Understanding India's Digital Commerce via UPI Data

Aman Ostwal (ago34@drexel.edu)
Darshit Rai (dr3264@drexel.edu)
Sanskruti Ajay Chavanke (sc4323@drexel.edu)
Ram Kishore Karuppiah Nadar Venkateswaran (rk999@drexel.edu)
Sai Pokuri (sp3867@drexel.edu)

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Abstract

The project involves in encompassing month-wise digital commerce metrics in various states of India. With the UPI data, the analysis investigates transaction volume, user base in each state and the transaction frequency. By examining these metrics over time and across states, the visualization unveil nuanced patterns and trends in India's digital commerce landscape. This concise yet comprehensive exploration provides valuable insights for policymakers, and businesses seeking a deeper understanding of the dynamic evolution of digital transactions in the country.

1 Introduction

In the era of fast evolving digital transactions, the Unified Payments Interface (UPI) is an important change in India's financial landscape. UPI, which was created by the National Payments Corporation of India (NPCI), introduced in April 2016 and quickly became the country's preferred payment method, overtaking older payment methods such as cash and credit cards.This project aims to unravel the complex dynamics of India's digital commerce sector through a thorough examination of UPI data. The Unified Payments Interface (UPI) is an advanced, real-time payment system meant to simplify financial transactions. It allows customers to effortlessly connect their bank accounts to a mobile app, allowing for quick and easy payments. The virtual payment address (VPA), also known as a UPI ID, is what differentiate UPI and acts as a unique identification for transactions. This innovative approach eliminates the need to share complicated bank details with every financial interaction.

UPI's functionality relies around enabling customers to make fast payments by integrating their bank accounts with a mobile application. The UPI ID, which serves as a virtual payment address, improves the payment process by providing a safe and fast alternative to traditional banking procedures. This ease of use has been critical in bringing UPI to the top of the Indian payment environment.

In order to understand the changing environment of digital transactions in India, our study will conduct a month-by-month examination of digital commerce metrics across several states. The dataset under consideration spans diverse dimensions, including temporal variations captured by the month parameter, geographical distinctions delineated by state name, and critical metrics such as volume (in cr), value (in cr), users (in lakhs) and transactions (in lakhs). Each of these elements contributes to a nuanced understanding of the multifaceted dynamics inherent in the digital commerce paradigm.Our analysis, which is based on UPI data, goes into crucial areas such as transaction volume, user base in each state, and transaction frequency.

Against this backdrop, our study seeks to discern subtle patterns, identify key drivers of growth, and unveil the underlying factors shaping the trajectory of digital transactions. By delving into the intricacies of UPI data, we aim to provide valuable insights that transcend statistical observations, contributing to a holistic comprehension of India's digital commerce landscape. This research holds significance for policymakers, industry stakeholders, and academia, offering a lens through which to navigate the complexities of a burgeoning digital economy.

2 Methodologies

2.1 Research Design

Our project's main goal is to use UPI data to assess digital commerce trends in India. The focus will be on analyzing transaction volume, user base, and transaction frequency over time and across different states. Finding the main reasons for growth and underlying causes influencing digital transactions in India is the project's secondary goal. The insights derived from this analysis can be valuable for policymakers, companies, and academics as they navigate the evolving landscape of digital commerce and its changing geographical dynamics.

2.2 Data Collection

The Data on UPI transactions for all the Indian states from April 2016 to October 2023 was collected using ChatGPT and Claude.ai. These systems were instructed with the query: "Give me the data for UPI transactions from April 2016 to October 2023 for the states of Maharashtra and Uttar Pradesh." The specific details regarding the methodology employed to retrieve this data, such as the parameters used, the data sources accessed, and any filtering mechanisms applied to ensure accuracy and relevance, could be included for a more detailed explanation.

2.3 Limitations & Ethical Considerations

The retrieval of the complete UPI transaction dataset from NPCI (National Payments Corporation of India) faced challenges due to restrictions imposed by the developers. These restrictions implemented by developers prevented access to the entire dataset, which created difficulties accessing the complete dataset for UPI transactions. Requests for access were made to obtain the dataset from the portal. Although the request was recognized and approved, access to the dataset would require payment, according to the website. To ensure the highest standards of data privacy and security, it is vital to obtain the necessary permissions and exercise caution in handling sensitive information. Transparency regarding the data sources and acknowledging the limitations of the analysis is of great importance.

