peer (P2P) and person-to-merchant (P2M) transactions.

UPI acts as a digital infrastructure for digital payments through apps like google pay, BHIM, phone pay For the public, and much more helpful; the UPI was launched in 2016 by then RBI governor Dr. Raghuram Rajan under the government of Prime Minister Narendra Modi (NPCI, 2022). Since then, UPI and Rupay have emerged as financial weapons in modern warfare. These systems make India a self-reliant economy and less dependent on international payment apps. This is one major step towards Atmanirbhar Bharat. In January 2022 (UPI, 2022), the total number of transactions was 461 crores, with cashless retail transactions totaling Rs 8.32 lakh crore (4.61 billion). This increase in usage has made UPI a game-changer for the Indian economy's financial ecosystem.

3. Literature Review and Hypotheses Formulation

3.1. Literature Review

3.1.1. UPI As Digitalization Tool

Rangrajan (2008), in his policy, suggested building a strategy for the inclusive financial sector through leveraging technology-based solutions. In the digital India Program, the government transforms the economy towards digitalization. Kotarba (2017) studied the critical metrics of digitalization and found ICT (Information, Communication, and Technology) integration and digital transactions are the key indicators. Digital payments are made using the internet and mobile telecommunications. European Commission (2016) defined the digital economy and society index and suggested bank and shopping transactions as metrics. Szymanek (2015) considered integrating the API (Application Programming Interface) technologies and open platforms as the digitalization indicator. UPI works on the Open API technologies. The literature shows that UPI or mobile banking can substitute for ICT. Digitalization can be promoted with UPI and wallets (Daştan & Gürler, 2016). UPI-based apps support IMPS (Immediate Payment Service), which uses the operator's bank account details and allows instant money transfers. Wallets use money stored in a company's app that can later be used to make payments. The direct transaction between the banks in the UPI makes it better than wallets, where the latter serves as the bridge between the bank accounts.

With various other digital modes available (Cashless India, 2022), UPI is one such model that will drive the economy towards a cashless, faceless, and paperless society. UPI app encourages people to use digital money and banking services (Seranmadevi et al., 2019). Rastogi et al. (2020, 2021) suggest that UPI is used to support digitalization.

The TAM models help to understand the adoption of the UPI as the technology used for mobile money transfer among the beneficiaries, even for small transactions (Kapur et al., 2020).

The UPI ecosystem consists of payment services players (PSP), banks, or third-party software service providers. They enable UPI –PSP service through mobile apps. The transaction facilitated by the PSP-UPI is financial or non-financial (NPCI, 2022; Gochhwal, 2017). The financial transaction includes push transactions based on the virtual payment address, account number, Aadhar Card, and IFSC code. It also consists of the collect payment services on the payment address, which are virtual like the non–financial transactions on the UPI platforms and virtual address payment. They include a change or set of MPIN, OTP, and bank balance checks. According to NPCI (2021), the UPI's value and volume have shown a sparkling growth with a 103 percent increase in the volume and a 100 percent increase in the value in one year. UPI (UPI Statistics, 2021) volume's significant contribution of 4 percent is through a person–to–person transactions (P2P- 54 percent) and 46 percent through Person-to-Merchant (P2M).

3.1.2. Financial Inclusion

Financial inclusion ensures access to sufficient credit and financial services to the weaker section of society at an affordable cost (Rangrajan, 2008; Planning commission, 2008). The accessibility of services includes banking and other financial services like pension, equity, financial literacy, and others.

Some recent studies widen the principle of financial inclusion from access indicators to cost, usage, and quality indicators of the financial services (Demirgüç-Kunt et al., 2020; Pham & Doa, 2020; Ratnawati, 2020; Nguyen & Ha, 2021). The availability of the financial services indicates the 'access' levels. Using these financial services means the 'use.' The 'cost' is defined as the monetary and non-monetary costs of accessing and using financial services, such as bank fees or proximity to financial institutions.

It is thus essential that the financial services to decrease the stress of financial exclusion should be sustainable and affordable for the providers and customers, respectively (Rangrajan, 2008).

Financial inclusion is measured by creating the financial inclusion index (Ambarkhane et al., 2016; Sarma, 2008). Sarma (2008, 2012) and Beck et al. (2007) both proposed two indicators of financial inclusion. They used access indicators such as the geographic reach of the financial infrastructure, including the number of branches and ATMs per 1000 km^2. They also took into account indications of financial service utilization, such as loan account /capita and loan income ratio. Honohan (2008) advocated using metrics to measure financial inclusion, such as remittance payments, deposit services, increasing creditworthiness, and insurance.

Penetration or outreach into the system, availability of infrastructure, usage of financial services, and cost (Sarma 2008; Sarma & Pais 2011; Gupta et al., 2012) are considered significant indicators to measure financial inclusion. The penetration can be at the branch, credit, and deposit levels (CRISIL, 2013). Ambarkhane et al. (2016) used the number of transactions per account as another indicator of usage, showing its quantifiable extent, to quantify financial inclusion. These additional dimensions were categorized as demand-side dimensions of banks. Indicators of measurement include the number of NBFCs, Self-help groups (SHGs), microfinance accounts, and domestic remittances per lakh of the population. Financial Inclusion is also shown by metrics for insurance services like pension and insurance penetration (FI). The supply-side dimensions place a greater emphasis on the infrastructure's reach, including bank branches, ATMs, and mobile users.

