Digital Payment Service in India
Case of UPI

T221-VS-DT295: Reading Elective

Tanishq Jaswani
International Institute of Information Technology, Bangalore
IMT2018077
Tanishq.Jaswani@iiitb.ac.in

***Abstract*—The 'Unified Payment Interface' is an inter-bank transfer mechanism that allows you to send and receive money. National Payments Corporation of India (NPCI) established it, and it is governed along with support of the Reserve Bank of India. The BHIM-UPI software is based on the Immediate Payment Service (IMPS) infrastructure and allows users to send money immediately between two bank accounts. A client's UPI app can be linked to many bank accounts. Users of the BHIM app may send and receive money to and from UPI payment addresses, as well as non-UPI accounts (by scanning a QR code containing account number, IFSC code, or MMID (Mobile Money Identifier) Code). Payment Service Providers (PSPs) are banks that are listed with NPCI's UPI application. PSP refers to banks that have developed their own mobile application to ease transactions. Issuers are banks that do not have their own payment interface and rely on third-party software to conduct UPI transactions.**

The article begins with an overview of digital payments and the current state of UPI. After that, the focus changes to analyzing patterns and doing regressions to discover how and what factors influence digital payments. In order to fully achieve the objectives, this article has employed both primary and secondary data.

***Index Terms*—UPI, IMPS, NPCI(National Payment Corporation of India), PSP(Payment Service Provider), TPAP(Third Party Application Providers), VPA(Virtual Payment Address), MCC(Merchant Category Code), P2P(Peer to Peer), P2M(Peer to Merchant), BD(Business Decline), TD(Technical Decline)**

I. Introduction

India is no stranger to cashless transactions. Customers can choose from a variety of cashless transaction options to suit their needs. It can be accomplished in the following ways:-

1) Debit or Credit Card
2) Mobile Banking
3) Net Banking
4) NEFT / RTGS
5) Unified Payment (UPI)
6) Prepaid Cards
7) Mobile wallets
8) Immediate Payment Service (IMPS)
9) Aadhar Enabled Payment System (AEPS)
10) USSD (Unstructured Supplementary Service Data)

Use case solutions may be classed as these forms of digital payments.

1) Card and Mobile Payments
2) Authentication and AEPS solutions
3) AutoPay and Bulk Payments
4) Bill Payments
5) Loyalty and Offers API
6) Soft PoS and QR Based Solutions
7) Contactless Parking and Toll Payment Solutions

In this study, we will focus on UPI in particular. The Unified Payments Interface (UPI) is a system that integrates several financial services, seamless fund routing, and merchant payments into a single mobile app (of any participating bank). It also takes care of "Peer to Peer" collection requests, which can be paid as well as scheduled as needed and convenient.

In view of the aforementioned, the National Payments Corporation of India (NPCI), which serves as the country's umbrella organisation for all retail payments, conducted a test launch with 21 member banks. The pilot was inaugurated on April 11, 2016 in Mumbai by Dr. Raghuram G Rajan, Governor of the Reserve Bank of India. Banks have began submitting their UPI-enabled applications to the Google Play store from August 25, 2016. UPI records transactions of Rs 8000 crore per day.

The following are the different types of people who participate in UPI Architecture:

1) Payer PSP (Payment Service Provider)
2) Payee PSP
3) Remitter Bank
4) Beneficiary Bank
5) NPCI
6) Bank account holders
7) Merchants

In UPI, there are two types of financial transactions: Push (Send Money) and Pull (Receive Money) (Request Money). Mobile banking registration, generate OTP, set/change PIN, check transaction status, raise dispute/query are examples of non-financial transactions.

VPA (Virtual Payment Address), Account number and IFSC Code, and QR Code are the three payment methods available in UPI.

A. Key Features of UPI

So, the first thing that comes to mind is how UPI differs from other digital payments that are presently available to us.

Let's go over the advantages and features of UPI:

1) Money transfer through mobile device in real time 365 days a year, 24 hours a day, 7 days a week.
2) A single mobile application may be used to access several bank accounts.
3) Single Click 2 Factor Authentication – Meets regulatory standards while also providing a convenient single-click payment option.
4) The client's virtual address provides extra security for Pull and Push by eliminating the need for the customer to supply sensitive information such as card number, account number, IFSC, and so on.
5) Using a QR code is the greatest answer to the problems of Cash on Delivery, rushing to an ATM, or calculating precise amounts.
6) Payments to merchants through a single app or in-app transactions.
7) Payments for utility bills, payments made over the counter, and payments made using QR codes (Scan and Pay).
8) Donations, collections, and disbursements can all be increased or decreased in size.
9) Complaints may be sent directly from the app.

B. Roles and Responsibilities

1) NPCI:

- The Unified Payments Interface (UPI) platform is owned and operated by NPCI.
- With regard to UPI, NPCI establishes rules, regulations, and guidelines, as well as the participants' respective duties, obligations, and liabilities. This comprises transaction processing and settlement, dispute resolution, and settlement cut-offs.
- Issuer banks, PSP banks, Third Party Application Providers (TPAPs), and Prepaid Payment Instrument issuers (PPIs) are all allowed to participate in UPI, according to NPCI.
- The UPI system and network provided by NPCI is safe, secure, and efficient.
- Members who use UPI can use NPCI's online transaction routing, processing, and settlement services.
- NPCI can perform audits on UPI members and request data, information, and documents related to their involvement in UPI, either directly or through a third party.
- The NPCI gives participating banks access to a system where they may get information, file chargebacks, and check the progress of UPI transactions, among other things.

