EXPLORING UPI'S IMPACT ON CREDIT GROWTH IN RURAL INDIA: A PANEL DATA ANALYSIS (2011–2023)

A Thesis Submitted

In Partial Fulfilment of the Requirements for the Degree of

MASTER OF ARTS

in

ECONOMICS

by

Alisha Bharti

(Roll No. 2k23/MAE/02)

Under the Supervision of

Dr. Manisha G. Singh

University School of Management and Entrepreneurship

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Main Bhawan Road, Delhi – 110042. India

May, 2025

ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to everyone who supported me throughout this research journey.

First and foremost, I am deeply grateful to my mentor, **Dr. Manisha G. Singh** whose patience, encouragement, and scholarly insight have been instrumental in shaping both this research and my academic growth. Her guidance has not only enriched my understanding of the subject but also inspired me to explore ideas with greater depth and clarity.

I would also like to sincerely thank my co-learners and classmates, whose camaraderie, thoughtful discussions, and shared commitment to learning made this journey intellectually stimulating and personally fulfilling. The support, feedback, and collaborative spirit I received from my peers have greatly enhanced the quality of my academic experience.

To my family and friends, thank you for your unwavering belief in me, for your understanding during long periods of focus and stress, and for being my constant source of strength and motivation.

This dissertation is a reflection of many minds, hearts, and hands that have shaped it along the way. I remain sincerely thankful to each of you.

Finally, I offer my deepest thanks to the Almighty for the strength, clarity, and perseverance granted to me throughout this endeavour.

Alisha Bharti

23/MAE/02

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Main Bhawan Road, Delhi – 110042, India

CANDIDATE's DECLARATION

I **ALISHA BHARTI** hereby certify that the work which is being presented in the thesis entitled "**Exploring UPI's Impact on Credit Growth in Rural India: A Panel Data Analysis (2011-2023)**" in partial fulfilment of the requirements for the award of the Degree of Masters of Arts, submitted in the Department of UNIVERSITY SCHOOL OF MANAGEMENT AND ENTREPRENEURSHIP, Delhi Technological University is an authentic record of my own work carried out during the period from AUGUST 2024 To MAY 2025 under the supervision of **Dr. Manisha G. Singh**.

The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other Institute.

Alisha Bharti

Candidate's Signature

This is to certify that the student has incorporated all the corrections suggested by the examiners in the thesis and the statement made by the candidate is correct to the best of our knowledge.

manisha singh

Signature of the Supervisor **Signature of External Examiner**

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Main Bhawan Road, Delhi – 110042, India

CERTIFICATE BY THE SUPERVISOR

Certified that ALISHA BHARTI (Enrollment No. 23/MAE/02) has carried out her research work presented in this thesis entitled **'Exploring UPI's Impact on Credit Growth in Rural India: A Panel Data Analysis (2011-2023)**' for award of Master of Arts from the department of University School of Management and Entrepreneurship, Delhi Technological University, Delhi, under my supervision. The thesis embodies results of original work, and studies are carried out by the student herself and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

manisha singh

Signature
(Dr. Manisha G. Singh)

(University School of Management and Entrepreneurship,
East Delhi Campus, Delhi Technological University)

Exploring UPI's Impact on Credit Growth in Rural India: A Panel Data Analysis (2011–2023)

Alisha Bharti

Abstract

This dissertation investigates the impact of digital financial infrastructure—specifically the Unified Payments Interface (UPI) on credit growth across Indian states, with a particular focus on rural regions. Launched in 2016, UPI has transformed India's digital payment landscape, but its implications for formal credit expansion remain underexplored, especially in demographically and economically diverse rural areas.

Using a panel dataset covering major Indian states from 2011 to 2023, this study employs a fixed-effects regression model to examine the relationship between UPI adoption and the level of credit outstanding.

The findings indicate a nuanced relationship between digital payments and credit flows. While the average impact of UPI (captured through a post-2016 dummy variable) on credit growth is positive, it is not statistically significant suggesting that the overall national shift to UPI may mask substantial heterogeneity across regions. However, when focusing on states with a higher proportion of rural population and significant UPI transaction volumes, a positive significant association is observed, implying that digital payment infrastructure has facilitated greater credit expansion in rural settings. This finding supports the hypothesis that UPI may play a more catalytic role in areas traditionally underserved by formal banking systems.

The temporal analysis reveals a strong upward trend in credit outstanding before 2016, followed by stagnation and decline in subsequent years, despite the proliferation of UPI. This pattern may reflect broader structural disruptions, including the shock of demonetization in 2016, the credit crunch among non-banking financial companies (NBFCs) in 2018, and the economic upheaval caused by the COVID-19 pandemic in 2020–21.

This study contributes to the growing literature on digital financial inclusion by highlighting the evolving role of UPI not just in facilitating transactions, but in potentially enabling access to formal credit. The findings emphasize the need for policymakers to consider regional disparities and rural dynamics when designing credit and digital inclusion policies. Future research could benefit from more disaggregated data, particularly at the district or block level, to assess the micro-level impacts of digital finance on rural credit access and to refine policy interventions accordingly.

Keywords: Digital Finance, Credit Outstanding, UPI Transactions, Rural Financial Inclusion, State Panel Data, India.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Full Form
UPI	Unified Payments Interface
GDP	Gross Domestic Product
NBFC	Non-Banking Financial Company
RBI	Reserve Bank of India
NPCI	National Payments Corporation of India
KCC	Kisan Credit Card
ATM	Automated Teller Machine
ICT	Information and Communication Technology
SHG	Self-Help Group
FI	Financial Inclusion
FY	Financial Year
PSU	Public Sector Undertaking
QR Code	Quick Response Code
IMPS	Immediate Payment Service
NEFT	National Electronic Funds Transfer
RTGS	Real Time Gross Settlement
DFS	Digital Financial Services
COVID-19	Coronavirus Disease 2019
PSBs	Public Sector Banks
RRBs	Regional Rural Banks

CHAPTER 1

INTRODUCTION

1.1 Background and Context

India's financial ecosystem has undergone a transformative shift over the last decade, marked by the twin thrusts of financial inclusion and digital innovation. At the core of this shift is the sequential rollout of landmark public initiatives beginning with the Pradhan Mantri Jan Dhan Yojana (PMJDY) in 2014, followed by the Unified Payments Interface (UPI) in 2016. Together, these instruments have established a broad-based foundation for digital financial access.

Table 1.1: Number of Accounts Opened under PMJDY by Bank Type and Region (2015 - 2024)

Number of Accounts opened under PMJDY (All figures in Crore)						
Bank Type	**Rural**		**Urban**		**Accounts**	
	31/01/2015	18/09/2024	31/01/2015	18/09/2024	31/01/2015	18/09/2024
Public Sector Banks	5.33	26.17	4.51	15.54	9.84	41.71
Regional Rural Banks	1.85	8.56	0.33	1.43	2.17	9.99
Private Sector Banks	0.32	0.73	0.20	0.91	0.53	1.64
Grand Total	**7.50**	**35.46**	**5.04**	**17.88**	**12.54**	**53.34**

Source: pradhan mantri jan-dhan yojana | department of financial services | ministry of finance (pmjdy.gov.in)

The Pradhan Mantri Jan Dhan Yojana (PMJDY) has drastically expanded formal financial access, especially in rural India. The number of accounts opened under PMJDY has increased from 12.54 crore to 53.34 crore by September 2024. Notably, rural account ownership saw the sharpest rise— from 7.50 crore to 35.46 crore— demonstrating a focused effort to bring financially excluded populations into the banking fold. PSBs and RRBs

played a dominant role in this rural outreach. This mass financial inclusion effort laid the groundwork for digital innovation, as these newly banked individuals became potential users of UPI and other financial tools.

As illustrated in the graph below, UPI transactions grew from nearly negligible levels in 2016 to over 20 billion transactions in volume and ₹14 lakh crore in value by early 2024. This dramatic rise demonstrates both increased user trust in digital platforms and the deepening integration of UPI into everyday financial activities.

