



# Productivity

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## Focus : Financial Technology

Technology Investment and its Effect on the Productivity of Banks in India

Artificial Intelligence and Banking Services

Customer Experience with Digital Banking

Input-Output Model Selection in DEA Evaluation Framework

Financial Inclusion through Mobile Banking Technology of Public Sector

Peer to Peer Restricted Distributed Ledger Technological Arrangement

User Behaviour and Preferences towards Digital Wallets across Age Groups

Manufacturing Sector Employment in India: Evidence from panel data

Impact of Direct Institutional Credit on Agricultural Productivity in India

Agrarian Distress and Indebtedness of Farmer Households in Rural Uttar Pradesh

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# Technology Investment and its Effect on the Productivity of Banks in India

T VISWANATHAN, KARTIKAY PATHAK AND NIDHI NAIR

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*The objective of this paper is to examine whether technology leads to an increase in a bank's productivity. The main objective of technology investment is to improve the efficiency of operations, reduce employee cost and increase the revenue by offering innovative products and services. There is a trade-off between the cost of investment and the benefits arising thereon. The paper examines whether the investment in technology improves bank productivity. Return on Assets (ROA) and Return on Equity (ROE) are considered as the performance measures (outputs) of banks. The input variables are the ratio of IT investment to net fixed assets, IT to equity, IT to total cost, and IT to operating cost. Overall, 34 public and private banks were considered for the study, and panel data analysis are applied to measure the effect of leading indicators on profitability. The study covers the period between 2010 and 2019. We found there is a positive effect of investment in technologies on the profitability and performance of the Indian commercial banks. However, the effect is more evident in public sector banks than in private sector banks.*

*Dr T Viswanathan : Professor, Symbiosis Institute of Business Management, Bengaluru.*

*Kartikay Pathak : MBA Student, Symbiosis Institute of Business Management, Bengaluru.*

*Nidhi Nair : MBA Student, Symbiosis Institute of Business Management, Bengaluru.*

## Introduction

The liberalisation of the Indian economy in 1991 corresponds with the internet revolution in the world. The fast pace growth of internet impacted the way banks in India functioned with the manual process. The IT boom in India is a boon for using technology in banking operations. The core banking solution offered by companies like Infosys and TCS paved the way for business process automation in banking, enhanced customer service, process efficiency and increase in profitability. In addition to banking products, Indian banks used the concept of cross-sales to sell other financial products such as mutual funds, insurance etc. Traditionally the banks in India, especially the public sector banks, primarily focus on fund-based activities. The proliferation of new technologies has enabled the bank to have a mixed balance of fund-based and fee-based financial services. Banks were able to leverage technology by replacing multiple service counters with a single-window counter to save time for the customer. The launch of internet banking and mobile apps has eliminated the necessity to visit the bank branch. Banks can reduce the cost of operation, offer value-added services and provide 24x7 banking services. The Reserve Bank of India aptly brings regulations and recommendations on banking operations and computerisation. (Akilandeswari & Malfiga, 2016). The historical sequence of regulations includes the introduction of MICR, Electronic Clearing Services, Real Time Gross Settlement (RTGS), National Electronic Fund Transfer (NEFT) and Immediate Payment Service (IMPS). The progressive growth in the emergence of new technology has transformed traditional banking into a technology-driven financial technology firm. Integration of all bank ATM provides access to anytime anywhere money. The mobile wallets provide cashless transactions.

## Adoption of banking technology

Adoption of technology in banking started when banks in India were computerised in the late 1980s. The main motive of computerisation was to improve bank productivity using mechanisation and cope up with technology development across the globe. Earlier, it would take weeks for the banks to process the cheques. There were issues concerning the reconciliation of cheques and banks had to maintain funds in a separate account to handle the discrepancies. The process of computerisation gained pace with the opening of the Indian economy in 1991. The next pace of technology advancement is the digital revolution.

The RBI set up several committees to define and co-ordinate banking technology. These have included:

- Dr C Rangarajan, Committee on Mechanisation in the Banking Industry (1984): The committee recommended the introduction of MICR cheques in all banks in the metropolitan cities.
- Dr C Rangarajan, Committee on Computerisation in Banks (1988): The major milestones of the committee recommendations are computerisation of all banks branches and national level clearing for inter-city cheques. Followed by the recommendations, the process of computerisation began in 1993 after settlement with the bank employees associations.
- Chairman W S Saraf Committee on Technology issues relating to payment systems: The committee put forward recommendations related to cheque clearance and securities settlement. The committee proposed the mechanism for Electronic Funds Transfer with a common communication network. It also recommended MICR clearing mandatory for all banks.
- A committee to bring Legislation on Electronic Funds Transfer was set up in 1995.
- Reserve bank of India introduced the Cheque Truncation System (CTS) in 2008. CTS has converted physical cheques to electronic form. Instead of sending the cheques for collection, the banks would send the image of CTS for clearance.
- HSBC introduced the first ATM in India in 1987. In 2018, the Public and Private sectors banks installed 2,38,000 ATMs that include onsite and offsite.

## Technologies in Indian Banking System:

- Digital India, the vision to transform India into a digitally empowered society and knowledge economy paved the way for internet and mobile banking, e-wallets, chatbots for customer service etc.
- According to TRAI, India has 1026 million active mobile users in 2019. The number of smartphone users in India is expected to reach 859 million by 2022. (Business Standard, 2019) Banks are striving to offer digital banking through the mobile platform.
- With the number of mobiles in the country crossing one billion, of which more than 30 per cent are smartphones, banks are vying with each other to give the best digital solutions to the customers for payments and other banking services from anywhere, anytime. (Kannan, 2017)
- The emergence of Fintech companies has made structural changes among commercial banks. Few private sector banks have acquired small Fintech startups.
- The last decade had brought technology such as CBS, ATM Networks and Internet Banking that enabled the banks to improve their operating efficiency and enhanced customer service. The proliferation of financial technology in recent years introduced various digital banking services such as POS, MPOS, mobile wallets, chatbots etc. to offer value-added services.
- The Unified Payment Interface facility offered by the banks enables the customers to transfer funds from one account to another account without disclosing the beneficiary details.
- The recent scenario has changed; there are around 340 banks in India, public and private banks. Today, all the banks have started offering different channels like ATM, Credit Cards, Debit Cards, Mobile Banking, Internet Banking, etc. (Anbalagan, 2017).
- In 2020, India has the fifth largest banking sector, and by 2025 it would be the third largest banking sector in the world.

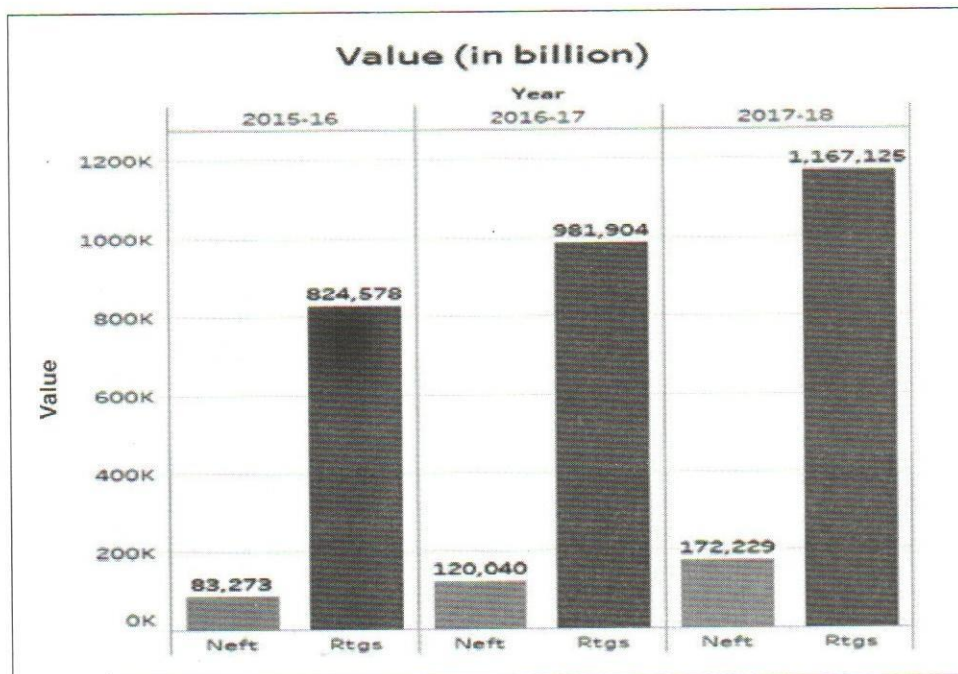
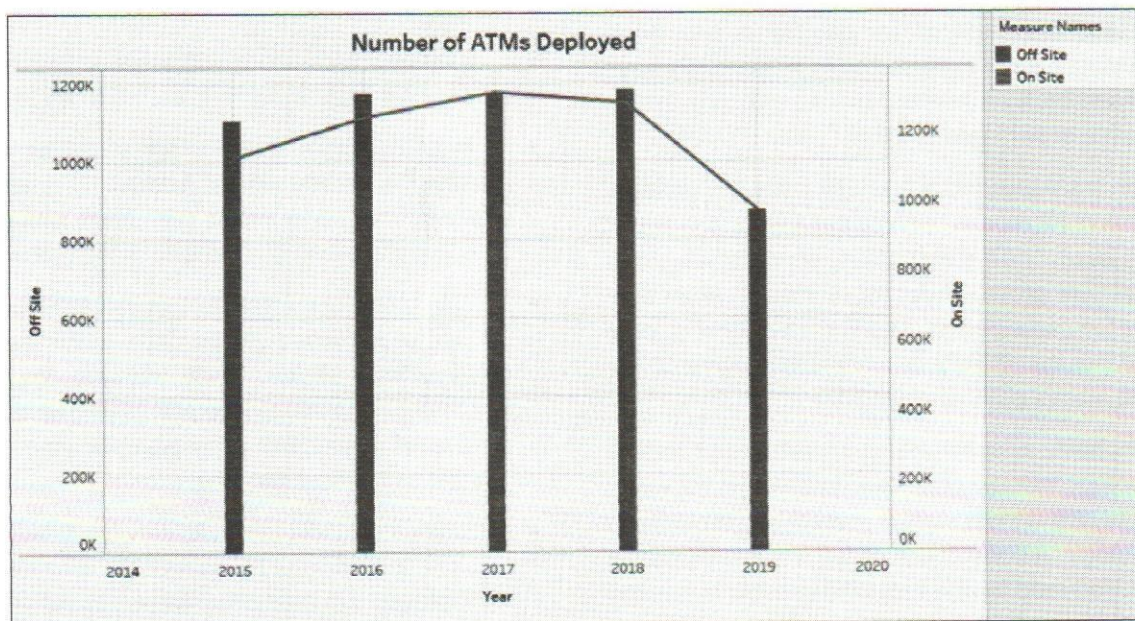
## Recent Trends in Banking

The ongoing technology evolution in banking has made a dramatic change in the Indian banking business. The

significant change in banking services are ECS, RTGS, NEFT, ATM, retail banking etc., and are including more products and services.

- **ATM:** Automated Teller Machine is an amalgam of several innovations. ATMs are one of the significant landmarks in the digital revolution. They have reduced the need for a customer making a personal visit to the bank for cash transaction and helped the banks to reduce the cost of handling cash.

- **Electronic Payment Services:** A cashless payment service based on e-governance, e-mail, e-commerce, e-mail etc.
- **Real-Time Gross Settlement (RTGS):** Introduced in India in March 2004 and operated by RBI, to transfer funds from their account to the account of another bank.
- **NEFT:** Nationwide payment system, one-to-one fund transfer.





- **Electronic Funds Transfer (EFT):** The National Electronic Fund Transfer (NEFT) was introduced in 2005. The NEFT facility has been extended to 1,40,339 branches in 2018. The EFT and digital payments gained attraction post demonetisation. According to RBI, electronic transaction accounts for 92.6 per cent of the total volume of retail payments in 2017–18. The Real-Time Gross Settlement (RTGS) settled 124 million transactions valued at 1.6 trillion in 2017–18.
- **Point of Sale Terminal (POS):** The acceptance of debit and credit cards for payments has been increasing in recent years. The POS terminals have increased from 2.53 million to 3.14 million in 2017–18, with a growth rate of 24 per cent.
- **Mobile banking:** India had 251 million registered customers for mobile banking services at the end of March 2018. The mobile banking services witnessed 13 per cent growth in terms of volume and value during the same period. The Reserve Bank of India anticipates that its transaction would become 50 per cent in mobile payments by 2021.
- **Blockchain:** Blockchain is a distributed ledger technology introduced to deal in cryptocurrencies. Many banks in India started investing in blockchain technology. A consortium of the 11 largest banks was introduced for the first time in India to link the loan system. The distributed ledger technology

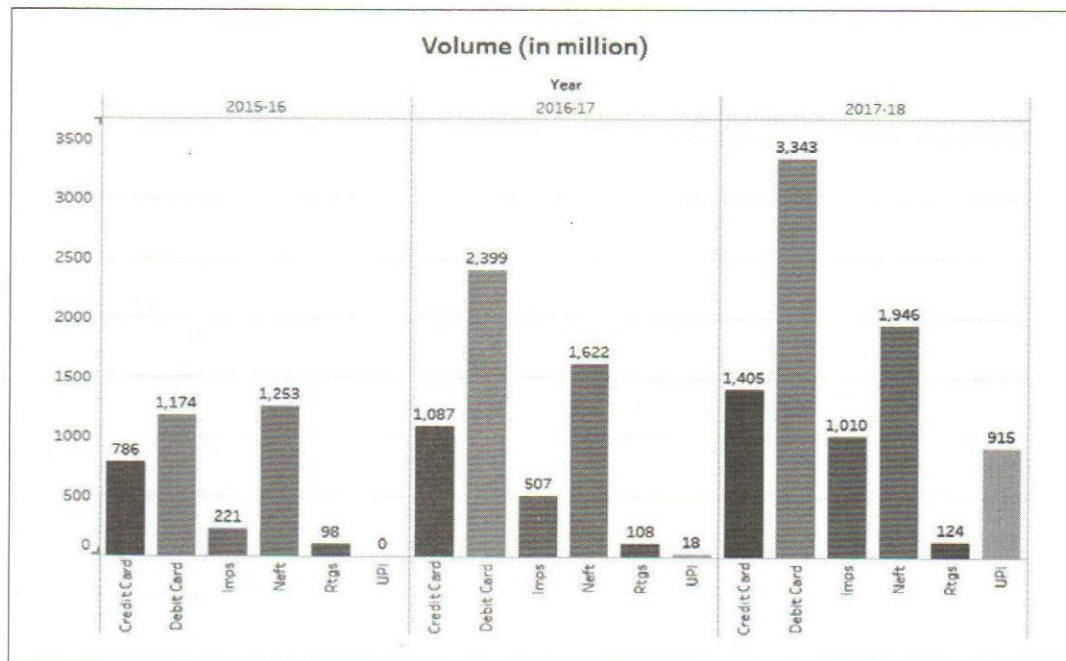
brings transparency in credit disbursement, eliminates manual process and improves operating efficiency.

### BIOMETRIC TECHNOLOGY:

Biometric authentication such as touch ID is a common way of using password-less authentication and is widely deployed in mobile banking. It eliminates the hassle of remembering passwords and makes the banking experience more secure and seamless.

According to Gartner,

- Biometric technology will affect up to 20 per cent of banking organisations in the next two to five years.
- In India, biometric technology adoption saw a boost after the introduction of Aadhaar, a unique 12-digit identification number that links citizens' bank accounts to their biometric data and mobile numbers.
- This is one of the key factors that influenced 83 per cent of surveyed global CIOs in the banking and securities sector. They indicate that they will continue investing in biometrics with either the same level of investment or by going beyond the current level in the next two years.
- Seven in 10 Indian financial services firms are actively experimenting with biometrics or have already deployed it in their organization in some capacity.



## Research Methodology

### Theoretical Background

Does investing in technology increase the profitability of banks or only adds to the cost without any significant impact on the output? The inquisitiveness to understand the impact of technology necessitates the need to create a framework to examine bank productivity. This study identifies the drivers of technology investment and its impact on a bank's profitability.

The banking sector or any sector invests in technology to enhance benefits i.e., improved sales in an extremely competitive environment or reduce losses or cost via replacing human efforts (Gobbi, 2007), which leads

to less labor cost. The introduction of technology also helps in predicting the exact customer base and subsequent forecast demand, which generates revenue for the business in terms of market share and control inventory carrying cost which was not the case earlier with the manual process (Shukla, 2014). The automation and technology also reduce other operational costs i.e. stationery, printing cost etc. The advent of technology works parallelly in favor of both revenue and cost which leads to profitability enhancement of banking business through measures of ROA and ROE. In this paper, three major drivers are considered. They are: improved sales<sup>1</sup>, reduced operating expenses<sup>2</sup> and enhanced employees' efficiency<sup>3</sup>, which eventually affects the banking sector's profitability and productivity (see Figure 1).

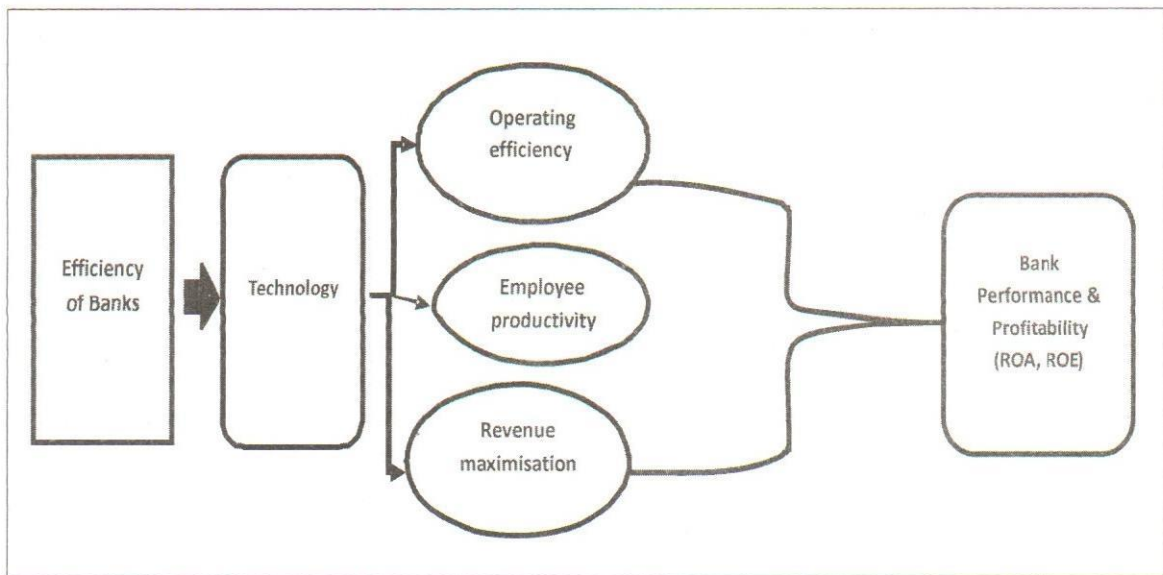


Figure 1: Framework for technology innovations in banking sector

Effect of Investment on IT and bank profitability has been analysed using equations mentioned, i.e.:

$$ROE \text{ or } ROA = A_0 * IT/NFA_{it}^{\alpha_1} * IT/Equity_{it}^{\alpha_2} * IT/TC_{it}^{\alpha_3} * IT/OC_{it}^{\alpha_4}$$

Where, IT/NFA: IT investment to net fixed assets, IT/Equity: IT investment to equity, IT/TC: IT investment to total cost, IT to operating cost, ROE: Return on equity & ROA tells about the ability of the company to pay its equity shareholders and to use its assets to create profit. A company should be able to create value for the resources that it holds like ROE, whereas ROA can be compared to returns of risk-free investments.

### Analysis and Results

We examine whether IT investment influences productivity of the banks. We run simple linear regression by considering IT investment as the independent variable and bank productivity as the dependent variable. The results are presented in Table 1.

The effect of IT investment on bank productivity shows mixed results. The IT has shown significant impact on the productivity of private sector banks and major public sector banks. The operating efficiency of technology investment is observed only for few private sector banks that include Axis bank, ICICI bank and Karur Vysya bank. The overall results indicate variation in the technology

**Table 1: Simple linear regression of IT investment and bank productivity (Return on Equity)**

ROA	R sq	Intercept		IT/NFA		IT/Equity		IT/TC		IT/OC	
		t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
Axis	0.9062	1.7222	0.1456	-1.4241	0.2137	-1.6712	0.1555	-5.1129	0.0037	5.7287	0.0023
BOB	0.9205	-1.8955	0.1165	2.2478	0.0745	-3.6506	0.0147	2.9554	0.0317	-1.6140	0.1674
BOI	0.8675	-2.2864	0.0710	2.5273	0.0527	-1.8607	0.1219	-0.9052	0.4069	-0.0842	0.9362
United	0.4860	0.0948	0.9282	1.7163	0.1468	0.6123	0.5671	-1.1024	0.3205	-0.6507	0.5440
Yes Bank	0.9587	-4.3128	0.0076	3.6434	0.0148	-1.1272	0.3108	-1.8145	0.1293	0.6011	0.5740
Federal	0.5466	0.8128	0.4533	0.2307	0.8267	1.0683	0.3342	-0.1280	0.9031	-0.0873	0.9338
ICICI	0.7513	1.5354	0.1853	-1.2061	0.2817	-3.1389	0.0257	-0.5682	0.5945	3.3831	0.0196
IOB	0.9455	-3.1694	0.0248	3.6684	0.0145	-6.4064	0.0014	-0.2957	0.7794	0.6460	0.5468
JK	0.5973	-0.1312	0.9007	0.3727	0.7247	-1.3361	0.2391	-0.1260	0.9047	0.2860	0.7864
Karnataka	0.7510	4.8714	0.0082	-0.1951	0.8548	-1.6273	0.1790	-0.3180	0.7664	-0.5577	0.6068
Kasur Vysya	0.9706	-3.8887	0.0081	4.7736	0.0031	-1.8154	0.1194	-3.6376	0.0109	1.5760	0.1661
Kotak Mahindra	0.5580	6.0932	0.0017	-2.1816	0.0810	2.0343	0.0976	0.1013	0.9232	-0.0275	0.9791
OBC	0.7966	-0.9984	0.3639	1.0242	0.3527	-3.9788	0.0105	1.1830	0.2900	-0.9859	0.3695
PNB	0.9110	2.9921	0.0304	-2.9935	0.0303	3.2551	0.0226	4.3862	0.0071	-4.5619	0.0060
SBI	0.8697	1.6465	0.1606	-1.2692	0.2602	-1.0394	0.3462	-0.8123	0.4535	0.8304	0.4441
South Indian	0.3862	0.6706	0.5322	-0.7765	0.4726	1.2747	0.2585	-0.7834	0.4689	0.6606	0.5381
Syndicate	0.8983	-1.0081	0.3597	1.2312	0.2730	-0.0562	0.9573	-0.3061	0.7719	-1.0170	0.3558
UCO	0.9336	1.4898	0.1965	-1.4740	0.2005	-0.6152	0.5653	1.2004	0.2837	-0.9307	0.3947
Union	0.2912	-0.7648	0.4789	0.1843	0.8610	1.0107	0.3585	0.8978	0.4104	-0.5491	0.6066

Source: Input data retrieved from Bloomberg and computed by the authors

**Table2: Simple linear regression of IT investment and bank productivity (Return on Assets)**

ROA	R sq	Intercept		IT/NFA		IT/Equity		IT/TC		IT/OC	
		t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
Axis	0.8916	0.8020	0.4589	-0.4318	0.6839	-2.4133	0.0606	-5.1766	0.0035*	5.9329	0.0019*
BOB	0.9112	-1.8262	0.1274	2.1461	0.0847	-3.6007	0.0155*	2.9335	0.0324*	-1.3293	0.2412
BOI	0.8618	-2.2691	0.0725	2.5021	0.0544	-1.5937	0.1719	-0.9181	0.4007	-0.2077	0.8437
United	0.6236	-0.3630	0.7314	2.0918	0.0907	0.8069	0.4564	-1.3965	0.2214	-0.4841	0.6488
Yes Bank	0.8666	-2.7873	0.0385*	2.5826	0.0492*	-0.9174	0.4010	0.5184	0.6263	-0.2371	0.8220
Federal	0.3830	0.4971	0.6402	0.2207	0.8341	0.3203	0.7617	-0.0035	0.9973	-0.0056	0.9957
ICICI	0.9436	3.0545	0.0282*	-2.1285	0.0866	-7.2179	0.0007*	-2.0740	0.0928	8.1771	0.0004*
IOB	0.9521	-3.5693	0.0161	4.1188	0.0092	-6.6867	0.0011*	-0.4996	0.6385	0.8549	0.4316
JK	0.6078	-0.1852	0.8604	0.4291	0.6857	-1.3348	0.2395	-0.2121	0.8404	0.3253	0.7581
Karnataka	0.6162	3.9873	0.0163*	-0.4198	0.6962	-0.8600	0.4383	-0.6603	0.5451	0.1131	0.9154
Karur Vysya	0.9803	-4.6245	0.0035*	5.9972	0.0009*	-4.0943	0.0063*	-5.3005	0.0018*	2.8473	0.0292*
Kotak Mahindra	0.6910	6.0722	0.0017	-3.0318	0.0290	2.9247	0.0328	0.4064	0.7013	-0.3478	0.7421
OBC	0.8081	-1.0379	0.3469	1.0701	0.3335	-4.0244	0.0101	1.3207	0.2438	-1.2308	0.2731
PNB	0.9089	3.1048	0.0267	-3.1009	0.0268	3.2920	0.0217	4.3932	0.0071	-4.5632	0.0060
SBI	0.8553	1.4208	0.2146	-1.0092	0.3592	-1.1845	0.2894	-0.6159	0.5649	0.6026	0.5730
South Indian	0.3571	0.7672	0.4776	-0.8018	0.4591	1.0985	0.3220	-0.6269	0.5582	0.5031	0.6362
Syndicate	0.8931	-1.2626	0.2624	1.4831	0.1982	-0.2677	0.7996	-0.7686	0.4768	-0.5066	0.6340
UCO	0.9204	1.9398	0.1101	-1.9089	0.1145	0.0945	0.9284	1.6299	0.1640	-1.5601	0.1795
Union	0.2882	-0.7711	0.4755	0.1945	0.8534	1.0089	0.3593	0.8674	0.4254	-0.5186	0.6262

Source: Input data retrieved from Bloomberg and computed by the authors

investment and productivity at individual bank level performance.

The impact of IT investment on ROE is significant for private sector banks as compared to public sector banks.