2) PSP Bank:

- PSP Bank is a member of UPI and connects to the platform to offer UPI payment services, which it then passes on to the TPAP, allowing end-user consumers and merchants to make and receive UPI payments.
- PSP Bank onboards and registers end-user clients on UPI, either through its own app or through TPAP's app, and ties their bank accounts to their individual UPI IDs.
- PSP Bank is responsible for end-user client authentication at the moment of registration, whether through its own app or TPAP's app.
- PSP Bank engages and onboards TPAPs so that end-user clients can utilise the TPAP's UPI app.
- To operate on the UPI platform, PSP Bank must verify that TPAP and its systems are sufficiently secure.
- PSP Bank is responsible for ensuring that the TPAP UPI app and systems are audited to guarantee the security and integrity of end-user customer data and information, including UPI transaction data and UPI app security.
- PSP Bank is required to keep all payments data, including UPI Transaction Data, exclusively in India in order to facilitate UPI transactions.
- PSP Bank is responsible for allowing all UPI consumers to link their UPI ID to any bank account from the list of banks available on the UPI network.
- PSP Bank is responsible for establishing a grievance redressal procedure for addressing end-user customer complaints and disputes.

3) TPAP:

- TPAP is a service provider that uses PSP Bank to participate in UPI.
- TPAP is responsible for adhering to all PSP Bank and NPCI criteria in connection to TPAP's involvement in UPI.
- It is the responsibility of TPAP to guarantee that its systems are sufficiently secure to operate on the UPI platform.
- In connection to UPI and TPAP's participation on the UPI platform, TPAP is responsible for complying with all applicable laws, rules, regulations, and guidelines set by any legislative or regulatory body, including any circulars and guidelines published by NPCI in this regard.
- TPAP is required to keep all payments data, including UPI Transaction Data, that it collects for the sole purpose of enabling UPI transactions in India.
- TPAP is responsible for allowing RBI, NPCI, and other RBI/ NPCI-designated agencies access to TPAP's UPI-related data, information, and systems, as well as conducting audits of TPAP as and when necessary by RBI and NPCI.
- TPAP should provide end-user customers with the ability to file a complaint using the TPAP's grievance redressal facility, which is accessible via the TPAP's UPI app or website, as well as other channels considered acceptable by the TPAP, such as email, messaging platforms, IVR, and so on.

II. Achievements - UPI Statistics at a Glance

When UPI was established in April 2016, there were just 21 member banks. UPI Bank has around 297 active members as of January 2022. This includes 46 PSPs and 251 Issuers. PSPs and Issuers range from well-known banks like Axis, ICICI, and HDFC to smaller regional rural banks like The Udupi Co-operative Town Bank Ltd and Rajkot Peoples Cooperative

Bank Ltd. Along with the expansion in the number of banks using UPI, the volume and value of transactions have expanded significantly, reaching a volume of 4,617.15 Mn and a value of 8,31,993.11 Mn respectively (in Cr.).

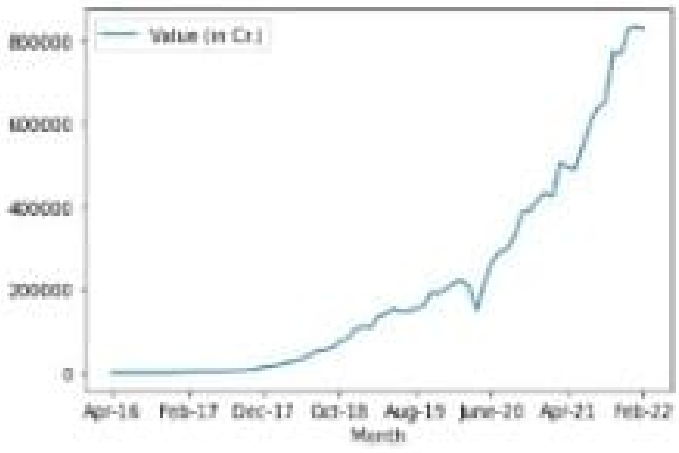

Fig. 1. UPI - Product Statistics - Value(in Cr.) Vs Time graph

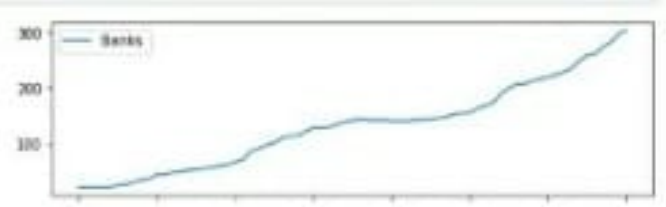

Fig. 2. UPI - Product Statistics - Banks(live in UPI) Vs Time graph

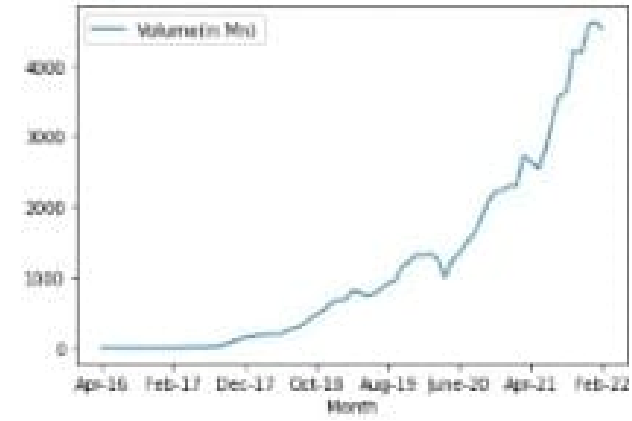

Fig. 3. UPI - Product Statistics - Volume(in Mn) Vs Time graph

In the 3 graphs above we see, increase in number of banks, volume and value throughout the UPI journey. However in the value vs time graph we see a sharp descend at a point which is in the month of Apr-20, which points us to nation-wide lockdown due Covid-19 pandemic.This has happened globally and has been coined in the term ”dash to cash” which means usage of cash under extreme uncertainity. After which we see

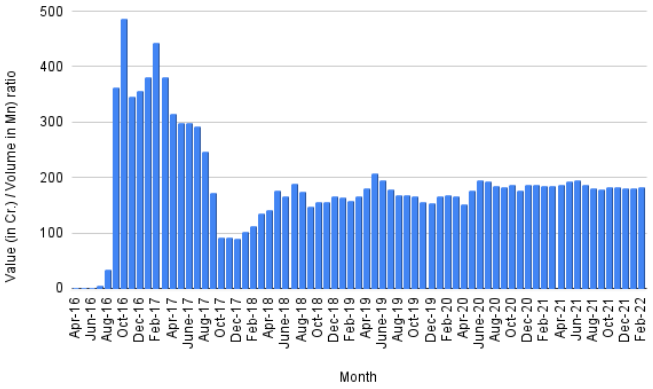

Fig. 4. UPI - Product Statistics - Value(in Cr.)/ Volume(in Mn) ratio Vs Time graph

straight sudden incline in the graph due to social distancing which gave boon to fast digital payments.

