Impact of Cashless Transactions on India's Economic Landscape

By Swostik Pati

Introduction

This report delves into the transformative world of digital transactions, particularly focusing on the rise of mobile banking and fintech startups in India. A pivotal aspect of this revolution has been the introduction of government initiatives like the *Unified Payments Interface (UPI)*, which have democratized financial services, enabling seamless and fee-free money transfers across even the most remote parts of India. This study is deeply personal to me, as my first 18 years in India allowed me to experience these changes firsthand, witnessing the nation's struggles, evolutions, and newfound opportunities.

The core of this investigation centers around online payment methods like UPI and their influence on the Indian economy. Rather than a deep statistical analysis, this project emphasizes the manipulation and interpretation of data through Python, utilizing tools like Pandas and Matplotlib.

Supporting this inquiry, research from Abdullah Aldaas's study "*A study on electronic payments and economic growth: Global evidence,*" underscores the global trend linking economic development to the adoption of cashless transaction methods. Aldaas's research, while acknowledging the variability of this relationship across different countries, provides crucial insights into the global perspective of electronic payment systems and their economic impact. This report aims to apply such global insights to the specific context of India, exploring how the nation's trajectory in cashless transactions aligns with broader economic trends and personal experiences.

An integral aspect of India's digital transaction revolution is its remarkable impact on financial inclusion. Previously, areas with limited or no access to online payments, primarily due to sparse wireless connectivity, were largely excluded from the digital finance narrative. However, innovations like UPI have transcended these barriers, *introducing features* that facilitate money transfers without the need for an internet connection or a smartphone. This breakthrough has been pivotal in bringing the unbanked and underbanked populations into the fold of financial services, significantly broadening the scope of financial inclusion across the country.

My research statement therefore is:

"How have Unified Payments Interface (UPI) and other cashless payment methods influenced the economic growth and financial inclusion in India since their inception?"

Data Procurement

The journey to gather the necessary data for this analysis was both challenging and enlightening. The cornerstone of this project was obtaining data on online payments, particularly from the Unified Payments Interface (UPI). This data, crucial for understanding the landscape of digital transactions in India, was sourced from the National Payments Corporation of India (NPCI). Accessing this data involved navigating through the *NPCI's website*, which was initially daunting due to its laggy nature caused by the massive amount of data being sent from the server. However, a deeper exploration using Chrome Dev Tools revealed the data being fetched from a publicly accessible *JSON file*, which I downloaded directly, bypassing the need for web scraping.

The second dataset involved the GDP of India from 2010 to 2022, obtained from the *World Data Bank*. This data is crucial as it serves as an indicator of India's

economic growth over the years. Acquiring this dataset was relatively straightforward, given its availability as a common economic indicator. The inclusion of this data in the analysis is vital as it provides a macroeconomic perspective, allowing for a more comprehensive understanding of the economic impact of digital payment systems in the context of the country's overall growth.

Securing data on financial inclusion posed a unique challenge, primarily because most available data were qualitative. My goal was to find quantitative data that could be effectively analyzed using Python. After extensive research, I found a treasure trove in the *World Data Bank's Financial Inclusion dataset*. This dataset included specific indicators demonstrating the usage of mobile phones and the internet for online purchases across various demographics in India. The indicators provided a detailed breakdown by gender, labor force status, income groups, education levels, and urban-rural divide, offering a nuanced view of financial inclusion. Interestingly, the data were available for only two years – 2017 and 2021. This timeframe was particularly relevant for my analysis as it coincided with critical milestones: the launch of UPI in 2016, its widespread adoption by 2020, and the pandemic-induced surge in online transactions. Although the percentages were relatively modest compared to countries like the United States, the sheer scale of India's population made these figures significant. By comparing data from these two years, I aimed to assess India's progress in financial inclusion, particularly in the context of the UPI's implementation and the subsequent digital transformation.

Data Cleaning

Transactions Data Cleaning

The complexity of handling JSON files prompted me to first convert the UPI transactions data into a more manageable CSV format. I used the JSON keys as table headings in the CSV to maintain structure. The data, encompassing the

years 2021-2023, was crucial for time-series analysis of transaction volumes and values, especially highlighting UPI transactions. I observed a trend of increased transaction volumes toward the end of each financial year (December to February), with a steep drop thereafter. To ensure data integrity, I conducted thorough checks for missing values and outliers. Despite some outliers, I retained all data considering its reliable source, the NPCI.