Technology is growing at a fast pace and at the same time the technology obsolescence is also prevalent in the banking and financial services industry. For instance, banks were using the information and communication

technology to provide customer care. The emergence of artificial intelligence has provided chatbots for handling customer complaints. The future of banking is moving toward virtual banking. Therefore, banks need to gradually embrace new and emerging technologies to stay competitive. The authors examine the cross-section data of technology investment and productivity measures and run panel regression applying fixed and random effect model. The results of panel regression–fixed effect model are shown in Table 3.

**Table 3: Panel regression: Fixed effect model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.598978	0.461917	1.296722	0.1965
IT_NFA	0.827446	0.561144	1.474569	0.1422
IT_EQUITY	-4.554279	0.992144	-4.590338	0.0000
IT_TC	1.194418	0.872989	1.368194	0.1731
IT_OC	-1.860022	0.522165	-3.562137	0.0005
<b>Effects Specification</b>				
Cross-section fixed (dummy variables)				
R-squared	0.566537	Mean dependent var		0.612531
Adjusted R-squared	0.509434	S.D. dependent var		0.928617
S.E. of regression	0.650407	Akaike info criterion		2.090639
Sum squared resid	70.64592	Schwarz criterion		2.483699
Log likelihood	-175.6107	Hannan-Quinn criter.		2.249862
F-statistic	9.921325	Durbin-Watson stat		0.952687
Prob (F-statistic)	0.000000			

Source: Computed by the authors

The fixed effect model indicates the group means of the sample banks, without showing any random effect. In the basic fixed effects model, the effect of each predictor variable (i.e. the slope) is assumed to be identical across all the groups, and the regression merely reports the average within-group effect. The authors have examined the correlations of other exogenous variables like the number of branches, credit deposit ratio and other operating parameters. These variables are highly correlated to IT

investment and therefore omitted, but considered the IT investments as exogenous and the productivity as endogenous variable. The fixed effect model is used to estimate mean for the sample while controlling for omitted variable bias. The fixed effect model indicates among the independent variables IT/equity, and IT to operating cost are significant @ 5 per cent. The observed R squared is 56 per cent which indicates the less influence of exogenous variables.

## Panel regression–Random effect

Random effect model is applied to control the heterogeneity in IT investment by public and private sector banks. The assumption of random effect model is that the independent

variables are uncorrelated with the independent variables. We run generalised least squares under random effect model and the results are shown in Table 4.

**Table 4: Panel regression–random effect model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.309444	0.385319	3.398337	0.0008
IT_NFA	-0.054828	0.450337	-0.121750	0.9032
IT_EQUITY	-5.832392	0.916744	-6.362072	0.0000
IT_TC	1.499858	0.505100	2.969427	0.0034
IT_OC	-1.234931	0.372845	-3.312182	0.0011
<b>Effects Specification</b>				
			S.D.	Rho
Cross-section random			0.279157	0.1556
Idiosyncratic random			0.650407	0.8444
<b>Weighted Statistics</b>				
R-squared	0.269955	Mean dependent var		0.363333
Adjusted R-squared	0.254170	S.D. dependent var		0.776455
S.E. of regression	0.670558	Sum squared resid		83.18486
F-statistic	17.10226	Durbin-Watson stat		0.810789
Prob (F-statistic)	0.000000			
<b>Unweighted Statistics</b>				
R-Squared	0.380980	Mean dependent var		0.612531
Sum squared resid	100.8879	Durbin-Watson stat		0.668517

Source: Computed by the authors

The random effect model shows IT/Equity, IT/TC and IT/OC have the power to influence a bank's productivity as the coefficients are significant at 5 per cent level.

## Conclusion

The banking and financial services industry is prone to technological disruption. The fintech companies have emerged as major competitors to the traditional banks.

Technology has become an indispensable driver for the sustainability of banks. Technology has become an important driver for banks to compete and improve productivity. While technology enhances operating efficiency, an inadequate technology or poor technology investment may have adverse impact on the profitability. This study examines whether IT investment improves bank productivity. The impact of technology on productivity is

examined using panel data regression. We tested fixed and random effect on public and private sector banks. The private sector banks show higher efficiency to leverage the effect of technology on productivity. The random effect model indicates technology investment has the power

to influence productivity of banks in India. The results indicate that investment in IT enhances the productivity of banks by improving the Return on Assets and Return on Equity.

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## Notes

- <sup>1</sup> Signals change in customer base and profitability of banks. Since the main objective of IT investment is to increase the profitability and customer base of the banks, it is assumed that increase in IT investment should lead to an increase in the 3 identified variables
- <sup>2</sup> Shows the efficiency of day-to-day operations. It should come as a no surprise that investment in IT should lead to decrease in operating expenses. Regarding the number of branches, it should increase as the IT investment would ideally bring in new customers which in turn would lead to opening of new branches
- <sup>3</sup> Signifies cost for banks. The main motive of IT investment is to reduce work on manpower and transfer it to machines. This would, in the long run, lead to decrease in workforce and subsequently lead to decrease in employee cost

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*“Banks need FinTech and FinTech need banks”*

*– Hugues Delcourt*

# Artificial Intelligence and Banking Services – Way Forward

SEEMA GHOSH AND DEEPAK CHANDA

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*Artificial intelligence (AI) is a dynamic tool that has incredible potential for positive effect if the organisations utilise it with adequate consideration and conscientiousness. The rise of AI has certainly brought transformation in financial services business in a very broad, multi-dimensional context.*

*This paper deals with the dimension where AI equally contributes positively to the financial services of a company and it may include trading, risk management, asset management, credit decisions, virtual assistants and prevention of fraud and banking services. The paper presents a holistic view on AI today: where it works and what is for the financial services industry to facilitate better delivery of customer services and robust decisions all across, on a transparent and integral manner.*

## Introduction

A recent scam/fraud report from the banking system exposes a wide gap between expectation and reality in the financial services sector. Fraudulent practices indicate that without the powerful tool of technology, the potency of the fraud had a multidimensional growth and resulted in financial services jolt that brought financial regulators and the society into shock and pain. It exposed the financial services of no absolute checks and balances prescribed by the financial authorities resulting in a fraud, siphoning of crores of public money without accountability and the resultant lack of credibility.

The financial services in India have a lot of economic worth and include businesses that manage money. It may be insurance companies, share markets, banks, investment funds etc. The country's financial services sector consists of the capital markets, insurance sector and non-banking financial companies (NBFCs). With technology taking core in all fields, the financial services had also upgraded to newer version of virtuality with an aim to promote transparency of operations and the integrity of any transactions being done in the domain.

India resides in its rural areas where the people are illiterate and unorganised in their financial exchanges. The utility of banking services can only be earmarked by convincing the rural public that their finances are in the safe custody and the requirement of any urgent payment schedule are met without much hassle. When the Indian government initiated the Digital India program, its main aim was to bring its rural people into the gambit of technological changes, which they can follow and utilise in a basic sense. After demonetisation, we found rural population moving towards digital payments and receivables, thus giving them the confidence on financial

*Dr. Seema Ghosh, Assistant Professor, Bhavans Vivekananda College of Science, Humanities and Commerce, Sainikpuri, Hyderabad*

*Dr. Deepak Chanda, Senior Assistant Director, ICAI, Kanpur*



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services, which seems to be transparent and integrates with their aspirations.

AI seems a right fit for the financial services and it has high potential in delivering the services to the customers, but for rural environment, it seems a herculean task to make people understand AI and its advantages in reduced risk in financial transactions. Moreover, the associated regulatory and ethical challenges will be beyond the rural society and they may not accept AI, and might discourage it by ignoring the same or by not trusting the services. For rural India, AI is a complex and evolving area requiring a multidisciplinary, legal, and acceptable approach. In India, if approached properly, AI can provide significant benefits to the society—especially rural areas—since this is a fact of life and for survival with robustness, AI provide most suitable ways to adapt to the change.

In the financial services industry, the flareout has been quite phenomenal. Bankers and insurers are looking at AI to provide meaningful resolutions to issues such as cost, efficiency, profitability and staffing among others, in line with rural population and their ignorance of the technology. Accenture, in its recent AI research report, provides a framework for evaluating the economic impact of AI for select G20 countries, and estimates that AI would boost India's annual growth rate by 1.3 percentage points by 2035.

The World Economic Forum Report 2018 gauges how technology is disrupting the financial services ecosystem. In his study, Wall, L. D (2018) notes that the financial services industry along with many sectors will be transformed by the rapid development and deployment of AI techniques. In a discussion paper, PWC global emphasised that AI itself will also become smarter with each passing year, not only more productive but also develop intelligence that humans do not yet have, accelerate human learning, and innovation. As we think about the gains, efficiencies and new solutions this creates for nations, business and for everyday life, we must also think about how to maximise gains for society and our environment. We live in exciting times; it is now possible to tackle some of the world's biggest problems with emerging technologies like AI. It is time to put AI to work for the planet. According to ICAEW, 2017 AI brings many opportunities for financial services to improve their efficiency, provide more insight and deliver more value to businesses and other stakeholders. In the longer term, AI raises opportunities for much more radical change, as systems increasingly take over decision-making tasks currently performed by humans.

SEBI, 2019 in its article highlighted the appreciation of the government on efforts to bring digitised operations in financial services for easy access and deployment to the people in the remote corners of the country. It also emphasised that Artificial Intelligence and big data are used to monitor market manipulations with a mission to make society well connected to the knowledge network, where the benefits can be appropriately extended to the villages in a desired pace, while fraud and money laundering can be minimised.

## Literature Review

The World Economic Forum Report 2018 gauges how technology is disrupting the financial services ecosystem. In his study, Wall, L. D (2018) notes that the financial services industry along with many sectors will be transformed by the rapid development and deployment of AI techniques. In a discussion paper, PWC global emphasised that AI itself will also become smarter with each passing year, not only more productive but also develop intelligence that humans do not yet have, accelerate human learning, and innovation. As we think about the gains, efficiencies and new solutions this creates for nations, business and for everyday life, we must also think about how to maximise gains for society and our environment. We live in exciting times; it is now possible to tackle some of the world's biggest problems with emerging technologies like AI. It is time to put AI to work for the planet. According to ICAEW, 2017, AI brings many opportunities for financial services to improve their efficiency, provide more insight and deliver more value to businesses and other stakeholders. In the longer term, AI raises opportunities for much more radical change, as systems increasingly take over decision-making tasks currently performed by humans.

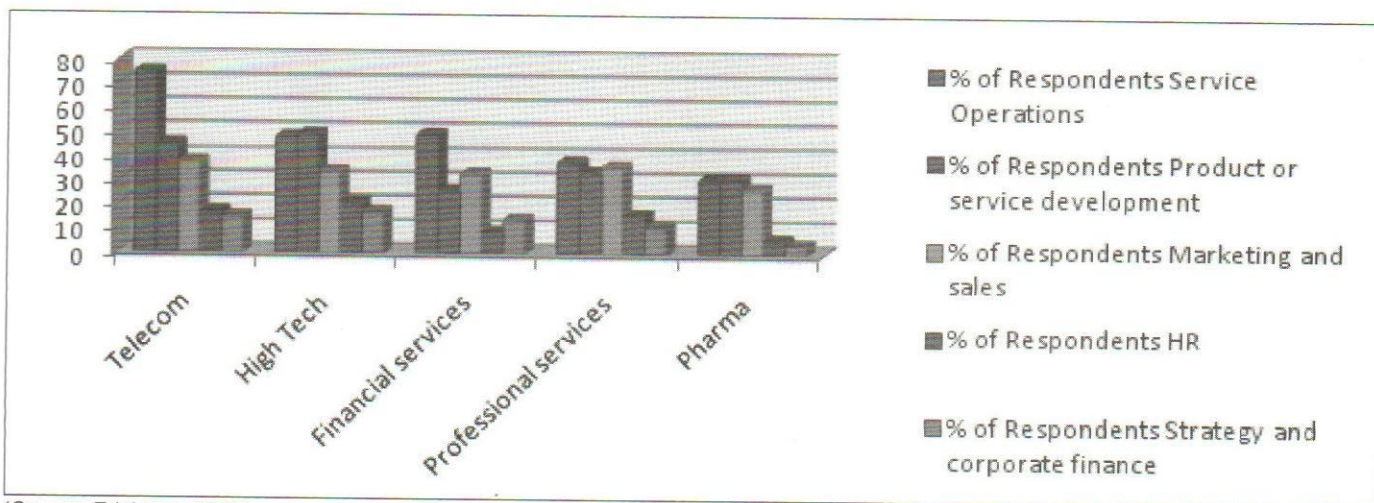
SEBI, 2019 in its article highlighted the appreciation of the government on efforts to bring digitised operations in financial services for easy access and deployment to the people in the remote corners of the country. It also emphasised that Artificial Intelligence and big data are used to monitor market manipulations with a mission to make society well connected to the knowledge network, where the benefits can be appropriately extended to the villages in a desired pace, while fraud and money laundering can be minimised.

A report by Deloitte promises certain seen traits in front running financial institution with a purpose to

disseminate AI-driven mechanisms to consolidate the financial array of the public—including small cities. The presentation matrix can be seen as a stepping stone of adaptability of the technology to the acceptance level. A report by Economic Times states, “over 36 percent of the financial institutions in the country have invested in artificial intelligence-focused technologies, and around 70 percent plan to embrace it in the near future”. This gives a bird’s eye view that the government is serious in establishing checks and balances for the finances of the people, and the target is to reach the rural population and spread the awareness of managing money effectively with integrity and robustness without fear of any malpractices.

## Where AI is being used

Sector-wise, telecom, high-tech, and financial-services firms are leading the way in overall adoption. That said, looking across sectors and functions, the results suggest that companies are generally following the money when deploying AI, which seems to be gaining the best traction in areas of businesses that create the most value within a given industry (see Fig. 1). In retail, for example, the use of AI in marketing and sales processes is most common: 52 percent of retail respondents say they are using AI in marketing and sales, compared with 29 percent of all respondents.



(Source: Edelman, 2019)

Figure 1: Usage of AI-Sector wise

## Technology Advantages

In the global banking scenario, technologies such as Big Data, artificial intelligence (AI), block chain, internet of things (IoT), open banking and cloud computing are positively impacting banking operations. Many international banks have already made indicative advancement through the adoption of cloud computing, and many Indian banks are fast adapting up to its many advantages.

According to a Boston Consulting Group Report, digitalisation in India is significantly affecting its banking structure. India’s digital lending stood at US\$ 75 billion in the year 2018 (see Fig. 2). It is expected to reach US\$ 1 trillion by 2023, steered by a five-fold increase in digital disbursements.

## Banking on Artificial Intelligence

Artificial intelligence (AI) is a powerful tool that is already

widely deployed in financial services. It has great potential for an error-free and positive impact if the organisations deploy it with sufficient diligence, prudence and care. Artificial Intelligence is the future of banking as it brings the power of advanced data analytics to combat fraudulent transactions and improve compliance. AI algorithm accomplishes anti-money laundering activities in few seconds, which otherwise would take hours and days. AI also enables banks to manage huge volumes of data at record speed to derive valuable insights from it. Features such as AI bots, digital payment advisers, and biometric fraud detection mechanisms lead to higher quality of services to a wider customer base. All this translates to increased revenue, reduced costs and boost in profits. According to a Forbes report, use of AI extensively assists improve anti-money laundering compliances of the banks and enhances accuracy and velocity of fraud detection (See Table 1).

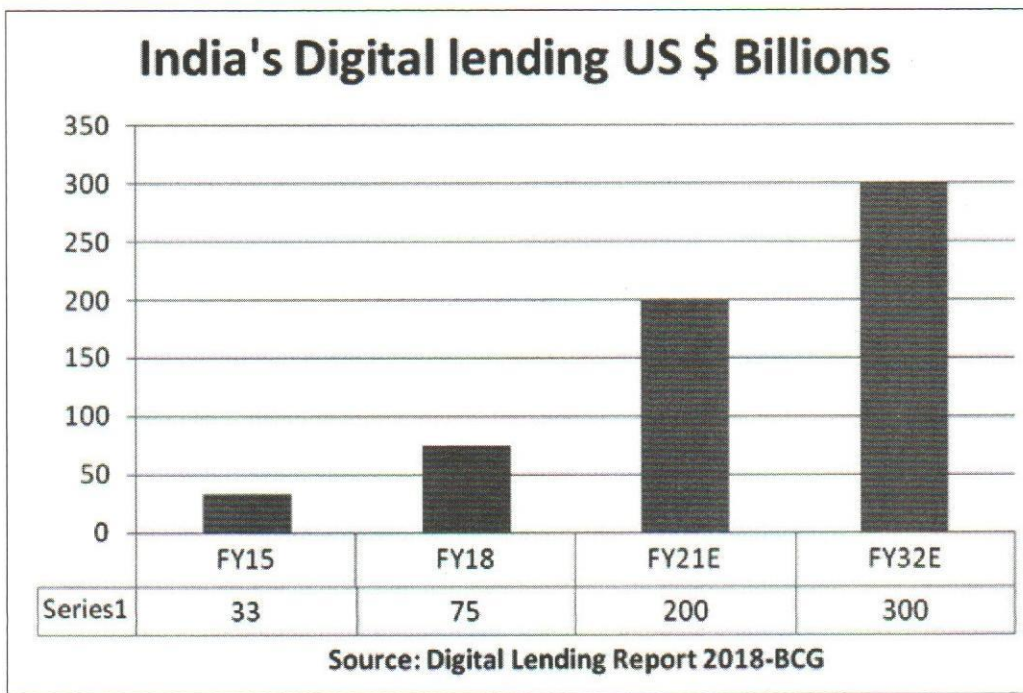


Figure 2: India's digital lending in US \$ billions

Table 1: Reasons for using Artificial Intelligence by banks

Reasons	Value (in %)
Data analysis and insights	60
Increased productivity	59
Cost benefits/savings	4
Optimise debt collection	14
Improve accuracy, velocity of fraud detection	72
Improve anti-Money Laundering compliance (AML)	95

Source: [www.forbes.com](http://www.forbes.com)

With its power to predict future scenarios by analysing past behaviors, AI helps banks predict future outcomes and trends. This helps banks to identify fraud, detect anti-money laundering pattern and make customer recommendations. Money launderers, through a series of actions, portray that the source of their illegal money is legal. With its power of Machine Learning and Cognition, AI identifies these hidden actions and helps save millions for banks. Similarly, AI is able to detect suspicious data patterns among humungous volumes of data to carry out fraud management. Further, with its key recommendation engines, AI studies the past to predict the future behavior

of data points, which helps banks to successfully up-sell and cross-sell. For instance, one of the most noticeable changes is affecting compliance, which is seeing the way data is handled and processed becomes completely automated. This is enabling accounting professionals to get reliable and fast data included in every tax report they generate. Automated data entry is now the rule for those who are behind maximum efficiency.

AI is strengthening competitiveness of financial services through enhanced customer experience. Based on past interactions, AI develops a better understanding of customers and their behavior. This enables banks to

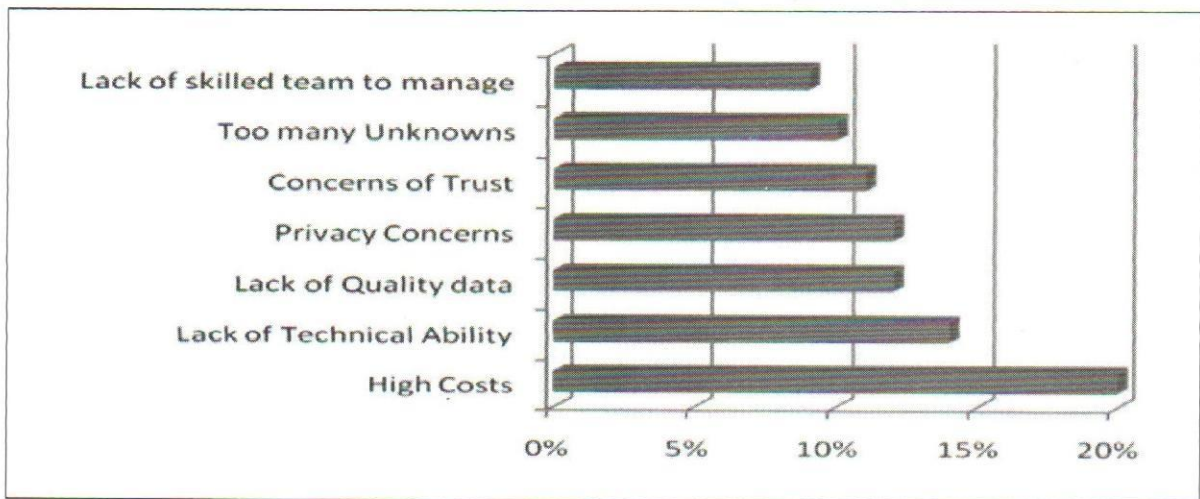
customise financial products and services by adding personalised features and intuitive interactions to deliver meaningful customer engagement and build strong relationships with its customers.

Cognitive systems that think and respond like human experts, provide optimal solutions based on available data in real-time. These systems keep a repository of expert information in its database called the knowledge database. Bankers use these cognitive systems to make strategic decisions. AI reviews and transforms processes by applying Robotic Process Automation (RPA). This enables automation of about 80 percent of repetitive work processes, allowing knowledge workers to dedicate their time in value-add operations that require high level of human intervention.

### Barriers to AI integration

The key barrier to AI integration for businesses in financial sector is the high cost involved, followed by the lack of technical ability among their existing workforce, as shown in Fig. 3.

This knowledge gap may affect consumers' appetite for new technology. Money is a very emotive subject and any perceived risk to our financial security can result in a breakdown in trust. It is therefore important for financial companies to innovate with prudence and be open and transparent on how AI is being used. Moreover, financial institutions across the country should start training their technical staff to conceive and redistribute AI solutions, as well as explain their entire workforce on the basics and advantages of AI.



(Source: Edelman, 2019)

Figure 3: Key barriers to AI integration

### AI-driven future

AI will not only empower banks by automating its knowledge workforce, it will also make the whole process of automation intelligent enough to do away with cyber risks and competition from financial service providers. AI, integral to the bank's processes and operations, keeps evolving and innovating with time. The typical-use cases of AI for financial institutions in view of reaching masses include: predicting cash-flow events and proactively advising customers on spending and saving habits, expanding the dataset for developing credit scores and applying AI to build advanced credit models for expanding reach and reducing defaults, providing AI merchant analytics "as a service", detecting patterns in transactions and

identifying fraudulent transactions as early as possible, reading documents and identifying errors for support activities such as information verification, user identification, and approvals, improving the underwriting process and capital efficiency and understanding customer queries via voice search on digital voice assistants or smart phones.

### The Future of Artificial Intelligence in financial services

As it has been understood what Artificial Intelligence is and its benefits in banking sector, this segment discusses the scope of Artificial Intelligence in the banking industry in the years to come. If we look at the development in the field of technology, we see that it is getting smarter every

day. This gives us assurance that in the future, we can only see that technology of Artificial Intelligence getting stronger and stronger, which makes a rural citizen to have a secure banking experience. Some of the areas in which artificial intelligence will rule in the future are:

- Enhancing convenience experience
- Saving time, both for the customer as well as for the bank
- Minimising human error
- Building strong and learned customers
- Promoting cashless transactions from any place and at any time, and adding value to the Digital India Program.

Artificial Intelligence in finance will help customers in villages and smaller cities to make quick financial decisions. It will give latest trends on the current market structure as well as support insight knowledge on stocks and bonds in which customers can invest judiciously. In its study, the financial brand, found that banking organisations are seeking to introduce AI technology for risk assessment, financial research, investment management, credit approval process, KYC and anti-money laundering systems and compliances for having a competitive edge in the industry (See Table 2).

Banking and Artificial Intelligence are at an advantageous position to unleash the next wave of digital disruption. A user-friendly AI ecosystem has the potential

**Table 2: Banking organisations are likely to introduce AI/Machine Learning technology**

Factors/Parameters	Value (In %)
Risk assessment	49
Financial analysis/Research	45
Investment/Portfolio management	37
Trading	33
Credit approval process	29
KYC and anti-money laundering	29
Regulation and Compliance	26
Administration	19
It is not being introduced	17
Sales	17
Senior management	5
Others	2

Source: The Financial Brand

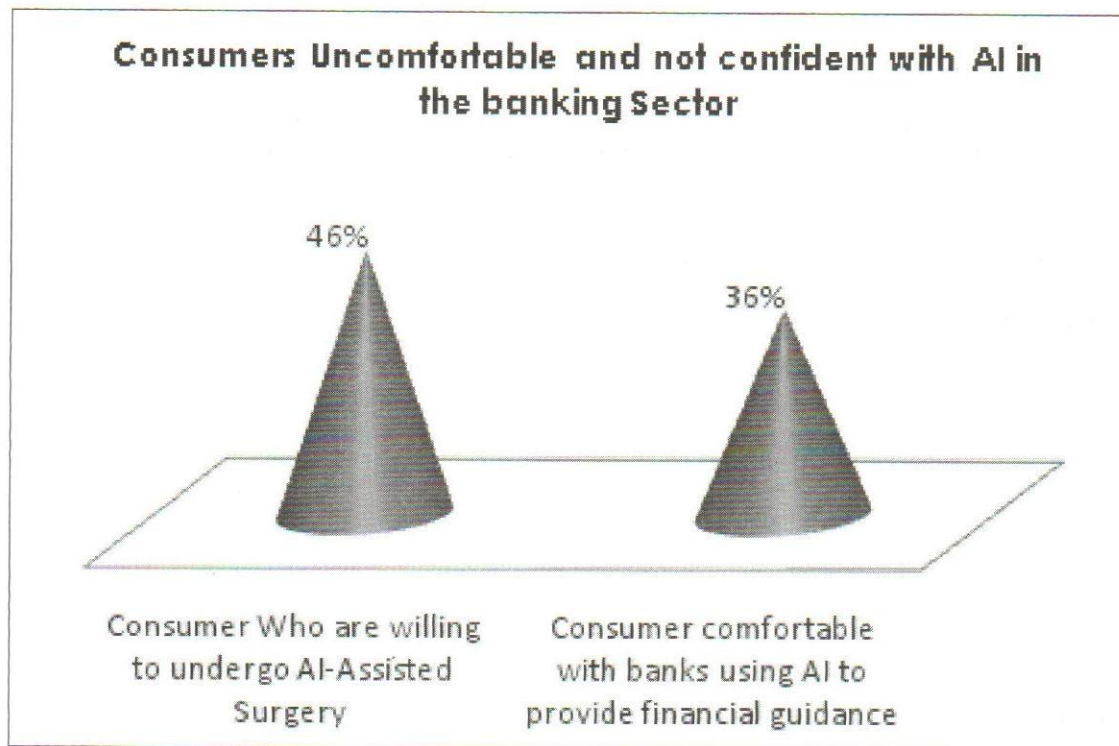
for creating value for the banking industry, as it will deliver the technology to the doors of the villagers and small business houses to achieve their desire to adopt financial solutions across all spectrums, at a click of a button, in the most confident manner. Some of the challenges in implementing this can be the long implementation timelines, limitations in the budgeting process, reliance on legacy platforms, and the overall complexity of a bank's technology environment.