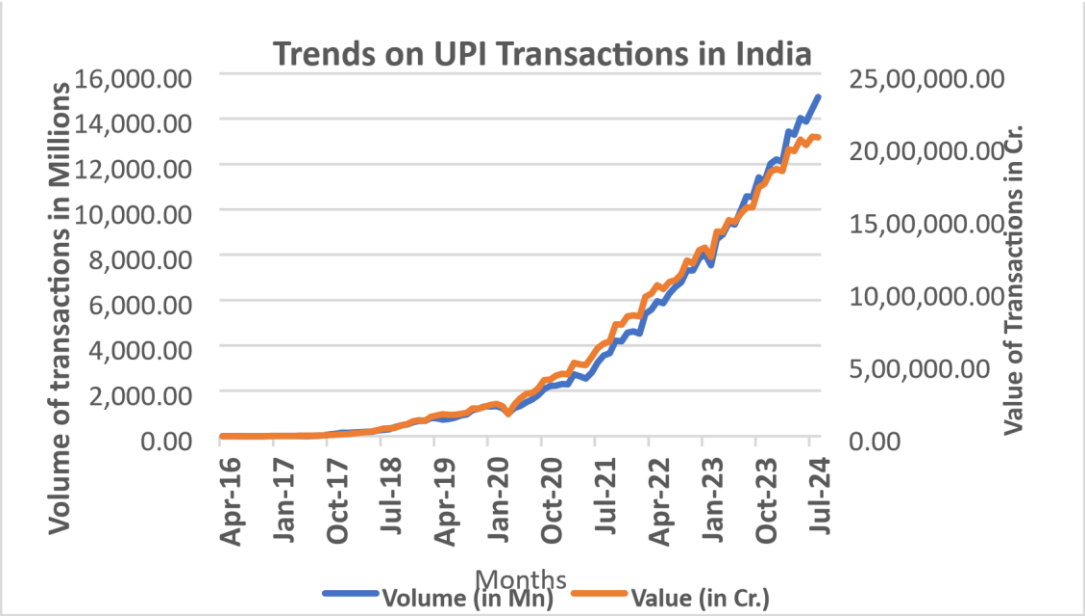

Figure 1.1: Trends in UPI Transactions in India (April 2016 – July 2024)
Source: Unified Payments Interface (UPI) Product Statistics NPCI

This trajectory not only signifies a shift toward digital payments but also raises critical questions about UPI's role in enabling other aspects of financial inclusion, especially credit. While UPI's utility as a payment platform is now well established, its potential role as an enabler of credit access remains less explored. The digital trails generated through UPI usage—especially among rural and first-time users—may help bridge the traditional 'information gap' that often excludes such populations from formal lending channels. Moreover, in a context where physical banking infrastructure remains unevenly distributed, particularly in rural India, digital interfaces like UPI offer an alternative route to engage with financial services.

While the impact of UPI on increasing digital payment volumes and financial inclusion has been widely documented, less is known about its deeper economic consequences, particularly its role in expanding credit access.

This research seeks to investigate the extent to which UPI adoption has influenced credit growth across Indian states, with a special focus on rural areas.

Using panel data from 2011 to 2023, this study employed a fixed effects regression framework to analyse the relationship between UPI transaction volume and the volume of credit outstanding. The analysis controls for economic size (Gross State Domestic Product), interest rates, and year-specific national shocks Like- demonetisation and the COVID19 pandemic.

By highlighting on the link between digital payment infrastructure and formal credit expansion, this study contributes to the ongoing dialogue on financial inclusion and rural development. It also aims to inform policymakers and financial institutions about the potential of digital platforms like UPI to serve as enablers of inclusive credit growth, beyond their primary role as payment facilitators.

1.2 Study Rationale

While UPI has effectively boosted digital payment adoption and financial inclusion, its potential impact on formal credit expansion has not been adequately studied. In particular, it remains unclear whether digital payment infrastructure such as UPI can meaningfully contribute to credit growth, especially in rural states where traditional banking avenues remain limited.

1.3 Research Objectives

- To examine the relationship between UPI adoption and credit outstanding across Indian states.
- To analyze whether rural states with higher UPI penetration experience greater credit growth.

1.4 Hypotheses

- H1: States experienced an increase in credit outstanding following the introduction of UPI.

- H2: Rural states with higher UPI penetration experienced stronger credit growth.

1.5 Significance of the Study

This study contributes to the evolving discourse on financial inclusion by highlighting the potential of digital platforms like UPI to drive formal credit expansion. By analysing state-level panel data from 2011 to 2023 using a fixed effects regression model, the research provides empirical evidence on how digital payment systems intersect with credit flows in a developing and diverse economy. The findings are expected to inform the policymakers, financial institutions, and development practitioners about the fine role of digital infrastructure in supporting inclusive financial growth, particularly in underserved rural regions.

Ultimately, this research seeks to highlight on the transformative potential of UPI beyond its payment facilitation role, positioning it as a catalyst for inclusive credit access and rural economic development.

CHAPTER – 2

LITERATURE REVIEW

The advent of digital financial infrastructure in India, particularly the Unified Payments Interface (UPI), has attracted considerable academic interest. A evolving body of literature has attempted to analyze the implications of UPI on various dimensions of financial development, ranging from payment efficiency to financial inclusion and economic empowerment. However, fewer studies have directly investigated its role in credit growth, especially in rural and underserved regions.

2.1 UPI and Financial Inclusion: Setting the Stage

Much of the early research on UPI focuses on how it has helped in bringing people into the financial system what we call *financial inclusion*. For example, **Kulkarni, Justin, and Bhatta (2024)** highlight how UPI was designed as a tool to connect financially excluded individuals to formal banking services. They point to the surge in digital transactions as evidence that more people are participating in the financial system. However, while their work documents greater access and usage, it doesn't explore how UPI has affected borrowing or lending patterns the core focus of this dissertation.

Similarly, Mukherjee and Banerjee (2022), in their study titled *"Importance of UPI in Socio-Economic Transformation,"* discuss the broader economic benefits of UPI, especially in semi-urban and rural areas. They link higher UPI adoption to increased economic activity and participation, but once again, credit outcomes remain outside their scope.

In short, these studies help paint a picture of UPI as a major step forward in digital inclusion. But they stop short of telling us whether UPI has actually helped people especially in rural areas to access formal credit.

2.2 Digital Infrastructure and Its Role in Credit Growth

A growing number of scholars have begun exploring the link between digital tools and credit delivery. **Agarwal (2022)** looks at how digital banking in general including mobile and internet banking—has helped banks expand credit. The study finds a positive trend but treats UPI as just one piece of a much larger puzzle. As a result, we're still left wondering what role UPI itself might be playing when it comes to credit growth.

Rastogi et al. (2021) add an interesting behavioural perspective. They argue that frequent use of UPI changes how people interact with digital finance it builds familiarity and trust. That comfort, in theory, could nudge people toward more formal financial behaviours like borrowing. But their study stops short of proving that these digital habits actually lead to more loans being taken or credit being accessed.

Sinharay (2024) explores how UPI and the Business Correspondent (BC) model work together in rural areas to improve access. This combined approach clearly makes financial services more available, but the study focuses more on reach than on results. We still don't know how this increased access affects credit usage.

A more holistic view comes from **Mahesh and Bhat (2021)**, who examine how UPI fits into India's larger digital payment ecosystem. They correctly point out that in rural areas, UPI could help solve the problem of invisibility people with no formal credit history suddenly have data trails through digital transactions. But while their argument is promising, they don't test it empirically.

Together, these studies suggest that **digital tools can support credit growth**, but there is still a lack of clear, quantitative evidence specifically connecting UPI to increased lending or borrowing especially in rural settings.

2.3 UPI in Rural Areas: Early Clues and Untapped Potential

Some recent studies are beginning to fill this gap by looking at UPI's reach in rural India. One such example is the work by **Divi, Minampati, and Kumar (2023)**, which finds that **increased digital transaction activity in rural areas is linked to deeper financial engagement**. While they do not

directly measure lending, their results support the idea that UPI might help build the kind of financial profiles that lenders need to make credit decisions.

Building on this idea, **Modwel and Trivedi (2024)** argue that UPI could play a major role in credit scoring, especially for people with no formal borrowing history. They suggest that transaction data from UPI could serve as a kind of "digital signature" for financial behaviour something lenders could use to assess risk. It's a compelling idea, but still theoretical; their study doesn't actually measure credit outcomes.

Across the surveyed literature, a consistent theme emerges: **UPI is changing the way people participate in the financial system**, especially in rural India. It is acknowledged as a transformative platform for digital financial inclusion. However, there is a conspicuous gap in studies that quantitatively assess UPI's direct influence on credit expansion, especially using rigorous econometric techniques and panel data. The literature has yet to fully explore the direct impact of UPI quick adoption on credit growth, especially at a macro level across rural India. Most studies emphasize digital payments and inclusion without quantitatively linking UPI usage to credit expansion. This research attempts to fill this gap by analysing panel data across states, focusing on rural penetration of UPI and credit outcomes.

This dissertation steps in to fill that gap.

Instead of looking only at how many people are using UPI or where it has reached, this study digs deeper it asks whether **UPI is helping people in rural areas actually get more access to credit**. Using panel data from Indian states over more than a decade (2011–2023), this research examines how credit outcomes change in relation to UPI adoption, especially in regions with large rural populations.

By focusing not just on digital access but on **credit behaviour**, and by using robust statistical tools to isolate UPI's effects, this study brings a fresh perspective to the literature. It builds on the idea that UPI can be more than a convenience it can be a **pathway to opportunity**, especially for people who have historically been left out of formal financial system.