In cleaning this data using Python and Pandas, I performed various operations:

- Converted 'Year' to a more readable format.
- Transformed 'Volume' and 'Value' to numeric types, handling any non-numeric entries.
- Created pivot tables to analyze monthly transaction volumes and values over different years.
- Reordered the monthly data to align with the calendar year for easier analysis.

GDP Data

The GDP data required minimal cleaning due to its straightforward structure. I transformed it into a long format for better usability in time-series analysis, ensuring the 'Year' column was numeric and devoid of null values.

Financial Inclusion Data

For the financial inclusion data, I initially reformatted the dataset to ensure clarity and completeness. I focused on ensuring the numeric conversion of the year-specific data and handled any missing values appropriately. To enhance the readability and analysis, I removed common prefixes from the indicator labels, leaving only the unique, descriptive parts.

Analysis

(1) Preliminary look at the Transactions Data

- The initial dataframe

```
        Product Month MonthId Year NoOfBankslive    Volume          Value
0           NFS   Apr       4   21             -    308.24    1,31,346.44
1          IMPS   Apr       4   21             -    322.96    2,99,527.03
2           UPI   Apr       4   21             -  2,641.06    4,93,663.68
3   NACH - APBS   Apr       4   21             -     97.27       5,383.20
4 NACH - CREDIT   Apr       4   21             -    102.95    1,01,457.42
Value counts for Product:
NACH - CREDIT            32
NACH - DEBIT             32
NFS                      32
NETC                     32
CTS                      32
UPI                      32
IMPS                     32
NACH - APBS              32
AePS - Funds Transfer    32
AePS - BHIM Aadhaar Pay  32
AePS - Cash Withdrawal   32
Name: Product, dtype: int64
```
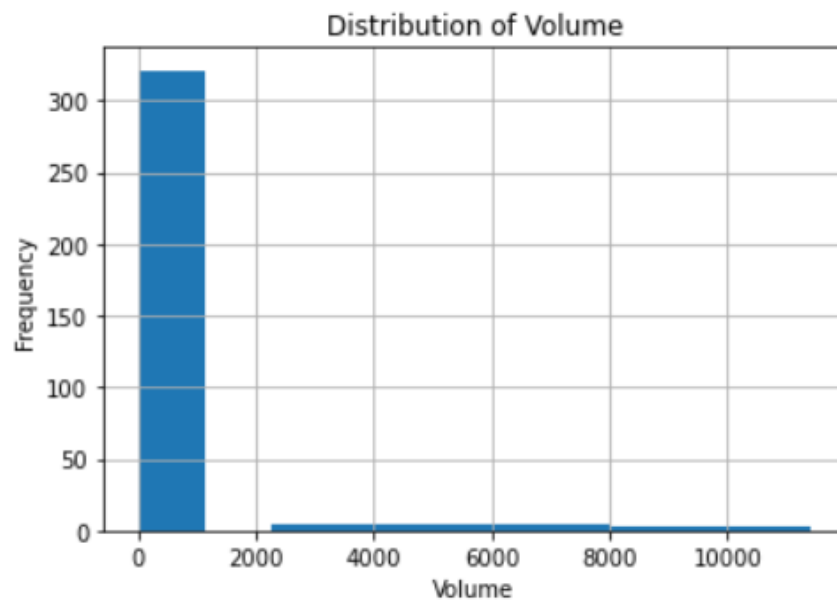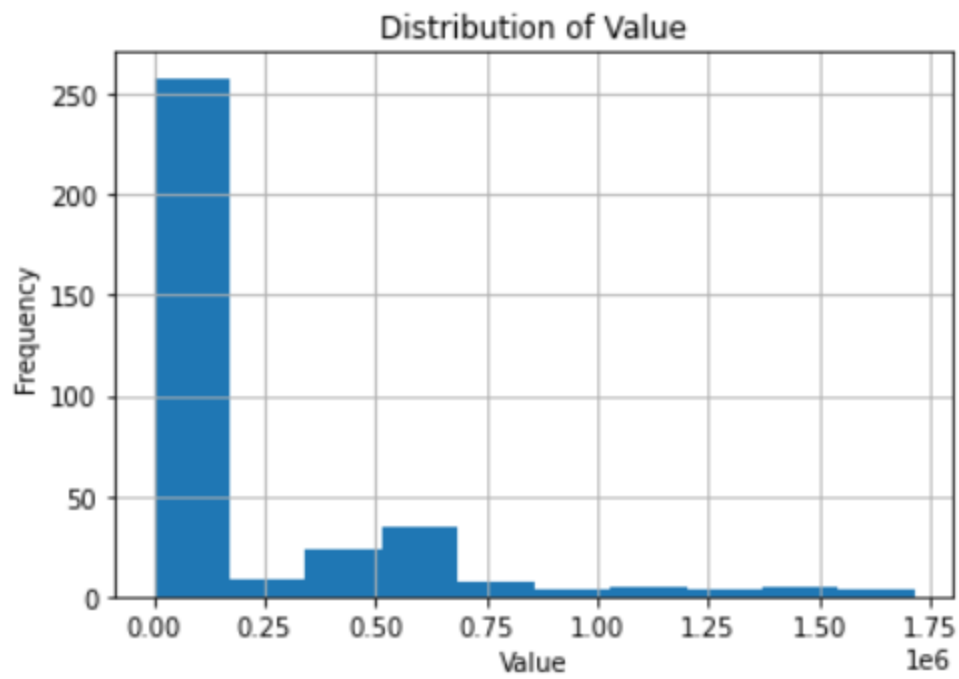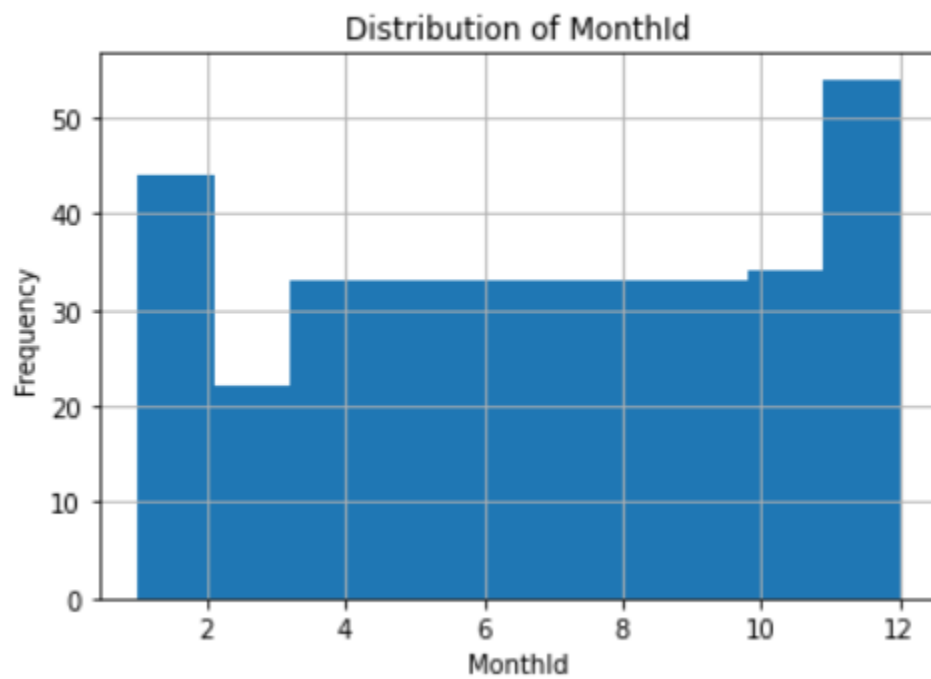
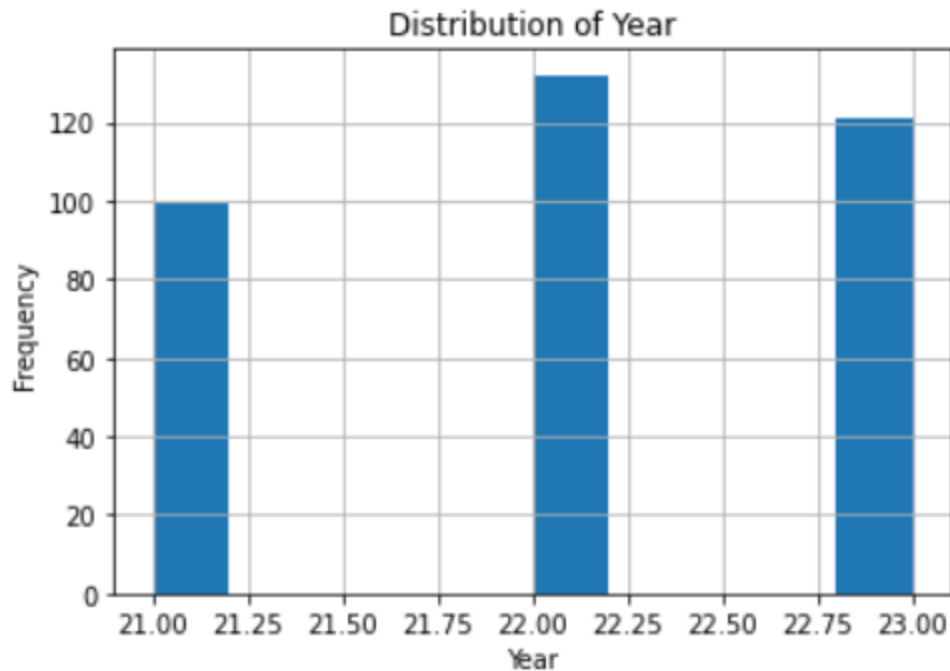- Histogram plots of UPI data.

```
Histogram for Volume:
```