To overcome the above challenges of introducing and building an AI-enabled environment, banks need to enable incremental adoption methods and technologies. The critical part is ensuring that the transition allows them to overcome the change management/behavioral issues. The secret of successful deployment is to ensure a seamless fit into the existing technology architecture landscape, making an effective AI enterprise environment.

The challenges to accepting AI in financial services include a) Resistance to change, b) Lack of knowledge, c) Lack of awareness in the rural area, d) Customers are completely disoriented and disorganised and e) Fear of security.

The banking system in India today distinctly allocates consistent “Information and communication Technology (ICT)” based, basic banking services, in rural and unbanked

areas and also focuses on digitisation and alternate delivery channels as some of their initiatives. Although a study by the financial brand, on the confidence and comfortability of consumers using AI in the banking sector, confirms that 46 percent of the consumers were willing to undergo AI-assisted surgery though only 36 per cent of them felt satisfied with banks adopting AI to provide financial assistance (see Fig. 4).



Source: May 2018, The Financial Brand

Figure 4: Consumers confidence with AI in banking sector

Statistics and predictions undoubtedly point in the direction that AI will herald a transformational change in the banking industry. According to Capgemini, one robot can perform the tasks of as many as five employees. Price waterhouse Coopers' FinTech Report on India released in 2017 said that global investment in AI applications touched US\$ 5.1 billion in 2016, up from US\$ 4.0 billion in 2015. Many analysts also counter job-defending technology-pessimists; Gartner predicts that AI will not make human employment obsolete but will create 2 million jobs by 2019. But to realise the full value of AI in banking, it cannot be applied in an unorganised piecemeal manner. A workforce that can implement AI at the enterprise-level will be highly valued. Intelligent technologies should be used to create

better work opportunities and that is probably the only way AI will bring about a long-lasting positive impact in the industry. A mindset change will be more important in the time to come than just deep subject matter knowledge. Jobs will have to be enriched in reply to emerging technologies being used as an aid to human intelligence.

### Conclusions

AI is very important for the financial services in India. The process of AI does encourage safety and security of financial services in applications such as banking, insurance, stock trading etc. This concept, for India, is like a panacea to emerge as the greatest tool for fraud control in all aspects—including regulatory and

compliances. The society we are living today needs AI as an essential part when handling/dealing with financial services either for an individual or for an organisation. As financial services companies advance in their AI journey, they will likely face a number of risks and challenges in adopting and integrating these technologies across the organisation, along with synchronising the knowledge base of people in smaller cities and villages. But not all are facing the same set of challenges.

To conclude, Artificial Intelligence is gaining popularity day by day and banks are exploring and implementing this technology in transforming the way customers are assisted. So, the future of Artificial Intelligence in banking sector is very bright and with the introduction of Artificial Intelligence, it makes it even easier for a customer to do transactions from any place and at any time without waiting in long queues at the bank. Hence, the aim of Artificial Intelligence is to provide personalised and high quality customer satisfaction along with efficient and time saving services.

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*"At the end of the day, customer-centric fin-tech solutions are going to win."*

*– Giles Sutherland*

# Customer Experience with Digital Banking - A Comparative Study of Private and Public Sector Banks

GAZIA SAYED AND NAJMUS SAHAR SAYED

*Financial Technology (Fintech) has completely changed the entire Indian financial ecosystem. Fintech has reshaped the banking system, especially after the 2008 financial crisis. There has been a huge growth in the usage of debit cards, mobile wallets, ATMs, prepaid cards, RTGS, NEFT, internet banking, mobile banking etc., in the past two decades. However, with advancement of technology, the customers' perception regarding probability of risk in conducting online banking transaction is also increasing. As the usage of internet has increased, the knowledge of people and their access to information has also improved. Hence, it is necessary to understand the perception of the bank customers with respect to digital banking. It is also necessary to do a comparative study of private and public sector banks customer's experience with digital banking. Hence, for this study, a descriptive research is used. The views and opinions of 300 respondents were collected through a structured questionnaire. The data was analysed through different statistical tools like frequency table with percentages rank order, and independent t test in SPSS. The analysis reveals that the main reasons for customers to use cashless or digital transactions is that they are a faster way of performing transactions. The study also concludes that for some of the services offered by private and public sector banks, there is no significant difference in the experience levels of the customers. But for the services regarding online home loan facility, online investing of funds, mobile banking services, online application for loan, internet banking services, chatbot and SMS alert facilities, there is a significant difference in the level of experience and satisfaction of customers. For these services, the customers of private sector banks are more satisfied than the customers of public sector banks. Hence, it is recommended that public sector banks should enhance their digital products / services.*

*Dr. (Ms.) Gazia Sayed, Faculty-Finance, IES Management College and Research Centre - Mumbai*

*Prof. (Ms.) Najmus Sahar Sayed, Faculty-Accounts, Oriental College of Commerce And Management - Mumbai*

## I. INTRODUCTION

Financial Technology (Fintech) has significantly transformed the entire Indian financial system. Fintech has reshaped the banking ecosystem, especially after the 2008 financial crisis. In fact, the Indian banking sector is the first to adopt Fintech to increase its reach. The rise of Fintech has changed every aspect of banking. Giving of loans, payment services, wealth management and remittance transfer has seen a sea change due to technology. There has been a huge growth in the usage of debit cards, mobile wallets, ATMs, prepaid cards, RTGS, NEFT, ECS, internet banking and mobile banking in the last two decades. The Indian government is also strongly advocating digital or cashless banking through its demonetisation policy in November 2016.

However, with the advancement of technology, the customers' perception regarding probability of risk in conducting online banking transaction also increases. The customers are very well aware of the various scams that are happening across the world which was not the case in the past. As the usage of internet has increased the knowledge of people, their access to information has also improved. Hence, it is necessary to understand the perception of the bank's customers with respect to digital banking.

## II. NEED OF THE STUDY

Information technology has led banking sector towards a progressive path. Indian government is also playing a significant role in the development of the banking sector. The expectations of customers from their banks are also increasing. Both public and private sector banks are trying hard to meet the expectations of their customers and are leveraging on technology to provide different types of



financial products to customers. There are several factors that obstruct the progress of banks towards digital and cashless transactions. Cyber security is one of the major concerns of Fintech industry. Lack of digital infrastructure, loss of confidentiality, and competition are some of the challenges faced by the Indian banking industry. In the context of challenges faced by Indian banking industry in going digital, and in order to identify the competitive levels between public and private sector banks, an attempt is made to study the customers' experiences with digital banking.

### III. LITERATURE REVIEW

Many academicians and researchers have studied the customers' perceptions and experiences of Indian banking sector from varied angles. Following are some of the very interesting and useful for our research.

Geethika, Tanuj Nandan and Ashwini Kr. Upadhyaya (2008) conducted a study on internet banking to analyse the issues and prospects related to it amongst the residents of Allahabad. The study concluded that the prime reason for not opening a net banking account is lack of time. The study states that customers prefer ease in conducting their banking transactions. It also identified that the net banking customers give the most importance to excellent services which is followed by the bank's brand identity.

Divya Singhal and V. Padhmanabhan (2008) conducted a study on customer perception towards Internet banking, identifying major contributing factors. The study found that majority respondents felt that internet banking is convenient, flexible and has transactional benefits like efficient and speedy transfer of funds.

Bhavesh Vanpariya and Parthasarathy Ganguly (2010) studied the service quality in banking sector in India with the help of SERVQUAL and SERVPERF models. The study revealed that service quality has positive and significant correlation with customer satisfaction.

Neha Dixit and Dr. Saroj K. Datta (2010) in their study found that security, trust, innovativeness, familiarity, privacy and awareness, positively influence the acceptance of e-banking services in India. In this study, majority of the respondents were willing to try online banking if their banks provided them with guidance. The distinguishing characteristic of his study is that it also included innovativeness as a factor which could affect the usage of net banking services.

Arpita Khare, Anshuman Khare and Shveta Singh (2010) analysed the role of consumer personality in determining the preference for online banking in India. The study found that younger consumers tend to perceive net banking as easy and convenient. The customers having traits of 'intelligent' and 'upper class' would be affected the most by the availability of information on the bank's website about internet banking. Detailed information related to product features and service alternatives are more likely to encourage and motivate them to use online banking.

Shah Ankit (2011) investigated the major factors that influence online customers' satisfaction with the overall service quality of their banks in Vadodara district. He used factor analysis technique to identify the factors that influence customers' satisfaction. His study revealed that banking needs, followed by core services, problem resolution, cost saved, convenience and risk and privacy concerns are the major factors that strongly affect the overall satisfaction of online consumers.

Dr. Snehal Kumar H Mistry (2013) studied the factors that affect customer satisfaction in banks and analysed their effects on the level of customer satisfaction by using SERVQUAL method. The study revealed that increasing reliability, responsiveness and assurance are the main factors that the banks should consider to increase the satisfaction of the customers.

Prema. C (2013) studied the factors influencing consumer adoption of internet banking in Coimbatore, India. The study found that perceived usefulness, perceived ease of use, and perceived reliability had a positive impact on the adoption of internet banking. Further, the study concluded that there exists no relationship between marital status and adoption.

Dr. Geeta Sharma and Mr. Surendra Malviya (2014) conducted a study to determine the impact of internet banking service quality on satisfaction level of customers in Indore district of Madhya Pradesh. The study indicated that there exists a direct relationship between service quality dimensions of net banking and customer satisfaction in the banking industry. The service quality dimensions which the study considered were the website's ease of use, comfort, confidence, accessibility and responsiveness.

Arathy. C and Dr. B. Vijayachandran Pillai (2015) examined the impact of service quality dimension on customer satisfaction in e-banking services through a

comparative analysis using SERVQUAL model. Two banks namely the State Bank of India (SBI) from public sector and South Indian Bank from private sector in Thiruvananthapuram district were selected as sample banks for the study. The study found the opinion of customers about the quality of service, courtesy of the staff etc.

Joshi, Surani, and Rajani (2017) conducted a study to determine whether there is an association between age, occupation and usage of online banking services among customers. The study concluded that gender and usage of online banking services are not related in any way. Instead, occupation and the usage of online banking services are related. Specifically, the timing of the occupation leads the individuals to use online banking services.

From the above studies it is clearly seen that the available literature is related with the measurement of customers' satisfaction of public and private sector banks. There are research articles and papers related to comparative studies of banking services and customer satisfaction in public and private sector banks. There are also studies related to perception and experience of customers with internet banking or digital banking. But there is a dearth of literature that tries to do comparative study of the experience of customers of private sector banks and public sector banks with reference to digital banking. Thus, in this research, the comparative study of private and public sector banks customers experience with digital banking is done.

#### IV. RESEARCH OBJECTIVES

The main objective of this research is to study the experience of customers with reference to digital banking transactions. The sub-objectives are:

1. To understand customers' perception / reasons for going cashless or digital banking.
2. To understand customers' preference for different digital platforms.
3. To study the experience of customers of public and private sector banks with different digital products / services offered.

#### V. RESEARCH DESIGN

In this study, Descriptive Research is used and under descriptive research, Cross- Sectional Design is used. In

order to collect the views of the customers, a structured questionnaire is prepared. The questionnaire includes open, close and multiple response questions. Descriptive and inferential statistics to test various hypotheses are used. Different quantitative tests to study the relationship of various variables are referred.

#### Data Collection

This study is based on the primary data. For the purpose of present study, the data is collected from 300 respondents who use digital banking services using convenience sampling. Under private sector banks, the customers from ICICI, HDFC, Axis, Kotak Mahindra and IDFC banks were covered. Similarly under public sector banks, the customers from SBI, Bank of Baroda, Canara Bank, BOI and Central Bank of India were covered.

#### Data Analysis

After collection, the data was thoroughly edited and quantified. Few responses/questionnaires were rejected due to missing information. The data was keyed in Microsoft excel and Statistical Package for the Social Sciences (SPSS) 16.0 for windows software to work out. The data was analysed by using different statistical tools like frequency table with percentages rank order and independent t test.

### VI. FINDINGS AND ANALYSIS

#### 1. Demographic information of the respondents

The Table 1 evaluates the demographics of the respondents:

##### Interpretation:

From the frequency table, the following interpretation can be done:

- a. **Gender** - Out of 300 respondents, 140 respondents or 46.7 percent are male and 160 respondents or 53.3 percent are female.
- b. **Qualification** - Out of 300 respondents, 48.3 percent are post graduates, 41.7 percent are graduates, 5 percent are undergraduates and 5 percent have professional qualifications.
- c. **Age** - Out of 300 respondents, 6 percent are below the age of 20 years, 7.3 percent are above 60 years of age. 23.7 percent are from the age group of 40 to 60 years while 63 percent are from the age group of 20 to 40 years.

Table 1: Demographics of respondents

	Measuring Group	Frequency	Percentage
<b>Gender</b>	Male	140	46.7
	Female	160	53.3
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Qualification</b>	Under Graduate	15	5.0
	Graduate	125	41.7
	Post Graduate	145	48.3
	Professional degree	15	5.0
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Age</b>	Below 20	18	6.0
	20 to 40	189	63.0
	40 to 60	71	23.7
	Above 60	22	7.3
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Occupation</b>	Business	66	22.0
	Professional	48	16.0
	Home maker	18	6.0
	Student	46	15.3
	Retired	7	2.3
	Salaried class	115	38.3
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Income</b>	Below 20,000 (p.m.)	11	3.7
	20,001 – 40,000	70	23.3
	40,001 – 60,000	53	17.7
	60,001 – 80,000	31	10.3
	80,001 – 1,00,000	90	30.0
	Above 1,00,001	45	15.0
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Marital status</b>	Married	110	36.7
	Unmarried	190	63.3
	<b>Total</b>	<b>300</b>	<b>100</b>
<b>Banking sector</b>	Private	153	51.0
	Public	147	49.0
	<b>Total</b>	<b>300</b>	<b>100</b>

(Source: Author's own computation)

- d. **Occupation** - Out of 300 respondents, 66 respondents or 22 percent are having their own businesses, 48 respondents or 16 percent are professionals, 18 respondents or 6 percent are home makers, 46 respondents or 15.3 percent are students, 7 respondents or 2.3 percent are retired while 115 respondents or 38.3 percent belong to the salaried class.
- e. **Marital status** - Out of 300 respondents, 36.7 percent are married and 63.3 percent are unmarried.
- f. **Banking sector** - Out of 300 respondents, 153 respondents or 51 percent are customers of private sector banks and 147 respondents or 49 percent are customers of public sector banks.

## 2. Preference for using digital banking or cashless transactions

Table 2 evaluates the preferences of respondents for using cashless transactions:

### Interpretation:

If rank 1 is the most preferred and rank 6 is the least preferred reason for doing cashless transactions, then the maximum value of rank order is the least preferred and the minimum value of rank order is the most preferred reason for doing cashless transactions. The rank order for 'cashless transactions are a faster way of doing' 'cashless transactions are a faster way of doing' are a faster way of doing

Table 2: Reasons for using digital banking

Ranks	1	2	3	4	5	6	Rank Order	Rank
It is a more secure way of transaction	38	30	35	96	44	57	1149	5
It is very convenient to do cashless transactions	32	102	40	42	43	41	985	2
It is a faster way of doing transactions	90	80	50	36	28	16	780	1
It is more user friendly	56	40	40	54	86	24	1046	3
It is a cheaper way of doing transactions	38	34	40	40	50	98	1224	6
It can be used anywhere	46	14	95	32	49	64	1116	4

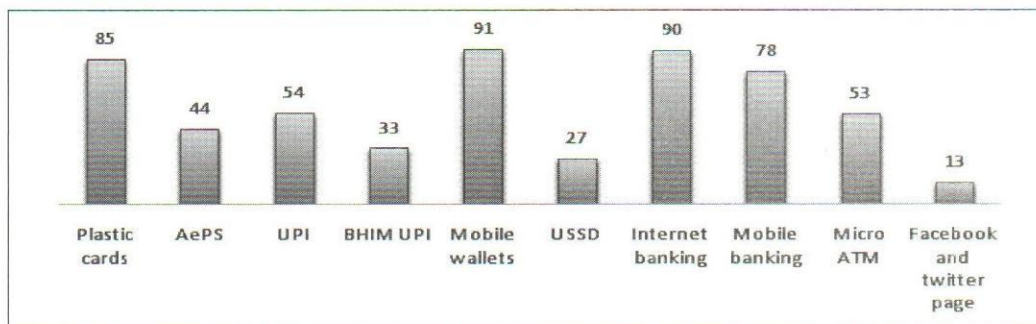
(Source: Author's own computation)

transactions' is 780, followed by 'cashless transactions are very convenient' is 985, followed by 'cashless transactions are user friendly' is 1046. The maximum rank order is for 'cashless transactions are a cheaper way of doing transactions' i.e. 1224. As the rank order for 'cashless transactions are a faster way of doing transactions' is the least, it can be concluded that people prefer to do cashless transactions because they are

faster and the second most preferred reason for doing cashless transactions is that it is convenient, while the least preferred reason is that it is a cheaper way of doing transactions.

## 3.Usage of digital platforms

Figure 1 evaluates the usage of digital platforms by respondents for banking transactions:



(Source: Author's own computation)

Figure 1: Customers' preference for digital platform

It is observed that 255 respondents out of 300 respondents or 85 percent use plastic cards. 132 respondents or 44 percent use AePS (Aadhaar-enabled Payment System). 162 respondents or 54 percent use UPI (Unified Payments Interface) like Google Pay, PhonePe, Paytm and Mobikwik. 100 respondents or 33 percent use BHIM UPI (Bharat Interface for Money) for their banking transactions, while 272 respondents or 91 percent use Mobile wallets like Apple Pay, Samsung Pay, Android Pay and PayPal for banking transactions. 80 respondents out of 300, or, 27 percent use USSD (Unstructured Supplementary Service Data) or \*99#. 270 respondents out of 300 or 90 percent use Internet Banking

or Net banking for banking transactions. Out of 300 respondents, 235 or 78 percent use Mobile banking. 160 respondents or 53 percent use Micro ATM and 40 respondents out of 300, or, 13 percent use Facebook and/or Twitter for banking transactions. Thus, it can be concluded that majority of respondents use mobile wallets followed by internet banking.

#### 4. Experience of customers of public and private sector banks with different digital products / services offered

Table 3 evaluates the customers' experiences with reference to cashless transactions:

**Table 3: Independent T Test**

Q. No.	Items	Hypothesis	P Value	Decision	Interpretation
Q.1	Obtaining plastic (ATM, debit, credit) cards	<b>H<sub>0</sub>a:</b> There is no significant difference between public and private sector bank customers' experience about the convenience of obtaining a plastic (ATM, debit, credit) card.	0.268	Accept H <sub>0</sub>	No difference
Q.2	Convenience in Funds transfer	<b>H<sub>0</sub>b:</b> There is no significant difference between public and private sector bank customers' experience regarding transferring of funds.	0.021	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.3	Opening an account	<b>H<sub>0</sub>c:</b> There is no significant difference between public and private sector bank customers' experience and convenience in opening an account.	0.380	Accept H <sub>0</sub>	No difference
Q.4	Balance enquiry	<b>H<sub>0</sub>d:</b> There is no significant difference between public and private sector bank customers' experience and convenience in getting balance enquiry.	0.363	Accept H <sub>0</sub>	No difference
Q.5	Paying of taxes	<b>H<sub>0</sub>h:</b> There is no significant difference between public and private sector bank customers' experience in paying taxes.	0.203	Accept H <sub>0</sub>	No difference
Q.6	Convenience in doing shopping	<b>H<sub>0</sub>f:</b> There is no significant difference between public and private sector bank customers' convenience in doing shopping.	0.094	Accept H <sub>0</sub>	No difference
Q.7	Getting home loan facility	<b>H<sub>0</sub>g:</b> There is no significant difference between public and private sector bank customers' experience in getting a home loan facility.	0.000	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.8	Investing funds	<b>H<sub>0</sub>e:</b> There is no significant difference between public and private sector bank customers' experience regarding investing the funds.	0.004	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference

Q.9	Mobile banking services	<b>H<sub>0j</sub></b> : There is no significant difference between public and private bank sector customers' experience in getting mobile banking services.	0.268	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.10	Locker application	<b>H<sub>0i</sub></b> : There is no significant difference between the public and private sector bank customers' experience regarding online locker application.	0.021	Accept H <sub>0</sub>	No difference
Q.11	Online application for loan	<b>H<sub>0k</sub></b> : There is no significant difference between public and private sector bank customers' experience regarding online application for loan.	0.380	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.12	Internet Banking services	<b>H<sub>0l</sub></b> : There is no significant difference between public and private sector bank customers' experience regarding internet banking services.	0.363	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.13	Booking of railway ticket (IRCTC)	<b>H<sub>0m</sub></b> : There is no significant difference between public and private sector bank customers' experience in booking railway tickets.	0.947	Accept H <sub>0</sub>	No difference
Q.14	Usage of ATM services	<b>H<sub>0o</sub></b> : There is no significant difference between public and private sector bank customers' experience in the bank's ATM services.	0.894	Accept H <sub>0</sub>	No difference
Q.15	Use of chatbot	<b>H<sub>0n</sub></b> : There is no significant difference between public and private sector bank customers' experience in using chatbot facility.	0.001	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.16	SMS alert facility	<b>H<sub>0p</sub></b> : There is no significant difference between public and private sector bank customers' experience regarding SMS alert facility.	0.000	Reject H <sub>0</sub> & Accept H <sub>1</sub>	Difference
Q.17	Utility bill payment	<b>H<sub>0q</sub></b> : There is no significant difference between public and private sector bank customers' experience in utility bill payment services.	0.145	Accept H <sub>0</sub>	No difference
Q.18	Cash deposit machines	<b>H<sub>0r</sub></b> : There is no significant difference between public and private sector bank customers' experience in cash deposit machines.	0.609	Accept H <sub>0</sub>	No difference
Q.19	E-lobby facility	<b>H<sub>0s</sub></b> : There is no significant difference between public and private sector bank customers' experience in E-lobby facility.	0.104	Accept H <sub>0</sub>	No difference
Q.20	Self-service passbook printing	<b>H<sub>0t</sub></b> : There is no significant difference between public and private sector bank customers' experience in using self-service passbook printing machines.	0.217	Accept H <sub>0</sub>	No difference

(Source: Author's own computation)

## Hypothesis

1.  $H_0a$ : There is no significant difference between public and private sector bank customers' experience in the convenience of obtaining a plastic (ATM, debit, credit) card.

$H_1a$ : There is a significant difference between public and private sector bank customers' experience in the convenience of obtaining a plastic (ATM, debit, credit) card.

### Interpretation:

On application of t test between public and private bank customers' experience about the convenience of obtaining a debit, credit or ATM card, it was found that the Sig. value i.e. P value for Levene's test is 0.002, which is less than 0.05. Hence, the assumption of equality of variances does not hold true. The P value for independent sample t test is 0.268. The P value is greater than  $\alpha$ , which is 0.05, therefore, null hypothesis is accepted. Thus, there is no statistically significant difference between public and private sector bank customers' experience about the convenience of obtaining plastic (ATM, debit, credit) card.

2.  $H_0b$ : There is no significant difference between public and private sector bank customers' experience regarding transferring of funds.

$H_1b$ : There is a significant difference between public and private sector bank customers' experience regarding transferring of funds.

### Interpretation:

On application of t test between public and private bank customers' experience regarding transferring of funds, it was found that the P value for Levene's test is 0.000, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.021. The P value is less than  $\alpha$  which is 0.05, therefore, there is no sufficient evidence to accept null hypothesis. Hence, the null hypothesis is rejected and alternative hypothesis is accepted; thus concluding that there is a significant difference between public and private sector bank customers' experience regarding transferring of funds. From the mean values, it is seen that the customers of public sector banks are more satisfied than private sector banks.

3.  $H_0c$ : There is no significant difference between public and private sector bank customers' experience and convenience in opening an account.

$H_1c$ : There is a significant difference between public and private sector bank customers' experience and convenience in opening an account.

### Interpretation:

On application of t test between public and private bank customers' experience regarding opening an account, it was found that the P value for Levene's test is 0.028, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.380. The P value is greater than  $\alpha$  which is 0.05, therefore, null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience and convenience in opening an account.

4.  $H_0d$ : There is no significant difference between public and private sector bank customers' experience and convenience in getting balance enquiry.

$H_1d$ : There is a significant difference between public and private sector bank customers' experience and convenience in getting balance enquiry.

### Interpretation:

On application of t test between public and private bank customers' experience and convenience in getting balance enquiry, it was found that the P value for Levene's test is 0.539, which is greater than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.363. The P value is greater than  $\alpha$  which is 0.05, therefore, null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience and convenience in getting balance enquiry.

5.  $H_0h$ : There is no significant difference between public and private sector bank customers' experience in paying taxes.

$H_1h$ : There is a significant difference between public and private sector bank customers' experience in paying taxes.

### Interpretation:

On application of t test between public and private bank customers' experience and convenience in paying taxes, it was found that the P value for Levene's test is 0.277, which is greater than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.203. The P value is greater than  $\alpha$  which is

0.05, therefore, null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience and convenience in paying taxes.

6.  $H_0f$ : There is no significant difference between public and private sector bank customers' experience in convenience in doing shopping.

$H_1f$ : There is a significant difference between public and private sector bank customers' experience in convenience in doing shopping.

### Interpretation:

On application of t test between public and private bank customers' experience and convenience in doing shopping, it was found that the P value for Levene's test is 0.000, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.094. The P value is greater than  $\alpha$  which is 0.05, therefore, null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience and convenience in doing shopping.

7.  $H_0g$ : There is no significant difference between public and private sector bank customers' experience in getting a home loan facility.

$H_1g$ : There is a significant difference between public and private sector bank customers' experience in getting a home loan facility.

### Interpretation:

On application of t test between public and private bank customers' experience in getting a home loan facility, it was found that the P value for Levene's test is 0.735, which is greater than 0.05. Hence the assumption of equality of variances holds true. The P value for independent sample t test is 0.000. The P value is less than  $\alpha$  which is 0.05, therefore, there is no sufficient evidence to accept null hypothesis, therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience in getting a home loan facility. For the mean values, it is observed that the mean value is high for the private sector bank's customers.

8.  $H_0e$ : There is no significant difference between public and private sector bank customers' experience regarding investing the funds.

$H_1e$ : There is a significant difference between public and private sector bank customers' experience regarding investing the funds.