2.4 Data Analysis

The analysis part is focused on year-wise growth after covid. The exploration seeks to unravel the patterns and exponential growth observed in the number of users, particularly influenced by the transformative effects of the COVID-19 pandemic. The data analysis reveals an exponential increase in the number of users, particularly evident from the onset of the COVID-19 pandemic. The top 5 states contributing significantly to this growth are Maharashtra, Tamil Nadu, Karnataka, Uttar Pradesh, and Gujarat. The observed growth in the number of users follows a distinct pattern.

	Month Year			
State Name	2020	2021	2022	2023
Maharashtra	63,749	153,367	320,881	564,596
Tamil Nadu	31,880	76,553	164,805	293,119
Karnataka	28,692	69,865	151,810	268,144
Uttar Pradesh	23,910	58,872	130,778	232,656
Gujarat	23,910	58,829	130,778	232,656

Figure 1: *Top 5 states year-wise with number of users*

The growth pattern suggests a substantial increase in user adoption each year. This is indicative of exponential growth from (figure 1), as the user base is not increasing at a constant rate but rather at an accelerating pace. The reasons for growth could be increased dependency on digital transactions and the adoption of digital payment methods during the pandemic contributed and with lockdowns and social distancing measures in place, each of them turned to online and contactless payment methods, boosting the overall user count. States with robust economic activities, such as Maharashtra, Tamil Nadu, Karnataka, Uttar Pradesh & Gujarat, experienced higher growth due to increased digital transactions associated with economic interactions. Also regions with well-established digital infrastructure witnessed smoother transitions to digital payment systems, fostering higher growth rates.

2.5 Data Visualization

The visualization of the India map (figure 2) with user data serves multiple purposes, providing a comprehensive overview of the geographic distribution of users engaging in UPI transactions. This visualization aids in understanding the spatial patterns, identifying key regions of activity, and making informed decisions based on the observed data. The map visually represents the geographical layout of India, allowing stakeholders to discern the concentration of UPI users across different states. The number of users in each state is depicted by a color gradient. Darker shades indicate higher user