On the NPCI website, there are around twenty (20) third-party apps mentioned, as well as PSP banks and their specified handles. These include popular apps like CRED, Google Pay, Amazon Pay, Phonepe, and, more recently, Whatsapp and YuvaPay. Note: WhatsApp’s UPI has a maximum user base of forty (40) million registered users.

Due to the UPI payment system’s upper limit of Rs. 2,00,000, NEFT and RTGS continue to dominate in terms of volume, accounting for 89.29% of digital transactions in May 2021, totaling 104.52 trillion rupees (RBI).

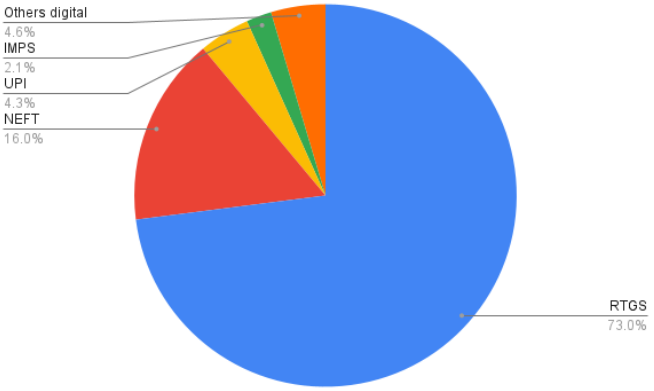

Fig. 5. Digital payments proportion in India, Source: RBI Data

Despite the development of digital payments in India, the vast bulk of transactions — about 90% — are still carried out in cash. Historically, cash demand remains strong throughout festival season since a big number of retailers still rely on cash payments for end-to-end transactions. Smaller towns and cities remain a weak link in the pan-India digital payments system, therefore cash remains a popular means of payment. For the fiscal year 21, the ratio of currency in circulation to GDP reached a record high of 14.5 percent. The rise occurred

as the epidemic raised cash demand while shrinking GDP. Simultaneously, the growth of all types of digital payments continues.

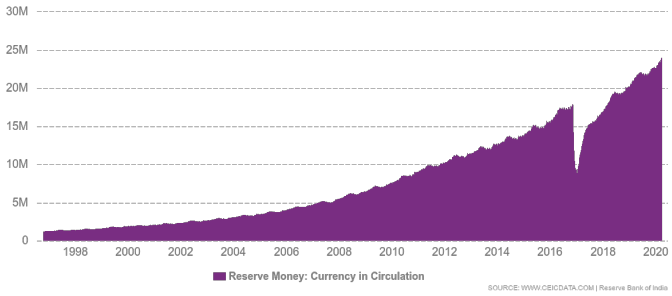

Fig. 6. Cash Trends - Source:CEIC

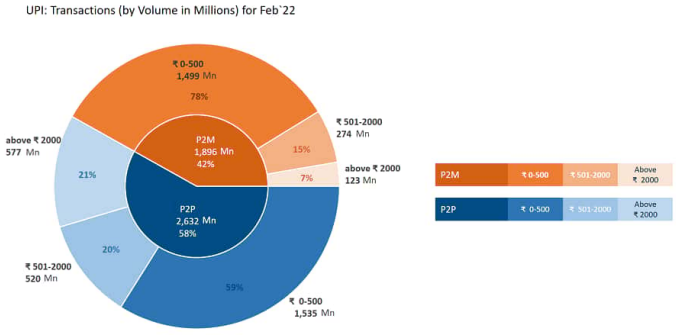

Fig. 7. UPI: Transactions (by Volume in Millions) for Feb'22, Source: NPCI

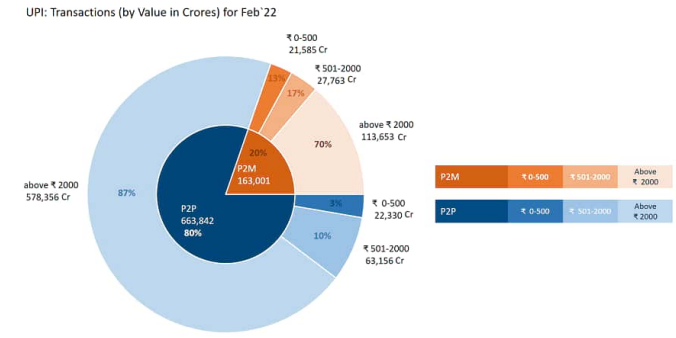

Fig. 8. UPI: Transactions (by Value in Crores) for Feb'22, Source: NPCI

Among the digital methods of payment, the amount of transactions using RTGS raised by 5.7 percent during the year, with a combined value of 1,056 lakh crore, a decrease of 19.5 percent from a year earlier year, owing to a reduction in large value corporate transactions in line with the stagnation in economic growth.The RTGS facility was offered across 1,75,947 branches of 227 banks by the end of March 2021. During the year, activities through the National Electronic Funds Transfer (NEFT) system increased by 12.7%. The