### Interpretation:

On application of t test between public and private bank customers' experience regarding investing the funds, it was found that the P value for Levene's test is 0.209, which is greater than 0.05. Hence the assumption of equality of variances holds true. The P value for independent sample t test is 0.004. The P value is less than  $\alpha$  which is 0.05, therefore, there is no sufficient evidence to accept null hypothesis. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience regarding investing the funds. From the mean values, it is observed that the mean value is high for the private sector bank's customers.

9.  $H_0j$ : There is no significant difference between public and private bank sector customers' experience in getting a mobile banking services.

$H_1j$ : There is a significant difference between public and private bank sector customers' experience in getting a mobile banking services.

### Interpretation:

On application of t test between public and private bank customers' experience in getting a mobile banking services, it was found that the P value for Levene's test is 0.042, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.001. The P value is less than  $\alpha$  which is 0.05, therefore, there is no sufficient evidence to accept null hypothesis. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience in getting mobile banking services. From the mean values, it is observed that the satisfaction of the customers of private sector banks is higher than the satisfaction of the public sector banks.

10.  $H_0i$ : There is no significant difference between the public and private sector bank customers' experience regarding online locker application.

$H_1i$ : There is a significant difference between the public and private sector bank customers' experience regarding online locker application.



### Interpretation:

On application of t test between public and private bank customers' experience regarding online locker application, it was found that the P value for Levene's test is 0.027, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.914. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there exists no statistically significant difference between public and private sector bank customers' experience in online locker application.

11.  $H_0k$ : There is no significant difference between public and private sector bank customers' regarding online application for loan.

$H_1k$ : There is a significant difference between public and private sector bank customers' regarding online application for loan.

### Interpretation:

On application of t test between public and private bank customers' experience regarding online application for loan, it was found that the P value for Levene's test is 0.012, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.039. The P value is less than  $\alpha$  which is 0.05, therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience regarding online application for loan. From the mean values, it is observed that the satisfaction of the customers of private sector banks is higher than the satisfaction of the public sector banks.

12.  $H_0l$ : There is no significant difference between public and private sector bank customers' experience regarding internet banking services

$H_1l$ : There is a significant difference between public and private sector bank customers' experience regarding internet banking services

### Interpretation:

On application of t test between public and private bank customers' experience regarding internet banking services, it was found that the P value for Levene's test is 0.104, which is greater than 0.05. Hence the assumption of equality of variances holds true. The P value for independent sample t test is 0.000. The P value is less than  $\alpha$  which is

0.05, therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience regarding internet banking services. From the mean values, it is observed that the satisfaction of the customers of private sector banks is higher than the satisfaction of the public sector banks.

13.  $H_0m$ : There is no significant difference between public and private sector bank customers' experience in booking railway tickets.

$H_1m$ : There is a significant difference between public and private sector bank customers' experience in booking railway tickets.

### Interpretation:

On application of t test between public and private bank customers' experience regarding internet banking services, it was found that the P value for Levene's test is 0.295, which is greater than 0.05. Hence the assumption of equality of variances holds true. The P value for independent sample t test is 0.947. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience in booking railway tickets.

14.  $H_0o$ : There is no significant difference between public and private sector bank customers' experience about the bank's ATM services.

$H_1o$ : There is a significant difference between public and private sector bank customers' experience about the bank's ATM services.

### Interpretation:

On application of t test between public and private bank customers' experience about the bank's ATM services, it was found that the P value for Levene's test is 0.018, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.294. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience about the bank's ATM services.

15.  $H_0n$ : There is no significant difference between public and private sector bank customers' experience in using Chabot facility.

$H_{1,n}$ : There is a significant difference between public and private sector bank customers' experience in using Chabot facility.

### Interpretation:

On application of t test between public and private bank customers experience in using chatbot facility, it was found that the P value for Levene's test is 0.942, which is higher than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.001. The P value is less than  $\alpha$  which is 0.05, therefore, there isn't sufficient evidence to accept null hypothesis. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between public and private sector bank customers' experience in using chatbot facility. From the mean values, it is observed that the satisfaction level of the customers of the private sector banks is higher than the public sector banks.

16.  $H_{0,p}$ : There is no significant difference between public and private sector bank customers' experience regarding SMS alert facility.

$H_{1,p}$ : There is a significant difference between public and private sector bank customers' experience regarding SMS alert facility.

### Interpretation:

On application of t test between public and private bank customers experience regarding SMS alert facility, it was found that the P value for Levene's test is 0.942, which is higher than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.000. The P value is less than  $\alpha$  which is 0.05. Therefore, there is no sufficient evidence to accept null hypothesis, therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus there is a significant difference between public and private sector bank customers' experience regarding SMS alert facility. From the mean values, it is observed that the satisfaction level of the customers of the private sector banks is higher than the public sector banks.

17.  $H_{0,q}$ : There is no significant difference between public and private sector bank customers' experience about the utility bill payment services

$H_{1,q}$ : There is a significant difference between public and private sector bank customers' experience about the utility bill payment services

### Interpretation:

On application of t test between public and private bank customers experience about the utility bill payment services, it was found that the P value for Levene's test is 0.351, which is higher than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.145. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience in the utility bill payment services.

18.  $H_{0,r}$ : There is no significant difference between public and private sector bank customers' experience regarding cash deposit machines.

$H_{1,r}$ : There is a significant difference between public and private sector bank customers' experience regarding cash deposit machines.

### Interpretation:

On application of t test between public and private bank customers experience regarding cash deposit machines, it was found that the P value for Levene's test is 0.183, which is higher than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.609. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience regarding cash deposit machines.

19.  $H_{0,s}$ : There is no significant difference between public and private sector bank customers' experience about E-lobby facility.

$H_{1,s}$ : There is a significant difference between public and private sector bank customers' experience about E-lobby facility.

### Interpretation:

On application of t test between public and private bank customers experience in using the E-lobby facility, it was found that the P value for Levene's test is 0.702, which is higher than 0.05. Hence the variances are assumed to be equal. The P value for independent sample t test is 0.104. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience in using the E-lobby facility.

20.  $H_0$ : There is no significant difference between public and private sector bank customers' experience of using self-service pass book printing machines.

$H_1$ : There is a significant difference between public and private sector bank customers' experience of using self-service pass book printing machines.

### Interpretation:

On application of t test between public and private bank customers experience of using self-service pass book printing machines, it was found that the P value for Levene's test is 0.009, which is less than 0.05. Hence the variances are assumed not to be equal. The P value for independent sample t test is 0.217. The P value is greater than  $\alpha$  which is 0.05, therefore, the null hypothesis is accepted. Thus, there is no significant difference between public and private sector bank customers' experience of using self-service pass book printing machines.

## VII. CONCLUSION

In this study, an attempt has been made to study the customer's perception for using cashless or digital banking services. In this study, the experience of customers' of public and private sector banks with different digital products / services offered is also examined in detail. From the rank order table, it is concluded that people prefer to do cashless transactions because cashless transactions are a faster way of doing transactions and the least preferred reason is that the cashless transactions are a cheaper way of doing transactions. This indicates that the top two reasons why consumers go cashless are (1) they are a faster way of doing transactions and (2) they are very convenient to do. On the other hand, the least important reason is that it is a cheaper way of doing transactions. The study also concludes that most of the people prefer to use mobile wallets as the digital mode, followed by internet banking.

Regarding the experience of customers' of public and private sector banks with digital products / services offered, it is concluded that there is no difference in the experience of customers' convenience in obtaining a plastic card, in opening an account, in getting balance enquiry, in paying taxes, in doing shopping, in online locker application, in booking railway tickets, about the bank's ATM services, about the utility bill payment services, about cash deposit machines, about E-loobby facility and experience of using self-service pass book printing

machines. Since there is no significant difference in the experience levels of the customers, it can be concluded that these services provided by private and public sector banks are on par.

There is significant difference in the customers experience in transferring of funds, experience in getting a home loan facility, in investing the funds, in getting mobile banking services, in online application for loan, in the internet banking services, in using chatbot facility and experience regarding SMS alert facility. Since there is a difference in the experience levels of the customers, it can be concluded that these services are not at par. From the mean table, it is observed that except for experience regarding transferring of funds, for all other services, the experience of customers of private sector banks are more satisfying than public sector banks.

It is clearly observed that the customers of public sector banks are not satisfied with their banks' digital services as compared to the customers of private sector banks. Hence, it is recommended that the public sector banks should provide better and enhanced services to their customers regarding getting a home loan facility, investing in funds, mobile banking services, online application for loan, internet banking services, chatbot and SMS alert facilities. Finally, it can be concluded that financial technology (Fintech) is the next step for all the banks, and for the public sector banks to remain competitive and to satisfy the customers, they should provide better digital services to their customers.

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*"Ignoring technological change in a financial system based upon technology is like a mouse starving to death because someone moved their cheese"*

*– Chris Skinner*

Table 4: Group Statistics

	Bank	N	Mean	Std. Deviation	Std. Error Mean
Q1	Private	153	3.06	1.082	.149
	Public	147	3.26	.675	.098
Q2	Private	153	3.32	1.123	.154
	Public	147	3.74	.642	.094
Q3	Private	153	3.13	.921	.126
	Public	147	3.28	.713	.104
Q4	Private	153	3.64	.762	.105
	Public	147	3.79	.832	.121
Q5	Private	153	3.85	.794	.109
	Public	147	3.66	.668	.098
Q6	Private	153	2.68	1.252	.172
	Public	147	2.32	.862	.126
Q7	Private	153	3.58	.819	.112
	Public	147	2.47	.804	.117
Q8	Private	153	3.04	1.055	.145
	Public	147	2.45	.928	.135
Q9	Private	153	3.26	1.179	.162
	Public	147	2.55	.996	.145
Q10	Private	153	3.00	1.109	.152
	Public	147	3.02	.847	.124
Q11	Private	153	3.60	.884	.121
	Public	147	3.15	1.233	.180
Q12	Private	153	3.25	1.017	.140
	Public	147	2.13	1.209	.176
Q13	Private	153	3.26	.964	.132
	Public	147	3.28	.902	.132
Q14	Private	153	3.36	1.058	.145
	Public	147	3.38	.768	.112
Q15	Private	153	2.81	.982	.135
	Public	147	2.06	1.111	.162
Q16	Private	153	3.38	.904	.124
	Public	147	2.53	.975	.142
Q17	Private	153	3.32	1.205	.166
	Public	147	2.98	1.113	.162
Q18	Private	153	3.83	1.069	.147
	Public	147	3.94	.987	.144
Q19	Private	153	2.94	1.027	.141
	Public	145	2.62	.886	.132
Q20	Private	153	3.47	.953	.131
	Public	147	3.68	.726	.106

(Source: Author's own computation)

**Table 5: Independent Samples Test**

	Levene's Test Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the		
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Q1	Equal variances assumed	10.581	.002	-1.086	98	.280	-.199	.183	-.562	.164
	Equal variances not assumed			-1.115	88.402	.268	-.199	.178	-.553	.155
Q2	Equal variances assumed	34.848	.000	-2.279	98	.025	-.424	.186	-.793	-.055
	Equal variances not assumed			-2.350	84.411	.021	-.424	.180	-.783	-.065
Q3	Equal variances assumed	4.982	.028	-.869	98	.387	-.145	.166	-.474	.185
	Equal variances not assumed			-.883	96.329	.380	-.145	.164	-.470	.181
Q4	Equal variances assumed	.380	.539	-.914	98	.363	-.146	.159	-.462	.171
	Equal variances not assumed			-.909	93.897	.366	-.146	.160	-.464	.173
Q5	Equal variances assumed	1.196	.277	1.282	98	.203	.189	.148	-.104	.483
	Equal variances not assumed			1.295	97.750	.198	.189	.146	-.101	.480
Q6	Equal variances assumed	13.573	.000	1.654	98	.101	.360	.218	-.072	.792
	Equal variances not assumed			1.690	92.565	.094	.360	.213	-.063	.783
Q7	Equal variances assumed	.116	.735	6.867	98	.000	1.117	.163	.794	1.440
	Equal variances not assumed			6.875	96.979	.000	1.117	.162	.794	1.439
Q8	Equal variances assumed	1.599	.209	2.956	98	.004	.591	.200	.194	.988
	Equal variances not assumed			2.979	97.995	.004	.591	.198	.197	.985
Q9	Equal variances assumed	4.225	.042	3.235	98	.002	.711	.220	.275	1.147
	Equal variances not assumed			3.268	97.781	.001	.711	.218	.279	1.143
Q10	Equal variances assumed	5.021	.027	-.107	98	.915	-.021	.199	-.417	.374
	Equal variances not assumed			-.108	95.951	.914	-.021	.196	-.411	.368
Q11	Equal variances assumed	6.614	.012	2.137	98	.035	.455	.213	.032	.877
	Equal variances not assumed			2.095	82.375	.039	.455	.217	.023	.887
Q12	Equal variances assumed	2.700	.104	5.019	98	.000	1.118	.223	.676	1.560
	Equal variances not assumed			4.967	90.379	.000	1.118	.225	.671	1.565
Q13	Equal variances assumed	1.109	.295	-.066	98	.947	-.012	.187	-.384	.359
	Equal variances not assumed			-.067	97.706	.947	-.012	.187	-.383	.358
Q14	Equal variances assumed	5.823	.018	-.131	98	.896	-.024	.187	-.395	.346
	Equal variances not assumed			-.133	94.446	.894	-.024	.183	-.389	.340
Q15	Equal variances assumed	.005	.942	3.572	98	.001	.747	.209	.332	1.163
	Equal variances not assumed			3.545	92.506	.001	.747	.211	.329	1.166
Q16	Equal variances assumed	.005	.942	4.500	98	.000	.845	.188	.473	1.218
	Equal variances not assumed			4.480	94.352	.000	.845	.189	.471	1.220
Q17	Equal variances assumed	.877	.351	1.468	98	.145	.342	.233	-.120	.804
	Equal variances not assumed			1.475	97.830	.143	.342	.232	-.118	.802
Q18	Equal variances assumed	1.801	.183	-.513	98	.609	-.106	.207	-.516	.304
	Equal variances not assumed			-.515	97.835	.608	-.106	.206	-.514	.302
Q19	Equal variances assumed	.147	.702	1.642	96	.104	.321	.196	-.067	.709
	Equal variances not assumed			1.662	95.968	.100	.321	.193	-.062	.705
Q20	Equal variances assumed	7.205	.009	-1.223	98	.224	-.209	.171	-.549	.130
	Equal variances not assumed			-1.243	95.889	.217	-.209	.168	-.543	.125

(Source: Author's own computation)

# Input-Output Model Selection in DEA Evaluation Framework for Efficiency Optimization of Indian Banks

SEEMA GARG AND PANKAJ KUMAR GUPTA

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*Efficiency of the banking system is critical to every economy. Owing to intense competition, increased customer expectation and a dynamic financial environment, the efficiency and performance evaluation have become a serious concern for the bank managers and stakeholders and regulators and government at large. The choice of an appropriate method of performance, efficiency evaluation is critical to decision makers and policy makers. In the recent past, Data Envelopment Analysis (DEA) has emerged as an effective tool for judging various efficiency aspects of the Decision-Making Units (DMUs). Within the DEA framework, we find a variety of methods and approaches which have their own benefits and limitations. Analysis of literature hints out that the major problem of contrasting research outputs owes to the selection of input and output variables. In this paper, we have formulated various models by combining inputs and outputs and using a sensitivity analysis, we evolve a methodology for model selection that can best suit to evaluate the performance efficiency of Indian banks. We argue that our approach is better compared to the conventional production approach used by authors in an Indian context and is independent of time frames and sample data sets.*

*Seema Garg, Associate Professor, Amity International Business School, Amity University, Noida*

*Pankaj Kumar Gupta, Professor, Centre for Management Studies, Jamia Millia Islamia University, New Delhi (India)*

## I. Introduction

In every managerial decision making, measurement and evaluation of performance are fundamental aspects. In the performance measurement exercise, the crucial task is to determine the appropriate measure that can rank performance. The most difficult part of performance measurement is the determination of appropriate measures to provide an overall ranking of performance. A single measure of evaluation may not be appropriate in large number of situations. The effectiveness of management is measured by results of the institution and utilization of its available resources to the fullest to produce the maximum output with full satisfaction of its employees. Hence, the measurement of institutional performance is critical to evaluate the effectiveness of management of the institution.

“The Indian banking sector went through structural changes since independence, keeping in view its financial linkages with the rest of the economy and to meet the social and economic objectives of development” according to Kumbhakar and Sarkar (2005). The banking system comprise of scheduled and non-scheduled banks, post offices, saving banks, cooperative sector banks, foreign and exchange banks. Mohan (2005) argue’s that “during the last few decades, the environment under which Indian banking sector has operated witnessed a remarkable change. India embarked on a strategy of economic reforms in the wake of a serious balance of payment crisis in 1991”. The Indian banking sector has undergone a host of changes since its liberalization policy in the early 1990s whereby a series of reforms have been implemented. The main objective of the banking sector reforms was to make banking more productive and efficient by limiting the state intervention to promote a competitive financial system. And the result of such reforms was the consolidation of

the banking industry through mergers and acquisitions. Financial deregulation and Technological progress have proved to be important factors in accelerating the merger and acquisition process in Indian banking industry. SBI is the largest public sector bank in India and on 1st April 2017 it had merged with its five associated banks. Because of technological progress, banks increase the scale at which financial services and products are produced which also results in their expansion .

Data Envelopment Analysis (DEA) is a non-parametric technique which is an extended application of Linear Programming. It is also referred as frontier analysis, which was first introduced in the Operations Research by Charnes, Cooper and Rhodes (EJOR, 1978) when all DMU's (DMU is non- market agencies or homogeneous units like schools, hospitals and courts which produce identifiable and measurable outputs from measurable inputs) are operating at an optimal scale. DEA has grown into a powerful and useful analytical and quantitative tool for measuring and evaluating performance

and efficiency of DMUs. In the present study DMUs are the Banks. However, "in practical situation many factors like imperfect competition, regulatory and legal framework put constraints on DMU's not operating at optimal scale. As a result, the use of CRS specification when some DMU is not operating at optimal scale will result in measures of technical efficiency, which are confounded by scale efficiencies" (Philip, 1999). If a DMU is fully (100%) efficient in both the CCR and BCC scores, this means it is operating at the most productive scale size. If DMU has the full BCC score, but a low CCR score then it is locally efficient, but not globally efficient due to its scale size. Thus, it is reasonable to characterize the scale efficiency of a DMU by the ratio of two scores. Technical efficiency score is the total weighted sum of output divided by the total weighted sum of inputs. In this model, the efficiency is measured by the ratio of weighted outputs to weighted inputs, thus the efficiency of the banks will be measured as to how efficiently they are able to utilize their inputs.

$$\text{Efficiency} = \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}} = \frac{u_1 y_1 + u_2 y_2 + \dots + u_n y_n}{v_1 x_1 + v_2 x_2 + \dots + v_n x_n}$$

Where,  $u$  and  $v$  are the weights for the outputs,  $(y_1, \dots, y_n)$  and inputs,  $x$   $(x_1, \dots, x_n)$  respectively. The best performing DMU is the one with an efficiency score of unity or 100% and the performance of other DMU ranges between 0-100 per cent relative to the best performing DMU. For inefficient DMU (efficiency <100%), the DEA measures the slacks in each input and output variables and also results a reference group of efficient units with which they can be directly compared. A bank with a score of less than 1 is deemed to be technically inefficient relative to the efficient banks. The efficiency score indicates the performance of banks that how well they convert inputs into outputs. For example, if a bank has a technical efficiency score of 70 per cent, it means that it would have to reduce its inputs by 30 per cent to become as efficient as its reference set i.e., those banks with 100 per cent scores.

Mathematically, the efficiency of the DMU can be evaluated by solving the following linear programming problem (LPP):

$$\begin{aligned} &\text{Maximize } u^T y_j / v^T x_j \\ &\text{Subject to:} \\ &u^T y_j / v^T x_j \geq 1, j=1,2,\dots,n, u, v \geq 0 \dots \dots \quad (1) \end{aligned}$$

Where  $u$  is the  $(sx1)$  vector of output weights and  $v$  is the  $(mx1)$  vector of input weights.  $T$  denotes the matrix transpose operator. Thus,  $u$  and  $v$  are chosen to maximize the efficiency measure of the DMU i.e. subject to the constraints that the efficiency levels of all units must be less than or equal to 1.

The above problem has an infinite number of solutions. For a unique solution, the following constraint is imposed = 1. Then the problem of maximization becomes a problem of minimization:

$$\begin{aligned} &\text{Minimize } v^T x_i \\ &\text{Subject to:} \\ &u^T y_j = 1, u^T y_j - v^T x_j \geq 0, \\ &j=1,2,\dots,n, u, v \geq 0 \dots \dots \quad \dots (2) \end{aligned}$$

The duality problem to equation (2) can be written as follows:

$$\begin{aligned} &\text{Maximize } \Phi \\ &\text{Subject to:} \\ &\Phi y_i \leq \lambda^T y, x_i \geq \lambda^T x, \lambda \geq 0 \dots \dots \quad (3) \end{aligned}$$



Where  $\lambda$  is a  $(n \times 1)$  vector and  $\Phi_i$  is a scalar. Search for all linear combinations of input vectors in current practices. Then compute the maximal proportional output vector that can be produced by these linear combinations. A firm is said to be technically efficient when it cannot increase any output or decrease any input without reducing or increasing the quantities of other outputs or inputs. The results of efficiency scores obtained from DEA may vary if output and input combinations are changed. Thus, input-output selection is critical to the effectiveness of DEA as an approach to efficiency optimization. In this study, we analyze the various combinations of DEA models and present an approach to model selection that can suit best to the performance efficiency evaluation of Indian banks.

## II. Review of Literature

In India, we find several studies that have examined the various aspects of performance measurement and efficiency of banks. Introduced by Charnes *et. al* (1978), the traditional form of DEA yields a single efficiency index that combines a set of multiple outputs and inputs. Various reviews have been conducted by authors on examination of efficiency of banks in developed markets, including US like Berger and Humphrey (1997). The study by Bhattacharyya *et. al.* (1997) shows that performance of Indian public sector banks has declined during the study period 1986-1991 and also the technical efficiency for 1995 examined by Das (1997) shows that "Indian banks were more technically efficient than allocatively efficient". Evaluation of branch productivity and employee productivity by Singh (1990) shows an upward trend in productivity. For the year 1996-99, Mukherjee *et al.* (2002) found that technical efficiency in public sector banks is more than private and foreign banks. Mohan and Ray (2004) comparison of bank categories – private, public and foreign find a higher revenue, efficiency in favor of public sector banks but raise questions on the applicability of different legal and regulatory frameworks.

The impact of mergers and acquisitions on bank performance and efficiency is unclear in the literature according to Berger *et. al.* (1999). The opinions are mixed. The two basis of bank performance evaluation – Value and quantity as applied private and foreign banks show contrasting results (Chakrabarti and Chawla, 2005).

Ketkar and Ketkar (2008) have evaluated the impact of reforms and liberalization on efficiency and profitability of Indian commercial banks for the sample period 1997-

2004 using a non-parametric DEA with two combinations of inputs and outputs. Both of their models show efficiency improves during the observation period. Similarly, a study by Kumar (2008) on the relationship between profitability and efficiency using the public sector banks' cross-sectional data shows SBI affiliates are best performing operationally. They also identify the benchmark banks using the analysis of efficiency-profitability matrix.

Gupta and Garg (2011) examine the competitiveness of commercial banks (SCBs) in India. The authors have investigated, analyzed and compared the efficiency of 49 DMU (SCBs) by employing Data Envelopment Analysis (DEA). For the first time in Indian context, based on the technical and scale efficiency, the authors have identified the relatively best performing banks and classifying the leaders, moderate performers and laggards among the sample sets.

Misra and Aspal (2013) have used the CAMEL rating approach to evaluate the performance of SMI and its affiliates. More recently, studies like Kaur and Priya (2017), Murlidhara and Lingam (2017), Kumar and Malhotra (2017) Kiran (2018) have used CAMEL approach for performance evaluation and their results are contrasting with the DEA based methods. Jayaraman and Srinivasan (2014) have suggested Shannon-DEA approach as an effective method for efficient evaluation of Indian banks. The study by Gupta and Garg (2014) have used the Range Directional Measure Model (RDM) to examine the situations of DEA based performance, efficiency evaluation whether some of the outputs and inputs can take positive and negative values. Arora (2014) has analyzed the scale, pure technical and technical efficiencies for various ownership categories of Indian banks. A non-parametric evaluation by Kaur and Gupta (2015) in which the monetary values of inputs and outputs is used to determine the efficiency scores for the sample period 2009-2013 shows that the results are consistent over the sample period, but the differences in efficiency diminish over a period of time as compared to previous researches. Berger and Humphrey (1997) found that the intermediation approach is appropriate for evaluating efficiency at the macro level and production approach for branch level. An input oriented multistage CRS DEA conducted by Suresh and Tibor (2019) on Indian banks for the period 2010 - 2016 suggest that input extension results in Decreasing Returns to Scale (DRS) and it must be set by the decision making DMU. Kaffash and Marra (2016) had reviewed 620 DEA papers indexed

in web of science journals and found that there is no unique methodological preference in various models that include directional distance models, slacks based models, network models and Nash bargaining game. In a recent work, Bou-Hamad *et al.* (2017) have used a boosted generalized linear model to examine the efficiency. Also, Wu and Hsu (2019) have developed a multiple criteria decision-making method based on decision trees technique to introduce to determine suitable warning mechanisms of bank failures that can probably throw light on the efficiency aspects.

We establish that in DEA analysis, the selection of variables to be included in the model is the most important aspect of evaluation. There is disagreement among the researchers regarding the selection of outputs and inputs for the performance efficiency evaluation of banks (Casu, 2002; Sathye, 2003). For example - deposits have both input and output attributes. In addition, there are problems of negative data sets like losses emanating from Non-performing assets (NPAs) and negative liquidity and other performance sub-variables (Gupta and Garg, 2014). Using a directional DEA approach, Goyal *et al.* (2019) have established the need for input reduction in case of Indian public sector banks using an intermediation approach.

The acceptability and reliability of the DEA evaluation results depend on the accurate selection of the input and output indicators. Pina and Torres (2001) emphasize on the convenience of defining input and output to be used. The DEA based performance evaluation of Indian banks by Mani (2019) also highlights that *time period* is a major limitation to the generalization of evaluation results. We are motivated to evolve a methodology based on a modified version of intermediation approach earlier proposed by Berger and Humphrey (1997) for selecting the input and output variables to be used of performance evaluation of efficiency of Indian banks in the DEA framework. We show that our approach is better compared to the conventional production approach used by authors in an Indian context.

### III. Procedure and Testing

The twin aspects of our analysis are *size of the sample* and *selection of variables*. The size of the sample has been an important factor in the DEA based measures since the reduction in the size of the sample results in a reduced number of observations required for comparative analysis.