3.2. Conceptual Framework

The literature review shows specific linkages between the FI and the UPI. Hence, a conceptual model is proposed for the current study. The model will explore the FI and the UPI relationship by taking various proxies to measure the FI and UPI.

Different studies have used different parameters to measure financial inclusion (Sarma & Pais 2011; Gupta et al., 2012). The networks of bank branches and ATMs promote the expansion of the banking industry. Financial inclusion will be aided by the expansion and performance of the banking industry (Dangi & Kumar, 2013). One such indicator of financial inclusion is ATM penetration, which also includes the availability of ATMs (Ambarkhane et al., 2016). The current study examined the number of ATMs and their availability while extending the body of previous research. The presence of ATMs is categorized into offsite and onsite. The number of ATMs inside the branch is referred to as onsite_ATM. Offsite ATM refers to the ATMs that are located outside of the bank branch. One of the most important criteria for the branches is the ease of access and the location of the ATM.s. The off-premise ATM requires a higher maintenance cost (Stavin, 2000). Maity and Sahu (2018) suggested that offsite ATMs are another vital indicator of financial inclusion. Its expansion can support the infrastructure parameter of financial inclusion, which depends on rural and urban areas.

According to RBI and NPCI, a center is defined as the revenue unit (and not just the locality) classified and delineated by the respective State Government, i.e., a revenue village/ city/ town/ municipality/ municipal corporation, etc., as the case may be, in which the branch is situated. (Ambarkhane et al., 2016) define the financial inclusion index by taking the branches per lakh of the population.

The number of branch networks is critical for the financial inclusion index. The Branch network can increase the accessibility to financial services. RBI segregates the geographic locations into different tiers based on the number of centers (branches) and the population. Thus, the current study creates different models where these variables act as proxies to measure financial inclusion.

3.3. Hypotheses

According to the European Commission (2016), modernizing and digitizing public services can save costs for the government, public sector, people, and enterprises, as well as for service delivery. The conserved financial system puts various limitations, leading to the unserved population. Until recently, a large proportion of India's population lacked access to formal banking services and relied heavily on cash for financial transactions. The RBI encourages financial inclusion by building infrastructure, such as bank ATMs, to keep participants, whether they be businesses or people, within the payment system and the regulatory limit. Understanding how the branch network and ATM density of the financial infrastructure affect transactions and UPI value is therefore crucial. The penetration of financial services is also impacted by rural and urbanization, thus the researcher is prompted to investigate if population density affects UPI value and transaction. The next hypotheses must be examined to test the link.

Group 1: Set –1

H1: *The number of Onsite_ATM significantly impacts the value of the UPI*

H2: *The number of Offsite_ATM significantly impacts the value of the UPI*

H3: *The rural area significantly impacts the value of UPI*

H4: *The semi-urban area significantly impacts the value of UPI*

H5: *The urban area significantly impacts the value of UPI*

H6: *The metropolitan area significantly impacts the value of UPI*

Group 1: Set - 2

H7: *The Tier 1 city significantly impacts the value of the UPI.*

H8: *The Tier 2 city significantly impacts the value of the UPI.*

H9: *The Tier 3 city significantly impacts the value of the UPI.*

H10: *The Tier 4 city significantly impacts the value of the UPI.*

H11: *The Tier 5 city significantly impacts the value of the UPI.*

H12: *The Tier 6 city significantly impacts the value of the UPI.*

Group 2: Set –3

H13: *Number of Onsite_ATM significantly impact the volume of the UPI*

H14: *Number of Offsite_ATM significantly impact the volume of the UPI*

H15: *The rural area significantly impacts the volume of UPI*

H16: *The semi-urban area significantly impacts the volume of UPI*

H17: *The urban area significantly impacts the volume of UPI*

H18: *The metropolitan area significantly impacts the volume of UPI*

Group 2: Set - 4

H19: *The Tier 1 city significantly impacts the value of the UPI.*

H20: *The Tier 2 city significantly impacts the value of the UPI.*

H21: *The Tier 3 city significantly impacts the value of the UPI.*

H22: *The Tier 4 city significantly impacts the value of the UPI.*

H23: *The Tier 5 city significantly impacts the value of the UPI.*

H24: *The Tier 6 city significantly impacts the value of the UPI.*

The conceptual model for the study mentioned will test the 24 hypotheses through 24 models. The model derives two proxies for the UPI measurement, which acts as the dependent variable for the study. One in terms of UPI value and the other as UPI volume. The study attempts to derive the various proxies to measure the FI and explore their relationship with UPI (Value and Volume) (Sankararaman & Suresh, 2019).

The proxy variable for financial inclusion acted as the independent variable for the study, and their impact on UPI is explored through various sub-models.

The model explains two groups based on the UPI measurement. Group 1 takes the value as the proxy to measure the UPI as the dependent variable, and group 2 takes the volume of UPI as the outcome variable. Different proxy measurement of the FI is taken from the literature, and the study thus creates different sets/sub-models to see their impact on digitalization/ UPI.