UPI Payer PSP Performance (Feb'22)					
Sr. No.	Payer PSP	Total Volume (In Mn)	Approved %	BD %	TD %
1	Yes Bank Ltd	1792.10	97.87%	2.13%	0.00%
2	Axis Bank Ltd.	723.79	98.06%	1.94%	0.00%
3	Paytm Payments Bank	634.58	98.06%	1.92%	0.02%
4	ICICI Bank	552.51	97.94%	2.06%	0.00%
5	State Bank Of India	446.83	97.74%	2.24%	0.02%
6	HDFC BANK LTD	418.82	98.61%	1.39%	0.00%
7	BHIM	25.47	91.28%	8.57%	0.15%
8	Kotak Mahindra Bank	7.18	96.20%	3.80%	0.00%
9	Airtel Payments Bank	6.65	87.23%	12.54%	0.23%
10	IDFC FIRST Bank	2.86	95.00%	4.96%	0.04%
11	India Post Payment Bank	2.36	93.44%	6.50%	0.06%
12	Federal Bank	2.36	96.84%	3.12%	0.04%
13	Jio Payments Bank	2.07	95.10%	4.40%	0.50%
14	Deutsche Bank	0.88	99.92%	0.08%	0.00%
15	INDUSIND BANK	0.81	94.84%	5.15%	0.01%

Fig. 9. UPI Payer PSP Performance Top 15 (Feb'22), Source: NPCI

UPI Payee PSP Performance (Feb'22)					
Sr. No.	Payer PSP	Total Volume (In Mn)	Approved %	BD %	TD %
1	Yes Bank Ltd	1712.70	98.95%	0.97%	0.08%
2	Paytm Payments Bank	927.78	99.68%	0.29%	0.03%
3	Axis Bank Ltd.	553.08	98.03%	0.57%	1.40%
4	ICICI Bank	486.09	98.39%	0.56%	1.05%
5	HDFC BANK LTD	243.04	97.90%	1.86%	0.24%
6	State Bank Of India	231.97	96.00%	0.72%	3.28%
7	Federal Bank	59.54	97.85%	0.04%	2.11%
8	INDUSIND BANK	23.53	96.35%	2.11%	1.54%
9	Airtel Payments Bank	15.75	99.34%	0.08%	0.58%
10	Kotak Mahindra Bank	10.77	98.65%	0.74%	0.61%
11	Citibank	9.04	99.42%	0.00%	0.58%
12	BHIM	8.19	88.62%	0.21%	11.17%
13	IDFC FIRST Bank	6.00	98.73%	0.13%	1.14%
14	Bank of Baroda	3.60	99.12%	0.17%	0.71%
15	AU small Finance Bank	2.88	99.26%	0.00%	0.74%

Fig. 10. UPI Payee PSP Performance Top 15 (Feb'22), Source: NPCI

NEFT facility was offered through 1,75,283 locations of 225 banks by the end of March 2021.

The number of card payment transactions made with credit and debit cards declined by 19.0 percent and 20.6 percent, respectively, in 2020-21. During the same time period, the value of credit card transactions decreased by 13.7%, while debit card transactions decreased by 5.9%.Prepaid Payment Instruments (PPIs) had a 7.4% decline in volume this year, compared to a 15.7% increase the year before, while transaction value fell 8.3% to 1.97 lakh crore, down from 1.98 lakh crore the year before. As of end-March 2021, the number of Points of Sale (PoS) terminals had risen by 6.5 percent to 47.20 lakh, and the number of Bharat Quick Response (BQR) codes had risen by 76.0 percent to 35.70 lakh. Furthermore, the number of ATMs climbed by 2.0% from 2.34 lakh at the end of March 2020 to 2.38 lakh at the end of March 2021.

India's digital payment system is a promising success story in its own right, thanks to recent regulatory measures and technology advancements. At the same time, the evidence suggests that cash usage is growing.

III. UPI Timeline

On the supply side, a healthy combination of technical innovation, regulatory interventions, and extension and reinforcement of existing infrastructure has fueled digitisation progress, while on the demand side, a growing proportion of the population is embracing financial and digital instruments. The Indian government and the Reserve Bank of India have been working together to push for policy and regulatory reforms. Clearly, UPI absorption was considerably lower at the time, but it has since grown. It is necessary to review UPI's timeline in order to comprehend how it was able to fulfil the aforementioned objectives.

A. Early years of UPI

According to the circular dated July 22, 2016, UPI enablement began for 1000 workers with 5000+ transactions with the issuer and PSP, with a success rate of 90% or above. In addition, a Third Party Audit, a user manual part on the Bank's website, and contact centre activation for UPI support with an application on the Play Store were also required. UPI infrastructure was able to achieve 99.9% uptime in a month, with the ability to handle 150 transactions per second (TPS) and 5,00,000 transactions per day via banks UPI infrastructure. UPI made their public debut on August 25, 2016. The number of member banks, both PSP and Issuer, expanded after the debut. NPCI increased volume handling to 5 million transactions per day while maintaining a TPS of 500. NPCI passed a compliance for successful debit reversals, managing considered approved transactions, and reconciliation to manage dispute handling.

Along with economic initiatives, NPCI established criteria, such as a Checklist for PSP SDK Integration and Web Enablement. All Meta APIs, including "On-us Transactions," are meant to be routed to NPCI by banks.

On June 14, 2017, NPCI announced the start of a Referral and Merchant Cashback scheme for BHIM users. In the same month, the USSD 2.0 system, which includes 41 member banks, was introduced. Technical failures of less than 1% were used to qualify UPI banks for inclusion in the BHIM Merchant Cashback and Referral Bonus scheme. The merchant received 10% of the transaction value as cashback at the end of the month, with a maximum incentive of Rs 50 per transaction. The maximum cashback per merchant per month is Rs 1000, with a minimum transaction value of Rs 25 and a maximum of 10 transactions. In the same year, further economic interventions included Single PSP Model Merchant Integration, RRC - "Refund/Return Reversal Confirmation," Standardization of the account statement narration in UPI, and a mechanism to manage chargebacks for incorrect account transfers.

