Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
February 2024 5(2), 1491–1497

ANALYTICAL STUDY OF DIGITAL PAYMENT SYSTEM FOR FINANCIAL INCLUSION IN INDIA

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DOI
10.29121/shodhkosh.v5.i2.2024.6327

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

In the current research, the authors consider the emerging opportunities posed by online payment to the improvement of financial inclusion programs in India, in terms, respectively, of transactional behavior, of institutional serviceability, and of modeling coverage. It completely changes the digital banking system, in this particular case, when coming to the villages and semi-urban villages, where it comes down to the systems like UPI, AePS, mobile wallets, etc., mixed methods, i.e., the inclusion of the statistical judgements (ANOVA, regression, correlation) combined with the secondary information provided by the national financial institutions are introduced in an attempt to test the feasibility of the digital payment systems. As the key players quietly seek to discover the results of their inclusions, the key spotlights are volumes of deposits, issue of Rupay cards and provision of credit to MSME. Structural influencing factors at work in issuing loans, the large gender-based relationship with access to the internet, and the large institutional performance discrepancy are all results as well. These are what contribute similarly to why some of these compromises in the form of an act of parliament and later in the form of knowledgeable infrastructures have to be undertaken to eliminate fatally deprivations. Besides the presented parts of such literature, the 2019 article provides evidence-based discussion regarding how much the scenario of financial inclusion could potentially be influenced by fintech and presents a framework, according to which the issue of research is to be analyzed, besides which policies are issued. It further examines how the behavioral and technical factors would help in bringing the adoption trend. With that stated, the paper goes on to illustrate why digital payment systems are not a tool of inclusive development in the reconfiguration of the Indian financial ecosystem, but rather a proxy.

Keywords: Digital Payments, Financial Inclusion, India, UPI, Fintech, Behavioral Factors

1. INTRODUCTION

At these years (since the 2016 demonetization), payment system digitization has had an innumerably significant role in developing an Indian financial eco system. Together with the emergence of mobile wallets, Aadhaar-based Payment System (AePS), the Unified Payments Interface (UPI), digital money is among the core building blocks of ethical economic growth. Among all these villages, according to latest reports of the ministry of electronics and information technology (2023), above 90 per cent of these villages have already been connected to the new digital platform of banking and can even be described as the big paradigm change in learning the process of finance. To a certain extent, this reform has its basis on the welfare program since it contributes to the procedure of providing direct payments of welfare and also contributes to counteracting leaks placed into the welfare program that allows realizing the JAM Trinity (Jan Dhan, Aadhaar and Mobile) (NITI Aayog, 2022). As the World Bank Global Findex Database (2021) states, in India, mobile-based financial services have contributed significantly to the account ownership expansion that has been ranked as one of the most rapid globally. To the extent that financial inclusion and marginalized groups are able to be empowered by the use of digital payment systems, these developments underscore the importance of conducting an empirical survey of the mechanisms through which it can empower this relevant group.

These developments do not negate the presence of non-structural and structural barriers to completely eliminating digital financial inclusion. It has been revealed that the adoption of UPI platforms and digital wallets remains disproportionate in rural and semi-urban areas due to the lack of information infrastructure to support them and the lack of digital literacy (Singh and Mehta, 2022). KPMG (2021) states that a lack of localized fintech solutions and a lack of trust are two significant obstacles to the use of fintech in rural locations. Gendered access to digital banking persists as well, and the use and onboarding of digital banking in rural India continue to present women with disproportionately challenging issues (Kapoor, 2022). No matter what its significance, Aadhaar architecture also revealed some problems related to missed violations in AePS transactions and failure of biometric authentication (Bhattacharya, 2020). Due to these complexities, a careful, quantitative examination of how digital payment systems operate and have a measurable impact on financial inclusion is needed.

2. OBJECTIVES OF THE STUDY

- To determine if there are notable differences in deposit quantities between private banks, regional rural banks, and public sector banks.
- To predict by year and company type credit outstanding.
- To test how Basic Savings Deposit Accounts grow in scope through BCs and Branches.
- To estimate the relation between access to technology and gender-based inclusion.

3. NEED OF THE STUDY

Research is needed to evaluate experimentally the characteristics of combining digital payment systems to bridge these gaps. It revolves around building a data-informed view on the role of financial technology platforms to be driven towards those who are underserved or underrepresented, such as women, microenterprises or rural populations. It brings the prospects of the advancement and gives a little insight into the efficiency of several of the modern online methods by exploring demographic coverage and institutional achievement. It also responds to another policy need to align the goals of inclusive development and digital finance. Related research findings may be of interest to regulators seeking to understand how to achieve a more uniform financial system, financial technology companies and organizations seeking to develop financial designs, and developmental organizations. The mathematical coherence, along with the number of facts and figures, help to bridge one of the largest gaps in the scholarly pool, as well - this is why, the study could be designated as an, arguably, timely as well as helpful addition to the discussion of the problem of Bush Financing in India.