4. Data and Research Methodology

4.1. Data

The current study chose 34 public and private sector banks from India. Seven banks were dropped from the sample due to the unavailability of synchronized data that fits the balance panel considered. The final sample is fixed with 432 annotations from 27 banks for sixteen quarters and four years, i.e., for the financial years 2016–17 to 2019–20. The data is collated from the RBI (Reserve bank of India) database and the official website of NPCI (National payments corporation of India). The variables considered for the study are Upi_value (The total amount of bank-wise transactions that had taken place in India) and upi_volume (Bank-wise number of UPI transactions carried in India) as the dependent variables Onsite_ATM's (Total number of ATMs arrayed by the banks within the branch premises); Offsite_ATM's (Total number of ATMs deployed outside the branch premises); rural (Population less than ten thousand); Semi_urban (Population above ten thousand and below a lakh); urban (Population above one and below ten lakh); metropolitan (Population above ten lakhs); Tier1 (Number of centers located in metropolitan and urban areas); Tier2, Tier3, and Tier4 (Number of centers situated in a semi-urban area); Tier5 and Tier6 (Number of centers located in the rural area).

4.2. Descriptive Statistics and Correlation

Table 1 shows the descriptive statistics of the variables used for the study. The descriptive statistics for the variables considered in the study are established in Table 1. The mean of the variables taken into account indicates how many ATMs and centers (branches) each bank has in India. The variables' high standard deviations indicate that the data is skewed away from the mean. The statistically significant positive correlation between the variables infers that they tend to move together in the same direction.

4.3. Econometric Model

Similar studies have employed panel data in different scenarios (Nguyen & Nguyen, 2020; Kalsie & Shrivastav, 2016; Panicker et al., 2016). The study uses cross-sectional and time-series data (balanced panel data). Panel data allows for the inclusion of time effects and the control of individual heterogeneity, captured by firm-specific fixed or random effects components, and leads to skewed results when ignored in cross-section or time-series estimations (Baltagi, 1998; Panda & Bag, 2019). Panel data analysis provides more informative data, more variability, more degree of freedom, and more efficiency (Manna et al., 2016; Hsiao, 2005). Hence, the literature justifies using the panel data in the current study. The estimated static models are grouped into two sets with l_upi_value and l_upi_volume as dependent variables. Furthermore, each group is divided into two sets: set 1 (eq 1–6), set 2 (eq 7–12), and set 3 (eq 13–18), set 4 (eq 19–24).

Set–1:

$$\text{l\_upi\_value}_{it} = \alpha + \beta \text{ onsite\_ATMs}_{it} + u_{it} \quad (1)$$
$$\text{l\_upi\_value}_{it} = \alpha + \beta \text{ offsite\_ATMs}_{it} + u_{it} \quad (2)$$
$$\text{l\_upi \_Value}_{it} = \alpha + \beta \text{ rural}_{it} + u_{it} \quad (3)$$
$$\text{l\_upi \_Value}_{it} = \alpha + \beta \text{ semi-urban}_{it} + u_{it} \quad (4)$$
$$\text{l\_upi \_Value}_{it} = \alpha + \beta \text{ urban}_{it} + u_{it} \quad (5)$$
$$\text{l\_upi \_Value}_{it} = \alpha + \beta \text{ metropolitan}_{it} + u_{it} \quad (6)$$

Set–2:

$$\text{l\_upi \_Value}_{it} = \alpha + \beta \text{ Tier1}_{it} + u_{it} \quad (7)$$

Table 1: Descriptive Statistics

	Mean	SD	Min	Max
Onsite_ATM's	11056.35	14730.64	596	87385
Offsite_ATM's	10172.29	18943	89	99279
rural	1172.106	1471.239	19	7969
Semi_urban	1128.336	1231.714	106	7190
urban	854.919	891.6212	74	5309
metropolitan	955.4468	872.2125	70	5367
Tier1	1816.141	1772.671	144	10574
Tier 2	314.2153	278.759	24	1672
Tier 3	478.4954	522.1056	55	3019
Tier 4	340.6435	456.5316	23	2636
Tier 5	408.7014	545.9306	13	2961
Tier 6	768.4329	944.1159	6	5008

Source: authors' own analysis. Note: Table 1 describes the descriptive statistics of the variables considered for the study.

$$l\_upi\ \_Value_{it} = \alpha + \beta\ Tier2_{it} + u_{it} \quad (8)$$
$$l\_upi\ \_Value_{it} = \alpha + \beta\ Tier\ 3_{it} + u_{it} \quad (9)$$
$$l\_upi\ \_Value_{it} = \alpha + \beta\ Tier\ 4_{it} + u_{it} \quad (10)$$
$$l\_upi\ \_Value_{it} = \alpha + \beta\ Tier\ 5_{it} + u_{it} \quad (11)$$
$$l\_upi\ \_Value_{it} = \alpha + \beta\ Tier\ 6_{it} + u_{it} \quad (12)$$

Set –3:

$$l\_upi\ \_Volume_{it} = \alpha + \beta\ onsite\_ATMs_{it} + u_{it} \quad (13)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ offsite\_ATMs_{it} + u_{it} \quad (14)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ rural_{it} + u_{it} \quad (15)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ semi\text{-}urban_{it} + u_{it} \quad (16)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ urban_{it} + u_{it} \quad (17)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ metropolitan_{it} + u_{it} \quad (18)$$

Set - 4:

$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier1_{it} + u_{it} \quad (19)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier2_{it} + u_{it} \quad (20)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier\ 3_{it} + u_{it} \quad (21)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier\ 4_{it} + u_{it} \quad (22)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier\ 5_{it} + u_{it} \quad (23)$$
$$l\_upi\ \_Volume_{it} = \alpha + \beta\ Tier\ 6_{it} + u_{it} \quad (24)$$

Where 'α' is a constant term, $i = 27$ firms and $t = 4$years, u_{it}= is the error term; where = represents the unobservable individual effect and = represents the remainder disturbance). In the econometric model, lagged values for upi_value and upi_volume are considered.