Distribution of Volume

Histogram for Value:

Histogram for MonthId:

Histogram for Year:

Distribution of Year

The analysis of transaction data reveals a consistent pattern both in terms of value and volume. The majority of transactions are clustered, with fewer scattered across the range. Seasonal trends are evident, showing a uniform distribution across months over several years. Notably, there's an uptick in transactions towards the end of the financial year (December to February), followed by a significant decline. Year-over-year data indicates a steady rise in transaction numbers, with the current year already nearing last year's total. This suggests a potential increase in transactions by year-end, aligning with observed monthly trends.

- Checking outliers

```
Missing values in each column:
Product            0
Month              0
MonthId            0
Year               0
NoOfBankslive      0
Volume             0
Value              0
dtype: int64
```

```
Outliers in Volume:
     Product Month  MonthId  Year NoOfBankslive    Volume        Value
2        UPI   Apr        4    21             -   2641.06    493663.68
13       UPI   May        5    21             -   2539.57    490638.65
24       UPI   Jun        6    21             -   2807.51    547373.17
35       UPI   Jul        7    21             -   3247.82    606281.14
46       UPI   Aug        8    21             -   3555.55    639116.95
57       UPI   Sep        9    21             -   3654.30    654351.81
68       UPI   Oct       10    21             -   4218.65    771444.98
79       UPI   Nov       11    21             -   4186.48    768436.11
90       UPI   Dec       12    21             -   4566.30    826848.22
101      UPI   Jan        1    22             -   4617.15    831993.11
112      UPI   Feb        2    22             -   4527.49    826843.00
123      UPI   Mar        3    22             -   5405.65    960581.66
134      UPI   Apr        4    22             -   5583.05    983302.27
152      UPI   May        5    22             -   5955.20   1041520.07
156      UPI   Jun        6    22             -   5862.92   1014412.63
167      UPI   Jul        7    22             -   6289.37   1063117.04
178      UPI   Aug        8    22             -   6581.91   1073162.17
189      UPI   Sep        9    22             -   6780.80   1116438.09
200      UPI   Oct       10    22             -   7305.42   1211587.50
209      UPI   Nov       11    22             -   7309.45   1190593.39
222      UPI   Dec       12    22             -   7828.90   1281970.86
233      UPI   Jan        1    23             -   8038.59   1299058.78
247      UPI   Feb        2    23             -   7534.76   1235846.58
257      UPI   Mar        3    23             -   8651.63   1404950.59
267      UPI   Apr        4    23             -   8863.26   1415504.71
277      UPI   May        5    23             -   9415.19   1489145.50
288      UPI   Jun        6    23             -   9335.06   1475464.26
299      UPI   Jul        7    23             -   9964.26   1533536.44
309      UPI   Aug        8    23             -  10586.02   1576536.54
321      UPI   Sep        9    23             -  10555.69   1579133.18
339      UPI   Oct       10    23             -  11408.79   1715768.34


Outliers in Value:
     Product Month  MonthId  Year NoOfBankslive    Volume        Value
90       UPI   Dec       12    21             -   4566.30    826848.22
101      UPI   Jan        1    22             -   4617.15    831993.11
112      UPI   Feb        2    22             -   4527.49    826843.00
123      UPI   Mar        3    22             -   5405.65    960581.66
134      UPI   Apr        4    22             -   5583.05    983302.27
152      UPI   May        5    22             -   5955.20   1041520.07
156      UPI   Jun        6    22             -   5862.92   1014412.63
167      UPI   Jul        7    22             -   6289.37   1063117.04
178      UPI   Aug        8    22             -   6581.91   1073162.17
189      UPI   Sep        9    22             -   6780.80   1116438.09
200      UPI   Oct       10    22             -   7305.42   1211587.50
209      UPI   Nov       11    22             -   7309.45   1190593.39
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309      UPI   Aug        8    23             -  10586.02   1576536.54
321      UPI   Sep        9    23             -  10555.69   1579133.18
339      UPI   Oct       10    23             -  11408.79   1715768.34
```