CHAPTER- 3

THEORETICAL FRAMEWORK AND APPLIED METHODOLOGY

The chapter outlines the conceptual logic and empirical design that guide the study. It presents the theoretical pathways linking digital financial infrastructure to credit growth in rural India, followed by a detailed explanation of the data sources, variables, and the econometric approach adopted for the analysis.

3.1 Theoretical Foundations: Understanding the Digital-Credit Nexus

The emergence of digital payment systems in India has redefined how financial services are accessed, especially in rural areas. The Unified Payments Interface (UPI), launched in 2016, has not only enabled seamless, real-time transactions but also created the possibility of alternative pathways to formal credit— particularly for populations that remain excluded from traditional financial networks. While UPI's contribution to digital payment efficiency and financial inclusion has been widely acknowledged, its role in facilitating formal credit access—especially in rural and underserved areas—is now gaining attention in academic literature.

3.1.1 Digital Platforms as Enablers of Financial Inclusion and Credit Access

In many rural parts of India, formal credit markets continue to face persistent structural barriers. These include limited access to bank branches, a lack of financial documentation among borrowers, and deeply rooted dependence on informal credit sources. UPI, however, offers a scalable digital solution that addresses many of these issues.

The most significant contribution of UPI lies in the creation of traceable, lowcost transaction data. Each digital payment made through UPI forms part of a data trail that reflects a user’s financial behaviour—ranging from income patterns to repayment reliability. While this information may not be captured by traditional credit bureaus, it holds immense value for lenders seeking to build alternative credit scoring models. As

Mahesh and Bhat (2021) argue, UPI transaction histories "bridge lender–borrower information gaps in rural markets," providing a data-driven foundation for credit assessment, particularly in cases where formal financial records are absent.

Additionally, Mahesh and Bhat (2021) suggest that the simplicity and accessibility of UPI lower entry barriers to the formal financial system. By allowing users to transact digitally through mobile phones—often without needing to visit a bank—UPI reduces both logistical and psychological frictions. This is especially transformative for women, daily wage earners, and informal workers, for whom time, mobility, and documentation are often major constraints.

These digital footprints also foster institutional confidence. As more users participate in the digital economy, financial institutions gain access to behavioural signals that allow for better targeting, segmentation, and underwriting. **Modwel and Trivedi (2024)** describe UPI as a "potential backbone of formal credit scoring for new-to-credit populations," emphasizing that this democratized data can reduce reliance on conventional collateral and documentation.

In this sense, UPI functions not only as a payment gateway but also as an onramp to deeper financial engagement—one that begins with transactions and may eventually culminate in access to savings, insurance, and credit.

3.1.2 Rural Credit Markets and the Promise of Digitization

Rural credit markets in India are characterized by historically low levels of formal borrowing. Factors such as geographic isolation, fluctuating incomes, and lack of digital or financial literacy have made it difficult for rural populations to integrate into mainstream credit channels. Formal institutions, in turn, have often been reluctant to lend in such contexts due to high operating costs and risk.

Digital payment systems like UPI offers an alternative path. By making financial transactions possible without the need for physical infrastructure, UPI significantly reduces the costs of financial intermediation. Even more critically, it expands the reach of financial institutions into remote areas where building a branch network may not be economically viable.

Sinharay (2024) emphasizes the powerful synergy between UPI and the Business Correspondent (BC) model. Together, they form a hybrid system that combines human outreach with digital efficiency. The BC acts as the

access point, while UPI enables secure, real-time payments. This model has allowed financial services to penetrate deeper into rural India than ever before, creating the conditions necessary for a more inclusive credit system.

Over time, consistent UPI use can generate valuable behavioural data that banks and NBFCs can use to design customized credit products. These may include short-term working capital for farmers, microloans for women entrepreneurs, or emergency credit for informal workers. The ability to tailor credit to actual usage and needs makes digital infrastructure a practical enabler of rural economic resilience.

In sum, UPI helps overcome long-standing challenges of distance, cost, and risk in rural lending—laying the groundwork for sustainable, scalable credit delivery.

3.1.3 Hypothesized Relationship: UPI and Credit Growth

Drawing on the above theoretical insights, this research posits that greater adoption and intensity of UPI usage—particularly in rural-dominant states—will be positively associated with formal credit growth.

The proposed relationship is driven by two main mechanisms:

1. **Enhanced Visibility of Borrower Behaviour**:
   UPI generates digital transaction data that can be used to assess a user's financial behaviour. This is especially valuable in rural contexts, where traditional credit histories are often unavailable. As **Agarwal (2022)** notes, digital innovations "enable banks to expand credit outreach through technology-driven models." UPI, by producing continuous and interpretable data, enables precisely this kind of expansion.
2. **Rising Digital Engagement as a Signal of Economic Activity**: Increased use of UPI may also reflect greater economic participation. **Rastogi et al. (2021)** describe UPI as a "behavioural shift agent," showing that users who engage with digital payments are more likely to develop trust in financial systems and transition to other formal products, including credit.

However, this relationship is unlikely to be uniform across all states. The strength and nature of the UPI–credit linkage will depend on multiple contextual factors: the extent of rural connectivity, the maturity of financial

institutions, the presence of BC networks, and complementary policies supporting digital and financial literacy.

By incorporating both conceptual logic and emerging empirical evidence, this paper aims to provide a rigorous assessment of how UPI adoption interacts with credit dynamics at the state level—particularly in regions where access to formal finance remains a critical challenge.

3.2 Research Design and Methodological Approach

To empirically examine the relationship between UPI adoption intensity and credit growth in rural India, the study adopts a panel data approach covering Indian states over the period 2011–2023. This allows for a dynamic and comparative assessment across both time and geography.

3.2.1 Data Sources and Variable Definitions

The analysis uses an annual state-level panel dataset constructed from multiple publicly available sources:

- **Credit Outstanding (ln_credit)**: The primary dependent variable is the total credit outstanding per state, measured in ₹ Crores and logtransformed to smoothen fluctuations and enable elasticity-based interpretation.
- **UPI Adoption (upi_dummy)**: A binary variable is created to represent the post-UPI period, with values of 1 assigned from 2016 onward—the year UPI was launched—and 0 prior to that.
- **Rural UPI Intensity (rural_upi)**: To approximate digital financial activity in rural areas, a composite proxy is used. This combines the proportion of the state's rural population with wireless subscriber data to estimate rural digital engagement. The natural logarithm is taken to maintain consistency with the model's specification.
- **Gross State Domestic Product (ln_gsdp)**: GSDP data, reflecting statelevel economic activity, is included in logarithmic form to control for the broader size and performance of the state economy.
- **Weighted Average Lending Rate (walr)**: This variable captures the average cost of borrowing in each state. Interest rate levels affect both the demand for credit and the willingness of institutions to lend.
- **Year Dummies**: To account for national-level shocks—such as demonetization (2016), the NBFC liquidity crisis (2018), and the COVID-19 pandemic (2020–21)—dummy variables are introduced for each year. These helps isolate the impact of such events from the core relationship under study.

3.2.2 Rationale for Using Panel Data and Fixed Effects

The use of panel data is appropriate for this study, as it has allowed for a more nuanced understanding of how digital infrastructure, specifically UPI, influences credit growth over time across Indian states. Panel data consists of both cross-sectional and timeseries dimensions, making it well-suited to isolate the effects of policy interventions like UPI adoption in a heterogeneous and temporally dynamic environment.

In the Indian context, each state differs significantly in terms of economic development, institutional quality, banking penetration, governance capacity, and even cultural attitudes toward credit. These state-specific characteristics may exert a significant influence on credit growth but often remain unobserved or unmeasurable. A fixed effects model helps control for such unobserved, time invariant heterogeneity by focusing on within-state changes over time rather than between-state differences.

By using fixed effects, the model effectively accounts for all state-level factors that do not vary over time—such as historical financial infrastructure, baseline trust in banking institutions, or regulatory nuances—thereby improving the internal validity of the analysis. This approach is particularly important for evaluating the impact of time varying variables like UPI penetration, which may unfold differently in each state depending on their starting conditions.

3.2.3 Model Specification and Estimation Strategy

The empirical models estimated in this study takes the following form:

$$\textbf{(ln\_credit) Yit} = \textbf{ai} + \textbf{B1}_{\textbf{it}}\ \textbf{(UPI\_dummy)} + \textbf{B2it Rural} + \textbf{B3}_{\textbf{it}}\ \textbf{ln(rural\_upi)} + \textbf{B4}_{\textbf{it}}\ \textbf{ln(GSDP)} + \textbf{B4}_{\textbf{it}}\ \textbf{(WALR)} + + \textbf{Errors} \quad (3.1)$$

This is the baseline fixed effects model, which controls for unobserved heterogeneity across states (via state fixed effects) but does not account for timespecific macroeconomic shocks. The model assesses the average impact of UPI introduction (upi_dummy) and rural UPI intensity (rural_upi) on state-level credit outstanding (ln_credit), alongside key economic controls like GSDP and lending interest rates.