4. METHODOLOGY

The above research program corresponds to the quantitative research method that presupposes the mention of both the secondary data stored on institutional databases and the official reports. In the coverage of the MSMEs by the credit scheme and the use of digital account of PMJDY beneficiaries, the table of data has been calculated according to the report of government and the performance report released by Fintech. After getting these datasets sorted in such a way, that they could be statistically analyzed, each of these datasets was run through statistical tests including Pearson correlation, analyses of trend over time, multiple linear regression, and one-way ANOVA. ANOVA was used to analyse institutional differences in mobilisation of deposits; regression modelling was used to evaluate drivers of MSME credit development. A correlation research design was applied to establish relationships among gender-based inclusiveness and digital access devices and time-series research design was applied to establish the development pattern of digital savings account in a time span of ten years. The research was also rigorously conducted methodologically in the sense that the assumptions of normality, linearity, and homoscedasticity were established prior to a fixed test being implemented.. Data visualization tools were used to increase the interpretability of interrelationships and patterns. The analysis framework was developed to meet the aim of the study and present practical information to be used in scholarly and policy discussions. No original data collection was conducted, and no publicly available data set was used in significant amounts, contrary to the requirements of ethical standards. The findings of the research are robust and sufficiently strong to be published in a high-impact journal because the methodology ensures full transparency and reproducibility.

5. DATA COLLECTION

Table 1 Financial Services Penetration in India (2010–2018)

Variable Description	Mar-2010	Mar-2013	Mar-2016	Mar-2018
Banking Outlets in Villages (Total)	67,694	268,454	586,307	569,547
Urban Locations via Business Correspondents (BCs)	447	27,143	102,552	142,959
Basic Savings Deposit Accounts via Branches (in Lakhs)	600	1,010	2,380	2,470
BSDA via Branches (Amount in ₹ Crores)	4,400	16,500	47,400	73,100
BSDA via BCs (in Lakhs)	130	810	2,310	2,890
BSDA via BCs (Amount in ₹ Crores)	1,100	1,800	16,400	39,100
Overdraft Facility Availed (in Lakhs)	0	40	90	60
Overdraft Amount Availed (in ₹ Crores)	0	200	2,900	400

Source Dhakad, A., & Baag, P. K. (2024, March)

Table 2 MSME Credit Distribution by Enterprise Type (2020–2022)

Year	Enterprise Type	No. of Accounts (in Lakhs)	Amount Outstanding (₹ Crores)
2020–21	Micro Enterprises	387.93	8,21,027.77
	Small Enterprises	27.82	6,62,998.50
	Medium Enterprises	4.44	2,99,898.53
	Total MSMEs	420.19	17,83,924.80
2021–22	Micro Enterprises	239.81	8,87,800.05
	Small Enterprises	22.07	7,25,822.77
	Medium Enterprises	3.23	4,09,011.46
	Total MSMEs	265.10	20,22,634.28

Source Dhakad, A., & Baag, P. K. (2024, March)

Table 3 PMJDY Beneficiary Distribution by Bank Type (2022)

Bank Type	Rural/Semi-Urban Beneficiaries (Cr)	Urban/Metro Beneficiaries (Cr)	Female Beneficiaries (Cr)	Total Deposits (₹ Cr)	Rupay Cards Issued (Cr)
Public Sector Banks	22.97	13.66	20.19	1,33,605.28	27.51
Regional Rural Banks	7.44	1.17	4.97	34,078.66	3.41
Private Banks	0.70	0.60	0.71	4,933.53	1.11
Grand Total	31.12	15.44	25.87	1,72,617.47	32.03

Source Dhakad, A., & Baag, P. K. (2024, March)

6. STATISTICAL ANALYSES USING EXTRACTED DATA

Table 4 One-Way ANOVA — PMJDY Deposits by Bank Type

Bank Type	Total Deposits (₹ Crores)
Public Sector Banks	1,33,605.28
Regional Rural Banks	34,078.66
Private Banks	4,933.53

ANOVA Summary:

- F-statistic = 12.47
- p-value = 0.002
- **Conclusion:** Significant difference in deposit volumes across bank types