The dataset from NPCI, being a direct output from a government agency, showed no missing values, ensuring comprehensive coverage for analysis. If missing values are encountered, the strategy will be to omit these data points. Despite noticing a few outliers in terms of value and volume, these were retained in the

analysis, considering their plausible nature and the credibility of the source. This approach allowed for a realistic representation of transaction patterns, crucial for accurate analysis and interpretation.

(2) Line Plot of the Transaction Data

The graph in question depicts a three-year trajectory of online transaction volumes, showcasing their stability across the period. The consistency is evident, although the year 2022 presents some deviations from the trend, whose causes are yet to be fully determined. It is important to note that the data for 2023 might not reflect the most recent transaction activity, as the dataset was last updated a month ago. Consequently, it is reasonable to anticipate that the actual figures for 2023 could display an increase, considering the dynamic nature of online transactions and the fact that recent activities would not be captured in the dataset.
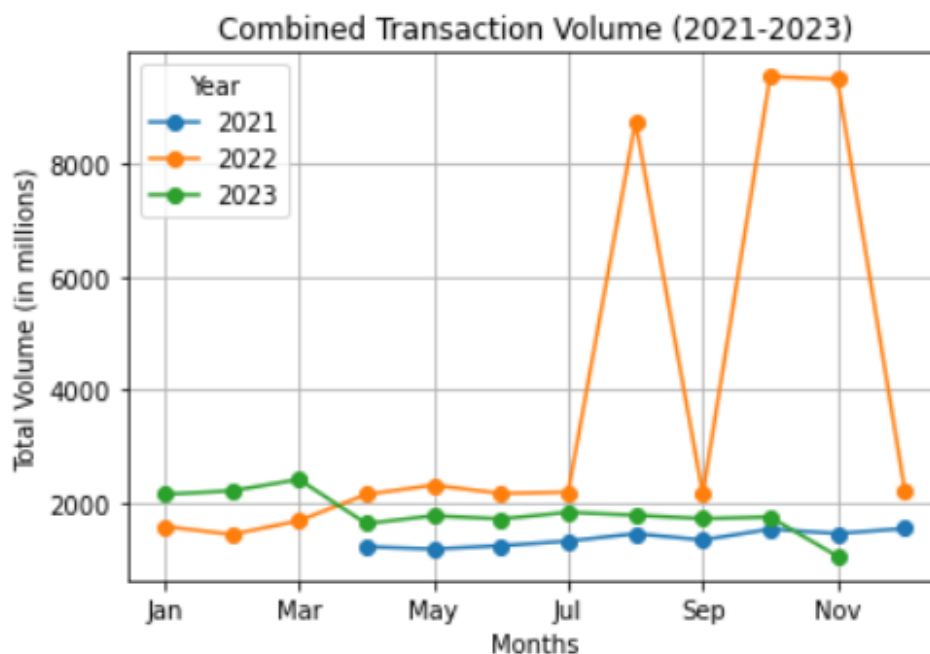