However, not controlling for year specific macroeconomic shocks may cause omitted variable bias if national-level events (e.g., demonetization,

COVID-19) affected credit across all states similarly, but are not explicitly captured.

$$\textbf{(ln\_credit) Yit} = \textbf{ai} + \textbf{B1}_{it}\textbf{ (UPI\_dummy)} + \textbf{B2it Rural} + \textbf{B3}_{it}\textbf{ ln(rural\_upi)} + \textbf{B4}_{it}\textbf{ ln(GSDP)} + \textbf{B4}_{it}\textbf{ (WALR)} + \sum \textbf{Year dummies (2012-2021)} + \textbf{Errors} \quad (3.2)$$

This is the main model specification—a fixed effects model that include state fixed effects and control for year specific macroeconomic shocks (∑ Year Dummies). This model offers a more precise estimation of the relationship between UPI-related variables and credit outcomes.

The inclusion of year dummies help isolate the true impact of UPI from nationallevel policy events or economic disruptions (like demonetization in 2016 or the pandemic in 2020–21), making this the preferred and more robust specification for drawing causal inferences.

where:

- i indexes' states, t indexes years.
- αi captures state fixed effects.
- Ei is the error term.
- Year dummies capture common shocks affecting all states.

Robust standard errors are clustered at the state level to account for possible heteroskedasticity and serial correlation, which are common in macro panel datasets. The log-log form of the dependent and some independent variables also facilitates the interpretation of coefficients as elasticities, aiding comparative insights across diverse states.

3.2.4 Limitations in Data and Estimation

Despite the strengths of the panel approach, certain limitations should be acknowledged. While this dataset offers a comprehensive view, several limitations exist. Credit data used in this study is aggregated at the state level and does not disaggregate credit by purpose—such as consumption, agriculture, microenterprise, or housing. This aggregation may obscure sector-specific dynamics and limit the ability to differentiate between

productive and nonproductive credit flows, which often respond differently to economic and digital stimuli.

The measurement of rural UPI intensity is based on a proxy that combines the percentage of rural population with wireless subscriber data. While this approach offers a reasonable approximation in the absence of granular UPI transaction data by region, it may introduce measurement error. The unavailability of direct rural-level transaction data from NPCI remains a constraint on precision.

The study focuses on state-level dynamics, which may mask intra-state disparities. Rural districts within a high-performing state could be underserved, while some regions in lagging states may show localized successes. Future work using district- or block-level data would enhance spatial resolution.

Lastly, while fixed effects address time-invariant unobservable, they cannot control for all time-varying omitted variables that may influence credit trends, such as sudden policy shifts, natural disasters, or targeted welfare programs. Nonetheless, the inclusion of year dummies and robust controls helps mitigate these risks.

CHAPTER- 4

DESCRIPTIVE STATISTICS AND TRENDS

4.1 Summary Statistics

Before delving into regression analysis, it is important to understand the nature of the dataset and the distribution of key variables. The summary statistics below highlight patterns across 18 Indian states from 2011 to 2023. The mean of the log of credit outstanding (ln_credit) reflects a substantial range across states, with some exhibiting significantly higher formal credit penetration. Similarly, GSDP figures show strong disparities in economic size.

Key Variables (2011–2023, N = 234):

Table 4.1: Summary Statistics of Key Variables (2011–2023)

Variable	Mean	Std. Dev.	Minimum	Maximum
Ln_Credit	12.07	1.12	9.52	14.43
UPI_Dummy	0.53	0.49	0	1
Rural_upi_	0.33	0.34	0	0.89
Ln_gsdp	17.69	0.77	15.79	19.30
walr	10.75	1.15	4	8

4.2 Trends in Credit Outstanding (2011–2023)

A close examination of state-level credit data for the years 2011, 2017, and 2022 brings to light a consistent and persistent pattern of regional disparity in access to formal credit, which forms the primary motivation for this study.

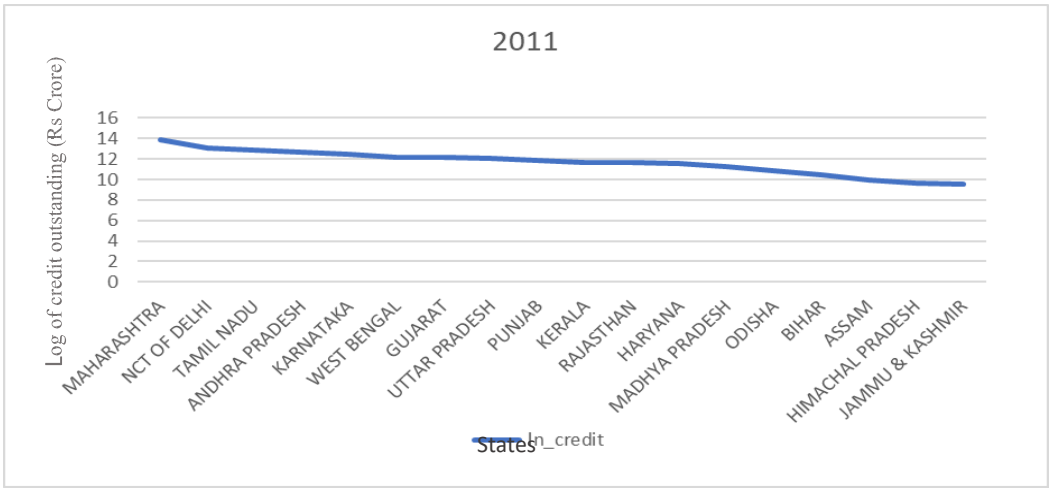

Figure 4.1: Credit outstanding across states of India (2011)
Source: https://data.rbi.org.in

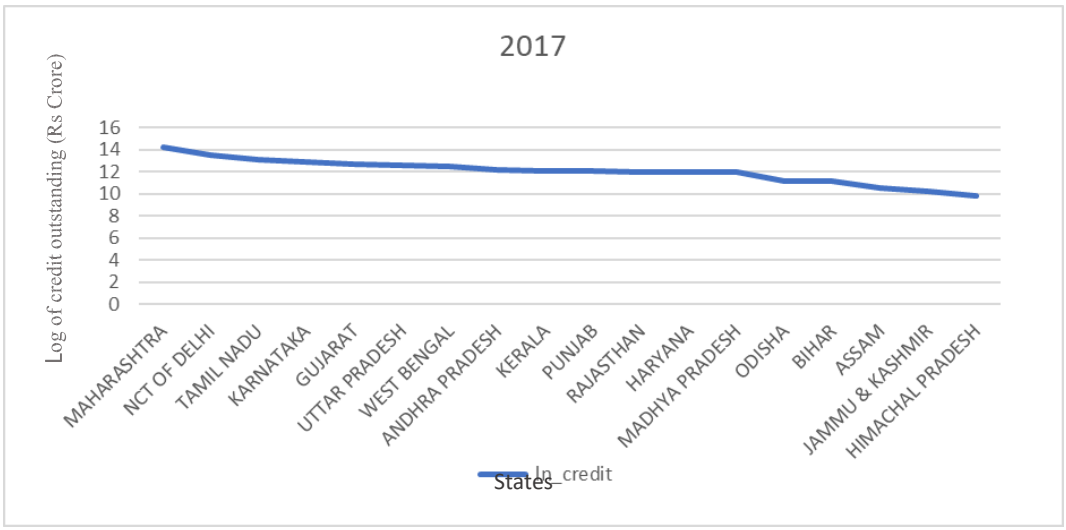

Figure 4.2: Credit outstanding across states of India (2017) Source: https://data.rbi.org.in

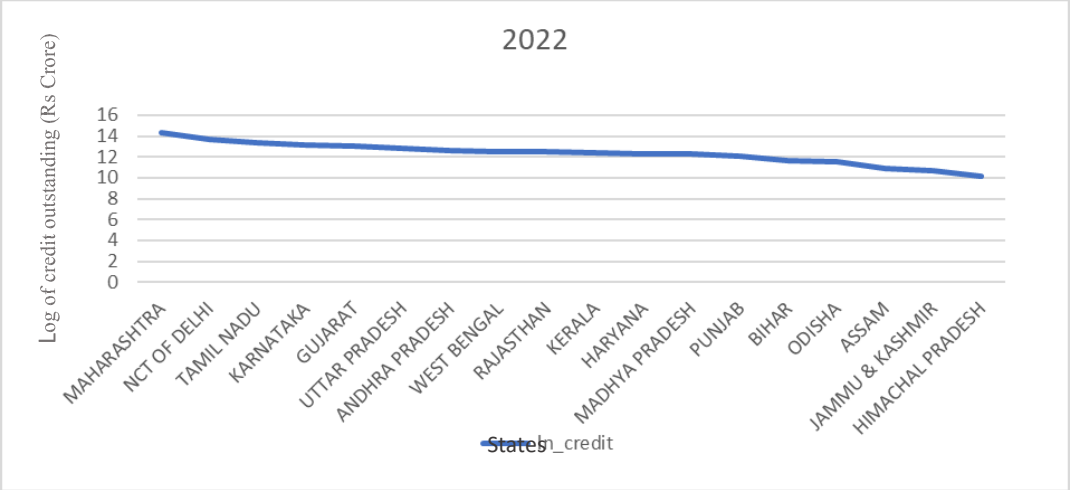

Figure 4.3: Credit outstanding across states of India (2022)

Source: https://data.rbi.org.in

Despite the overall expansion of India's financial sector, the top-performing states— such as Maharashtra, the National Capital Territory of Delhi, and Tamil Nadu—have maintained their dominance in terms of credit volumes across all three observed years. These states continue to benefit from urban agglomeration, higher income levels, greater institutional presence, and advanced financial infrastructure. The position of these states at the top of the credit distribution curve has remained virtually unchallenged, suggesting a concentration of credit in already developed regions.