5. Empirical Results

5.1. Static Panel Data Analysis

The models' static panel data estimates are reported in Tables 2–5. Tables 2, 3, 4, and 5 show that both the fixed effect and BP-test for random effects are significant, thus the Hausman test is used to determine which model for the study fits the data the best (Baltagi, 2008). Except for models 2, 6, and 8, all the twelve models in Group 1 have a fixed effect in the static panel estimation, as shown by the Hausman results. Models 14, 15, 21, 22, 23, and 24 in Group Two are given fixed effects, while models 13, 16, 17, 18, 19, and 20 are given random effects as recommended by the Hausman test.

The model with l_upi_value as the dependent variable (Eq–1–12) is reported in Tables (2 and 3), whereas the model with l_upi_volume as the dependent variable (Eq – 13–24) is reported in Tables (4 and 5). With the exception of onsite ATMs and rural, all the other variables in group one's twelve exploratory variables used in the models (1–12) are significantly associated with the regressand variable at a significance level of 5%. Except for rural, all the other factors in group 2 of the twelve exploratory variables used in the models (13–24) are significantly related to the number of UPI transactions per bank (l_upi_volume) at the 5% level of significance. From the presented empirical shreds of evidence, it is evident that onsite_ATMs in group one, i.e., is in the case of l_upi_value, and rural in both groups one and two, i.e., is in the case of l_upi_value, and l_upi_volume has no impact on the of UPI transactions consistently at 5% significance.

5.2. Endogeneity Testing

The authors carried out an endogeneity test to check the endogeneity of the variables used in the present study. The target variables are presumed to be exogenous in the null hypothesis of the Durbin-Wu-Hausman test, with the exception of model 1 variable (onsite_ATMs) in group one and model 13 and 18 variables (onsite_ATMs and metropolitan) in group 2. The chi-square and *F*-values of the Durbin-Wu-Hausman test are more significant than 0.05. Hence null hypothesis cannot be rejected, and the variables are exogenous. As in the case of model 1, for the variable onsite_ATMs, the values of the chi-square (5.08722* (0.0241)) and *F*-values (5.11792 * (0.0243)) of the Durbin-Wu-Hausman test are less than 0.05, hence null hypothesis is rejected, and the variable is endogenous.

6. Discussion

Table 6 summarizes the study results.

The hypothesis testing results (Table 6) show that the three primary FI indicators, ATMs, geographic areas based on population, and geographic regions based on centers (number of branches), impact the UPI value and volume. The off_site ATMs, urban, semi-urban, urban, and metropolitan cities, Tier–1, 2, 3, 4, 5, and 6 type cities with different centers (bank branches) impact the UPI transaction value. onsite_ATM does not significantly impact the value of the UPI transactions tested through the 2-stage least square method due to endogeneity. People access bank branches mainly for cash transactions and physical interactions. The off_site and on-site_ ATMs, urban, semi-urban, urban, and metropolitan cities, Tier–1, 2, 3, 4, 5, and 6 type cities with different centers (bank branches) impact the UPI transaction volume. There are three hypotheses, H1, H3, and H14 are rejected, and the rest are accepted.

The rural area is found to have an insignificant association with the UPI value and volume. The reason is that rural areas in India are still untapped in terms of technology, and very little financial inclusion happened here. There are some

Table 2: Result of Regression Analysis (Group 2)

l_upi_Value – Robust Estimates _Set 1 (Models 1–6)						
	Model – 1 (FE) – 2SLS	**Model – 2 (RE)**	**Model – 3 (FE)**	**Model – 4 (FE)**	**Model – 5 (FE)**	**Model – 6 (RE)**
	Coeff	**Coeff**	**Coeff**	**Coeff**	**Coeff**	**Coeff**
Constant	16.38*	15.54*	17.51*	14.33*	14.53*	14.73*
Onsite_ATMs	0.0001	–	–	–	–	–
Offsite_ATMs	–	0.0001*	–	–	–	–
rural	–	–	0.0003	–	–	–
semi_urban	–	–	–	.0018*	–	–
urban	–	–	–	–	0.0022*	–
Metropolitan	–	–	–	–	–	0.0017**
R-Square	0.2668	0.3365	0.1654	0.2975	0.2701	0.3879
SE of Regression	0.8357	1.352	0.8076	1.3368	1.3267	1.3388
Note: No observations (*n*)	432	432	432	432	432	432
Degree of freedom	404	404	404	404	404	404
F-test Fixed Effect	21.61* (0.0000)	18.65* (0.0000)	26.45* (0.0000)	22.19* (0.0000)	23.33* (0.0000)	19.03* (0.0000)
Breusch and Pagan Test	96.43* (0.0000)	85.14* (0.0000)	10.08* (0.0000)	96.51* (0.0000)	10.58* (0.0000)	85.46* (0.0000)
Hausman Test	5.19* (0.0227)	0.41 (0.5215)	13.43* (0.0002)	7.24* (0.0071)	5.20* (0.0226)	2.50 (0.1139)
Wald test for Heteroscedasticity[1]	83.14* (0.0000)	7165.37* (0.0000)	6510.34* (0.0000)	6646.10* (0.0000)	6542.99* (0.0000)	1598.86* (0.0000)
Wooldridge Autocorrelation Test[2] AR (1)	107.2* (0.0000)	111.7* (0.0000)	99.9* (0.0000)	104.2* (0.0000)	96.8* (0.0000)	95.2* (0.0000)