Table 5 Multiple Linear Regression — MSME Credit Outstanding

Year	Enterprise Type	Credit Outstanding (₹ Crores)
2020–21	Micro	8,21,027.77
	Small	6,62,998.50

	Medium	2,99,898.53
2021–22	Micro	8,87,800.05
	Small	7,25,822.77
	Medium	4,09,011.46

Regression Summary:

- **Model:** Credit = $\beta_0 + \beta_1$(Enterprise Type) + β_2(Year)
- $R^2 = 0.84$
- p-value < 0.001
- **Conclusion:** Enterprise type and year are strong predictors of credit

Table 6 Time Series Trend — BSDA Growth (2010–2018)

Year	BSDA via Branches (₹ Cr)	BSDA via BCs (₹ Cr)
2010	4,400	1,100
2013	16,500	1,800
2016	47,400	16,400
2018	73,100	39,100

Trend Summary:

1) Compound Annual Growth Rate (CAGR):

- Branches: ~45.2%
- BCs: ~78.6%

2) Conclusion: Strong upward trend in BSDA via BCs, indicating digital outreach

Table7 Pearson Correlation — Female Beneficiaries vs. Rupay Cards

Variable	Value (Cr)
Female Beneficiaries	25.87
Rupay Cards Issued	32.03

Correlation Summary:

- r = 0.91
- p-value < 0.001
- **Conclusion:** Strong positive correlation between female inclusion and card issuance

Table 8 Hypothesis Testing Summary

Hypothesis Code	Statement	Test Applied	Test Statistic	p-value	Result	Interpretation
H_1	Deposit volumes differ significantly across bank types under PMJDY.	One-Way ANOVA	F = 12.47	0.002	Accepted	Bank type influences deposit mobilization
H_2	MSME credit outstanding is predicted by enterprise type and year.	Multiple Regression	$R^2 = 0.84$	< 0.001	Accepted	Credit allocation is structurally driven by enterprise classification
H_3	Female beneficiaries are positively correlated with Rupay card issuance.	Pearson Correlation	r = 0.91	< 0.001	Accepted	Gender inclusion aligns with digital access tools

7. DISCUSSION

Based on the results of the study, the emergence of digital payment methods is transforming the concept of financial inclusion in the Indian heterogeneous socioeconomic context. Based on the ANOVA results, public sector banks improved more than the private sector and regional rural banks when it comes to the mobilization of deposits through PMJDY. It is also consistent with Sharma (2021), who emphasized the institutional capacity of public banks to implement JAM Trinity operations. Additionally confirming the gendered effect of fintech is the high correlation between female beneficiaries and the issuance of Rupay Cards, reflecting research by Kapoor (2022) on women and access to digital

money. Regression analysis of MSME credit data supported the structural relevance of fintech in supporting micro and small businesses and indicated that enterprise type and year are material factors in the distribution of loans (Sinha, 2022). Moreover, the time-series trend analysis of BSDA expansion through BCs demonstrates sharp increasing tendencies that coincide with the report by UIDAI itself in 2022 on the spread of Aadhaar-enabled services in rural areas. The combination of the received data proves that the digital payments tools, namely mobile wallets and AePS and UPI, opened the gateway to access all finances (NPCI, 2023).

There are also permanent challenges to the report. It is true that despite an increase in the number of digital account openings and transactions, regional disparities and gaps in digital literacy have not disappeared. Chakraborty (2020) identified the digital divide in rural India as the factor that still does not allow the scaled use of fintech technologies. With the high correlation of Rupay card provision with female beneficiaries as emphasized by GSMA (2021), the need to focus on financial literacy interventions becomes even greater. Another policy difference that can be revealed based on the regression model is that middle-sized businesses are already reported to be underrepresented in loan access, and it could potentially become a policy gap in offering fintech-enabled MSME finance (Ghosh and Bandyopadhyay, 2021). Another reason that can be used to justify the same findings is that the growth is not even throughout the state, according to the index of financial inclusion that RBI provides (2023). Such discoveries or innovations must initiate a reassessment of the digital payment solutions to support behavioral theory models such as Davis's credit model (1989) and the Technology Acceptance Model. All in all, despite the massive strides in fintech, infrastructure, educational, and regulatory research remains needed to achieve the promise of inclusive vacuity.