In stark contrast, states such as Bihar, Assam, Odisha, Himachal Pradesh, and Jammu & Kashmir have consistently remained at the bottom of the credit distribution hierarchy. These lagging states reflect deep-seated structural challenges, including lower financial literacy, weaker institutional penetration, limited physical and digital banking infrastructure, and a higher reliance on informal credit sources. The inability of these regions to close the credit gap with their more developed counterparts raises questions about the effectiveness of past financial inclusion policies and creditenhancement schemes.

Interestingly, the data from 2017 and 2022 show slight improvements among a few middle-tier states like Gujarat, Karnataka, West Bengal, and Uttar Pradesh, indicating emerging trends of gradual convergence. However, the overall slope of the credit distribution curve suggests that the pace of convergence is slow, and the gap between the top and bottom states remains substantial. This entrenched disparity highlights the uneven impact of financial sector reforms and digital innovations such as the PMJDY, MUDRA loans, and the UPI.

What makes this disparity particularly striking is that it persists even in the context of widespread adoption of digital technologies and policy-driven attempts to enhance financial access. The promise of fintech-led democratization of finance appears to have had a limited effect on deepening credit access in the country's most underserved regions. This contradiction between technological progress and regional inequality in credit access forms a critical gap in the literature and calls for deeper empirical investigation.

The observed trends in credit distribution are not merely descriptive—they are diagnostic of broader structural asymmetries in India's financial landscape. These patterns provide a strong empirical foundation for this research, which aspires to contribute both to academic understanding and to the formulation of more inclusive and effective credit policies in India.

4.3 Rural UPI Adoption Across States

The intensity of UPI usage in rural areas was proxied using the combination of wireless subscriber data and rural population ratios. While exact state-wise UPI transaction volume data is not available, the proxy reflects realistic trends in adoption. States such as Uttar Pradesh, Madhya Pradesh, Rajasthan, and Bihar showed a substantial rise in rural UPI usage post-2017. These states also align with historically underserved regions in terms of formal credit.

4.4 Preliminary Visual Insights

Line Graphs To better illustrate these trends Comparing ln_credit, ln_gsdp, and UPI transactions across years.

Post-2017, the blue line (real credit) deviates significantly from the long-term trend (dotted line) for several states like: Andhra Pradesh, Karnataka, Gujarat, Kerala, Madhya Pradesh, Rajasthan, Delhi & Maharashtra, suggesting that macroeconomic factors are at play indicating economic growth.

But from year 2021 onwards we can see a fall in credit, however the UPI is consistently increasing.

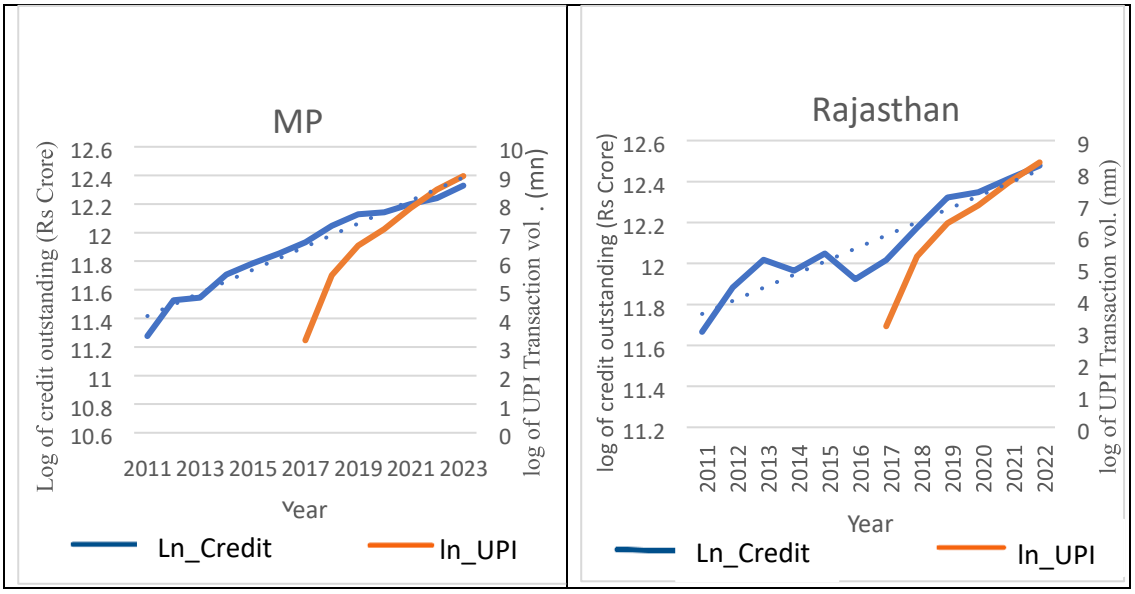

Figure 4.4: Trends in Credit Outstanding and UPI Activity in [Madhya Pradesh and Rajasthan] (2011– 2023) Source: https://data.rbi.org.in

The credit surge in 2018 is not completely explained by GSDP acceleration. The credit bump between 2017–2019 is not aligned with GSDP trends. This reinforces the hypothesis that digital payment infrastructure might helped accelerate credit growth, independent of broader economic activity.

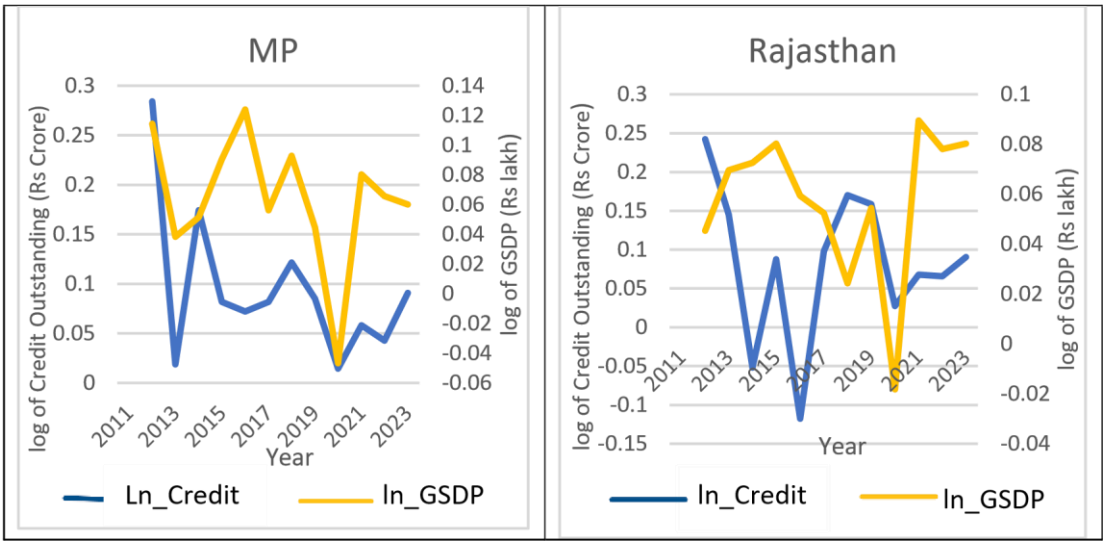

Figure 4.5: Trends in Credit Outstanding and GSDP in [Madhya Pradesh and Rajasthan] (2011– 2023) Source: https://data.rbi.org.in

These visual patterns reveal that although economic indicators like Gross State
Domestic Product (GSDP) help explain a portion of the variation in credit levels across states, they do not tell the whole story. The steady rise in UPI usage— even in states with modest economic output—suggests that digital transformation is beginning to act as a quiet but powerful enabler of credit access. This is particularly evident in rural areas, where the ability to make secure, real-time transactions via a mobile phone is helping people—many of whom had limited or no prior engagement with formal financial systems— become visible and creditworthy in the eyes of banks and financial institutions. In these regions, UPI is not just a convenience; it is a digital bridge that is gradually connecting underserved individuals to formal economic opportunities.