B. Technical Interventions

In 2018, NPCI performed significant infrastructure modifications in order to assess system capabilities (switching capacity, network bandwidth, server/DB capacity, application capacity, and so on). It was required to guarantee that the Production (PR), High Availability (HA)/Backup, and Disaster Recovery (DR) systems were all in sync, and that the DR system was ready to be used in the event that the Production/Primary, or HA systems failed.

1. Implementation of new CRR (Credit Reversal Request) Response Code (RC) – CS:

NPCI sends a credit request message to the recipient bank after the debit authorization is approved. If the Beneficiary bank does not respond, NPCI will send up to three Check Transaction (CT) notifications to determine the status of the original transaction (Approved/Declined). If NPCI receives no answer after three CT messages, it will send a CRR - Credit Reversal Request Message. The transaction would be considered successful in the aforementioned flow when the beneficiary bank sends an online response to NPCI indicating that it has been accepted, i.e. RC - CS (Credit Success) for CRR. Instead of declining an approved transaction, NPCI suggested that it be approved by using the new response code RC-CS. The permission number must be included in the bank's answer to CRR.

This reduced the number of timed-out and refused transactions while simultaneously boosting the approval rate.

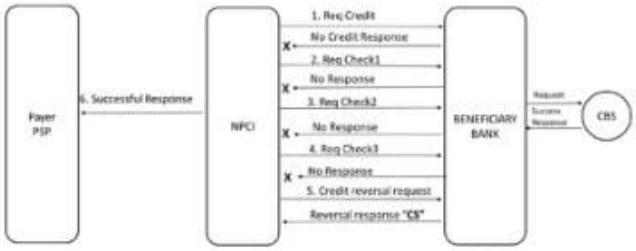

Fig. 11. Implementation of new Response Code (RC).

2. Decline response code for I/O (Input/Output) Error:

Existing Process - If a debit request submitted to the remitter bank fails due to a connection timeout, the UPI switch sends the Check Transaction Request (up to three times) and Debit Reversal Request to the remitting bank. The UPI switch sends Check Transaction Requests (up to three times) and Credit Reversal Requests to the beneficiary bank in the same way it does in the Credit Request situation.

Proposed Process - In the proposed process, the UPI switch would treat a connection timeout as a decline transaction and will not send check transaction or debit/credit reversal request messages, which will save banks time and effort.

3. Execution of VR/CT between Beneficiary switch and CBS (VR – Verification Request / CT – Check Transaction)

Existing Process: When a UPI switch delivers a credit request message to a beneficiary switch, the beneficiary switch will pass it to CBS and wait up to 29 seconds, or the time set by the banks (as the response time to NPCI is 30 seconds). If CBS does not respond within that time, the beneficiary switch will send the UPI switch a response timeout status. NPCI sends check transaction (CT) and credit reversal request (CRR) messages to beneficiary switches in the same way. The

following is the TAT for credit log messages: 30 seconds for the original request, 30 seconds for CT-1, 2, and 3 (each CT TAT is 10 seconds), and 30 seconds for CRR TAT, for a total of 90 seconds.

Proposed process - Instead of waiting 29 seconds, the beneficiary bank could launch VR/CT to CBS every 5 seconds to inquire about the status of the transaction (whether accepted or rejected). Checking transaction messages and credit reversal request messages supplied by NPCI should follow a similar procedure. This method will dramatically reduce the number of presumed authorised transactions, which can occur due to network fluctuations or other factors.

C. The way forward - UPI 2.0

NPCI granted Foreign Inward Remittance (FIR) over UPI in the summer of 2018, coupled with the introduction of Bill Pay feature (BBPS) on the BHIM app. Because AADHAAR numbers are sensitive information, and the updated framework for their use in the financial environment is still emerging, NPCI has withdrew Pay to Aadhaar feature from UPI and IMPS. The features of UPI 2.0 will be rolled out on August 14, 2018.

- One-time mandate with block functionality: The consumer can pre-authorize a transaction and assign the funds in their account for a future debit.
- In UPI, an underlying account is an overdraft (OD) account: UPI now allows for the inclusion of savings and current accounts. With this new functionality, the user may now link an overdraft account if his or her bank determines that he or she is eligible for one.
- The invoice will now arrive in the inbox (View attachment and pay).
- For P2P, the UPI transaction ceiling has been increased to 2L, while the transaction frequency restriction has been reduced to 10 transactions.

NPCI concentrated its efforts in 2019 on the P2PM category for unorganised or small merchants, as well as the onboarding of RRBs (Regional Rural Banks) as UPI acquirers. In UPI, the NPCI also forbids merchants and channel partners from levying a premium. Following SEBI's request, NPCI included a PAN validation in the UPI process to prevent applications from being submitted via third-party accounts. To improve the client experience, it also developed a secondary/backup UPI ID.

To avoid duplicates and protect the UPI ecosystem, NPCI changed the nomenclature in 2020. PSP and TPAP must ensure that the total volume of transactions initiated through the TPAP does not exceed 30% of the overall volume of transactions processed in UPI during the preceding three months (on a rolling basis).

The main goals set for future are encouraging healthy competitions, improving customer convenience with self regulatory organization and online dispute resolution. Along with ensuring affordable cost, increasing confidence.

NPCI introduced a Rs 5L per transaction restriction for certain categories in UPI - IPO, G Sec under RBI Retail Direct Scheme in late 2021. For safe transaction authentication, NPCI has established the Server-Side Common Library (S-CL), which is designed exclusively for feature phone and voice-based payments. International merchant payments acceptance using UPI - UPI Global was included in the final deployment. In September 2021, Liquid Group, a cross-border digital payment service provider, struck an agreement with NIPL to launch a UPI-based QR code payment system in Singapore, Nepal, Malaysia, Thailand, Philippines, Vietnam, Cambodia, Hong Kong, Taiwan, South Korea, and Japan starting in 2022. Every end-user client can file a complaint about a UPI transaction on the PSP app / TPAP app for the dispute resolution mechanism. If the complaint/grievance is not handled, the PSP Bank will be the next step of escalation, followed by the bank (where the end-user customer's account is maintained), and then the NPCI, in that order. Following the exhaustion of these alternatives, the end-user client can file a complaint with the Banking Ombudsman and/or the Ombudsman for Digital Complaints, if applicable.