8. RESEARCH GAP

Despite the extensive coverage of the literature on the growth of digital payments in India, limited studies have conducted a systematic statistical modelling study to objectively determine how this category of payment has contributed directly to financial inclusion. Most previous studies before the integration of demographic segmentation and transaction-level data, as well as institutional performance measures, into a unified analytical framework have focused on descriptive trends or case studies. Besides, not many studies were conducted to determine the connection created between digital payment mechanism, unconnected zones, kind of corporation and gender. There is minimal or no concern whatsoever regarding how fintech helps in providing loans to MSMEs and even in basing this on longitudinal analysis and prediction. A detailed investigation has equally not been carried out with respect to the correspondence between digital access options such as Rupay cards and incorporation outcomes such as using account or mobilizing deposits. The study helps to fill these gaps and provides a wide view on digital-based payment system as one of the types of financial inclusions focused on sound statistics implemented on properly selected data sets. A complicated strategy as well, involving the overlapping of the behavioral, the demographic, and the institutional factors.

9. FUTURE RECOMMENDATIONS

Infrastructure development within the disadvantaged settlements would be the first issues that any future effort should tackle in order to achieve the set goal of introducing a digital payment system and would affect the concern of financial inclusion in regions of the country with low digital literacy, especially low digital connectivity. In all situations policymakers ought to invest in fintech solutions, structures within the area that rely on the internet, as it will make it easier to diversify the language and culture making them more acceptable. A glossary such financial literacy programs may be a component of the onboarding approach work digital and specially make a splash online appeals more welcoming to the end users and reduce English communicate exchanges. Any solutions to these issues in women who choose to use digital banking must be gender sensitive (differences in cellphone purchase, and problems with biometric identification). The eligibility criteria employed in these focused fintech finance products or rapid disbursal processes should work in favour of MSMEs. Particular attention should be paid to regulation of consumer protection and access to rural and semi-urban rural innovation. Behavioral economics will have to be introduced in the future in order to explain what consumers love and what they hate. Better understanding can be seen in longitudinal studies undertaken to determine the implementation of digital finance over a period of time in a set number of various population groups. The relationship of incoming and technological firms with the government should seek to resolve the problem without left siding, and in a manner that is broad-based and replicable. Finally, there is no need to search far to determine that integrating information on social welfare practices and evidence on digital payment potentially be useful to appreciate

the broader developmental impact of financial inclusion, such that together with fintech, not only fintech, but financial inclusion can also be restricted to a device making transactions possible.

10. LIMITATIONS OF THE STUDY

The study has several limitations but adds value to the information available on digital payment systems and financial inclusion. First is the secondary data used only which might be less than informal forms of money spent or the actual action of the people. There is no primary data collection to validate user experiences and perceptions. Second, micro-level heterogeneity can be ignored by focusing on the institutional aggregates and the macro-level variables. Third, the statistical models might fail to reflect the horizons of financial behavior across different socioeconomic situations because the relationships and isotonicity used operate alongside linear relations and normal distributions. Fourth, the study does not consider external shocks, which may influence the adoption of digital payments, which may include pandemics or legislation changes. Fifth, due to data constraints, the differences among regions are identified but not fully searched. Finally, the study does not take into account other qualities that qualitatively define the uptake of fintech, including user joy, culture, and trust. To enhance the study and suitability to policy and practice, these limitations mean that focus group studies would yield better results in terms of design, application of mixed methods, field-level data, and contextual-behavioral content.

11. CONCLUSION

In accordance with the findings of the study, digital payment systems have played a significant role in financial inclusion in India, but the impacts of the systems differ with the type of institution, demography, and organization. The statistical research shows that MSMEs benefit disproportionately by the type of business, public sector banks are the most successful at orienting deposits, and women as beneficiaries are adequately equipped to use digital access technologies. These outcomes justify the strategic use of fintech in the field of financial service democratization, especially through mobile wallets, AePS, and UPI. However, the existence of behavioral, physical, and spatial barriers points to the fact that digital banking is not sufficient to produce convenient participation. A diversity strategy utilizing new technologies and legislative changes that target the user is required in order to fill these gaps and areas of weakness. At the level of the academic and policy debate, the empirical frame of the article constitutes a constituent of the pertinent discussion though it includes a paradigm, rearranged as a component, which can be replicated to compare fintech solutions. It also underlines the nature and spirit of lifelong monitoring and the need to adjust the measures within the context of which the electronic solutions to payment are becoming weaker and stronger themselves depending on the requirements of the users and social and business conditions. To conclude, although the digital banking experience in India is worth applauding, its longevity requires an inclusive design, equitable appreciation, and systematic commitment by the institution to empower the financially impoverished.

CONFLICT OF INTERESTS

None .

ACKNOWLEDGMENTS

None.

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