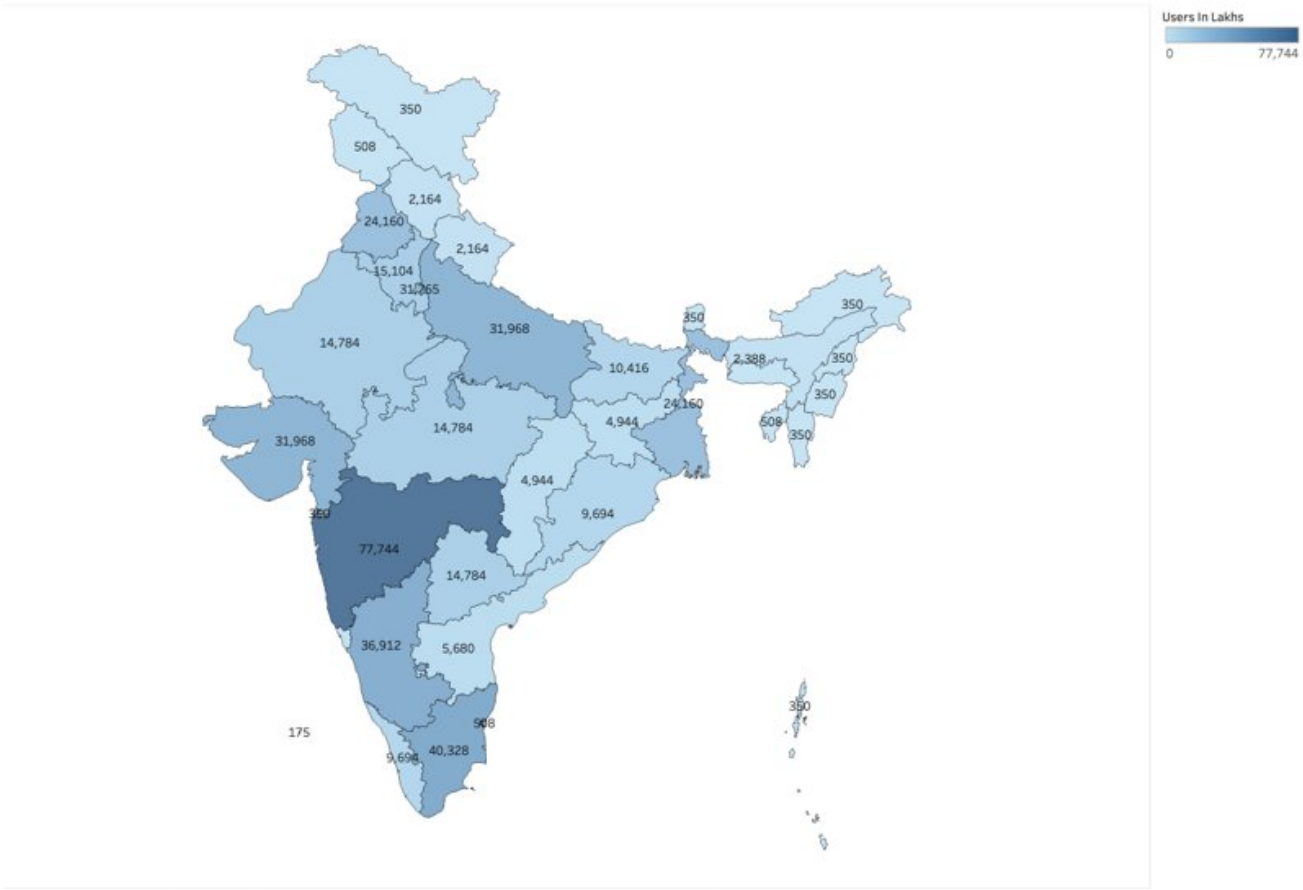

Figure 2: *Geographical representation of Number of Users*

density, creating an immediate visual association between color intensity and the concentration of users. Interactivity is introduced by enabling users to hover over each state, revealing detailed information such as the exact number of users and the corresponding transaction volumes. This data enhances the user experience and facilitates deeper exploration. For this a legend is provided, indicating the color range and corresponding user counts. This legend serves as a reference guide, helping viewers interpret the significance of the colors used in the map.

From this we can make business decisions like - Darker shades on the map signify regions with a higher concentration of UPI users. Decision-makers can promptly identify states or regions with notable user engagement, guiding targeted strategies for user acquisition and retention. The map aids in evaluating the performance of specific states or regions over time. Stakeholders can assess whether user counts are increasing or decreasing, guiding resource allocation and strategic planning. Policymakers can leverage the visualization to inform policy decisions related to financial inclusion, digital literacy programs, and infrastructure development, aligning initiatives with the observed spatial trends. Comparative analysis of user distribution among states provides insights into the competitive landscape. Decision-makers can benchmark against competitors and devise strategies to gain a competitive edge in specific regions.

3 Discussion

The discussion of the UPI dataset analysis presents a nuanced interpretation of the key findings, contextualizes them within the broader landscape of digital commerce, and explores their implications.

3.1 Transactions made per year

The line chart (figure 2) depicting UPI transactions over the years illustrates a consistent upward trend. Year by year, the transaction volumes have been steadily increasing, indicating the growing acceptance and popularity of UPI as a preferred mode of digital payment. By seeing line chart the year 2021 witnessed a remarkable surge in UPI transactions. This significant uptick suggests a pivotal moment in the widespread of digital transactions, maybe due to increased awareness, improved infrastructure, and a surge in digital literacy. The COVID-19 pandemic served as a catalyst for the growth in UPI transactions, particularly from 2021. With safety concerns around physical currency, people turned to contact-less payment methods, propelling UPI transactions to the forefront. The convenience, safety, and accessibility of UPI contributed to its heightened usage during the challenging circumstances of the pandemic.