Source: authors' own analysis. Note:[1]Wald test of heteroscedasticity has the null of no heteroscedasticity. [2]Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). SE of the regression is the standard error of the regression. Standard Errors are robust estimates due to both significant Heteroscedasticity and Autocorrelation @* being significant at 5 percent. As the variable in model 1 is detected with endogeneity, to treat endogeneity two-stage least square is applied using an instrument variable.

Table 3: Result of Regression Analysis (Group 3)

I_upi_Value – Robust Estimates_ Set 3 (Models 7 to 12)						
	Model – 7 (FE)	**Model – 8 (RE)**	**Model – 9 (FE)**	**Model – 10 (FE)**	**Model – 11 (FE)**	**Model – 12 (FE)**
	Coeff	**Coeff**	**Coeff**	**Coeff**	**Coeff**	**Coeff**
Constant	14.31*	14.62*	13.89*	14.09*	14.17*	13.93*
Tier–1	0.0011*	–	–	–	–	–
Tier–2	–	0.0056*	–	–	–	–
Tier–3	–	–	0.0052*	–	–	–
Tier–4	–	–	–	0.0068*	–	–
Tier–5	–	–	–	–	0.0054*	–
Tier–6	–	–	–	–	–	0.0032*
R-Square	0.3271	0.3998	0.3085	0.2171	0.1845	0.1761
SE of Regression	1.3262	1.3263	1.3247	1.3309	1.3259	1.318
Note: No observations (n)	432	432	432	432	432	432
Degree of freedom	404	404	404	404	404	404
F-test Fixed Effect	21.53* (0.0000)	19.06* (0.0000)	22.52* (0.0000)	25.35* (0.0000)	26.66* (0.0000)	27.36* (0.0000)
Breusch and Pagan Test	948.65* (0.0000)	855.39* (0.0000)	955.59* (0.0000)	1051.34* (0.0000)	1092.61* (0.0000)	1105.53* (0.0000)
Hausman Test	5.24** (0.0221)	2.93 (0.0870)	12.13* (0.0005)	16.09* (0.0001)	16.42* (0.0001)	18.09* (0.0000)
Wald test for Heteroscedasticity1	65.81* (0.0000)	2274.94* (0.0000)	6522.21* (0.0005)	6436.30* (0.0000)	6374.44* (0.0000)	6271.41* (0.0000)
Wooldridge Autocorrelation Test2 AR (1)	91.82* (0.0000)	96.472* (0.0000)	99.675* (0.0005)	100.851* (0.0000)	98.441* (0.0000)	93.486* (0.0000)

Source: authors' own analysis. Note:[1]Wald test of heteroscedasticity has the null of no heteroscedasticity. [2]Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). SE of the regression is the standard error of the regression. Standard Errors are robust estimates due to both significant Heteroscedasticity and Autocorrelation @* being significant at 5 percent.

Table 4: Result of Regression Analysis (Group 3)

l_upi_Volume – Robust Estimates- Set 3 (Models 13 to 18)						
	Model – 13 (RE) – 2SLS	**Model – 14 (FE)**	**Model – 15 (FE)**	**Model – 16 (RE)**	**Model – 17 (RE)**	**Model – 18 (RE) – 2SLS**
	Coeff	**Coeff**	**Coeff**	**Coeff**	**Coeff**	**Coeff**
Constant	17.01*	18.52*	16.52*	16.85*	16.88*	16.44*
Onsite_ATMs	0.0001*	–	–	–	–	–
Offsite_ATMs	–	–0.00004	–	–	–	–
rural	–	–	0.0013*	–	–	–
semi_urban	–	–	–	0.0011*	–	–
urban	–	–	–	–	0.0014*	–
Metropolitan	–	–	–	–	–	0.0015*
R-Square	0.2652	0.3635	0.1600	0.2808	0.2505	0.3577
SE of Regression	0.8854	1.108	1.0535	1.0592	1.0515	2.6921
Note: No observations (n)	432	432	432	432	432	432
Degree of freedom	404	404	404	404	404	404
F-test Fixed Effect	31.56* (0.0000)	26.96* (0.0000)	39.66* (0.0000)	33.29* (0.0000)	35.14* (0.0000)	28.74* (0.0000)
Breusch and Pagan Test	1352.65* (0.0000)	1183.96* (0.0000)	1530.69* (0.0000)	1391.05* (0.0000)	1449.12* (0.0000)	1264.47* (0.0000)
Hausman Test	1.30 (0.2541)	5.04* (0.0248)	7.85* (0.0051)	2.88 (0.0898)	1.80 (0.1795)	0.42 (0.5156)
Wald test for Heteroscedasticity1	1951.82* (0.0000)	1532.45* (0.0000)	1483.93* (0.0000)	2068.92* (0.0000)	2272.17* (0.0000)	1942.18* (0.0000)
Wooldridge Autocorrelation Test2 AR (1)	107.675* (0.0000)	98.760* (0.0000)	99.158* (0.0000)	102.701* (0.0000)	98.675* (0.0000)	95.632* (0.0000)