As such the number and pattern of efficient DMUs may be misleading. This problem is more severe where the efficiency scores are in a close range. To overcome this difficulty, the authors like Dyson *et al.* (1998) have evolved a rule of thumb. The rule says that the Size of the Sample  $\geq$  Number of inputs and Number of outputs. A competing rule says that Size of the Sample  $\geq 3$  (Number of inputs + Number of outputs). In agreement with (Avkiran, 1999), the size of the sample in our case is higher than computed as per these rules.

Efficiency scores derived through DEA are highly sensitive to the selection of input and output variables. Combinations of varying inputs and outputs can lead to different testable models. In the literature as said before, there is no preferred or perfect model that can be universally applied for efficiency evaluation of banks. The best is to conduct a sensitivity analysis across the formulated models which can reduce the biases and aid in selecting the appropriate fit. Accordingly, it is sensible to several models of input and output matrices that allows to offer a more detailed and accurate vision of the behavior of each DMU. Varying input and output specifications aids in analyzing the strength's and weaknesses of the DMUs (Banks) from various perspectives. It is important to analyze how the results change when we change the combinations of inputs and outputs. We use the sample of 46DMUs for the period 2005-2018. The names of banks and their groups are listed in Table 7. We have suitably adjusted the data to account for any corporate restructuring announced during the sample periods. We demonstrate the behavior of DEA results when introducing changes in inputs and outputs array and select the best model having appropriate inputs and outputs by application of sensitivity analysis and statistical tools for maximum practical utility.

### IV. Results and Discussion

Based on the literature and discussion with experts in the banking industry, we have constructed five models with different array of inputs–output variables shown in Table 1. These variables are common in many previous studies that have been conducted on evaluating the performance efficiency of Indian banks. To quote, Bhattacharyya *et al.* (1997) have used deposits, advances and investment and deposits as the output variables. Number of employees, borrowings, and deposits have been used as inputs and interest and non-interest income as outputs by Das (2000). Mukherjee *et al.* (2009) have used the number of branches

**Table 1: Models with varying Input and Output Matrices**

Model	Inputs	Outputs
<i>Model 1</i>	Equity Funds Number of Employees Operating Expenses	Advances (Loans) Interest Incomes (Spreads) Profit after Tax (PAT) Deposits Spread Non-Interest Incomes
<i>Model 2</i>	Number of Employees Interest Expenses Operating Expenses Non-Interest Expenses	Non-Interest Expenses Deposit, Non-Interest Income
<i>Model 3</i>	Operating Expenses Borrowings Deposits Fixed Assets (net)	Advances Investment Non-Interest Income Profit after Tax (PAT)
<i>Model 4</i>	Net Worth Number of Employees Cash in hand Share Capital Borrowings Operating Expenses	Net Interest Income Profit after Tax Interest Earned Net Non-performing Assets (NNPA)
<i>Model 5</i>	Fixed Assets Operating Expenses Number of Employees Equity Funds Deposits	Investments Net Profits Advances Non-Interest Income

**Table 2: Summary Results of Test 1**

DMU	2	Private Sector Banks Public Sector Banks
Input Variables	3	Equity Funds Number of Employees Operating Expenses
Output Variables	5	Advances (Loans) Interest Incomes (Spreads) Profit after Tax (PAT) Deposits Spread Non-Interest Incomes
Result	Test Failed (100% Efficient)	

Source: Author's calculation

**Table 3: Summary Results of Test 2**

DMU	2	Bank group (Public and private)
Input Variables	5	Advances (Loans) Interest Incomes (Spreads) Profit after Tax (PAT) Deposits Spread Non-Interest Incomes
Output Variables	3	Equity Funds Number of employees Operating Expenses
Result	Test Failed (100% Efficient)	

Source: Author's calculation

as a variable on input side. In our constructed models, cost and revenue factor is common to each one of the DEA runs.

For all the selected combinations of input and output variables, we observe a heterogeneity reflected by variances. This implies that the input and output data sets need to be evaluated with the selected models with adherence to time frames.

In all the five models, output oriented CCR approach has been applied for computing the technical efficiency of Indian commercial banks comprising of public sector and private sector banks. We present the results of the tests as follows.

In the *first test*, the data from Indian Scheduled Commercial Scheduled banks as divided into two DMUs (two banking groups) i.e. Public Sector (SBI Group and Nationalized) and Private sector (Old and New Private) bank. In this test, scores of all DMUs in each banking group averaged to represent a single score for each decision variable for each of the two banking groups tested (Table 2). Since all DMUs have achieved the efficiency score as 1, it is difficult to discriminate between efficient and inefficient unit, as all the DMUs were deemed to be equally efficient. The failure of results of this test verifies the thumb rule for application of DEA means that the number of DMUs must be more than the product of the number of inputs and outputs (Dyson *et al.*, 1998).

Our interest in conducting the second test is to verify *whether the reversal of the input and output variables would provide any additional information*. Test 2 is built on Test 1 with the only change in the reversal of input and output variables. Table 3 shows the summary of the results.

The reversal is also inconclusive as all the DMU's displayed equal efficiencies of 1 i.e. 100% efficient. The failure of results of this test also verifies the thumb rule for application of DEA, as the number of DMUs i.e. 2 is less than the product of input and output variable i.e. 15.

Now we move to *testing all the DMUs in Full Cohort*. The full cohort of all 46 banks for all 5 models over the sample period (2005-2018) has been used for testing. The segregation by individual banks is abandoned and the results of the technical efficiency have been presented separately for each model for all 46 DMUs together. The trial is conducted for CCR-O. There is no difference observed in the efficiencies on CCR-I and CCR-O conducted on the sampling units.

We present the results obtained for each of the selected input-output models for the sample period 2005-2018 which includes the major events like global financial crisis and introduction of insolvency and bankruptcy code.

Model 1 comprises of three inputs and five outputs for all 46 DMUs (Banks). The results of technical efficiency scores over the study period indicate that there is a reduction of efficient units during the sample period (Figure 1). This reduction attributes to global financial crisis.

Model 2 consisting of four inputs and four outputs for all 46 DMUs tested for technical efficiency shows that *in sample period* the number of efficient DMU is following a different pattern as initially from 2005 the efficient banks increases during global crisis periods and then decreases in the post crisis period (Figure 2).

Model 3 comprising of five inputs and five outputs for all 46 DMUs shows that the number of efficient banks is following up and down trend and finally it recovered the

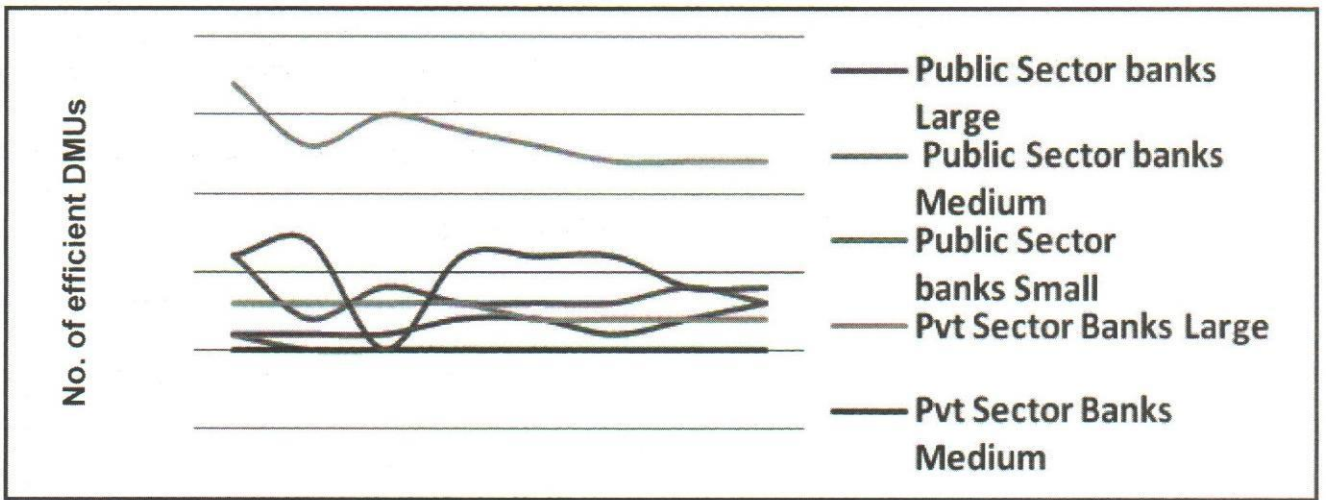


Figure 1: No. of Efficient DMUs in Full cohort Model 1

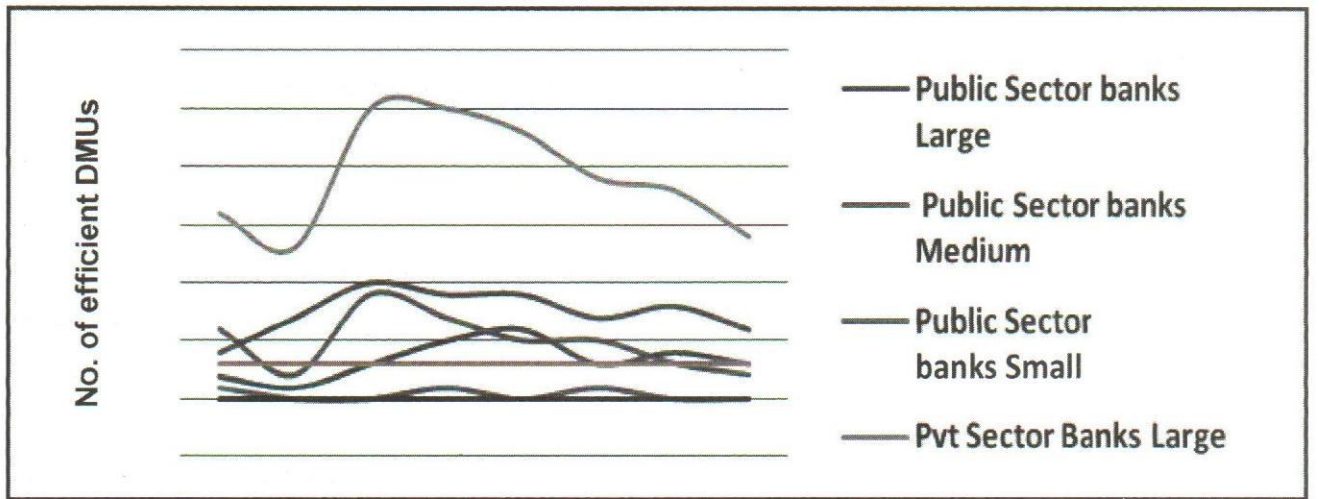


Figure 2: No. of efficient DMUs in Full Cohort Model 2

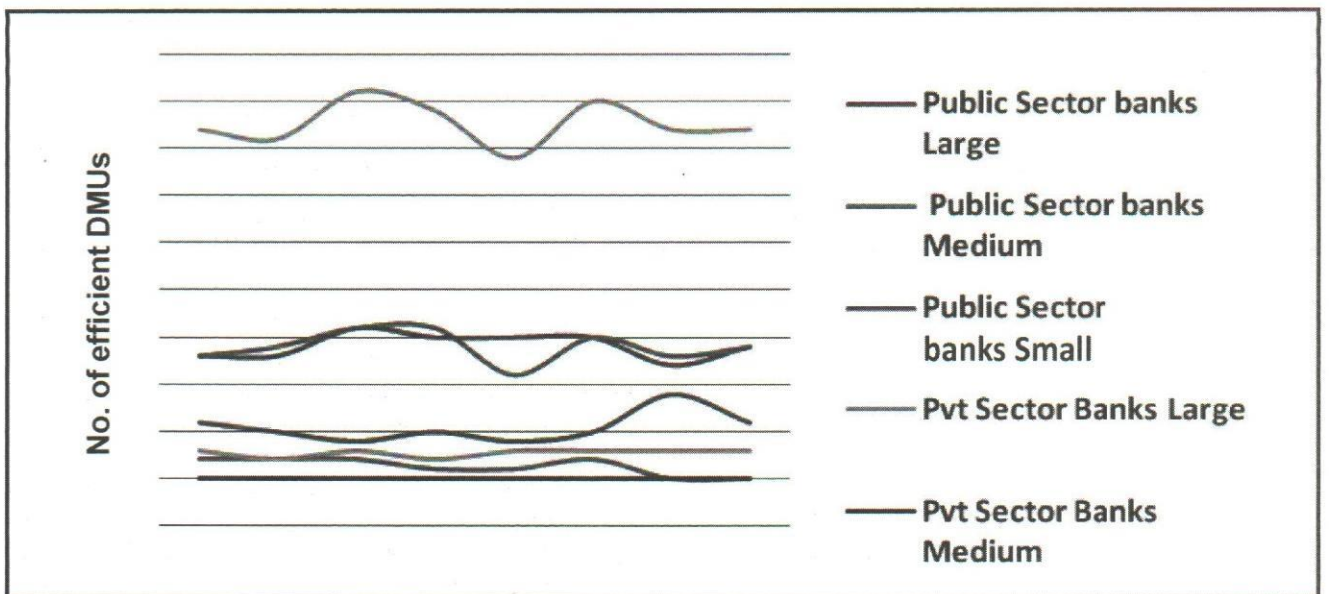


Figure 3: No. of efficient DMUs in Full Cohort Model 3

status quo in 2012 and then in 2014 and 2017(Figure 3). We also find an active step taken by the central bank (RBI) to reduce NPA followed by the implementation of Insolvency and Bankruptcy code.

Model 4 comprises of six inputs and three outputs and indicate the trends that imply that there is a continuous

reduction of efficient units from the start of sample period in 2005 to 2011 except 2012 and then some increase is witnessed (Figure 4).

*Model 5:* Model 5 with four inputs and four outputs also imply that there is a reduction of efficient units from 2005 to 2018 (Figure 5).

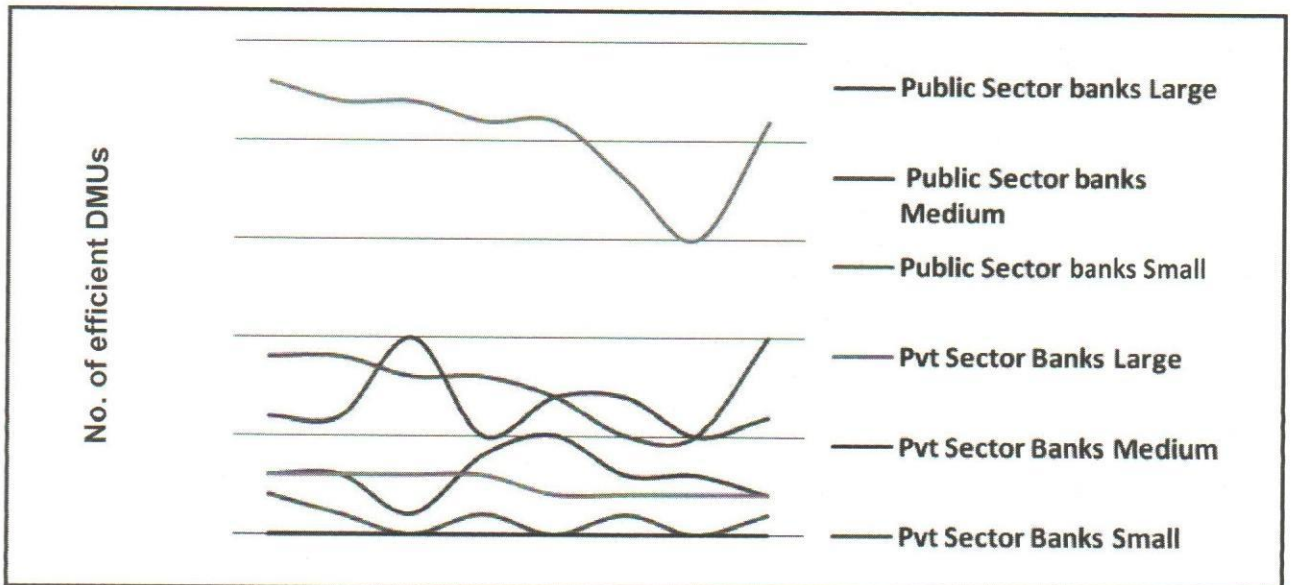


Figure 4: No. of efficient DMUs in Full Cohort Model 4

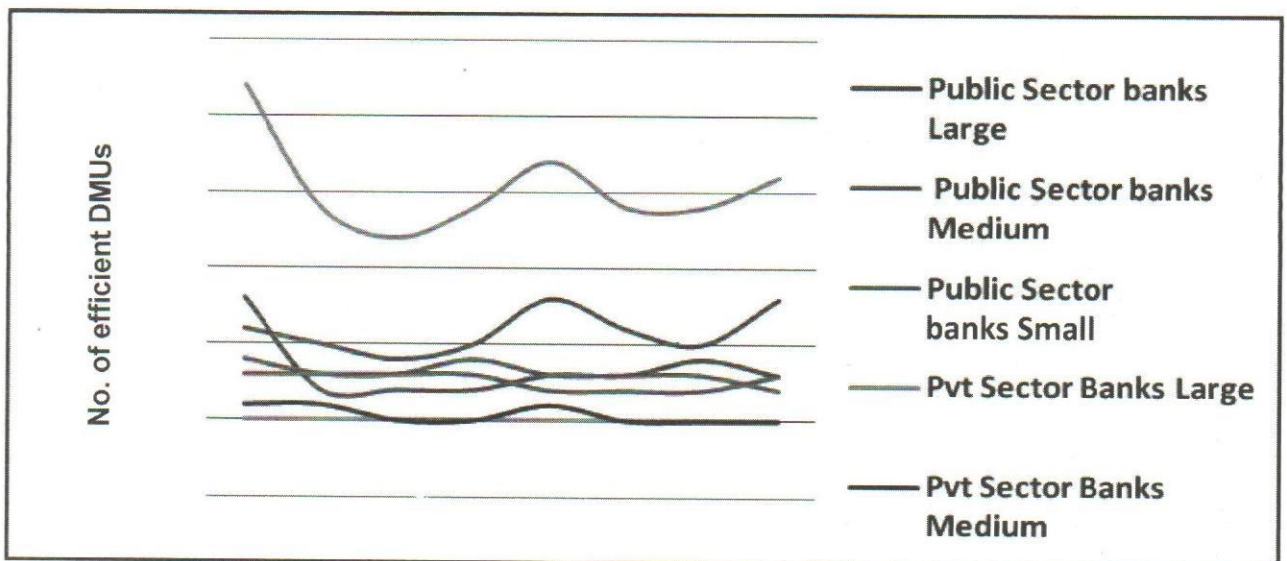


Figure 5: No. of efficient DMUs in full Cohort Model 5

After getting the results of efficiency scores of various sets of inputs and outputs the next step is to compare the different sets. The efficient banks, which are most common among all the models in each financial year are shown in Table 4.

For the first period 2005-2013, IDBI maintains its consistent performance among all the models and least affected by inputs and output in the modeling. After an IDBI bank crisis, in the second period, we find that HDFC bank is a consistent performer along all models. The

**Table 4: Year wise most efficient DMUs**

Year	Efficient DMUs	No of Efficient DMUs
2005	IDBI, HDFC, AXIS, OBC, SBH, SBP	6
2006	IDBI, AXIS, HDFC, SBP, TMB	5
2007	IDBI, AXIS, HDFC, ICICI, KARUR, TMB	6
2008	IDBI, HDFC, ICICI, CORP, FED	5
2009	IDBI, AXIS, ICICI, CORP, FED, KARUR	6
2010	IDBI, HDFC, ICICI, FED, TMB, YES	6
2011	IDBI, ICICI, CORP, J&K, YES	5
2012	IDBI, BOB, ICICI, J&K, YES	5
2013	IDBI, BOB, ICICI, J&K, YES	5
2014	HDFC, YES, AND, SBI, FB	5
2015	HDFC, YES, PNB, AND, SBI, FB, CUB	6
2016	HDFC, YES, AND, SBI, FB, CUB, ALLB	6
2017	HDFC, YES, AND, SBI, FB	5
2018	HDFC, YES, AND, SBI, FB	5

Source: Author's calculation

**Table 5a - Model wise most efficient DMUs [2005-2013]**

Year	Efficient DMUs	No. of Efficient DMUs
Model 1	IDBI, AXIS, ICICI, SBH, J&K, TMB	6
Model 2	IDBI, AXIS, HDFC, SBP, J&K, YES	6
Model 3	IDBI, HDFC, BOM, CORP, SBP, UCO, SBBJ, SBT	6
Model 4	IDBI, ICICI, ORP, OBC, NAINI TMB	6
Model 5	IDBI, SBI, AXIS, ICICI, SBH J&K, TMB	7

Source: Author's calculation

**Table 5b: Model wise most efficient DMUs [2014-2018]**

Year	Efficient DMUs	No. of Efficient DMUs
Model 1	HDFC, AXIS, ICICI, FB, ALLA	5
Model 2	HDFC, SBI, AXIS, YES, CUB, FB	6
Model 3	HDFC, CORP, CUB, YES, AXIS	5
Model 4	HDFC, ICICI, ANDB, AXIS, CUB, YES	6
Model 5	HDFC, AXIS, SBI, FB, ANDB	5

Source: Author's calculation

Table 6: Sensitivity Analysis

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5
<b>Panel A</b>					
<b>Inputs</b>					
Borrowings			*	*	
Capital				*	
Cash in Hand				*	
Deposit			*		*
Equity Funds	*				*
Fixed Assets			*	*	
Interest Expenses		*			
Net Worth			*		
No of Employees	*	*		*	*
Non-Interest Expenses		*			
Operating Expenses	*	*	*	*	*
<b>Outputs</b>					
Advances	*	*	*		*
Core Operating Profit				*	
Deposit	*	*			
Interest Earned				*	
Interest Spread	*				
Investment			*		*
Net Interest Income		*	*		
Net NPA				*	
Non-Interest Income	*	*	*		*
Profit after Tax (PAT)	*		*		*
<b>Panel B</b>					
<b>Estimated Results</b>					
Correlation with Model1	1	0.8395	0.6452	0.2253	0.7442
No of Efficient Banks	12	14	37	21	16
Efficiency Score (Mean)	0.8573	0.951	0.9241	0.995	0.877
Standard Deviation	0.1228	0.0555	0	0.0074	0.1059
Minimum Efficiency	0.5281	0.7778	0.9241	0.9602	0.6547
Inference	<b>Accepted</b>	<b>Rejected</b>	<b>Rejected</b>	<b>Rejected</b>	<b>Rejected</b>

Source: Author's calculation

\*indicates the presence of particular input & output in the Corresponding Model.



**Table 7: List of DMUs (Banks) and Groups**

Bank Group	Type of Banks	Abbreviation of Banks	Name of Bank
<b>Large</b>	N Pvt	AXIS	Axis Bank Limited
	Nation	BOB	Bank of Baroda bank
	Nation	BOI	Bank of India
	Nation	CAN	Canara Bank
	Nation	CBI	Central Bank of India
	N Pvt	HDFC	HDFC Bank Limited
	N Pvt	ICICI	ICICI Bank Limited
	Nation	IDBI	IDBI Bank Limited
	Nation	PNB	Punjab National Bank
	SBI Gp	SBI	State Bank of India
	Nation	UNION	Union Bank of India
	Nation	ALB	Allahabad Bank
	Nation	ANDH	Andhra Bank
	Nation	BOM	Bank of Maharashtra
Nation	CORP	Corporation Bank	
Nation	DENA	Dena Bank	
Nation	INDIAN	Indian Bank	
Nation	IOB	Indian Overseas Bank	
Nation	OBC	Oriental Bank of Commerce	
<b>Medium</b>	Nation	SBBJ	State Bank of Bikaner and Jaipur
	SBI Gp	SBH	State Bank of Hyderabad
	SBI Gp	SBP	State Bank of Patiala
	SBI Gp	SBT	State Bank of Travancore
	Nation	SYNDI	Syndicate Bank
	Nation	UBI	United Bank of India
	Nation	UCO	Uco bank
	Nation	VIJAYA	Vijaya Bank
	O Pvt	CATHO	Catholic Syrian Bank Limited
<b>Small</b>	O Pvt	CITY	Citi Union Bank Limited
	N Pvt	DCB	Development Credit Bank Limited

	O Pvt	DHAN	The Dhanlakshmi Bank
	O Pvt	FED	Federal Bank Limited
	N Pvt	INDUS	Indus Ind Bank Limited
	O Pvt	ING	Ing Vysya Bank Limited
	O Pvt	J&K	Jammu & Kashmir Bank Limited
	O Pvt	KARN	Karnataka Bank Ltd
	O Pvt	KARUR	Karur Vysya Bank Limited
	N Pvt	KOTAK	Kotak Mahindra Bank Limited
<b>Small</b>	O Pvt	LAKSHMI	Lakshmi Vilas Bank Ltd
	O Pvt	NAINI	Nainital Bank Limited
	Nation	PSB	Punjab and Sind Bank
	O Pvt	RATN	Ratnakar Bank Limited
	SBI Gp	SBM	State Bank of Mysore
	O Pvt	SOUTH	South Indian Bank Limited
	O Pvt	TMB	Tamilnad Mercantile Bank Ltd
	N Pvt	YES	Yes Bank Limited

Source: Author's Extractions using website of RBI

O Pvt: Old Private Sector Banks

N Pvt: New Private Sector Banks

SBI Gp: SBI and its associates

Nation: Nationalized Banks

summary of the efficient DMUs model wise and year wise are given in Table 5a and Table 5b respectively.

Thus, we are able to derive a benchmark DMU that does not get affected by variation of the input or output variable. Generally, there is no ideal model among the set of various potential models, but to select the one which includes model specification with alternative specification of input and output variables which can give robust results. We use this comparison for further sensitivity analysis.

To select the appropriate model for an efficiency analysis, sensitivity analysis has been conducted for each model in terms of discriminatory power. Firstly, Model 1 has been considered as a baseline model remaining four models have been used in our sensitivity analysis in order to capture various aspects of technical efficiency. Using the rejection criteria suggested by Chen and Yeh (1999) and Kumar and Gulati (2008), we select the appropriateness of the model. The correlation coefficient of Technical Efficiency scores of

base Model 1 with other models is the highest and the number of efficient DMUs is the least (Table 6).

The results of sensitivity analysis infer that all the cases having a different array of input and output variables have been rejected in favor of Model 1 based on aforementioned rejection criteria. Thus, Model 1 is considered as the most preferred model. Thus, the choice of input and output variables reflected by Model 1 for evaluating the efficiency of Indian banks is most appropriate.