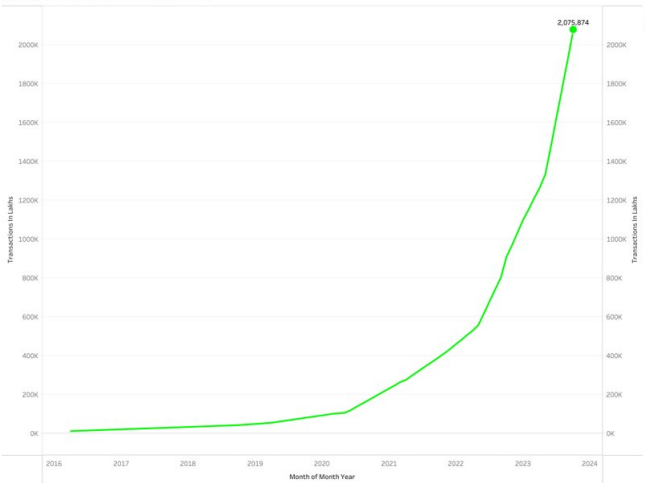

Figure 3: *Transaction growth per year for number of users(in lakhs)*

The observed surge in 2021 aligns with the broader global trend of a shift from cash transactions to digital alternatives during the pandemic. UPI, being a convenient and hygienic option, gained prominence as users sought safer and more efficient means of conducting financial transactions. Also the line chart indicates that UPI transactions reached their highest point in 2023. This shows the enduring and escalating preference for UPI as a reliable and convenient digital payment method. The peak in 2023 suggests a culmination of the ongoing trend, solidifying UPI's status as a dominant force in India's digital commerce landscape.

3.2 Volume in Crores per each state

In the Figure 3, we can see that maharashtra exhibits a notably high transaction volume in crores (Cr), suggesting a robust and substantial economic activity within the state. Maharashtra, particularly Mumbai, is a financial and economic hub with a dense population and extensive commercial activities. The high transaction volume could be attributed to the bustling economic landscape, with numerous financial transactions occurring daily.

The North Eastern states show comparatively lower transaction volumes in crores. The possible reason could be due that the while the North Eastern states

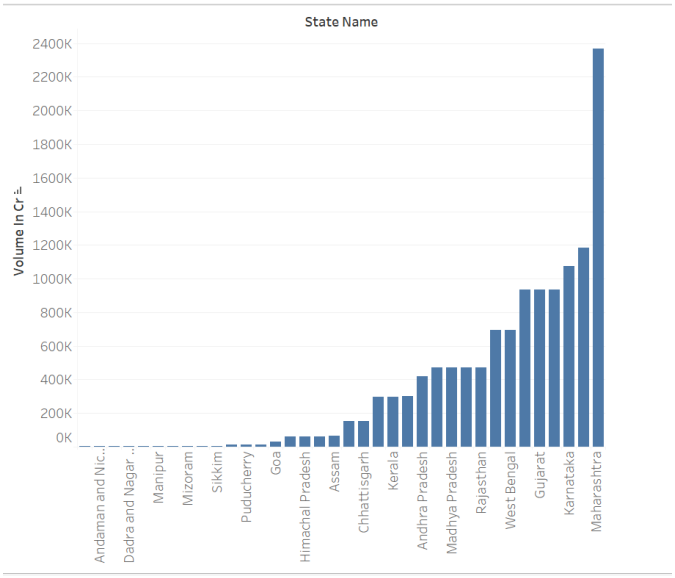

Figure 4: *Volume (in cr) per state*

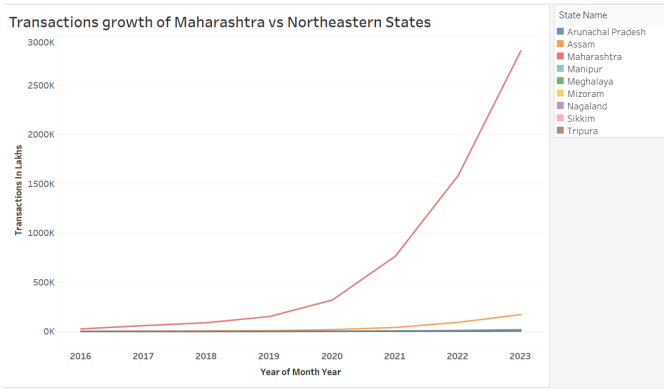

Figure 5: *Growth Analysis of Maharashtra vs Northeastern states*

are culturally rich, may have a smaller population and a less developed economic infrastructure compared to states like Maharashtra and Tamil Nadu. Lower transaction volumes could be reflective of a less intensive economic activity or a preference for traditional payment methods.