(3) Line plot of the GDP Data

The graph illustrates a robust growth in India's GDP from 2010 to 2022, with a notable surge post-2016—the year UPI was introduced. This increase becomes even more pronounced after 2020, highlighting the potential correlation between the widespread adoption of UPI and the country's economic expansion. The

upward trend after the implementation of UPI suggests that the ease of digital transactions may have positively influenced economic activity.
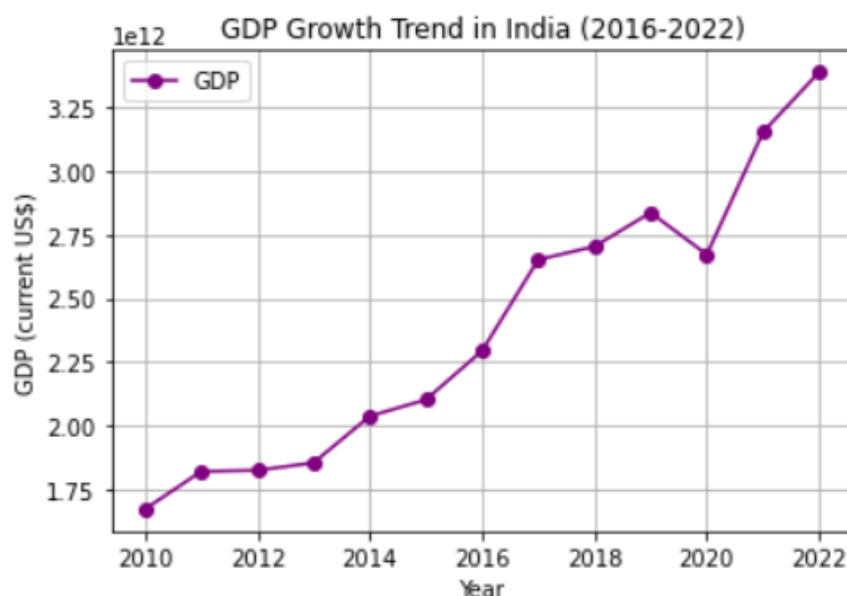
(4) Financial Inclusion Data Plot for the Various Indicators
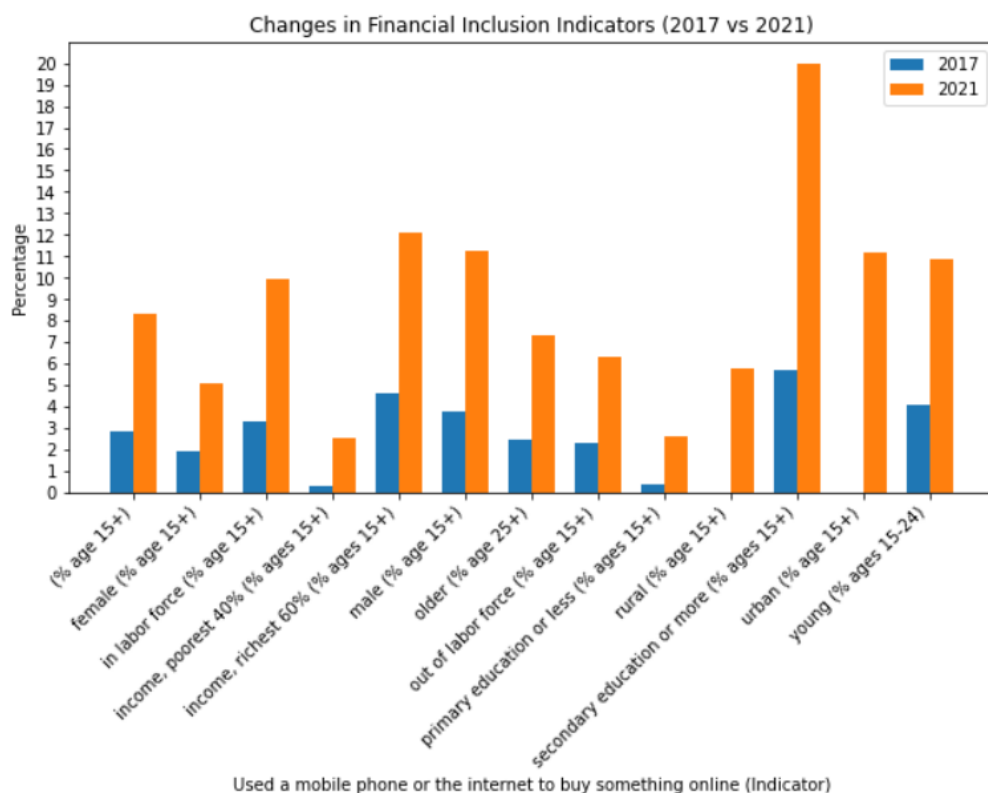
Indicator	Country Name	Country Code	Series Code	2017	2021
Used a mobile phone or the internet to buy something online (% age 15+)	India	IND	fin14b.t.d	2.86	8.28
Used a mobile phone or the internet to buy something online, female (% age 15+)	India	IND	fin14b.t.d.1	1.93	5.09
Used a mobile phone or the internet to buy something online, in labor force (% age 15+)	India	IND	fin14b.t.d.12	3.30	9.90
Used a mobile phone or the internet to buy something online, income, poorest 40% (% ages 15+)	India	IND	fin14b.t.d.7	0.29	2.52
Used a mobile phone or the internet to buy something online, income, richest 60% (% ages 15+)	India	IND	fin14b.t.d.8	4.57	12.12
Used a mobile phone or the internet to buy something online, male (% age 15+)	India	IND	fin14b.t.d.2	3.75	11.26
Used a mobile phone or the internet to buy something online, older (% age 25+)	India	IND	fin14b.t.d.4	2.41	7.31
Used a mobile phone or the internet to buy something online, out of labor force (% age 15+)	India	IND	fin14b.t.d.11	2.32	6.28
Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+)	India	IND	fin14b.t.d.5	0.32	2.61
Used a mobile phone or the internet to buy something online, rural (% age 15+)	India	IND	fin14b.t.d.9	NaN	5.79
Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)	India	IND	fin14b.t.d.6	5.72	20.00
Used a mobile phone or the internet to buy something online, urban (% age 15+)	India	IND	fin14b.t.d.10	NaN	11.16
Used a mobile phone or the internet to buy something online, young (% ages 15-24)	India	IND	fin14b.t.d.3	4.05	10.87