## V. Conclusion

In DEA, valuation of efficiency scores is very sensitive to the selection of input and output variables. The selection of the appropriate input/output variable is debatable and critical task. The choice of the variables for the decision-making depends on the objective of the decision maker.

Keeping in view this objective, we have developed a methodology to simplify the procedure for selection of the right variable array of input as well output. We have developed five models with varying combinations of input and output. To choose the right model among various models, a sensitivity analysis has been conducted for each model in terms of discriminatory power for further in-depth study. We establish that Model 1 is found to be most effective where Number of employees, Equity Funds Operating Expenses are as input variables and Interest Spread, Non-Interest Income, Advances, Profit after Tax (PAT), Deposits as output variables. Across models, the common DMU can be designated as benchmark DMU and the model whose results are unaffected by time periods and captures the common significant DMUs is the most reliable and predictable model. Our approach can also be applied to other areas of performance efficiency evaluation.

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*"We're in charge now, our generation and our FinTech entrepreneurs will, make things change the world, but make it a better place for everyone."*

*– Carlos Ochoa*

# A Study on Financial Inclusion through Mobile Banking Technology of Public Sector Banks

R. GOKILAVANI AND M. DURGARANI

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*Mobile banking is an emerging trend among all segments of people across all geographical regions of India. Mobile banking increases the hope that financial services given through mobile phones can remove all constraints of conventional banking and enhance financial inclusion of people in simple and easy ways. The findings of this study reveal that significant difference exists between insight of customers on mobile banking of public sector banks and their personal features. Convenient, security for transactions, cost-effective, user-friendly, privacy for personal information and minimum efforts are the features that have positive and significant influence on the financial inclusion of customers of public sector banks. Thus, public sector banks should cost-effectively provide mobile banking and must ensure privacy for personal information. These measures will enhance financial inclusion of customers of public sector banks.*

## 1. Introduction

Financial inclusion is the continuous process of delivering services of banks at a reasonable cost to low income and disadvantaged sections of the population. In present times, majority of people in rural and backward regions of India have not used services of banks that may help them to improve their financial security, savings, borrowings and development of entrepreneurial activities (Anyasi and Otubu, 2009, p. 2). Thus, Reserve Bank of India and the Government of India have encouraged the expansion of banks in such areas to provide various banking services to people through modern and advanced technologies (Rao, 2004, p. 24). To attain financial inclusion in India, they undertake numerous initiatives that consist of providing fundamental banking services, such as zero bank account or no-frills account to low income and underprivileged sections of society, providing cheap credit of a maximum of Rs. 25,000, simplified norms, application of information and communication technologies, cards, electronic transfer, business activities and drives for 100 per cent financial inclusion (Thapar, 2013, p. 212).

At the same time, the reach of financial inclusion in India is very low and the utilization of banking services by people is also very low in rural areas because a large number of branches of banks operate in urban areas rather than rural areas (Subramanian, 2014, p. 106). Only 40 per cent of the population in India has bank accounts, and it is little bit more in South India. At this juncture, it is recognized that mobile banking is one of the most effective means for financial inclusion for people in India. Widely spread information and communications technologies, internet facilities and penetration of mobile phones across India pave the way for the adoption of mobile banking. It is a new mode of availing financial and banking services by the people (Sharma, 2011, p. 148).

R. Gokilavani, Associate Professor, PSG College of Arts & Science, Coimbatore, India

M. Durgarani, Assistant Professor, Jeppiaar Engineering College, Chennai, India.

Majority of people in India are living in rural areas and most of them cannot access services of banks. The conventional system of banks is inefficient in meeting their needs. The establishment of branches in rural regions will require a huge investment for creating infrastructure and employing additional employees (Vadavadagi and Allagi, 2014, p. 110). Nevertheless, India is the second biggest market for telecommunications, and nearly 700 million people have mobile phones. Nowadays, the mobile phone is common in all parts of India, including remote areas. The mobile phone industry in India is growing rapidly at 100 million annually. Given this progress, the mobile phone is playing a significant role in accessing financial services, and mobile banking is an emerging trend among all segments of people across all geographical regions of India (Dermish et al. 2012, p. 83).

Mobile banking is also called m-banking, SMS banking, or M-Banking. It is used for availing of all types of banking and financial services by people very easily. Mobile banking is a group of activities that helps people avail banking services through their mobile phones. It provides a wide range of facilities to people for performing their banking operations efficiently (Kaur, 2015, p. 1251). Mobile banking increases the hope that financial services given through mobile phones can remove all constraints of conventional banking and enhance the financial inclusion of people in simple and easy ways. Mobile banking has immense potential to enhance the efficiency of banking operations, decrease dependency on cash payments, expand accessibility of financial services (Peha and Kahmitov, 2004, p. 385) and reduce the cost of availing banking and financial services. As an outcome, almost all public sector banks have introduced mobile banking for customers to enhance their financial inclusion. With this background, this research was conducted to study financial inclusion through mobile banking of public sector banks in Tamil Nadu.

## 2. Review of Literature

Morawczynski and Pickens (2009) stated that poor people effectively used M-Pesa, and that accessibility, risk, cost, efficiency and the variety of financial services were significantly influencing the financial inclusion of poor people. They also stated that poor people used mobile banking to perform borrowing and savings activities effectively and conveniently.

Leasi (2010) indicated that mobile banking had increased the financial inclusion of people considerably.

Efficiency, mode of payments, banking services, cost of services, networks, internet facilities and safety of transactions were significantly affecting the financial inclusion of people.

Moin and Ahmed (2011) found that mobile banking has emerged as a modern type of banking, and that it could provide efficient banking services to customers. Mobile banking was not well adopted by customers in rural areas because of poor coverage of networks, lack of security, high operational costs and inconvenient applications. Thus, it was necessary to improve mobile banking services in rural areas by banks to enhance financial inclusion of customers.

Bamoriya and Singh (2012) concluded that mobile banking had enhanced the financial inclusion of people significantly. Convenience, easy to use, timely services, safety of transactions and cost were affecting mobile banking among people. Poor networks, poor services, availability of mobile phones and lack of awareness were the major constraints for the adoption of mobile banking by people.

Mishra and Sahoo (2013) revealed that customers adopted mobile banking at a low rate, and they used mobile banking for transfer of funds, payment of bills, online transactions and saving of money. Lack of internet facilities, risk in transactions, fear of loss, lack of mobile phones and poor awareness were important constraints for customers in adopting mobile banking.

Siddik et al. (2014) showed that subjective norms and perceived risks were directly influencing the behavioural intention for the adoption of mobile banking by people, and that mobile banking had a large and significant impact on the services of banks availed by people. Accessibility, degree of use of services, types of banking services, internet facilities and efficiency were significantly affecting the financial inclusion of people.

Ponnuraj and Nagabhusanam (2015) indicated that mobile banking was not effective for the financial inclusion of the population in rural areas because of the barriers in the adoption of it. Lack of financial services, non-affordability, high cost, inconvenience, rigid applications, poor networking and awareness affected the use of mobile banking among customers in rural areas. But mobile banking had a vast potential for financial inclusion of rural population.

Shen and Huang (2016) found that internet banking was a modern method of using information and communication technologies to perform various banking services, such as payment to third parties, lending through online platforms, transfer of funds and insurance and banking operations through online and mobile banking. Cost of transaction, efficiency, risk and networking for mobile banking were affecting financial inclusion of customers.

Kumari (2017) concluded that mobile banking has great potential for giving banking services to customers, and it was an efficient instrument for financial inclusion of customers. Customers used mobile banking for payments for merchandizing, transferring funds, enquiry for balance, payment of bills, checking transactions, online request for getting cheques and so on. Customers were using mobile banking at low degree than mobile phone users. Customers were not well aware of mobile banking, and its application was very low. To improve the usage of mobile banking, banks had to address issues related to mobile banking efficiently.

Haider (2018) revealed that access to digital technologies including smartphones, internet facilities and biometric system permitted for a large range of banking services, namely, banking through online, mobiles and digital credit method for financial inclusion of a large number of people. Mobile banking was convenient, affordable, easy and effective for saving and borrowing funds, and these factors were significantly influencing the financial inclusion of people.

Venkatalaxmi and Ramachandra (2019) indicated that real-time gross settlement, national electronic funds transfer, electronic clearing system and immediate payment service were various kinds of digital financial transactions facilities provided by banks. Customers in rural areas were not interested in using mobile banking for their financial transactions, and they did not have sufficient access to digital facilities. They had no awareness of mobile banking and it affected their financial inclusion significantly.

### **3. Research Methodology**

This study was conducted in Tamil Nadu state. Customers of public sector banks were chosen by employing a convenience sampling method. A structured questionnaire was used to get data from a primary source of 300 customers of public sector banks. Personal features of

customers of public sector banks were examined by using percentages. The insight of customers on mobile banking of public sector banks was studied through mean and standard deviation. The difference among insight of customers on mobile banking of public sector banks and their personal features was examined by applying Analysis of Variance (ANOVA) and t-tests. The influence of the insight of customers on mobile banking of public sector banks on their financial inclusion was analyzed through regression analysis.

The study also includes the Reserve Bank of India (RBI) data for 2019 to understand the volume of banking transactions conducted using mobile banking technology and to predict the mobile banking transaction for 2020.

## **4. Results and Discussion**

### **4.1. Personal Features of Customers of Public Sector Banks**

The personal features of customers of public sector banks are shown in Table 1. Males are the largest number of customers of public sector banks (55.67 per cent), and 30.33 per cent of them belong to the age group of 31 to 40 years. One-third of them are undergraduates (33.00 per cent), 37.33 per cent of them earn Rs. 25,001–Rs. 35,000 monthly and 79.67 per cent of them were married.

### **4.2. Insight of Customers on Mobile Banking of Public Sector Banks**

The insight of customers on mobile banking of public sector banks is shown in Table 2. The customers of public sector banks agree that mobile banking is convenient, easily adoptable, gives security for transactions, user-friendly, very quick, reduces paper works, provides timely services, and requires minimum efforts. At the same time, they are unsure whether mobile banking is cost-effective and whether it gives privacy for personal information.

#### **4.2.1. Insight of Customers on Mobile Banking of Public Sector Banks and Their Personal Features**

The relation among insight of customers on mobile banking of public sector banks and their personal features is detailed below.

##### **4.2.1.1. Gender and Insight on Mobile Banking of Public Sector Banks**

The relation between the gender of customers and their insight on mobile banking of public sector banks is shown

**Table 1: Personal Features of Customers of Public Sector Banks**

Personal features	Number	Percentage
<b>Gender</b>	300	
Male	167	55.67
Female	133	44.33
<b>Age</b>		
21 to 30 Years	58	19.33
31 to 40 Years	91	30.33
41 to 50 Years	86	28.67
51 to 60 Years	65	21.67
<b>Education</b>		
Secondary	50	16.67
Larger Secondary	70	23.33
Under-graduation	99	33.00
Post-graduation	81	27.00
<b>Monthly Income</b>		
Less than Rs. 25,000	54	17.00
Rs. 25,001 to Rs. 35,000	112	37.33
Rs. 35,001 to Rs. 45,000	78	26.00
More than Rs. 45,000	56	18.67
<b>Marital Status</b>		
Married	239	79.67
Unmarried	61	20.33

Source: Primary data.

**Table 2: Insight of Customers on Mobile Banking of Public Sector Banks**

Insight on Mobile Banking	Mean	Standard Deviation
Mobile banking is convenient	3.87	0.86
Mobile banking is easily adoptable	3.80	0.92
Mobile banking is cost-effective	3.36	1.09
Mobile banking gives security for transactions	3.75	0.98
Mobile banking is user-friendly	3.78	0.95
Mobile banking is very quick	3.70	1.04
Mobile banking reduces paperwork	3.73	1.01
Mobile banking gives privacy for personal information	3.30	1.12
Mobile banking provides timely services	3.83	0.89
Mobile banking requires minimum efforts	3.68	1.07

Source: Primary data.



**Table 3: Gender and Insight on Mobile Banking of Public Sector Banks**

Gender	N	Mean	Standard Deviation	t-value	Sig.
Male	167	39.15	5.45	4.348**	.000
Female	133	36.26	5.76		

Source: Primary data.

Note: \*\* Significant at 1% level.

**Table 4: Age and Insight on Mobile Banking of Public Sector Banks**

Age	N	Mean	Standard Deviation	F-Value	Sig.
21 to 30 Years	58	39.15	5.28	6.435**	.000
31 to 40 Years	91	37.24	5.51		
41 to 50 Years	86	36.03	5.85		
51 to 60 Years	65	35.91	5.54		

Source: Primary data.

Note: \*\* Significant at 1% level.

in Table 3. The mean value of insight on mobile banking of public sector banks to male and female customers are 39.15 and 36.26 respectively, which explains that the insight on mobile banking of public sector banks is larger for male than female customers.

The t-value is 4.348, and it explains that significant difference exists between the gender of customers and insight on mobile banking of public sector banks.

#### **4.2.1.2. Age and Insight on Mobile Banking of Public Sector Banks**

The relation between the age of customers and their insight on mobile banking of public sector banks is shown in Table 4. The mean value of insight on mobile banking of public sector banks for customers falling in the age categories of 21 to 30 years, 31 to 40 years, 41 to 50 years and 51 to 60 years of age are 39.15, 37.24, 36.03 and 35.91 respectively, which explains that the insight on mobile banking of public sector banks is larger for customers falling in the age category of 21 to 30 years than for other age categories.

The F-value is 6.435, and it explains that significant difference exists between the age of customers and insight on mobile banking of public sector banks.

#### **4.2.1.3. Education and Insight on Mobile Banking of Public Sector Banks**

The relation between the education of customers and their insight on mobile banking of public sector banks is shown in Table 5. The mean value of insight on mobile banking of public sector banks for customers having secondary, upper secondary, under-graduation and post-graduation education are 36.82, 35.79, 39.46 and 37.00 respectively, which explains that the insight on mobile banking of public sector banks is larger for customers having under-graduation than any other education.

The F-value is 6.316, and it explains that significant difference exists between the education of customers and insight on mobile banking of public sector banks.

#### **4.2.1.4. Monthly Income and Insight on Mobile Banking of Public Sector Banks**

The relation between the monthly income of customers and their insight on mobile banking of public sector banks is shown in Table 6. The mean value of insight on mobile banking of public sector banks for customers obtaining income of less than Rs. 25,000, Rs. 25,001–Rs. 35,000, Rs. 35,001–Rs.45,000 and more than Rs. 45,000 per month are 35.45, 36.71, 39.40 and 37.88 respectively, which explains that insight on mobile banking of public sector

**Table 5: Education and Insight on Mobile Banking of Public Sector Banks**

Age	N	Mean	Standard Deviation	F-Value	Sig.
Secondary	50	36.82	6.83	6.316**	.000
Larger Secondary	70	35.79	5.45		
Under-graduation	99	39.46	4.84		
Post-graduation	81	37.00	5.16		

Source: Primary data.

Note: \*\* Significant at 1% level.

**Table 6: Monthly Income and Insight on Mobile Banking of Public Sector Banks**

Age	N	Mean	Standard Deviation	F-Value	Sig.
Less than Rs. 25,000	54	35.45	4.52	6.394**	.000
Rs. 25,001 to Rs. 35,000	112	36.71	6.27		
Rs. 35,001 to Rs. 45,000	78	39.40	5.80		
More than Rs. 45,000	56	37.88	4.78		

Source: Primary data.

Note: \*\* Significant at 1% level.

banks is larger for customers obtaining income of Rs. 35,001–Rs.45,000 monthly than other monthly incomes.

The F-value is 6.394, and it explains that significant difference exists between the monthly income of customers and insight on mobile banking of public sector banks.

#### 4.2.1.5. Marital Status and Insight on Mobile Banking of Public Sector Banks

The relation between the marital status of customers and their insight on mobile banking of public sector banks is shown in Table 7. The mean values of insight on mobile banking of public sector banks for married and unmarried

customers are 39.97 and 36.22 respectively, which explains that the insight on mobile banking of public sector banks is larger for married than unmarried customers.

The t-value is 4.978, and it explains that significant difference exists between the marital status of customers and insight on mobile banking of public sector banks.

#### 4.3. Influence of Insight of Customers on Mobile Banking of Public Sector Banks on Their Financial Inclusion

The influence of the insight of customers of mobile banking of public sector banks on their financial inclusion was analyzed through regression analysis, and the results are

**Table 7: Marital Status and Insight on Mobile Banking of Public Sector Banks**

Marital Status	N	Mean	Standard Deviation	t-value	Sig.
Married	239	39.97	5.52	4.978**	.009
Unmarried	61	36.22	5.85		

Source: Primary data.

Note: \*\* Significant at 1% level.

**Table 8: Influence of Insight of Customers on Mobile Banking of Public Sector Banks on Their Financial Inclusion**

Insight on Mobile Banking	Partial Regression Coefficients	t-value	Significance
Constant	1.014**	10.246	.000
Convenient (X <sub>1</sub> )	.391**	6.420	.000
Easily adoptable (X <sub>2</sub> )	.155	1.394	.213
Cost-effective (X <sub>3</sub> )	.352**	5.938	.000
Security for transactions (X <sub>4</sub> )	.376**	6.112	.000
User-friendly (X <sub>5</sub> )	.340**	5.750	.000
Quickness (X <sub>6</sub> )	.098	1.012	.415
Reduction in paperwork (X <sub>7</sub> )	.142	1.258	.276
Privacy for personal information (X <sub>8</sub> )	.323**	5.658	.000
Timely services (X <sub>9</sub> )	.120	1.117	.302
Minimum efforts (X <sub>10</sub> )	.297**	5.275	.000
R <sup>2</sup>	0.64	-	-
Adjusted R <sup>2</sup>	0.62	-	-
F	23.724**	-	.000

Source: Primary data

Note: \*\* Significant at 1% level.

shown in Table 8. The values of Adjusted R<sup>2</sup> (0.62) and R<sup>2</sup> (0.64) reveal the regression model is in good fit. The F-value is 23.724, which says that the model has significance. Convenience, security for transactions, cost-effective, user-friendly, privacy for personal information and minimum efforts are the factors that are positively and significantly influencing the financial inclusion of customers of public sector banks.

#### 4.4. Mobile Banking in India: A Prediction for 2020

The RBI data for mobile banking transaction of all the banks for each month (Table 9) during 2019 shows the upward trend, which proves that financial transactions through mobile banking increases the cashless economy and the improves the productivity of the individual and the economy as a whole.

The prediction model chart (Figure 1) shows that the customers of banks are increasingly using mobile-based

financial transaction, and it is predicted that the volume of transactions in 2020 will be more than thrice that of 2018.

The mobile banking transaction for the public sector banks are also increasing year on year, and it is expected to grow to a large extent. The performance in mobile transactions is tremendously increasing for banks that support and encourage technology. Banks such as State Bank of India (SBI) and Canara bank has grown 8 or more times (refer Table -10) from the beginning of 2018 to the end of 2019.

It is observed that the volume of mobile transactions for most of the top-performing banks is high and in an increasing trend in 2019. It is forecast that transactions through mobile phones for most of the banks are going to be higher than the previous years. Hence banks should be ready and encourage their customers to take advantage of the technology.

**Table 9: Prediction for the usage of Mobile Banking in All the Banks in India**

Monthly transaction	Year	Volume of transaction in Million	
<b>October</b>	<b>2018</b>	<b>559.48</b>	
November	2018	575.99	
December	2018	661.43	
January	2019	710.90	
February	2019	739.41	
March	2019	872.93	
April	2019	881.23	
May	2019	841.74	
June	2019	848.61	
July	2019	932.25	
August	2019	1015.78	
September	2019	1107.64	
October	2019	1252.54	
November	2019	1362.31	
December	2019	1432.20	
<b>March</b>	<b>2020</b>	<b>1501.42</b>	Mobile-based banking transactions predicted for the year 2020.
<b>April</b>	<b>2020</b>	<b>1560.71</b>	
<b>May</b>	<b>2020</b>	<b>1677.38</b>	
<b>June</b>	<b>2020</b>	<b>1692.21</b>	
<b>September</b>	<b>2020</b>	<b>1871.28</b>	
<b>December</b>	<b>2020</b>	<b>2048.40</b>	

Source: RBI website, bank-wise volume for mobile transactions.

Note: 2020 data calculated using forecast technique.

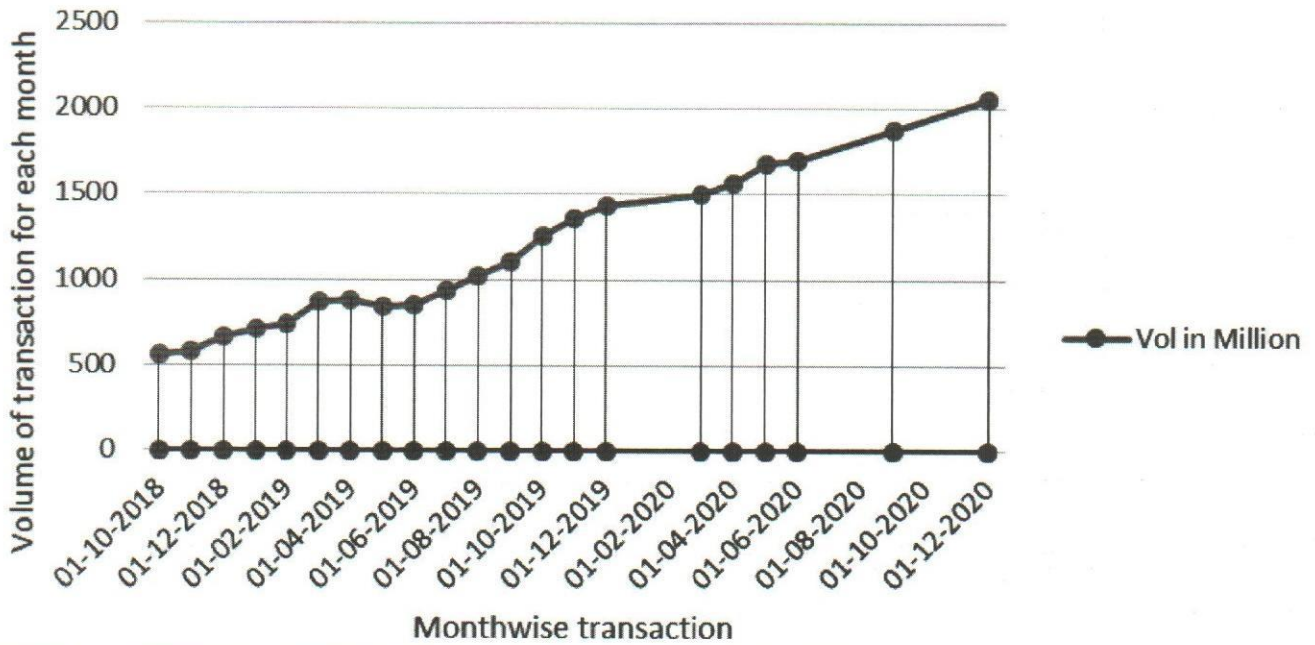
**Table 10: Volume of Mobile Transactions for the Top-performing Public Sector Banks and Its Projection for 2020**

Monthly transaction	Volume of transaction in million										
	SBI	PNB	BANK OF BARODA	CANARA BANK	BANK OF INDIA	UNION BANK	SYNDICATE BANK	CENTRAL BANK	INDIAN BANK	CORPORATION BANK	TOTAL
30-01-2018	42	1	3	4	8	1	2	0.5	1	2	64.5
28-02-2018	41	1	3	4	8	1	2	1	2	2	65
30-03-2018	45	1	4	5	9	2	2	0.5	3	3	74.5
30-04-2018	45	1	4	5	9	2	2	0.5	3	3	74.5
30-05-2018	47	1	4.5	5	10	2	2	0.5	3	3	78
30-06-2018	51	1	4	6	12	2	2.5	0.5	3	3	85
30-07-2018	64	1	5	7	15	3	3	0.5	4	2	104.5
30-08-2018	70	1	6	7	16	2	3	0.5	4.5	4	114
30-09-2018	84	1	5	9	19	2	4	0.5	5	5	134.5
30-10-2018	116	1	6	11	21	2	4	1	6	6	174
30-11-2018	115	2	6	12	22	2	5	1	7	7	179
30-12-2018	122	1	6	14	72	2	6	1	9	9	242
30-01-2019	134	1	6	17	37	24	7	1	9	11	247
28-02-2019	130	1	6	18	37	21	7	1	10	3	234
30-03-2019	145	1	9	22	38	36	8	1	12	12	284
30-04-2019	189	1	11	23	43	19	8	1	12	11	318
30-05-2019	183	1	8	23	40	34	7	1	12	11	320
30-06-2019	187	1	0.26	23	40	28	7	1	12	12	311.3
30-07-2019	210	1	8	27	46	32	8	1	14	14	361
30-08-2019	230	1	9	29	51	35	9	1	15	15	395
30-09-2019	241	1	8	30	47	28	9	1	16	17	398
30-10-2019	291	2	9	35	56	46	10	1	20	19	489
30-11-2019	301	45	9	37	51	45	11	19	20	18	556
30-12-2019	318	50	10	40	63	51	12	16	23	20	603
<b>30-03-2020</b>	<b>321</b>	<b>21</b>	<b>7</b>	<b>21</b>	<b>38</b>	<b>21</b>	<b>7</b>	<b>3</b>	<b>10</b>	<b>9</b>	<b>457</b>
<b>30-04-2020</b>	<b>339</b>	<b>23</b>	<b>8</b>	<b>22</b>	<b>39</b>	<b>22</b>	<b>7</b>	<b>3</b>	<b>10</b>	<b>10</b>	<b>481</b>
<b>30-05-2020</b>	<b>352</b>	<b>24</b>	<b>8</b>	<b>22</b>	<b>40</b>	<b>23</b>	<b>7</b>	<b>3</b>	<b>11</b>	<b>10</b>	<b>499</b>
<b>30-06-2020</b>	<b>368</b>	<b>26</b>	<b>8</b>	<b>23</b>	<b>41</b>	<b>23</b>	<b>7</b>	<b>3</b>	<b>11</b>	<b>10</b>	<b>520</b>
<b>30-09-2020</b>	<b>411</b>	<b>31</b>	<b>8</b>	<b>24</b>	<b>42</b>	<b>25</b>	<b>7</b>	<b>3</b>	<b>11</b>	<b>10</b>	<b>572</b>
<b>30-12-2020</b>	<b>453</b>	<b>36</b>	<b>9</b>	<b>25</b>	<b>44</b>	<b>25</b>	<b>7</b>	<b>3</b>	<b>11</b>	<b>11</b>	<b>624</b>

Source: RBI website for the years 2018 and 2019.

Note: Data projected for 2020 using forecasting technique.