This could be due to high levels of urbanization, like Maharashtra Tamil Nadu and Karnataka tend to have higher transaction volumes due to increased economic activities, digital penetration, and consumer spending. The variation in transaction volumes might be linked to the level of digital literacy and awareness of digital payment methods. More digitally literate populations may embrace digital transactions more readily. States with a strong presence of industries that depend heavily on digital transactions, such as IT or e-commerce, may experience higher transaction volumes.There are small & medium Enterprises (SMEs) have businesses that embrace digital payment methods can contribute to increased transaction volumes. Also cultural factors, including preferences for traditional payment methods, can influence transaction patterns. Some regions may still rely on conventional forms of payment. The socioeconomic status of a region plays a crucial role. Higher-income states may witness more extensive use of digital transactions.

3.3 Yearly Transaction(in lakhs) growth of Maharashtra vs Northeastern States

We can see the yearly transactions from the figure 4, Maharashtra, particularly Mumbai, is a major economic hub and financial center in India. The state's robust economic activities contribute to higher transaction volumes. Maharashtra has highly urbanized areas where digital payment adoption is more prevalent. Cities like Mumbai are at the forefront of digital transactions due to the presence of a tech-savvy population and advanced digital infrastructure. Maharashtra hosts a significant concentration of industries, businesses, and financial institutions. This concentration fosters a higher frequency of transactions. Rest of the lines are the northeastern states - Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland & Tripura. Some of the states have been overlapped and not much difference can be observed between them. When combining transactions for all Northeastern states, the total may still be lower than Maharashtra due to the cumulative effect of the reasons mentioned above. Combining transactions doesn't necessarily overcome individual state challenges.

This could be due to smaller economies compared to states like Maharashtra which results in fewer transactions. Some areas in the Northeast may have limited access to banking services, leading to traditional payment methods rather than digital transactions. Looking at the security concerns associated with digital transactions may deter individuals from adopting such methods, particularly in areas where cybersecurity awareness is low.

4 Future Work & Applications

The UPI dataset can be used for future exploration and analysis, offering opportunities to gain deeper insights into evolving trends and make informed decisions in the realm of digital payments. Predictive modeling can be done to forecast future trends in UPI transactions. This could involve predicting user growth, transaction

volumes, or identifying potential factors influencing future adoption. The dataset can be utilized to develop advanced fraud detection models and also analyze transaction patterns to identify anomalies and enhance security measures in UPI transactions. It can also be used to identify potential collaboration opportunities by analyzing transaction data.

Some of the applications are - it can be used to optimize financial institutions services. Insights can be taken into transaction patterns, user behavior, and preferences which can guide the development of products and services. The dataset is valuable for developing sophisticated risk management and fraud detection systems. Analyzing transaction anomalies and patterns which can enhance security measures, protecting users from fraudulent activities.

5 Conclusion

The UPI dataset's analysis illustrates the significant growth in user numbers, propelled by the impact of the COVID-19 pandemic, showcasing India's adaptability in the digital commerce arena. The geographic visualization of user distribution facilitates strategic decision-making by identifying high-activity regions and informing targeted interventions.This dataset stands as a crucial resource for policymakers, businesses, and researchers, guiding strategic decisions that can enhance financial inclusion, security measures, and overall efficiency in the digital payments landscape. The analysis emphasises the transformative role of technology and data-driven insights in shaping the future of financial services in India. The future potential of the UPI dataset spans predictive analytics, behavioral analysis, and user experience optimization, promising continued innovation.

References

[1] UPI transactions more than COVID-19 - study

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