CHAPTER- 5

EMPIRICAL RESULTS AND DISCUSSION

5.1 Main Regression Output

The fixed-effects regression includes ln_credit as the dependent variable and logtransformed explanatory variables such as ln_upi_dummy, ln_gsdp, ln_rural_upi_D, and ln_walr. Robust standard errors are used to address heteroskedasticity. The results show:

Table 5.1: Regression Results on ln (Credit Outstanding)
(Dependent Variable: ln_credit, N = 234)

Variable	*Coefficient*	*P-Value*
UPI-Dummy	*0.84*	*0.135*
Rural_UPI_D	*0.27*	*0.059*

Refer to Appendix I to get actual Stata outputs

The empirical analysis yields several insights into the relationship between digital financial infrastructure—particularly the Unified Payments Interface (UPI)—and state-level credit outstanding in India, with a focus on rural and urban disparities.

5.1.1 *UPI Dummy Variable*:

No Clear Link Between UPI Rollout and Credit Growth in Urban Contexts. The coefficient on the upi_dummy variable, which indicates the average change in credit outstanding after the national introduction of UPI in 2016, turns out to be statistically insignificant in the final regression model. This means that UPI's rollout, when averaged across all states, does not have a strong or direct impact on increasing credit.

This result may seem surprising at first after all, UPI has revolutionized how millions of Indians make payments. However, it's important to understand where and how UPI operates differently.

In urban areas, which already have strong financial networks, digital lending platforms, credit cards, and salaried formal employment, UPI mostly serves as a convenience tool. People already had access to credit through credit cards. So, when UPI entered the scene, it enhanced transactional efficiency, but it didn't fundamentally expand access to credit in those regions. From a lender's perspective, urban consumers were already visible and credit-scored; UPI didn't bring new borrowers into the fold. In contrast, rural credit is still largely dependent on targeted instruments like the Kisan Credit Card and may not reflect uniform gains across regions. Therefore, while the average post-UPI credit increase is notable, it is insufficiently precise to establish a robust causal effect across all states.

That's likely why the broad effect of UPI on credit growth is not statistically strong it is being diluted by states where it didn't make a big difference to credit access.

5.1.2 Rural UPI: Where the Impact Truly Emerges

In contrast, the picture is very different when we look at the interaction term rural_upi_D, which captures how UPI adoption behaves in states with a larger rural population.

This variable shows a positive and statistically significant relationship with credit growth. In simple terms, the more a rural-dominated state adopts UPI, the more credit growth it experiences.

This is a powerful insight. It supports the idea that UPI is not just a payment app it is a gateway to financial inclusion for rural populations who were previously invisible to the formal banking system. In these areas, UPI adoption often represents a first step into the formal financial world. Every digital transaction creates a data trail proof that a person exists economically, that they transact, earn, and repay. This digital footprint helps financial institutions make better lending decisions for people who would otherwise remain excluded due to lack of documentation or credit history.

The result aligns strongly with the study's core hypothesis: UPI has a more meaningful impact on credit in regions where the need for inclusion is highest. It is not just about technology it is about access.

5.2 Discussion: The Bigger Story Behind the Numbers

The above findings from this study underscore the nuanced impression of UPI on credit expansion across Indian states. While the log of UPI adoption

(upi_dummy) exhibits a positive relationship with credit growth, the lack of statistical significance indicates that this effect is not uniform across the country. This aligns with the hypothesis that the effectiveness of digital financial infrastructure is contingent on broader contextual factors, such as state-level economic conditions, financial literacy, and digital readiness.

More strikingly, the variable representing rural UPI penetration (rural_upi_D) is both economically and statistically significant. This suggests that UPI's creditenabling role is more tangible in rural contexts, where traditional financial services are often limited. It validates the idea that digital platforms can act as alternatives to physical banking infrastructure, especially in underbanked regions.

The use of log-log transformations throughout the model enhances comparability across states of different sizes. This approach emphasizes proportional rather than absolute changes, allowing for meaningful insights into how states like Uttar Pradesh and Himachal Pradesh despite their demographic and infrastructural differences respond to UPI adoption in relative terms.

Results tell a compelling story about why context matters in evaluating digital innovations like UPI. While the average effect of UPI across all states may appear muted, this masks important variation between urban and rural India.

In rural areas, UPI is doing much more than just helping people send money to each other. Every digital payment people make leaves behind a small but powerful trace of their financial activity. And for the first time, that trace is something banks and lenders can see.

This visibility matters. When a lender can see that someone receives regular payments, makes timely transfers, or runs a small business digitally, they are more willing to offer credit. And for someone in a rural area, that access to credit can be life-changing it could mean buying better seeds, expanding a roadside stall, or having a cushion during a health emergency.

Our study shows that UPI has genuinely helped increase credit in rural areas. Where traditional banking often struggles to reach, UPI has stepped in not just as a payment app, but as a quiet enabler of opportunity. It is giving people a way to be seen, trusted, and supported financially in ways they never were before.

In contrast, in urban areas where access to finance is already mature and varied, UPI has not had the same transformative role in credit delivery. It’s certainly useful but it’s not disruptive in the same way.

Additionally, the weighted average lending rate (WALR), while a standard control in credit models, plays only a limited role in this context. In rural areas, where the supply of formal credit itself is patchy, changes in lending rates have less influence on whether someone gets a loan at all. The formal system's reach not its cost is the more binding constraint.

Taken together, these results suggest that UPI's credit-enabling power is conditional. It works best where there was little or no access before and it works precisely because it lowers the barriers to entry, offers traceable data, and does not require the physical presence of a bank.

5.3 A Digital Bridge.

UPI is often celebrated as a digital success story and rightly so. But this study shows that its impact goes beyond flashy transaction volumes or QR codes on every street corner.

In rural India, UPI is a quiet revolution. It is building a bridge between the individual and the institution. It is turning economic activity into a digital identity. And it is helping bring formal credit to people who were long left out of the system.

It does not automatically solve the challenges of rural credit, nor does it replace the need for infrastructure, financial education, or targeted lending products. But it does make those solutions more possible and more scalable.

If we want to fully harness its potential, we need to recognize where UPI is working and double down on supporting it with better credit frameworks, smarter outreach, and stronger rural connectivity. Only then can we ensure that this digital bridge leads not just to faster payments, but to real financial empowerment.

CHAPTER- 6

CONCLUSION, FUTURE SCOPE AND SOCIAL IMPACT

6.1 Policy and Institutional Implications

The empirical results translate into actionable insights for policymakers, financial institutions, and regulators committed to enhancing financial inclusion.

1. Focus on Rural Digital Credit Integration: The marginally significant impact of rural UPI usage suggests that policies should prioritize digital credit delivery models in rural areas. This includes leveraging UPI transaction histories for credit scoring, integrating rural UPI data with public credit registries, and incentivizing banks and NBFCs to lend in digitally active but traditionally underserved geographies.

2. Enable Alternative Credit Scoring: Thin-file customers—those with no formal credit history—can now be evaluated using behavioural data from their digital transaction patterns. Regulators like the RBI can play a key role in enabling frameworks that allow UPI transaction history to feed into alternative credit scoring mechanisms, reducing reliance on collateral or traditional documentation.

3. Encourage Fintech–Bank Collaborations: Fintech companies often have superior data capabilities and user-centric design models, while banks bring capital and regulatory experience. A blended model that combines both can expand credit efficiently. Government-backed credit guarantee programs could further de-risk such partnerships in rural areas.

4. Promote Financial and Digital Literacy: Infrastructure alone is not sufficient. For UPI to serve as a pathway to credit, users must understand how digital tools translate into financial opportunities. Public and private literacy campaigns especially targeting women, informal workers, and rural youth can increase not only usage but

the quality of usage, helping users build trustworthy digital financial profiles.

5. Bundle UPI with Formal Lending Schemes: Schemes like PM Mudra Yojana or PM SVANidhi can be bundled with UPI adoption incentives. Offering features like cashback on credit-linked payments or UPI-based interest subsidies may promote responsible borrowing and encourage digital repayment behaviour.
6. Invest in Rural Digital Infrastructure: Finally, for UPI's credit-enabling potential to be realized, rural infrastructure such as broadband internet, smartphone access, and BC agent density must be improved. Without connectivity, even the best-designed digital tools fail to reach their full potential.

6.2 Social and Economic Impact

The implications of UPI's credit-enabling role go beyond economics—they are deeply social.