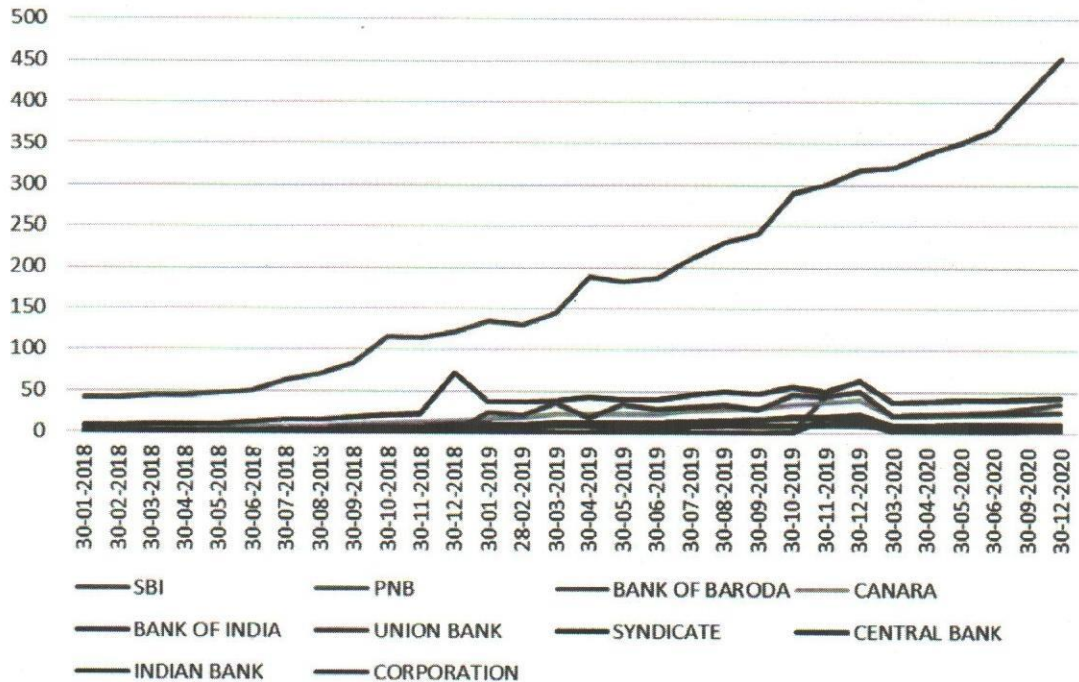
## Prediction of Mobile banking transaction for 2020



Source: RBI website.

Figure 1. Prediction of Mobile-based Financial Transaction during 2020

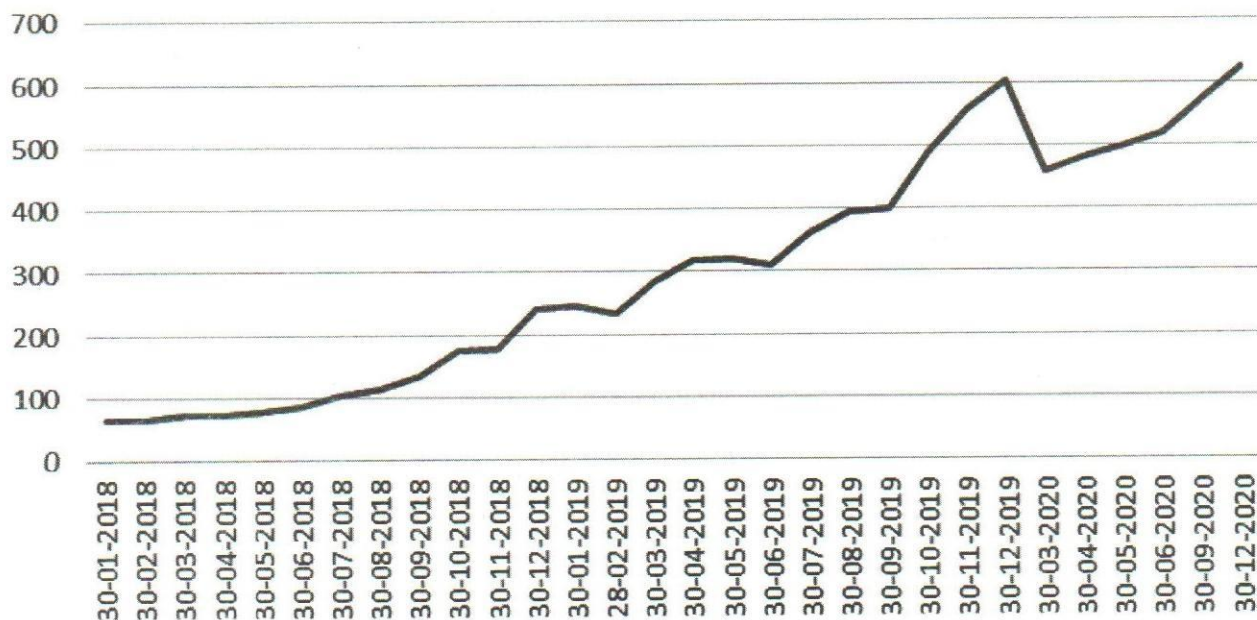
## Volume of Mobile transaction for Public sector bank 2018 & 2019 : A Projection for 2020



Source: Data for 2018-19 is from the RBI website.

Figure 2. Prediction of Mobile-based Financial Transaction during 2020 for Top 10 Public Sector Banks

## Total Mobile volume transaction of Top 10 Public Sector Banks and its projection for 2020



Source: RBI website.

Figure 3. Prediction of Total Mobile-based Financial Transactions for Top Public Sector Banks for 2020

The above chart (Figure 3) indicates that the total volume of transactions for top-performing public sector banks is increasing. It is also projected that there will be an average increase of more than 10 per cent in mobile-based banking transactions from 2018 to 2020 in public sector banks.

### 5. Conclusion

These findings elucidate that customers of public sector banks agree that mobile banking is convenient, easily adoptable, give security to transactions, user-friendly, very quick, reduces paperwork, provides timely services and requires minimum efforts. There is a significant difference between the insight of customers on mobile banking of public sector banks and their personal features. Convenient, security for transactions, cost-effective, user-friendly, privacy for personal information and minimum efforts have positive and significant influence financial inclusion of customers of public sector banks. Thus, public sector banks should cost-effectively provide mobile banking and they must ensure privacy of personal information. Thus, these measures will enhance financial inclusion of customers of public sector banks.

It is also found that the overall usage of mobile banking technology in India is increasing the cashless economy and productivity in general. Both private and public sector banks' mobile banking transactions are predicted to perform on a larger base in 2020. Public sector banks must increase their technological capacity and encourage their customers to increase technology-based transactions.

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<https://www.rbi.org.in/Scripts/NEFTView.aspx>

*"FinTech is not only an enabler but the driving engine"*

– Pierre Gramegna



# Peer to Peer Restricted Distributed Ledger Technological (P2PRDLT) Arrangement - A Proposed Model in Indian Payment System

**RAHUL JAIRAM NIKAM**

*Technological innovations in financial sector, commonly known as Fintech, have the potential to transform the present financial practices across the globe. Here, the application of Distributed Ledger Technology (DLT)/blockchain technology has garnered wide interest within the central banking community and the regulators as it is having a potential to overcome from present critical challenges in financial inclusion and transformation. Such as the currency and critical payments infrastructure (payment, clearing and settlement processes), operational & risk management, cyber resilience, how funds are transferred and used in securities market to clear and settle securities, commodities and derivatives. As there is no accepted term & potential having wide spectrum of possible deployments of DLT arrangement, various industries are using various ways according to their needs. The paper explains, reviews the different DLT arrangements, and their potential benefits and challenges in implementing it in the retail segment's payment infrastructure in India. This paper proposes a model DLT arrangement in the form of Peer to Peer Restricted Distributed Ledger Technological (P2PRDLT) Arrangement and related architecture resilience with present payment framework in India. In P2PRDLT arrangement, care is taken wherever it is necessary, control and present responsibilities of various participants (Nodes) are retained and synchronized. The paper envisages the need for integrating the new fintech potential implications for efficient systemic stability, innovations and overall safety for financial markets more broadly as a positive step from the present classic banking towards taking India to Payments 2.0 Banking.*

*Dr. Rahul Jairam Nikam, LL.M, Ph.D., Associate Professor of Law at Faculty of Law, Marwadi University, Rajkot, Gujarat, India.*

## 1. Introduction

In the 21<sup>st</sup> century, technology is growing rapidly and having the potential to disrupt the present payment and settlement related activity of a financial institution. One such technology in financial services is Distributed Ledger Technology (DLT) including blockchain technology. (Nakamoto, 2008) The DLT has the ability to drastically change the way presently assets are maintained, stored, discharge of obligations, enforcement of financial contracts, risk management and financial services markets that can be transformed. Another potential effect of the said technology is on payment, clearing and settlement system in terms of faster, updating, preserving integrity of a central ledger (Mills et al., 2016) maintained by central banks including Reserve Bank of India (RBI) and National Payments Corporation of India (NPCI). In India, NPCI is an umbrella organization for operating retail payments and settlement systems established under the Payment and Settlement Systems Act, 2007 for creating a robust payment and settlement infrastructure. It becomes more significant in the Indian context where the Report of Inter-Ministerial Committee for Finalization of Amendments of the PSS Act, 2007 has submitted to the government of India where in RBI and across the world financial markets DLT is viewed as having vast features. The features include reducing complexity, enabling faster end to end processing, making funds and assets available faster, higher reliability, rapid synchronized reconciliation infrastructure with immutability and transparency for multiple record keeping, distributed date management, improves network resilience and minimizes operational and financial risks. These features ultimately boost participation while preserving trusted reliance in updating and preserving the integrity of a central ledger maintained in a manner of

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distributed ledgers by promoting inclusive participation and holding them accountable for funds and financial assets transactions with greater transparency (R Gandhi, 2016). However, DLT is not riskfree as there are various risks associated with operational & security issues of technology, interoperability of process structure, settlement issues, laws relating to and governance of DLT framework along with data privacy, integrity and immutability. (CPSS-IOSCO Report, 2012) With this background, Section 1 of the paper briefly explains the fintech technology, and its importance and utilization in the present financial market. Section 2 briefly gives an overview of what is DLT, various forms, technicalities and typical DLT arrangements. Section 3 proposes the model of Peer-to-Peer Restricted Distributed Ledger Network (P2PRDLN) in Indian retail payment segment, its technicalities, structural arrangements, process flow and potential configuration and tradeoffs. Section 4 is the analysis of framework and various implications on Indian retail payment segment and functionalities. Lastly, the Conclusion section offers proposed suggestions how P2PRDLN arrangement can be framed and utilized to upgrade and incorporate new innovative fintechs.

## **2. Distributed Ledger Technology (DLT)**

DLT is a technology which is evolving in nature, requirement of market place with emerging applications. For this paper, DLT means a technological process creating a network / *secure arrangement for validating the status of record changes or updates to a ledger in a synchronized manner which is distributed across the network, node by node, in a network.* In contrast to relying on a central authority to maintain a single copy of ledger (of payment, clearing, and settlement), DLT enables established procedures and protocols to be used by nodes (different entities involved in transaction) to carry out transactions. The term arrangement is used for DLT application / implementation referring as technical design / institutional structure of systems, platforms and layers. Both DLT and arrangement establish a system designed to stand alone and fulfill its functions.

DLTA's core functions are to maintain the various records & information on ledgers and responsibilities of updating the ledger which is distributed on multiple nodes / participating institutions. These core functions can be achieved by designing DLTA based on requirement and policy decision which can support targeting some or all parts of a transaction flow. Such arrangements mostly

involve key technical inputs of information to be maintained in certain forms and ways to be updated. Among the core function of DLTA is to record digital representations of ownership or balance of physical assets in payment, and clearing and settlement of a transaction. There are two types of digital assets: 1. Native tokens i.e. native assets 2. Non-native tokens i.e. physical assets electronically originated on ledger. (Pinna and Ruttenberg, 2016) Forms of record keeping can vary but aforementioned core functions of ledger will remain same.

### **2.1. Various forms of DLTA**

First form is blockchain ledger which maintains a transactions history / account balances in batches known as blocks. Once a valid block is confirmed, it is linked / chained to all earlier transactions on the ledger. This is one form of maintaining book keeping. In another form, DLTA is made to simply update the balance of user's accounts or the ledger maintains more records other than ownership records of assets (i.e. actual financial contracts, its terms & conditions) as a standard book keeping. (UK Government Office for Science, 2015) In other case of ledger, advanced DLT arrangements allow for smart contract / automated contracts tools which permits users to add self-executing code on ledger which automatically fulfills the terms of contract (like National Automated Clearing House (NACH) / multiple Electronic clearing).

#### **2.1.1. Typical DLT Arrangements**

DLT arrangements typically use various protocols in communicating within nodes and consensus facilitation between nodes in order to update a Synchronized Distributed Ledger (SDL), current status of ledger and transaction history records. Typically, updation of a SDL is based on consensus which is relying on Cryptographic Tools (CT). CT is basically public key cryptography and public key infrastructure which identifies, approves and authenticates, i.e. cryptographic digital signatures credentials participants, confirmation of data records while facilitating consensus on updating ledger. The consensus process involves two steps. 1. Validation based on the rules of the arrangement like originator, assets availability, entitled to exchange the assets to beneficiary, chain of previous states of ledger records etc. 2: Agreeing on ledger updation. This stage involves algorithms to resolve conflicting changes, ensuring that valid changes are made only once and reflects the state of changes are synchronized across the distributed ledgers.

## 2.2. Distribution of Responsibilities

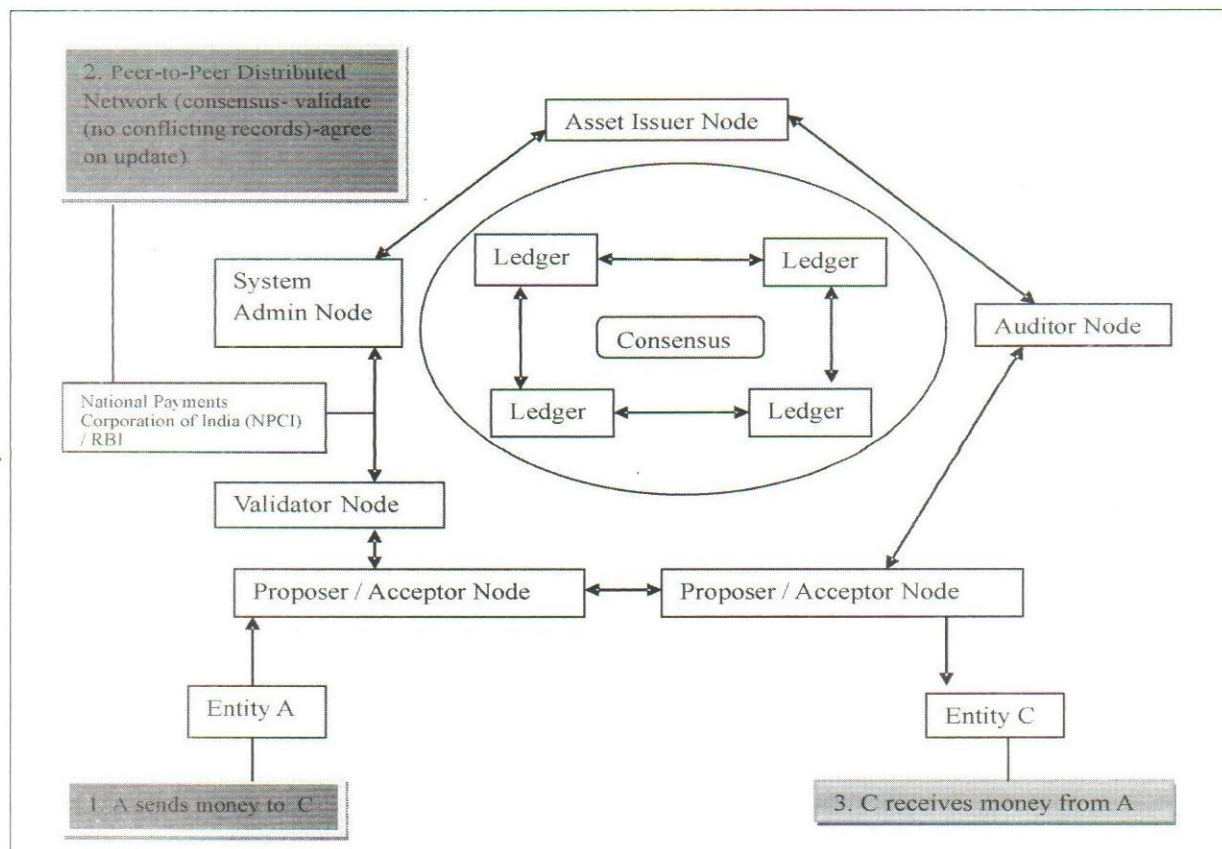
The different responsibility of participating nodes in ledger is based on policy decision, how a structure of ledger can work, i.e. various services provided by multiple nodes deployment on multiple sites, jurisdictions and institutions. Depending upon the DLT Arrangements, access can be restricted or unrestricted, i.e. open for all or only authorized participants / nodes, standard rules, procedures, layers, consensus and changes to be reflected in all identical copies maintained by various nodes within a stipulated time span. There are some structures reflecting same distribution of responsibilities like ledgers distributed across multiple nodes with similar roles for updating a synchronized distributed ledger through validation and consensus. Another type is ledger distributed across multiple nodes with varying roles or permissions-based roles which are not mutually exclusive. In the next section we will examine the proposed Stylised DLT arrangements and process flow for payment system in India under the amended PSS Act 2007 which shall cover the rules and standard procedures as mentioned in Figure 1.

## 3. Proposed Stylised DLT Arrangement and Process Flow

The structure of proposed DLT arrangement is basically Peer-to-Peer Restricted Distributed Ledger Network (P2PRDLN) for the retail payments and settlement system in India. It is a restricted DLT arrangement where only authorized participants are allowed after obtaining permission from RBI which shall constitute as a node. These nodes are connected with each other in a network distributed application architecture of peer-to-peer network manner of nodes.

### 3.1. Technical Roles of Nodes in P2PRDLN

Aforementioned nodes in the network play a variety of assigned technical roles that are not mutually exclusive. NPCI shall act as a gatekeeper that controls access to the system and continues to do all such activities which it is doing presently and the roles of system admin and validator nodes. Either NPCI or RBI is to decide who can be the asset issuer node and is permitted to issue new



Source: Secondary data, 2020 (edited).

Figure 1: Peer-to-Peer Restricted Distributed Ledger Network (P2PRDLN)

assets. Proposer node would be those authorized participating banks / operators who are permitted to propose updates to the P2PRDLN. Validator node would be those authorized participating banks / operators who are permitted to confirm the validity of proposed state of changes in P2PRDLN. Lastly, RBI to decide who can be the auditor node and is permitted to view the P2PRDLN but not to make updates. In the inner circle, algorithm will take care of consensus for updating distributed ledgers. The algorithm shall be generated and maintained by a consortium under the aegis of RBI, where all the stakeholders will be contributing in continuous development of algorithm with the help of National Informatics Centre, Ministry of Electronics & Information Technology, Government of India. Further, RBI will decide the nodes' various accesses to see stored records on P2PRDLN. For example, nodes can see only counterparty transactions or of their client's having interest in the transactions irrespective of a copy of the complete encrypted ledger maintained by them.

### **3.2. Structural Arrangement of P2PRDLN**

In the P2PRDLN structure, NPCI, Asset Issuer Node, Auditor Node and Proposer / Acceptor Node are the important entities that shall have authorized access and various roles and responsibilities assigned.

P2PRDLN is the restricted network having cryptographic technology especially devoted for clearing and settlement of payment transactions on real-time basis. Only RBI-authorized participants (Nodes) will have access and participation on the network with designated roles and responsibilities. The said ledger will be maintained together by NPCI and authorized participants (Nodes) who will have access to update it. Participants and services can be multiple or restricted.

NPCI is presently an umbrella organization for operating retail payments and settlement systems in India and shall remain playing the same role in the form of system administrator node and validator node. Whenever the transactions are initiated, proposer / acceptor node shall be verified and authenticate the credential of various aspects of transactions through NPCI.

Asset issuer node—once NPCI approves, asset issuer node will issue the asset for transfer/debit.

Auditor node—once asset issuer node is clear, auditor will cross-verify the credentials of transfer details and approve it. Auditor shall also make sure that all nodes

are following standard procedure and correct information is maintained on the ledger.

Proposer node—initiates the payment and is permitted to propose updates to P2PRDLN.

Validator node—authenticates proposer node identity and validates the transaction, and is permitted to confirm the validity of proposed state changes in P2PRDLN.

### **3.3. Process Flow**

In the above example, the transaction process involves three broad steps:

1. Initiation of Transaction—Entity A initiates a payment. Proposer node will use cryptographic digital signature for proposed transactions update and share it on ledger. In this step, authentication and consensus will take place and shared ledger will be updated. The ledger would transfer the funds from its account on the ledger to entity C's account.
2. Authentication, Consensus and Validation of Transfer of Amount—Upon receiving the transfer request on ledger, other nodes initiate P2PRDLN through the steps of network, i.e. validator and system administrator node, asset issuer node and auditor node. These nodes authenticate various aspects related to credentials of A's identity. All the nodes make sure that Entity A's cryptographic credentials match with the shared P2PRDLN and sufficient fund available for payment to make an update of the record of transaction. In this stage, the inner circle will play algorithm which follows two steps, i.e. Consensus, and which is relying on Cryptographic Tools (CT). Simultaneously, all relevant nodes will take part in consensus process to agree to update payment transactions and it is included in the next update on ledger status.
3. Once an update is accepted by nodes, the details of asset transactions will be modified and all future related transactions of said asset will be initiated using entity B's cryptographic credentials.

### **3.4. Potential Configurations of P2PRDLN and Tradeoffs**

Table 1 highlights some of the potential configurations, i.e. institutions, services & technical architecture that a P2PRDLN arrangement might take place keeping in mind the rapid changes in financial ecosystem. P2PRDLN

arrangement is not only customizable based on technological elements of nodes but also on different roles

that can be played by nodes.

**Table 1: Potential configurations of P2PRDLN and trade-offs**

Potential Configurations of P2PRDLN arrangements under PSS Act, 2007		
Description of arrangement	Authorized entities use the service based on assigned role	Services Incorporated
Operation of the arrangement	Multiple authorized entities, i.e. NPCI, Banks, NBFC & Service providers	UPI, RuPay (Contactless / Prepaid), BHIM, IMPS, NETC, Bharat Bill Pay, *99#, NACH, CTS, NFS, AePS, BharatQR, BHIM Aadhaar  Other services can also be included as per requirement
Access to the arrangement	Restricted	
Technical roles of nodes	Differentiated	
Validation and consensus	Across multiple entities	

Source: Secondary data, 2020 (edited).

P2PRDLN arrangement is having restricted access in the form of services to be provided and only authorized participants will participate in network for clearing, payment and settlement processes. This will help in faster processing, optimize scalability of algorithm and information security as participation is restricted. This will help in security by mitigating cyber attacks or curbing illicit activities. This arrangement more closely fits in within the existing RBI legal and regulatory frameworks. Assigning specific role to participating nodes will achieve faster consensus on the state of the ledger and improve the overall resilience of the network as entities are known and trusted by participants. Also, bringing NPCI on network platform—who is having a role of system admin and validator node—will improve overall supervisory and regulatory control of RBI. Thus, access rules and defined roles of participants / nodes will be taking care of crucial aspects such as governance, settlement and operational risk management in validation and consensus on network.

Thus, the approach taken in Table 1 to DLTA shows that one size fits all approach is not viable to address different challenges in payment clearing settlement process. So, depending upon the nature and services and addressing the problems, different types of DLT arrangements can be made. This will have a radical impact and specific constraints of particular use vis-à-vis realizing more benefits of DLT arrangements.

## 4. Analysis of Framework Implication

While understanding the structured approach of DLT arrangement for payment, clearing and settlement activities, it is important to analyze its implications keeping in mind its benefits and risks. Scope, efficiency, safety, legal and wide range implications are the main components that have a major impact of any DLT arrangements, as authorities and stakeholders are viewing it as the starting point to understanding DLTA and identifying a range of issues emerging from it.

### 4.1. Scope of P2PRDLN

P2PRDLN's structural arrangement consists of functionality of design and technology, nature of services provided, and factors affecting implementation. The functions will be: keeping of records of assets transfer / updating balances, data lookups, screening and analysis, and automation tools (smart contracts taking care of ECS, NACH etc.). So, P2PRDLN could simplify processes, improve the flow of information, reduce the operational costs, provide greater access to services, and financial inclusion.

### 4.2. Functions and Efficiency Implications

Increasing efficiency and accuracy could be achieved, as automation will reduce human interference. The arrangement will be balancing efficiency benefits &

resilience to be achieved in particular outcome as well as potential trade-offs involved. It will improve clarity on functionality of the current offerings (CPMI and the World Bank Group, 2016) and nature of the service such as customer identification (Know Your Customer norms), pre-transactions (validation, transfer, obligation and assets verification), clearing process (transaction nettings), final settlement position of transferring assets and post reconciliation, recording, reporting and enforcement activities. In the said arrangement initially—NPCI, banks, financial institutions and service providers are the market participants who have RBI's permission for retail banking segment payment, clearing and settlement activities that shall play a crucial role for its effective implementation. The single P2PRDLN arrangement will improve market efficiency and faster settlement of transactions by reducing friction to sharing of information between participants. (CPMI Report, 2016) It will reduce the potential maintenance and updating costs of distributed ledger in contrast to central ledger, as it is shared and maintained across the participants. Distributed ledger will help to create single format of data entry to be speedily reconciled, free from discrepancy, reduction in back office load and bring more transparency. This will lead to improving the credit and liquidity management in faster freeing up assets and thus reducing the costs associated with it. DLTA is designed in a manner that performs certain functions automatically like smart contract that execute, enforce and facilitate parts of agreements in payment system.

#### **4.3. Operations, Settlements, Security and Safety Risk Implications**

P2PRDLN structure is having ample scope to be developed and compatibility which can handle large volumes and peak hour volumes transactions in payment system. The present P2PRDLN arrangement is not covering the transactions of exchange of securities against cash or one currency against another and exchange of value. So, in a settlement operation, proof of work will help in finalization of settlement and more time the transaction is confirmed, less it will be revoked and speedily processed. Validator node, asset issuer node and auditor node will play crucial role in the speedy settlement process. The process having systematic steps to be followed in transferring of assets, discharge of obligations and algorithm censuses in a clear, well-defined point in time, which will help finalizing the settlement as legally final. So, applicable legal framework and regulations of RBI would expressly support finality of such settlements

in disputes or as per order of court in particular cases. The system node and validator node have power in exceptional situations to trace and rectify the malicious or faulty code in automated contract tools. So, the integrity of data on the ledger will be preserved & genuinity cannot be questioned. Structure is distributed in a restricted manner that helps in minimizing operational and security risks as multiple ledgers are synchronized with multiple processing nodes / participants that reduces the cyber threats using regular updated cryptographic tools in system.