Source: authors' own analysis. Note: [1]Wald test of heteroscedasticity has the null of no heteroscedasticity. [2]Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). SE of the regression is the standard error of the regression. Standard Errors are robust estimates due to both significant Heteroscedasticity and Autocorrelation @* being significant at 5 percent. As the variables in model 13 and model 18 are detected with endogeneity, to treat endogeneity two-stage least square is applied using an instrument variable.

Table 5: Result of Regression Analysis (Group 4)

l_upi_Volume – Robust Estimates-Set 4 (Models 19 to 24)						
	Model – 19 (RE)	**Model – 20 (RE)**	**Model – 21 (FE)**	**Model – 22 (FE)**	**Model – 23 (FE)**	**Model – 24 (FE)**
	Coeff	**Coeff**	**Coeff**	**Coeff**	**Coeff**	**Coeff**
Constant	16.74*	16.66*	16.32*	16.46*	16.50*	16.28*
Tier–1	0.0007*	–	–	–	–	–
Tier–2	–	0.0045*	–	–	–	–
Tier–3	–	–	0.0037*	–	–	–
Tier–4	–	–	–	0.0048*	–	–
Tier–5	–	–	–	–	0.0039*	–
Tier–6	–	–	–	–	–	0.0023*
R-Square	0.3116	0.3695	0.2983	0.2027	0.1634	0.1575
SE of Regression	1.0518	1.053	1.0546	1.0585	1.0535	1.0466
Note: No observations (n)	432	432	432	432	432	432
Degree of freedom	404	404	404	404	404	404
F-test Fixed Effect	32.23* (0.0000)	29.36* (0.0000)	32.90* (0.0000)	37.26* (0.0000)	39.55* (0.0000)	40.48* (0.0000)
Breusch and Pagan Test	1366.97* (0.0000)	1284.98* (0.0000)	1366.96* (0.0000)	1473.49* (0.0000)	1523.30* (0.0000)	1534.92* (0.0000)
Hausman Test	1.57 (0.2105)	0.46 (0.4996)	5.05* (0.0247)	8.38* (0.0038)	9.18* (0.0025)	10.64* (0.0011)
Wald test for Heteroscedasticity1	2134.63* (0.0000)	2009.58* (0.0000)	2261.57* (0.0000)	1732.40* (0.0000)	1484.74* (0.0000)	1475.44* (0.0000)
Wooldridge Autocorrelation Test2 AR (1)	93.619* (0.0000)	97.221* (0.0000)	99.427* (0.0000)	99.152* (0.0000)	98.196* (0.0000)	94.400* (0.0000)

Source: authors' own analysis. Note: [1]Wald test of heteroscedasticity has the null of no heteroscedasticity. [2]Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). SE of the regression is the standard error of the regression. Standard Errors are robust estimates due to both significant Heteroscedasticity and Autocorrelation @* being significant at 5 percent.

Table 6: Summary of Study

S.No.	Hypothesis	Model-Panel Results	Result	Hypothesis	Model-Panel Results	Result
	Group 1			Group 2		
1	H1	FE (2SLS)	Rejected	H13	RE (2SLS)	Accepted
2	H2	RE	Accepted	H14	FE	Rejected
3	H3	FE	Rejected	H 15	FE	Accepted
4	H4	FE	Accepted	H16	RE	Accepted
5	H5	FE	Accepted	H17	RE	Accepted
6	H6	RE	Accepted	H18	RE (2SLS)	Accepted
7	H7	FE	Accepted	H19	RE	Accepted
8	H8	RE	Accepted	H20	RE	Accepted
9	H9	FE	Accepted	H21	FE	Accepted
10	H10	FE	Accepted	H22	FE	Accepted
11	H11	FE	Accepted	H23	FE	Accepted
12	H12	FE	Accepted	H24	FE	Accepted

Note: FE and RE explain the fixed effect and the random effect models. 2SLS describes the 2 Stage Square model.

models showed the fixed effect (4, 5, 7, 9, 10, 11, 12, 15, 21, 22, 23, and 24). The models with the random effects shown are 2, 6, 8, 16, 17, 18, 19, and 20).

The study tests the conceptual framework. The current research supports the finding of the previous literature that the number of ATMs is essential to increasing the value of UPI transactions (Ambarkhane et al., 2016; Qizam, 2021). Still, it is seen from the current study that the offsite_ATM plays a significant role in the value creation of the UPI. The value of UPI transactions can also be increased due to urbanization. Urbanization creates the banking infrastructure, and hence the unserved population can be served better, increasing the value of UPI. With the increasing network in the semi-urban, urban and metropolitan cities, knowledge and technology usage has increased, leading to an overall increase in the digitalization measured through UPI payments. The robustness of the model is tested through the volume of UPI. The results are in line with the previous discussion and suggest that urbanization, branch network, and the number of on-site and number of _offsite ATMs impact the volume of the UPI.