Economically, increased access to formal credit reduces reliance on informal moneylenders, many of whom charge exploitative interest rates. For farmers, shopkeepers, and micro-entrepreneurs, this means more affordable capital to invest in productivity. For informal workers, it means financial flexibility during emergencies.

Socially, the ability to engage with digital financial tools and build a credit profile through usage repositions rural individuals as bankable, creditworthy citizens. Women, in particular, stand to gain as they often manage household budgets yet remain invisible to the formal banking system. With targeted outreach, UPI can help create independent credit profiles for women, allowing them to access loans, grow businesses, or respond to personal financial needs.

Moreover, UPI has enhanced transparency and accountability in government welfare transfers. Direct Benefit Transfers (DBTs) and credit-linked schemes now reach beneficiaries without leakages, reducing dependency on intermediaries and boosting confidence in formal institutions.

During crises like COVID-19, UPI served as a resilient digital safety net. It enabled people to receive relief payments, pay for essentials, and access emergency funds without needing to visit a branch highlighting how digital finance can support welfare distribution even amid systemic shocks.

In essence, UPI is doing more than facilitating payments. It is redefining trust, reducing exclusion, and creating digital identities that have real-world financial value.

6.3 Conclusion

This dissertation contributes to the growing conversation around digital finance and inclusion by empirically analyzing the relationship between UPI adoption intensity and credit growth in India's rural states.

Over the past decade, UPI has completely transformed how millions of Indians send and receive money. But behind the fast-growing transaction numbers lies a deeper opportunity especially for those who have long been left out of the formal financial system.

By analysing data from Indian states between 2011 and 2023, this research findings support a shift in how we think about UPI not solely a payment utility, but as a basic digital public good that can reshape how credit is delivered, assessed, and accessed.

UPI, on its own, has not led to a significant rise in volume of credit at the national level. That's understandable. In cities and urban areas, where credit cards, consumer loans, and digital lending were already widespread, UPI simply made payments easier it did not fundamentally change how people borrow.

But in rural India, the story is different and more hopeful.

In places where banks are far, documentation is hard to produce, and financial history is nearly invisible, UPI has quietly become more than just a payment app. It has become a way for people to build a digital trail, a financial identity. And that identity matters because it makes them visible to lenders, giving them access to credit they may never have had before.

This study shows that in rural-dominated states, where people were historically underserved, UPI adoption is strongly linked to rising credit levels. That means digital payments are not just about convenience they can be a stepping stone to financial empowerment.

At the same time, UPI is not a magic fix. It works best when supported by strong infrastructure, financial literacy, and policies that encourage inclusive lending. Interest rates alone cannot solve the rural credit gap if people still do not have access to banks or formal lending channels.

What this research highlights are that digital tools like UPI have the power to open doors as credit level has increased in rural areas due to UPI but we still need to walk through them with the right support systems in place.

In the end, this is not just about technology. It is about trust, visibility, and the promise of inclusion. UPI has given millions of Indians a way to be seen by the formal financial world. Now, the challenge is to turn that visibility into opportunity so that more people, especially in rural India, can borrow with confidence, grow with dignity, and thrive on their own terms.

6.4 Future Research Directions

While this study adds valuable insights, it also leaves room for deeper and more granular investigations. Future research can strengthen the evidence base by:

- Moving to Micro-Level Analysis: Access to district, block, or household-level data would allow researchers to examine the direct behavioral impact of UPI usage on credit decisions. This would enable a more targeted understanding of regional disparities and local effects.
- Exploring Gender Dimensions: Integrating gender-disaggregated data would help unpack how digital infrastructure affects women differently—and how gendered access to UPI translates into credit access and economic autonomy.
- Analyzing Long-Term Financial Behaviour: Future studies could examine whether initial digital engagement through UPI leads to longterm borrowing, repayment, and financial discipline—providing a fuller picture of how digital platforms affect financial health.

Final Reflection

UPI has revolutionized how Indians pay—but perhaps its most powerful legacy will be how it helps them borrow, grow, and thrive.

In rural India, where access to financial opportunity has long been unequal, UPI is building a bridge—one transaction at a time. It is connecting the

invisible with the institutional, the informal with the formal, and the excluded with the empowered.

This study provides evidence that this bridge is not only necessary—it is beginning to work. The next step is to walk further across it, ensuring that digital access becomes a doorway to real, lasting financial inclusion.

REFERENCES:

1. Agarwal, A. (2022). *Impact of Digitalization on Banks' Credit in India*. Journal of Economic Policy and Research, 17(1), 50–65. https://www.academia.edu/download/109743361/Impact_of_Digit aliz ation_on_Banks_Article.pdf
2. Agarwal, R. (2022). *Impact of digitalization on banks' credit in India*. Journal of Financial Services and Technology, 14(2), 75– 89.
3. Alonso, C., Bhojwani, T., Hanedar, E., Prihardini, D., Uña, G., & Zhabska, K. (2023). ***Stacking Up the Benefits: Lessons from India's Digital Journey*.** IMF Working Paper No. 2023/078.
4. Bhardwaj, N. (2022). India's Account Aggregator Network: Financial Data Sharing Made Efficient. 5. Divi, S., Minampati, V. R., Sahoo, M. K., & Shah, K. (2024). *Penetration of Digital Transactions in Rural India and Financial Inclusion: An Analysis of Progress and Problems*. Evolutionary Studies in Imaginative Culture, 104–115. https://doi.org/10.70082/esiculture.vi.798
6. Divi, V., Minampati, S., & Kumar, R. (2023). *Digital payments and financial deepening in rural India: A district-level analysis*. Indian Journal of Digital Economics, 5(1), 45–60.
7. "Financial Inclusion - An Impetus to the Digitalization of Payment Services (UPI) in India" https://www.researchgate.net/profile/PrashantBarge2/publication/366875463.
8. "Growth of Digital Payment System in India" https://thinkindiaquarterly.org.in
9. Karmakar, A. (2024). *Unified Payments Interface (UPI): A Comprehensive Study of Its Impact on India's Financial Landscape and Global Aspirations*. https://doi.org/10.13140/RG.2.2.34671.82087
10. Kulkarni, V. T. K., Justin, A., & Bhatta, P. (2023). *Impact of UPI Utilisation on Financial Inclusion: Empirical Evidence from India*.

Journal of Management and Entrepreneurship, 17(1), 105–112.
https://xime.org.in

11. Mahesh, A., & Bhat, G. (2021). *Digital Payment Service in India: A Case Study of Unified Payment Interface (UPI)*. International Journal of Case Studies in Business, IT and Education (IJCSBE), 5(1), 256– 265. https://zenodo.org/records/397693
12. Mahesh, A., & Bhat, G. (2021). *Digital payments in India: A casebased exploration of UPI's rural reach*. Journal of Banking and Technology, 11(3), 102–117.
13. Modwel, G., & Trivedi, M. (2024). *The Impact of Unified Payments Interface (UPI) on Financial Inclusion and Economic Development*. Educational Administration: Theory and Practice, 30(5), 3581–3588. https://doi.org/10.53555/kuey.v30i5.3494
14. Mukherjee, S., & Banerjee, R. (2023). *Importance of UPI in SocioEconomic Development: An Empirical Study*. Journal of Management and Entrepreneurship, 17(1), 27–39. https://doi.org/10.26573/2023.17.1.3
15. Mukherjee, M., & Banerjee, R. (2022). *Importance of UPI in socioeconomic transformation*. Journal of Rural Economics and Development, 7(4), 120–137.
16. ML Kavitha - 2019 - indianjournals.com "Digital revolution in the Indian banking sector and its impact on rural area"
17. 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*. https://www.researchgate.net/publication/353016519_Unified
18. Sinharay, A. (2024). *UPI and Business Correspondence Model as a Game Changer*. Economic and Political Weekly, LIX(4).
19. Sinharay, A. (2024). *Expanding rural finance through UPI and the business correspondent model: Evidence from India*. Rural Banking Review, 8(1), 33–50