Reqpay	List PSP
RespAuthDetails	List Account Providers
ReqAuth	List Keys
ReqTxn	List Account
RespPay	List Verified Address Entries
	Manage Verified Address Entries
	Validate Address
	Set Credentials
	Pan API,
	Bal Enquiry API
	List VAE
	Reqval customer
	Mandate API
	QR validation API
	Check Transaction
	Req OTP

Fig. 12. List of API's as of 2020.

IV. Cost Structure

We answer a simple question in accordance with Section 10A of the Payment and Settlement Systems (PSS) Act, 2007, and the mandated electronic means of payment, the Unified Payment Interface (in short UPI). Is it true that banks and system providers are prohibited by law from charging anyone who makes or receives a payment over UPI?

Following the release of UPI 2.0, prominent private banks have begun charging fees for person-to-person (P2P) payments utilising UPI that exceed 20 transactions per month. For transactions of less than or equal to Rs 1000, the fee is Rs 2.50; for transactions of more than Rs 1000, the fee is Rs 5. These fees are also subject to the goods and services tax (GST). For any unaided digital means of payment above four debits per month, the largest public sector bank levied a tax of Rs 17.70 (including of GST). This was especially true for our large group of impoverished depositors with Basic Savings Bank Deposit (BSBD) accounts (which include all Pradhan Mantri Jan Dhan Yojana (PMJDY) accounts). Despite

the Reserve Bank of India (RBI) and the PSS Act forbidding direct or indirect charges for NEFT- and UPI-based electronic transactions, this occurred during the last few years, including in Q4 of FY20.

According to Section 10A of the Payment and Settlement Systems (PSS) Act, 2007, "no bank or system provider shall impose, whether directly or indirectly, any charge upon a person making or receiving a payment by using the electronic modes of payment prescribed under section 269SU of the Income-tax Act, 1961." Under Rule 119AA of the Income-tax Rules, 1962, UPI (BHIM-UPI) was notified as a prescribed electronic means of payment as of January 1, 2020. As a result, banks and system providers are forbidden from charging a person for BHIM-UPI payments made or received.

It goes without saying that banks spend a lot of money on cash management in order to ease financial transactions in the country. The majority of these costs are not passed on to clients directly by banks. The cost of servicing UPI, on the other hand, is insignificant when compared to the fees that banks experience when dealing with cash.

However, while we work on UPI pricing, there is an underlying assumption that if banks are not permitted to charge, they would lose money. If that's the case, why should the government insist on it? It's important to remember that customers implicitly pay a high price to banks by foregoing income on savings and current accounts. The yearly implicit price paid by depositors in savings and current accounts (for FY19-20) is in the region of Rs 1.29 lakh crore. As a result, what is viewed as a "free" service provided by banks in the form of savings/current accounts is really paid ex ante by depositors who choose to park their cash in these accounts at a reduced rate of return. This might be one of the reasons why the government insists on a zero-fee digital payments solution like the UPI.

Is it realistic for the government to make digital transactions free? Given that digitization via UPI saves banks money in several ways as compared to delivering the same service via paper-based services (cash and cheques), the government has ample rationale to make UPI payments free of charge. While banks must contribute to the payment system, this does not negate the government's and RBI's responsibility to share the cost burden in their efforts to expand the country's digital payment system and enable consumers to shift away from cash for all small, medium, and big transactions. The government and the Reserve Bank of India have been enduring enormous costs associated with cash printing and administration. They've spent almost Rs 5000 crore on cash printing alone in the last several years, and considerably more on cash management. The amount of money spent on UPI might be significantly smaller, and it could even reduce the amount of money spent on currency. A lower cash-cost burden must be channelled in part to maintain the UPI ecosystem. While UPI is still in its infancy in terms of replacing cash, it needs RBI's full support due to its quick advancement and future promise. In the same way that the RBI accounts for the cost of currency in its books, it should account for the costs of administering the UPI system. As a digital payments platform, UPI improves tax compliance efficiency and provides general convenience for the public benefit. With the government's goal of no direct or indirect charges on UPI payments, an equitable cost-sharing arrangement between the government and the RBI is required (with UPI being the simplest alternative to cash in this era of mobile phones).

UPI and Rupay transactions are both free. These businesses, on the other hand, still generate revenue although not enough but by the following ways -

1) They get money from telecom companies when we recharge our phones.
2) They get commissions when we pay our bills, such as DTH, insurance, and electric bills.
3) When we make an online purchase using these applications, they receive a commission.
4) They gain money by enrolling merchants.
5) They may make money by selling their POS equipment.
6) They allow retailers to place advertisements on their app.
7) They can generate income based on the volume of transactions done by enabling partners to utilise their platform as a switch.
8) They have a large user base and may benefit from the data. Data gives significant insights into consumer buying behaviour; this sort of knowledge may be used to anticipate what customers will buy or how they will make purchasing decisions; this is just one example; many more predictions could be produced.

Most of these PSP providers are now losing money, but with over 2 billion UPI transactions every month, existing players have a great opportunity to profit once fee limitations are lifted and they are able to charge even a little fee.

V. Around the Globe

A. Addressing

New systems are depending on aliases and other directory services more than ever before to improve the user experience by making payment addressing easier. Customers may choose between phone numbers, account numbers, and domain-based aliases (e.g., user@bank) when UPI launched in 2016. Customers may choose how they wanted to identify themselves for the sake of receiving payments thanks to this invention.