The study contributes to the importance of financial inclusion, which includes the banking infrastructure, which increases its usage and serves the financially excluded population. The inclusion of people in the financial system will further support digitalization and increase UPI payments through value and volume.

The implication derived for the country is to connect the government, people, and businesses through applications, technology, and infrastructure. The RBI should aggregate the stakeholders to create a fintech ecosystem in India. The increase in UPI transactions will extend the payments in credit and personal finance, insurance, and wealth management through financial inclusion.

7. Conclusion

The study's primary objective was to determine how financial inclusion through a socio techno-ecosystem impacts the digital payment systems. The study concludes that FI impacts the UPI. The finance infrastructure thus helps to develop an ecosystem, where financial access and the awareness level help people to transit to new channels of payment. The increased banking infrastructure usage also boosts confidence in financial services and accessibility through innovative and technology-based platforms.

The study's contribution will help more and more retailers, individuals, and business houses to use UPI platforms for swift payments without hassle. The Indian finance ministry wants to boost the UPI value and volume of transactions, and the banking and financial infrastructure will create a backbone for the overall increase.

The study can also help develop more indigenous payment platforms and gateways. The study can be helpful for industries that are still not digitally disrupted, and industry-specific UPI transactions can be monitored and analyzed to boost the growth of UPI in a specific sector.

The study comes with a few limitations, and the data is only sourced for five years, which can be increased. The study's future focus could include more infrastructure on the demand and supply sides to measure financial inclusion and see how it affects UPI. Researchers can separately take retail and merchandise UPI transactions and check how financial infrastructure influences them.

References

Ambarkhane, D., Shekhar Singh, A. S., & Venkataramani, B. (2016). Developing a comprehensive financial inclusion index. *Management and Labour Studies*, *41*(3), 216–235. https://doi.org/10.1177/0258042X16666579

Baltagi, B. H. (1998). Panel data methods. In A. Ullah & D. E. Giles (Eds), *Handbook of applied economic statistics* (pp. 311–323). Boca Raton, Florida: CRC Press.

Baltagi, B. H. (2008). *Econometric analysis of panel data* (4th ed.). NJ: John Wiley & Sons.

Beck, T., Demirguc-Kunt, A., & Martinez Peria, M. S. (2007). Reaching out: Access to and use of banking services across countries. *Journal of Financial Economics*, *85*(1), 234–266. https://doi.org/10.1016/j.jfineco.2006.07.002

Dangi, N., & Kumar, P. (2013). Current situation of financial inclusion in India and its future visions. *International Journal of Management and Social Sciences Research*, *2*(8), 155–166.

Daştan, İ., & Gürler, C. (2016). Factors affecting the adoption of mobile payment systems: An empirical analysis. *EMAJ: Emerging Markets Journal*, *6*(1), 17–24. https://doi.org/10.5195/EMAJ.2016.95

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The global Findex database 2017: Measuring financial inclusion and opportunities to expand access to and use of financial services. *World Bank Economic Review*, *34*(1), S2–S8. https://doi.org/10.1093/wber/lhz013

European Commission. (2016). *Digital economy and society*. https://ec.europaEU/digital-single-market/en/europe–2020-strategy.

Gochhwal, R. (2017). Unified payment interface—An advancement in payment systems. *American Journal of Industrial and Business Management*, *07*(10), 1174–1191. https://doi.org/10.4236/ajibm.2017.710084

Gupte, R., Venkataramani, B., & Gupta, D. (2012). Computation of financial inclusion index for India. *Procedia – Social and Behavioral Sciences*, *37*, 133–149. https://doi.org/10.1016/j.sbspro.2012.03.281

Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking and Finance*, *32*(11), 2493–2500. https://doi.org/10.1016/j.jbankfin.2008.05.004

Hsiao, C. (2005). Why panel data? *Singapore Economic Review*, *50*(2), 143–154. https://doi.org/10.1142/S0217590805001937

Kalsie, A., & Shrivastav, S. M. (2016). Analysis of board size and firm performance: Evidence from NSE companies using panel data approach. *Indian Journal of Corporate Governance*, *9*(2), 148–172. https://doi.org/10.1177/0974686216666456

Kapur, P. K., Sharma, H., Tandon, A., & Aggarwal, A. G. (2020). Studying Bhim App adoption using the bass model: An Indian perspective. *International Journal of Mathematical, Engineering and Management Sciences*, *5*(1), 120–135. https://doi.org/10.33889/IJMEMS.2020.5.1.011

Kotarba, M. (2017). Measuring digitalization–key metrics. *Foundations of Management*, *9*(1), 123–138. https://doi.org/10.1515/fman–2017–0010

Maity, C. S., & Sahu, T. N. (2018) Bank Branch Expansion and Financial Inclusion: Evidence from Selected Commercial Banks in India. *Al-Barkaat Journal of Finance and Management*, *10*(1), 48–65. https://doi.org/10.5958/2229–4503.2018.00005.X

Maken, P., & Shekhar, S. (2017). Demonetization: A game changer from black economy to digital economy. *CLEAR International Journal of Research in Commerce & Management*, *8*(11), 1–52.