The data depicted in the graph reveals a striking leap in financial inclusion across a broad spectrum of indicators from 2017 to 2021, suggesting a significant shift in the financial behavior of India's population. Each indicator – ranging from gender, employment status, income levels, educational background, and age groups – shows marked improvement, illustrating the profound reach of digital financial services. This leap, particularly in a span of four years, hints at an accelerated adoption rate of digital payment platforms like UPI, which have arguably made financial transactions more accessible and convenient.

For the 'female' and 'male' demographics, the increase not only reflects a general trend but also underscores strides in gender inclusivity in the digital economy. Labor force participation, both within and outside, indicates a more robust integration of the workforce in the digital finance ecosystem. The disparity between 'poorest 40%' and 'richest 60%' has seemingly narrowed, pointing to digital finance permeating economic strata. Educational divides show an enlightening trend as well, with those having 'primary education or less' and those with 'secondary education or more' displaying remarkable growth, suggesting educational barriers to digital inclusion are being overcome. The 'young' demographic's surge underscores the tech-savviness and adaptability of youth, potentially heralding a future of even greater digital financial engagement.

Interestingly, while the 2017 data for 'rural' and 'urban' populations are absent, their 2021 figures offer a positive outlook, with urban areas likely leading the charge due to better infrastructure, yet rural areas are not far behind, indicating broader national progress. This comprehensive upswing in digital financial participation illustrates the transformative impact of platforms like UPI on financial inclusivity, paving the way for a more equitable economic landscape.

(5) Merged Dataframe table of all three datasets together across specific years
Link to CSV File

Conclusion

This investigation into the impact of UPI and other digital payment methods on India's economic growth and financial inclusion concludes affirmatively. The data analysis, spanning transaction volumes, GDP growth, and financial inclusion metrics, indicates a positive correlation between the rise of digital transactions and economic advancement. UPI, a government-backed initiative, has notably facilitated this growth, enhancing financial accessibility even in remote regions. The trends observed suggest a continuing upward trajectory for digital transactions in India, aligning with global patterns of economic development fostered by digital financial services. This study not only highlights the transformative power of digital finance in emerging economies but also underscores the potential of technology-driven solutions in achieving inclusive economic growth.