******

APPENDICES

Appendix I: Regression Tables

Appendix I -1

```
. xtreg ln_credit upi_dummy ln_gsdp  rural_upi_D walr i.year, fe vce(robust)
note: 2022.year omitted because of collinearity
note: 2023.year omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       234
Group variable: state_id                        Number of groups   =        18

R-sq:                                           Obs per group:
     within  = 0.7389                                         min =        13
     between = 0.4738                                         avg =      13.0
     overall = 0.1443                                         max =        13

                                                F(14,17)           =    150.06
corr(u_i, Xb)  = 0.1966                         Prob > F           =    0.0000

                                (Std. Err. adjusted for 18 clusters in state_id)
```

ln_credit	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
upi_dummy	.8399384	.5345274	1.57	0.135	-.2878158	1.967693
ln_gsdp	.0974939	.550285	0.18	0.861	-1.063506	1.258494
rural_upi_D	.2708546	.1341115	2.02	0.059	-.0120959	.5538051
walr	.1178122	.0644383	1.83	0.085	-.0181407	.2537652
year						
2012	.2312482	.047236	4.90	0.000	.1315888	.3309075
2013	.3023045	.0980636	3.08	0.007	.0954083	.5092006
2014	.3011147	.1068665	2.82	0.012	.075646	.5265834
2015	.3975285	.1789225	2.22	0.040	.0200351	.775022
2016	.4738767	.2491769	1.90	0.074	-.0518405	.999594
2017	-.436162	.245375	-1.78	0.093	-.953858	.0815341
2018	-.3258786	.1856284	-1.76	0.097	-.7175204	.0657632
2019	-.2264043	.1512997	-1.50	0.153	-.5456188	.0928102
2020	-.1382234	.1294954	-1.07	0.301	-.4114348	.1349879
2021	-.0357864	.0354814	-1.01	0.327	-.1106457	.0390729
2022	0	(omitted)				
2023	0	(omitted)				
_cons	8.501866	8.763105	0.97	0.346	-9.986669	26.9904
sigma_u	1.0867338					
sigma_e	.13468478					
rho	.98487238	(fraction of variance due to u_i)				

Appendix I- 2

```
. xtreg ln_credit upi_dummy ln_gsdp  rural_upi_D walr, fe vce(robust)

Fixed-effects (within) regression               Number of obs      =       234
Group variable: state_id                        Number of groups   =        18

R-sq:                                           Obs per group:
     within  = 0.6881                                         min =        13
     between = 0.8133                                         avg =      13.0
     overall = 0.7808                                         max =        13

                                                F(4,17)            =     31.35
corr(u_i, Xb)  = 0.6654                         Prob > F           =    0.0000

                                (Std. Err. adjusted for 18 clusters in state_id)
------------------------------------------------------------------------------
             |               Robust
  ln_credit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  upi_dummy |  -.1917404   .0962081    -1.99   0.063    -.3947217    .0112408
    ln_gsdp |   .6911417   .1935081     3.57   0.002     .2828752    1.099408
rural_upi_D |   .2358191   .1322877     1.78   0.093    -.0432835    .5149218
       walr |  -.0634617   .0285804    -2.22   0.040     -.123761   -.0031624
      _cons |   .5551046   3.628903     0.15   0.880    -7.101212    8.211421
-------------+----------------------------------------------------------------
    sigma_u |  .70287519
    sigma_e |  .14369093
        rho |   .9598837   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix II. Variable Definitions and Sources

VARIABLES	SOURCE	TRANSFORMATION
Credit outstanding	https://data.rbi.org.in	Total credit outstanding (aggregated to state level)
Real_credit	Created manually (to adjust for inflation)	(Credit/CPI)*100
Ln_credit	Created manually	Transformed into logs
State_share	Created manually	(State Value(wireless subscribers)/ National Total(wireless subscribers)
State_upi_cl	Created manually	State_share * upi
Ln_state_upi_cl	Created manually	Log transformed state_upi_cl
Ln_gsdp	MOSPI	State's GDP (at constant prices) Transformed into logs
Accounts	RBI	State wise number of accounts opened
Ln_accounts	Created manually	Log transformed accounts
Upi_dummy	Created manually	0 for year before 2017, 1 after 2017

VARIABLES	SOURCE	TRANSFORMATION
Rural_intensity	Population projections	Percentage of rural population in each state
Rural_intensity_cs	Census 2011	Percentage of rural population in each state.
Rural_upi	Created manually	Rural_intensity* ln_state_upi_cl
Rural_upi_D	Created manually	Rural_intensity * upi_dummy
walr	RBI	Weighted average lending rate (annual- national level data)

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Main Bhawan Road, Delhi – 110042, India

PLAGIARISM VERIFICATION

Title of the Thesis: "Exploring UPI's Impact on Credit Growth in Rural India: A Panel Data Analysis (2011–2023)"

Total Pages: 42 pages **Name of the Scholar:** Alisha Bharti

Name of the Supervisor: Dr. Manisha G. Singh

Department of Economics

This is to report that the above thesis was scanned for similarity detection. Process and outcome are given below: -

Software used: **Turnitin**

Similarity Index: **6%**

Total word count: **9281**

Date of report generation: **Jun 3, 2025, 1:47 PM**

Alisha Bharti

Candidate's Signature

manisha singh

Signature of the Supervisor

PLAGIARISM REPORT

Alisha- 02_Thesis_Documentation.pdf

42 Pages

9,281 Words

51,881 Characters

Turnitin

Document Details

Submission ID **trn:oid:::31142:99134656**

Submission Date
Jun 3, 2025, 1:46 PM GMT+5

Download Date

Jun 3, 2025, 1:47 PM GMT+5

File Name

Alisha- 02_Thesis_Documentation.pdf

Submission ID trn:oid:::31142:99134656

Match Groups

- **62** Not Cited or Quoted 6%
  Matches with neither in-text citation nor quotation marks
- **0** Missing Quotations 0%
  Matches that are still very similar to source material
- **0** Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- **0** Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

2% Internet sources
1% Publications
5% Submitted works (Student Papers)

Top Sources

File Size

991.8 KB

6% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography
- Quoted Text
- Cited Text

Match Groups

62 Not Cited or Quoted 6%
Matches with neither in-text citation nor quotation marks

0 Missing Quotations 0%
Matches that are still very similar to source material

0 Missing Citation 0%
Matches that have quotation marks, but no in-text citation

0 Cited and Quoted 0%
Matches with in-text citation present, but no quotation marks

Top Sources

2% Internet sources
1% Publications
5% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

No suspicious text manipulations found.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Submitted works	
Liverpool John Moores University on 2025-06-01		<1%
2	Internet	
www.coursehero.com		<1%
3	Submitted works	
Liverpool John Moores University on 2023-05-02		<1%
4	Submitted works	
London School of Economics and Political Science on 2024-08-15		<1%
5	Submitted works	
University of Sheffield on 2024-08-29		<1%
6	Internet	
etd.aau.edu.et		<1%
7	Internet	
era.library.ualberta.ca		<1%
8	Internet	
open.uct.ac.za		<1%
9	Publication	
S. N. Rajesh Raj, Komol Singha. "The Routledge Handbook of Post-Reform Indian.		<1%
10	Submitted works	
Coventry University on 2023-12-11		<1%

Submitted works

<1%

Submitted works

<1%

RDI Distance Learning on 2025-03-30

12 Submitted works

University of Witwatersrand on 2024-09-16 <1%

13 Submitted works

Business College of Athens on 2024-09-02 <1%

14 Internet

rural.nic.in <1%

15 Submitted works

King's College on 2025-04-24 <1%

16 Submitted works

Brunel University on 2023-09-01 <1%

17 Submitted works

Liverpool John Moores University on 2025-04-27 <1%

18 Submitted works

University of Leicester on 2016-08-10 <1%

19 Submitted works

University of Northumbria at Newcastle on 2025-04-21 <1%

20 Submitted works

Berner Fachhochschule on 2024-10-15 <1%

21 Submitted works

Nilai University College on 2024-10-22 <1%

22 Internet

dcoll.ajou.ac.kr <1%

23 Internet

worldcommercereview.com <1%

24 Submitted works

Associatie K.U.Leuven on 2025-05-21 <1%

Submitted works

<1%

Submitted works

<1%

Business College of Athens on 2024-02-07

26 Publication

Dilip Dutta. "Development under Dualism and Digital Divide in Twenty-First Cent <1%

27 Submitted works

Loughborough University on 2022-05-31 <1%

28 Submitted works

Manipal University Jaipur Online on 2025-02-18 <1%

29 Submitted works

Midlands State University on 2024-05-19 <1%

30 Submitted works

University of Glasgow on 2022-11-23 <1%

31 Submitted works

University of Northumbria at Newcastle on 2025-05-13 <1%

32 Submitted works

University of Portsmouth on 2025-05-28 <1%

33 Internet

digital.lib.usf.edu <1%

34 Internet

ebin.pub <1%

35 Submitted works

Higher Education Commission Pakistan on 2024-03-15 <1%

36 Publication

Rangachar Govinda, M. Poornima. "India's Social Sector and SDGs - Problems and <1%

37 Publication

Ravi Prakash Achanta, Yangchen Doma Lepcha. "Digital financial knowledge, insi <1%

38 Submitted works

Sheffield Hallam University on 2023-04-19 <1%

Submitted works

<1%

University of Hull on 2012-01-04

40 Publication

Vijay Paul Sharma, Harsh Wardhan. "Marketed and Marketable Surplus of Major.F <1%

41 Submitted works

Sharda University on 2019-07-31 <1%