Many effective quick payment systems, such as InstaPay in the Philippines (which began in 2018), continue to rely on account and bank routing numbers, forcing receivers to submit difficult-to-remember and occasionally sensitive information. Phone numbers are used in schemes between mobile network carriers in countries like Tanzania (introduced in 2015) and Kenya (launched in 2018), while off-network transactions sometimes require a distinct menu.

Brazil's solution came up with a lot of the same addressing characteristics as UPI. Users can choose an alias from a phone number, e-mail address, or any other alphanumeric character. In contrast to the decentralised concept of UPI's domain-based addressing, where data linking a person's alias to their

account is saved in their provider's database, user data is maintained in a centralised directory at the Brazilian central bank. With any strategy, there are trade-offs. For address resolution and routing, centralised models require additional data to be provided with the payment system. Decentralized models necessitate a mechanism for the sender to identify both the receiver's account and financial institution, which may limit the alternatives for identifying a consumer.

The Reserve Bank of Australia (RBA) and Australia's banking industry collaborated to establish Australia's New Payments Platform (NPP) in 2018. NPP Australia Ltd (NPPA), a not-for-profit corporation with 13 owners — 12 industry participants and the regulator — oversees the system. With no central switch, the system has chosen a distributed clearing design based on SWIFT messaging. The RBA serves as the settlement agent, and settlement takes place in real time.

Jordan Mobile Payment (JoMoPay) is a mobile payment system created and maintained by Jordan's Central Bank (CBJ). It supports EMIs and banks that issue e-money wallets by providing wallet interoperability. Initially, all wallet providers were required to connect to JoMoPay and pass both on-net and off-net transactions via it. Ownership and operation of JoMoPay were eventually transferred to the Jordan Payments and Clearing Company, a distinct public/private company (JoPACC).

B. Connecting Fintechs

Separates user experience from account ownership - Customers may begin a UPI-based payment using the app of any Connecting bank or non-bank, regardless of which institution controls their account. Even fintechs who do not engage in UPI directly (for example, Google Pay) can use it indirectly through a participant, with commercial conditions established separately.

Other markets have begun to implement third-party payment initiation, but none have done it as gracefully as India. Payment initiation service providers (PISPs) are regulated in the European Union and the United Kingdom, with nations like Singapore and Japan establishing similar regulations. To complete payment authorisation, many of these solutions still require the consumer to transfer (change applications) to their account provider. Non-bank account issuers can engage directly in Brazil's system, although the subject around third-party initiation has been split from the continuing debate in Brazil about open banking. Brazil's open banking system is being pushed out in phases until 2021, after the issuance of a resolution to introduce open banking in 2020.

C. Customer/Merchant Fees

Some systems establish exchange rates but let the market decide on fees. Others take the opposite approach, establishing guidelines for end-user price but keeping interchange more flexible. Other systems (or regulators) establish standards in both of these areas.

These guidelines have been revised several times in India. Initial interchange rates were applied to P2P and merchant transactions, which allowed for a limited number of costs. Late January 2019, India's Ministry of Finance changed instructions to prevent any consumer or merchant fee over UPI, while requiring acceptance for enterprises with annual sales of more than Rs 50 crore (about $7 million).

The Indian government announced fresh financing of roughly $200 million in February 2021 as a "incentive to boost digital payments."

PIX began with a ban on any consumer fees, but it now enables acquirers to impose merchant fees without restriction. There is also no PIX-mandated exchange, which means the acquirer can retain the full charge (unlike, for example, card transactions where fees are often shared with the issuer).

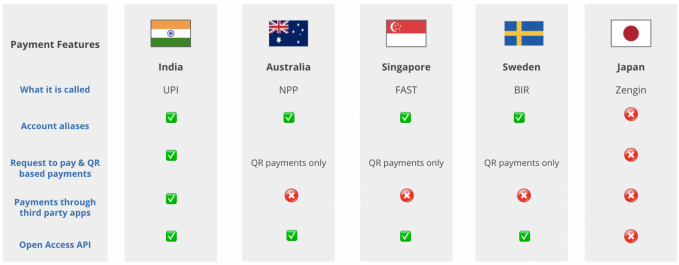

Fig. 13. Source: ThoughtWorks

VI. ML - Regressions

A. Methodology

We illustrate how to vectorize the corpus into machine-understandable notations using correct pre-processing and feature extraction approaches.

1) Data Collection: The data has been collected from the official site of NPCI and RBI only. The data does not contain any survey-related data or any unknown source. Followed by is the exploratory data analysis and pre-processing.

2) Model used: Timestamp series - A timestamp is a symbol that represents a certain point in time. The term "period" refers to a time span. Periods can be used to see if a certain event occurred during the specified time period. After that, we use linear regression, a statistical approach for modelling connections between a dependent variable and a collection of independent variables.

B. Inferences

Heat-map Correlation matrix: A heatmap is a color-encoded matrix representation of rectangular data. It accepts a 2D dataset as a parameter. It's possible to convert the dataset into an array. Because it can display the relationship between factors, including time, this is a wonderful method to depict data. To symbolise more common values or greater activities, brighter colours, primarily reddish hues, are utilised, whereas darker colours are favoured to represent less common or activity values. The name of the shading matrix also defines the heatmap. Correlation is a statistical technique for demonstrating the relationship between two variables. It's used to discover the pairwise correlation between all of the dataframe's

columns. Any NA values are immediately removed from the equation. For any columns in the table that aren't numeric are ignored.