Manna, A., Sahu, T. N., & Gupta, A. (2016). Impact of ownership structure and board composition on corporate performance in Indian companies. *Indian Journal of Corporate Governance*, *9*(1), 44–66. https://doi.org/10.1177/0974686216635787

Nguyen, A. H., & Nguyen, L. H. (2020). Determinants of sustainability disclosure: Empirical evidence from Vietnam. *Journal of Asian Finance, Economics, and Business*, *7*(6), 73–84. https://doi.org/10.13106/jafeb.2020.vol7.no6.073

Nguyen, Y. H. D., & Ha, D. T. T. (2021). The effect of institutional quality on financial inclusion in ASEAN Countries. *Journal of Asian Finance, Economics, and Business*, *8*(8), 421–431. https://doi.org/10.13106/jafeb.2021.vol8.no8.0421

Panda, B., & Bag, D. (2019). Does ownership structure affect firm performance in an emerging market? The Case of India. *Asian Journal of Business and Accounting*, *12*(1), 189–227. https://doi.org/10.22452/ajba.vol12no1.7

Panicker, V. S., Mitra, S., & Sensarma, R. (2016). Corporate governance determinants of FII in Indian IT firms. *Indian Journal of Corporate Governance*, *9*(1), 1–18. https://doi.org/10.1177/0974686216635785

Pham, M. H., & Doan, T. P. L. (2020). The impact of financial inclusion on financial stability in Asian countries. *Journal of Asian Finance, Economics, and Business*, *7*(6), 47–59. https://doi.org/10.13106/jafeb.2020.vol7.no6.047

Qizam, I. (2021). The impact of disclosure quality on firm performance: Empirical evidence from Indonesia. *Journal of Asian Finance, Economics, and Business*, *8*(4), 751–762. https://doi.org/10.13106/jafeb.2021.vol8.no4.0751

Rakesh, N., Kumar, K. S., & Kumar, S. S. (2018). UPI-the growth of the cashless economy in India. *Oman Chapter of Arabian Journal of Business and Management Review, 7*, 36–40. https://doi.org/10.12816/0044903

Rangrajan. (2008). *Report on the committee of financial inclusion*. http://slbckarnataka.com/UserFiles/slbc/Full%20Report.pdf Retrieved 8/2/2022

Rastogi, S., Kanoujiya, J., Bhimavarapu, V. M., & Gautam, R. S. (2022). The impact of competition on the profitability and

Risk-Taking of commercial banks in India. *Journal of Asian Finance, Economics, and Business*, *9*(5), 377–388. https://doi.org/10.13106/jafeb.2022.vol9.no5.0377

Rastogi, S., Panse, C., Sharma, A., & Bhimavarapu, V. M. (2021). Unified payment interface (UPI): A digital innovation and its impact on financial inclusion and economic development. *Universal Journal of Accounting and Finance*, *9*(3), 518–530. https://doi.org/10.13189/ujaf.2021.090326

Rastogi, S., Sharma, A., & Panse, C. (2020). Open banking and inclusive growth in India. *Indian Journal of Ecology*, *47*, 75–79.

Ratnawati, K. (2020). The impact of financial inclusion on economic growth, poverty, income inequality, and financial stability in Asia. *Journal of Asian Finance, Economics, and Business*, *7*(10), 73–85. https://doi.org/10.13106/jafeb.2020.vol7.no10.073

Sankararaman, G., & Suresh, S. (2019). A study on unified payment interface (UPI). *Transactions of the (A Digital Banking Tool) in Chennai City*, *7*, 10431–10440.

Sanmath, P. A. (2018). FinTech banking–the revolutionized digital banking. *International Journal of Trend in Scientific Research and Development*, *1*(1), 172–180.

Sarma, M. (2008). Index of financial inclusion (Working Paper No. 215). *New Delhi: Indian Council For Research On International Economic Relations. http://icrier.org/pdf/Working_Paper_215.pdf*

Sarma, M. (2012). *Index of financial inclusion–a measure of financial sector inclusiveness (Working Paper No 07/2012).* Delhi, India: Centre for international trade and development, School of International Studies working paper Jawaharlal Nehru University. https://finance-and-trade.htw-berlin.de/fileadmin/HTW/Forschung/Money_Finance_Trade_Development/working_paper_series/wp_07_2012_Sarma_Index-of-Financial-Inclusion.pdf

Sarma, M., & Pais, J. (2011). Financial inclusion and development. *Journal of International Development*, *23*(5), 613–628. https://doi.org/10.1002/jid.1698

Seranmadevi, R., Winster Praveenraj, D. D., & Latha Natarajan, M. (2019). E-wallet–a technological revolution in digital India. *International Journal of Innovative Technology & Exploring Engineering*, *8*(11), 3870–3877. https://doi.org/10.35940/ijitee.I8932.0981119

Stavins, J. (2000). Atm fees: Does bank size matter? *New England Economic Review*, *16,* 13–24.

Szymanek, J. (2015). *Achieving unified data quality representation by constraints transformation* [Master's Thesis]. ETH Zürich. https://doi.org/10.3929/ethz-a–010510131

Vishnoi, Y. C., & Bishla, K. (2021). Critical study of unified payment interface (UPI): E-payment mode of the digital revolution. *Academic Social Research*, *7*(4), 16–18.