Fig. 14. Heat-map between above UPI Variables

	Banks	Volume(in Mn)	Value (in Cr.)
Banks	1.000000	0.943858	0.940353
Volume(in Mn)	0.943858	1.000000	0.998723
Value (in Cr.)	0.940353	0.998723	1.000000

Fig. 15. Correlation matrix between above UPI Data Variables

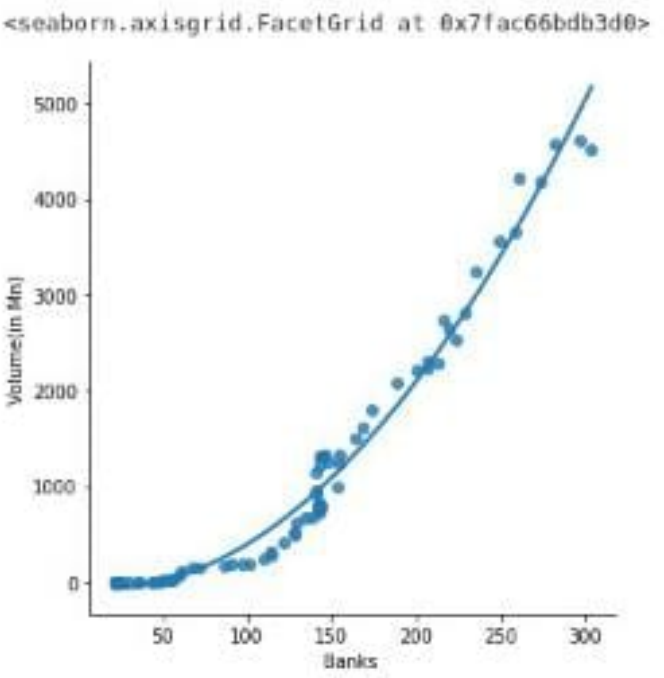

Fig. 16. Seaborn Scaler plot

Fig. 17. Linear Regression Score

Linear Regression: The two variables are presumed to be linearly connected from the above. As a result, we strive to find a linear function that properly predicts the response value(y) as a function of the feature or independent variable (x). The two variables are believed to be linearly connected. As a result, we strive to find a linear function that properly predicts the response value(y) as a function of the feature or independent variable (x). Linear regression is a supervised learning machine learning technique. It carries out a regression job. Based on independent variables, regression models a goal prediction value. It is mostly utilised in predicting and determining the link between variables. The type of link between dependent and independent variables differs amongst regression models.

Step 1: Importing all the required libraries Step 2: Reading the dataset Step 3: Exploring the data scatter Step 4: Training our model Step 5: Exploring our results

The high score of our model suggests that our regressive model has fitted very well into the existing data as our x is number of banks and y is volume of transactions in UPI.

VII. Conclusion

Due to customers' preference for contact-less payments over other methods, UPI has seen significant development in recent years. According to the study, the expansion of digital payments has accelerated, particularly in the retail payment sector on the UPI platform. The first key facilitators of this transition were smartphone penetration and high-speed internet access, and their widespread adoption across the country was an essential prerequisite for the quick acceptance of digital payments. Demonetization, and more recently, the virus, have further reinforced this trend by encouraging customers to choose secure, contact-less payments to cash. State wise penetration indicates huge variance and room for growth.

A. Challenges faced by UPI and suggestions to Improve

Every invention comes with its own set of problems and hazards. Some of these issues fade away with time, while others persist, needing the user to make modifications, and UPI is no exception. UPI has its own set of problems that must be addressed. These are :-

1) The four-party UPI approach, in which a client of one bank is free to utilise the application of another, creates a gap and a risk of transaction failure. It also makes grievance resolution harder since the client may be unsure to whom the matter should be directed. Many times, the consumer brings his problem to the bank that

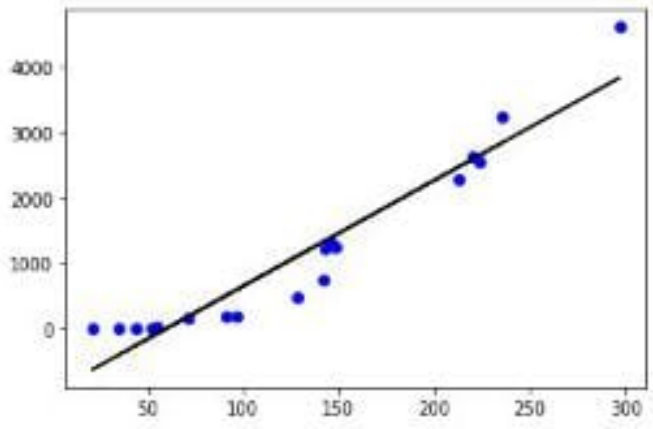

Fig. 18. Regression Predict

controls his account, but the transaction may not have been accessible to his bank because it was completed using another bank's UPI application.

2) Despite the fact that India has the world's second biggest Smartphone user population, surpassing even the United States (Indian Express, 2016), smartphone penetration in India, particularly in rural areas, is still quite low.
3) Despite the government's promotion of UPI and other digitalized payment modes, and even after the strong move on demonetization, people continue to be heavily reliant on cash, owing to a lack of financial literacy, education, awareness, and, most importantly, deeply ingrained attitudes and habits that will take a long time to change.

The facts and numbers from NPCI, as well as the research findings from this study, imply that the individual-to-merchant payment area might produce higher volumes. This might be for rent, bill payments, chit fund or mutual fund donations, and so forth. UPI should develop a more compelling value offer for merchants, such as loyalty programmes, post-purchase analytics, merchant ratings, systematic savings, and so on, in order to move UPI into the peer-to-peer arena.

VIII. Acknowledgement

Every accomplishment is accompanied by an indescribable outpouring of appreciation to those who made it possible, without whom it would not have existed in the first place. I present them with the words of thanks that I had engraved on my mind.

I'd want to express my gratitude to IIITB for providing me with this chance as well as the required facilities and library assistance.

I'd like to express my gratitude to my mentor, Prof. V. Sridhar, for his timely and insightful advice and ideas for this report.

References

[1] Medium
[2] Hindustan Times
[3] NPCI
[4] RBI
[5] Bloomberg
[6] Live Mint
[7] Research Gate