#### **4.4. Governance and Data Management Implication**

The P2PRDLN arrangement is designed in such a manner that RBI, through NPCI, governs the structure of P2PRDLN as authorized, multiple participants / node will be sharing and maintaining the information with distributed ledgers and controlled by NPCI. Also, the technological evaluation of algorithm will be developed and regularly updated by the consortium (stakeholders) lead by RBI. Thus, as there is a well thought-out governance and safety, the participants are clearly understanding the governance arrangements / changes occurring / incident management and enforcement of governance decisions. The ledger is maintained in such a manner where the system allows tracking of data for compliance of various financial laws as well as not subject to loss or tampering of data. Thus the data integrity is also preserved.

#### **4.5. Market Implications**

Present architecture of financial market would require to be upgraded incrementally against present arrangements relating to the technical inter-connectivity issues and standards, operability to facilitate implementations, and integration costs along with network scale efficiency. This will lead to greater market participation, transparency and efficient risk management across financial systems.

### **5. Conclusion**

The present paper is an attempt to develop a model framework focusing on peer to peer restricted distributed ledger technology in place of the present payment, clearing and settlement system in India. The framework is not addressing possible different DLT arrangements which would be comprehensive or exhaustive, as this is an early stage. Before formulating and exploring the DLT arrangement, a lot of work is required to be done to arrive on any concrete architecture or elements of particular

design / arrangements. The proposed P2PRDLN arrangement is a test system framed for the maximum synchronization with the present payment and settlement arrangement of RBI and shall be in a less disruptive manner. The idea behind this is to utilize the maximum benefit of technology in maintaining the distributed ledger technology with interoperable payments systems vis-à-vis retaining the regulatory control and role of RBI to create regulatory conversions, keeping in mind its monetary policies.

Through the suggested model, an attempt is made to understand the various possible uses of DLTA and in this process identifies the opportunities, risks and challenges related to the said technology. So RBI can better determine the DLTA potential in operational efficiencies to make robust and resilient financial market in India. It is also to be noted that this paper does not discuss legal implications in detail. As mentioned earlier, it requires well thought-out DLT arrangements to be formulated, then test the legal underpinnings of said arrangements' soundness, and governance structures along with technological solutions to meet the needs of financial industry. Furthermore, there is a possibility that the present financial laws may be required to amendment or new laws or regulations to be crafted to cover the DLTA.

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"Marketplace Banking is all about building financial ecosystems"

– Philippe Gelis,  
CEO, Kantox

# A Study of User Behaviour and Preferences across Age Groups Towards Digital Wallets

SUSHIL MAVALE, FIZA NIYAS AND PARAG A. NARKHEDE

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*Information technology has transformed multiple industries with startlingly rapid progress. Banking is one of the industries which is determinedly using information technologies to automate many of its services. One such area that got transformed is the way money was transferred. With the advent of digital wallets, there has been a dramatic shift in payment method preferences and behaviour. The present research paper studies the behaviour and preferences of digital wallet users across various age groups. The data was collected from 101 respondents from four different age groups using structured questionnaire. The data was analysed using tests like cross-tabulation, Leven statistics and ANOVA. The researchers found that Google Pay was the most preferred digital wallet followed by Paytm and PhonePe. Google Pay was successful in capturing significant market even after coming late into the market. Most users of digital wallets use it for bookings, bill payments, fees payments and transportation payments. It was found that respondents believe that digital wallets are safe to use.*

## INTRODUCTION

Payment is basically the exchange of money or goods or services with another form of goods and services. The means of payment have taken varied forms from time to time. Traditional methods of payments started with the barter system which is an exchange of goods and services between two parties.

Later, money or currency came into play as a medium of exchange which shifted to cryptocurrencies and online payments. Cash and cheque are substituted primarily by the debit cards, and credit cards are beneficial in the extended payments, especially when you travel to different countries with different currencies (Ron borzekowski, 2007 ).

With the introduction of Information Technology and Communication, the conditions of online transactions have drastically changed and now with the development of e-commerce, consumers have started adopting new payment methods like PayPal, Google Pay, Paytm, PhonePe etc. that makes the transactions between people much easier. In digital wallets, all that the user needs to do is to link the user's bank account and then they can pay using phone, bank account, UPI ID, QR which enable transactions within seconds, even though different apps may have different schemes.

After the demonetization initiatives in India in 2016, there has been an increase in the use of digital transactions. According to Economic Times report, since demonetization the card transactions in towns with population up to 1 million have doubled in two years.

Replacing the physical currency notes with the digital ones mainly includes the use of plastic money, digital means and online transactions. Government has launched

*Dr. Sushil Mavale and Fiza Niyas, Symbiosis Centre for Management Studies, Symbiosis International University, Pune*

*Dr. Parag A. Narkhede, Institute of Management and Research, Jalgaon*



BHIM app based on UPI and also launched Aadhar merchant pay to promote cashless transactions. Moreover, going cashless will result in the decline of black money and could ease tax collection. (Anita Venaik, 2019)

After the demonetization initiatives in India in 2016, there has been an increase in the use of digital transactions. According to an Economic Times report (Pratik Bhakta, 2018), since demonetization, the card transactions in towns with population up to 1 million have doubled in two years. The prime minister of India has also put in motion the digital India initiative which increased the digital and cashless payment system in the country. It is observed that BHIM and UPI too are helping in faster adoption of e-payments.

There are closed e-wallets, semi-closed and open e-wallets in the country, as per the Reserve Bank of India guidelines.

- Closed wallets are those e-wallets which are approved for making payment to the service offered by the issuer. They are mainly found in cab services and e-commerce platforms like Jabong, Shein etc.
- PayTm, MobiKwik, Airtel money are the examples of semi-closed wallets. They are like the closed wallets, however, they can also purchase from those who have contract with the intermediate company.
- Open wallets are used for fund transfer, cash withdrawal from an ATM and also to make some purchase. M-Pesa is an example of such open e-wallet launched by Vodafone in association with ICICI bank.

Even though cashless transactions save time and money, decrease the production cost of cash and coins and increase the economic growth, the government should ensure security from cybercrimes being committed, which are a major threat for a cashless economy. Also, everyone in the society should also have access to an electronic system. With every country moving towards a cashless economy, it is just a world trend India is trying to catch up. (Tawade, 2017)

In an extensive research done with a Dutch-speaking population in the Netherlands (Crujisen & Horst, 2016), there were 2,322 respondents who filled the survey. The payment situation is interesting in Netherlands. In 2015, 50 per cent of point of sale purchases were made by using debit cards, 49.5 per cent were paid in cash and just 0.5 per cent were done using credit cards. The payment

behaviour varies from situation to situation as well. For example, at fuel stations, 72 per cent of consumers preferred using debit cards, 24 per cent in cash and 3 per cent used credit cards for the payments. A range of socio-psychological factors are found to be important drivers of payment behaviour. Important findings of this study include an observation that perceived attributes of a particular payment instrument determines consumers' payment attitudes. To improve the perceived attributes, the focus should be on perceived safety and acceptance. To affect the payment intentions, media campaigns need to be designed as per users age and lifestyles. The researchers also emphasised on targeting social norms. If the users feel that others are also using a particular mode, their chances of using that mode increases.

## Objectives

- To study the preference for digital wallets by respondents from various age groups.
- To study the usage behaviour of users towards digital wallets.
- To understand the perception regarding security of digital wallets.

## Research Methodology

The present research is exploratory in nature. The researchers used structured questionnaire to collect the data. The respondents were from 4 different age groups (Age groups: 15–20, 21–40, 41–60 and above 60). Likert scale technique was used in the questionnaire to collect the responses.

## Sampling Technique

Researchers used simple random convenience sampling technique for the data collection.

## Literature Review

According to Tom Akana (Akana, 2019), there has been a steady usage in cash and the credit card growth is faster compared to debit card in the customer payment usage and volume. Also, there has been a more frequent usage of credit cards and the digital payment channels by the younger population compared to the previous ones.

Hitesh Kapoor (Kapoor, 2015) found out in his survey that the customers believe that the internet banking has a very bright future in India and that for a bank's growth, internet services are essential and therefore need huge

investment. On the other hand, there were also some customers who felt that net banking is not suitable for everybody and has a very high risk involved in it.

The usage of digital payments is rising globally. In China, Alipay and WeChat Pay have gained a lot of popularity and wider adoption (Braintree, 2020). Compared to China, the U.S. has seen slower implementation of mobile payments. In U.S., PayPal is leading and has 250 million active users of their service globally. Studies suggest that people are more and more comfortable with this technology and it is certainly more convenient too. Moreover, organisations are becoming innovative in their promotional techniques as well. In China, customer with a smartphone might just receive a real-time discount offer.

Brian Mantel and Timothy McHugh (Mante & McHugh, 2001) observed that the consumer's payment decisions are influenced by several factors such as convenience, confidentiality, security, incentives or special benefits, the nature of transactions, financial position of the consumer etc. It also suggests that the adoption of new technologies and products would be initiated by the young population that generally has the affinity to try out the new products.

Joanna Stavins (Stavins) applied regression analysis that show the effect of individual attributes on the probability of using each payment instrument, while keeping all the other demographic attributes constant.

Qing Xu and Rene Riedl (Xu & Riedl) used a multi-method approach (eye-tracking and survey data) for further understanding of the online payment method choice. Fixation duration and pupil size are physiological signals based on visual system which shows that emotions play an important role in human decision making.

Venkateswararao Podile and P. Rajesh (Podile & Rajesh, 2017) concluded from their research that India would transform into a completely cashless economy only when the conceptions and viewpoints of the consumers are addressed by the government and the banking institutions rightly.

Brian Mantel (Mantel, 2000) observed that adoption of electronic payment may be motivated by legally authorized business practices and consumer protection, and that the consumer choices are consistent with their preferences.

Savneet Kaur (Kaur, 2018) found that the majority of online shoppers were from the age group of 16–34 years and are mostly urban women. On the contrary, it is mainly men who form the majority of online shoppers in rural areas. Moreover, majority of the rural consumers prefer cash on delivery over debit or credit card payments.

According to Madhu Arora and Miklesh Prasad Yadav (Arora & Yadav, 2019), transformation to digitalization is not an easy process for Gen X and Gen Y as they are already accustomed to cash payments, unlike the millennials who are ready to take risks. Also, more skilled wallet staffs are required by Gen X than Gen Y and millennials.

Joaquin Silva, Jose Carlos Pinho, Ana Soares and Elisabet (Silva, Pinho, Soares, & Sampaio, 2019) indicated that to lower the risk perception, managers should focus on building trust, namely using guarantees. An effective way to make consumers shift from their intention to action on buying is to build their trust in the payment methods. More trust affects the amount and frequency of purchase strongly.

It is analysed in the study conducted by J. Mohammed Ali and L. Vijaya Gopalan (Ali & Gopalan, 2018) that e-wallets have contributed in some way or the other in digitalizing India and that people would still be inclined towards it due to its ease of use, availability and convenience.

According to Jan Lukas and Wenwei Li (Lukas & Li, 2018), in China, high share of mobile payments take place *in the urban areas rather than the rural areas, which are still settled in cash, with respect to the retail stores.* In Germany, traditional banks offer direct debit due to which many payment methods are digitalized.

According to Dr Jasmine Padiya, E-wallets are gaining wide momentum and being used in online as well as offline businesses as a mode of payment (Jasmin Padiya, 2018). Also, there is a scope of mobile camera usage in the future for payments. The low preference of e-wallets is mainly due to the security, privacy concerns and the fees of payment. There are also people who are comfortable in the traditional mode of payment that prefer not to start using e-wallets. The longer transaction time sometimes taken during e-payments can also be considered as a reason.

It was observed that the adoption of digital payments had a major impact on the banking sector of the country.

This has certainly boosted the nation's motive of cashless economy and has given emphasis on the role of the banking sector to increase the required awareness on utilizing the technology to the fullest. (K.Suma vally, 2018)

In a study by Sana Khan, it was found that digitalization has brought about a change in the way the people communicate, make their payments, purchase and perform the business. There are various technologies like block chain and biometrics that replace many traditional methods. Organisations, through digitalization, are now able to give their customers a variety of options like cashback offers, discounts, mode of transactions and likewise. (Sana Khan, 2018)

### Data Analysis and Interpretation

A survey was conducted on 101 respondents from various age groups as mentioned earlier. The interpretations from the data analysed are as follows.

1. Following table shows the age-group wise digital wallet usage behaviour of respondents (see Table 1).  
Out of all the responses received, maximum respondents—which is 66, said that they use Google Pay. The next preferred was Paytm. It is evident from the cross-tabulation results that in all the four age groups which were studied, Google Pay was preferred by the maximum number of people over other digital wallets. Second preferred came out to be Paytm and third was PhonePe.
2. More than 62 per cent of the respondents prefer to use digital wallets frequently. Around 18 per cent use occasionally and 9.9 per cent said that they used digital wallets rarely.
3. It can be seen that 70.3 per cent respondents preferred to use digital wallets for online bookings. 66.3 per cent preferred to use it for bill payments at restaurants, fees payment, and transportation

**Table 1: Age-group wise usage behaviour - Cross-tabulation results**

		Age groups				Total
		15 to 20	21 to 40	41 to 60	Above 60	
		User Count	User Count	User Count	User Count	User Count
Digital Wallets Usage Behaviour <sup>a</sup>	Paytm	13	18	13	0	44
	Google Pay	25	23	15	3	66
	PhonePe	1	6	4	0	11
	BHIM	1	0	1	0	2
	Freecharge	1	0	0	0	1
	Airtel Money	2	1	0	0	3
	Other:	0	3	6	1	10
Total		30	33	23	3	89

Percentages and totals are based on respondents.

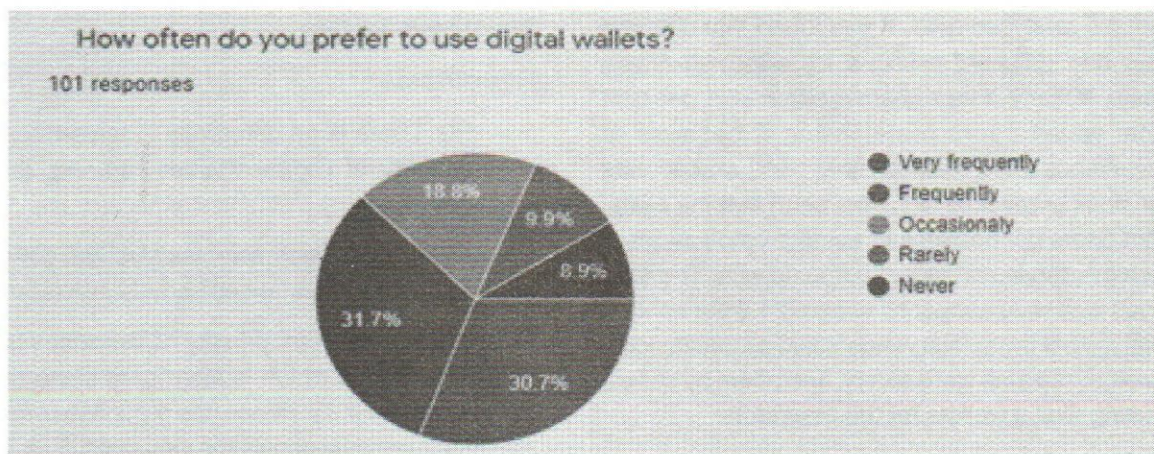
a. Dichotomy group tabulated at value 1.

(Source: Authors' own contribution)

payment transactions. 63.4 per cent used it for recharges and 60.4 per cent used it for fund transfer and then for grocery purchases (48.5 per cent).

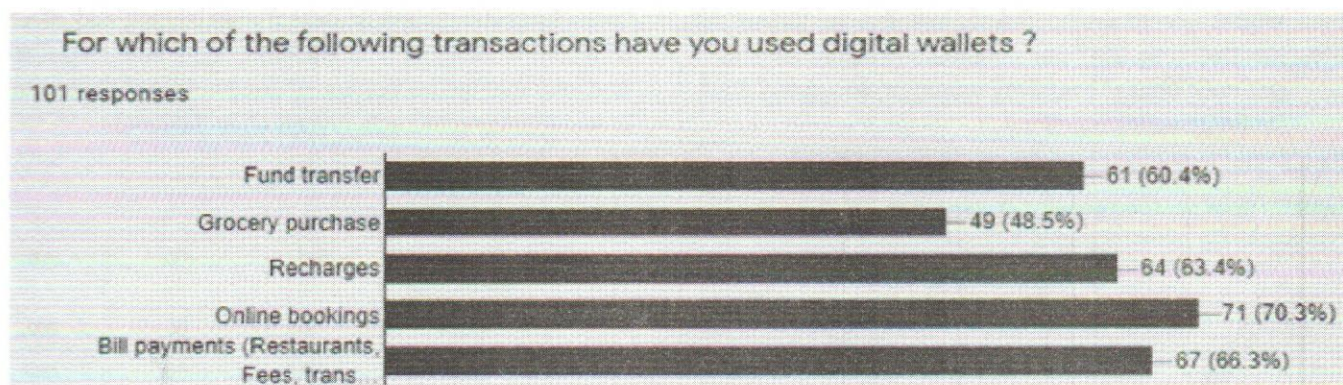
4. Occupation-wise data was collected from students, working professionals, businessmen and retired individuals (see Table 2).

In order to find out the trend between the profession of the respondents and the usage behaviour, the cross-tabulation table shows that Google Pay is the most popular digital wallet among students as well as working professionals, followed by Paytm. Compared with students, Paytm is more popular among working professionals.



(Source: Authors' own contribution)

Graph 1. Frequency to prefer using digital wallets



(Source: Authors' own contribution)

Graph 2. Preference for types of transactions using digital wallets

Table 2: Profession-wise digital wallet usage behaviour (Cross-tabulation)

		Profession				Total
		Student User	Working Professional	Business man	Retired person	
		Count	Count	Count	Count	Count
Usage Behaviour <sup>a</sup>	Paytm	15	23	6	0	44
	Google Pay	29	30	6	1	66
	PhonePe	2	8	1	0	11
	BHIM	1	0	1	0	2
	Freecharge	1	0	0	0	1
	Airtel Money	1	1	1	0	3
	Other:	1	7	1	1	10
Total		34	45	9	1	89

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

(Source: Authors' own contribution)

5. From the analysed data, it was found that different users had different reasons for adopting digital wallets. Majorly, it was observed that 86.1 per cent digital wallet users prefer using it because of convenience. The second most cited reason was cash back or rewards (31.7 per cent) that the digital wallet users get because of sales promotion offers which the service providers come up with. The third reason was wide adoption / usage (24.8 per cent) of digital wallets by various vendors and acquaintances. The other reasons were safety, and offers by sellers for using digital wallets for the payments.
6. A question was asked to see when given a choice to digital wallet users, what would they prefer – cash or digital wallets. 57.4 per cent responded that they would prefer using digital wallets for financial transactions, 26.7 per cent were not sure and 15.8 per cent opined that they would prefer giving cash for financial transactions.

## Hypothesis Testing

### Hypothesis

H0: There is no difference in the perception about security of Digital Wallets among different age groups.

To test the hypothesis, researchers conducted test of homogeneity of variances and ANOVA (see Table 3).

The test of Homogeneity of Variances table shows Levene statistics which is significant since the value of sig. is less than 0.05. Hence, the groups we are comparing are having unequal population variances,  $F(3,96) = 4.374$ ,  $p = 0.006$ .

There were statistically insignificant differences between group means as determined by one-way ANOVA ( $F(3,96) = 1.215$ ,  $p = .308$ ). We accept Null Hypothesis and infer that the perception about security of digital wallet is same among the age groups (see Table 4).

**Table 3. Test of Homogeneity of Variances**

		Levene Statistics	df1	df2	Sig.
Perception about security of digital wallet	Based on Mean	4.374	3	96	.006
	Based on Median	2.859	3	96	.041
	Based on Median and with adjusted df	2.859	3	87.941	.041
	Based on trimmed mean	4.357	3	96	.006

(Source: Authors' own contribution)

**Table 4. ANOVA**

Perception about security of Digital Wallet					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.355	3	1.118	1.215	.308
Within Groups	88.355	96	.920		
Total	91.710	99			

(Source: Authors' own contribution)

## Conclusion and discussion

### Preference for digital wallets

Preference-wise, Google Pay turned out to be highly preferred followed by Paytm and then PhonePe. Though

Google Pay came later into the market, it still has become popular among digital wallets users.

### Usage behaviour

Respondents mostly preferred to use digital wallets for online

bookings. The second preference was for bill payments at restaurants, fees payment, transportation payment related transactions. The third preference was for recharges followed by fund transfer and then for grocery purchases.

Different users are motivated by different reasons to use the digital wallets. Digital wallets provide users the convenience of making payment without worrying about availability of cash in their pocket. So the frequent trips to the ATM are avoided. The user doesn't even need to carry the debit or credit cards. That's why convenience is one of the major reasons why users prefer using digital wallets. After the launch of digital wallets, most of the wallets provided cashback or rewards to the users so that users become habitual and use the digital wallets frequently. These cashbacks and rewards have become the second most important reasons why users prefer digital wallets. The third reason was the wide adoption by various vendors and acquaintances.

### Perception regarding security of digital wallets

It was found that among all age groups, a substantially good number of people believed that digital wallets are safe to use.

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*“The major winners will be financial services companies that embrace technology.”*

– Alexander Peh

# What determines Manufacturing sector employment in India: Evidence from panel data?

SEEMA JOSHI

*Development economics literature provides contending hypotheses on whether the manufacturing or services sector is an engine of growth in developing economies. In the case of India, the services sector has become an engine of growth by 'leap-frogging'- side-stepping the industrial sector which can have serious repercussion for the economy. Therefore, there is an urgent need to revive the manufacturing sector to sustain India's growth rate in the medium and long term. With this background, the paper examines an important question: What determines manufacturing sector employment in India? In this paper the Random Effect Regression Model is applied on panel data for 20 states of India for three time periods i.e. 1999-2000, 2004-05 and 2011-12 to identify the factors which can be expected to influence manufacturing sector employment. URB, FLFPR and  $SERV_{EMP}$  were significant, emphasizing the importance of policies which promote urbanization, higher female labor force participation and service sector jobs.*

## I. Introduction

A vast literature has emerged on the services sector as an engine of growth. However, Kaldor in his work (1966, 1967, and 1968) empirically tested the "engine of growth hypothesis" by taking cross-sectional data for twelve member countries from the Organization of Petroleum Exporting Countries (OPEC). He found that the manufacturing sector is the engine of GDP growth. He also emphasized that as the economy develops there is a shift from agriculture to industry which leads to increase in productivity in both the sectors. There is a positive relationship between the manufacturing sector's productivity and growth (this is also known as Verdoorn's Law). The mechanism is driven by factors like increasing returns to scale and positive effects on capital accumulation (lower average costs) and technical progress.

To quote Kaldor, "As the industrial sector expands, it absorbs a growing amount of goods and services produced outside the industrial sector: these may be the products of agriculture or mining (food and industrial materials), or manufactures which it does not provide itself, or not in sufficient quantities, and which have to be imported". Further industrial growth generates demand for many kinds of services – banking, insurance and professional services of various kinds – and is thus partly responsible for a fast expansion of the "tertiary sector" (Kaldor, 1966).

The validity of Kaldor's Law, which states that the manufacturing sector is the engine of GDP growth has been generally confirmed in various studies (Cheney & Syrquin, 1975). But it is important to point out an alternative set of studies which recognizes the role of services sector as an engine of growth (Park & Shin, 2012; Joshi, 2008). In view of these contending emerging hypotheses,

*Dr. Seema Joshi is Associate Professor of Economics, Department of Commerce, Kirori Mal College, University of Delhi, Delhi.*

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development economics literature appears to be inconclusive on whether the manufacturing or the services sector is an engine of growth.

It has been highlighted in certain studies (Joshi, 2018) that “India’s economy, however, has witnessed the phenomenon of ‘leap-frogging’ (by side-stepping manufacturing sector) which is not in keeping with ‘Fisher-Clark-Kuznets’ thesis’ which states that as per capita income of a country grows, there is a shift from primary to secondary sector initially and from secondary to tertiary/ services sector subsequently.” Therefore, there is a need to revive the growth of manufacturing sector in India to sustain its long term GDP growth. With this background, the paper examines an important question: What determines manufacturing sector employment in India?

## II. Commodity and Services Sectors: Widening Growth Disparities

The sectoral composition of national income during the planning era clearly shows that the share of tertiary sector contributions (as percentage of GDP) has been continuously increasing from the First Five-Year Plan onwards till Eleventh (XI) plan. On the other hand, a declining trend can be observed for the share of commodity producing sectors as percentage of GDP, falling continuously from First Five Year Plan onwards (See Table 1). The table given below (Table 1) clearly shows that the share of services sector increased from 29% of GDP in the First Five Year Plan to 56% of GDP in the Eleventh Plan period. The share of commodity producing sectors declined from 68.22% of GDP to 46% of GDP during the same period.

**Table 1: Plan-Wise Share of Commodity Producing Sectors-Vis-a -Vis Services Sector in GDP (in percentage)**

Five Years Plan Period	Commodity sector output %of GDP	Service sector Output % of GDP
I (1951-56)	68.22433219	29.33358165
II(1956-61)	67.59819773	30.13725593
III(1961-66)	66.0999652	32.09461381
IV(1969-74)	64.42004772	34.16611718
V(1974-79)	62.81659255	35.6533415
VI(1980-85)	60.74997777	38.32395363
VII(1985-90)	57.59027777	41.61003449
VIII(1992-97)	54.80011107	44.95671499
IX(1997-2002)	50.38884786	49.58531436
X(2002-07)	46.79153796	53.20846204
XI(2007-12)	43.3823922	56.6176078

Source: Author's calculations

The faster growth of services sector vis-à-vis commodity producing sector has given rise to much debate on the subject. At one end of the debate are those who refuse to accept the rising share of services as an indicator of development especially in the context of developing countries (Rao, 1954, 1983, 1986). Patil (1989) expressed his apprehension that due to the rapid computerization and greater attraction of services sector, the importance of manufacturing will be denigrated<sup>2</sup>. In their study relating

to Indian economy, Bhattacharya and Mitra (1990) argued that if the tertiary sector expands rapidly and the gap between the growth rate of tertiary sector and the commodity sector widens, then it would have adverse implications for inflation and balance of payments.

Coming now to Table 2 which shows the growth rates of commodity producing sector vis-à-vis services sector for six decades i.e. from the 1950s to the decade of 2000 in the Columns I and II respectively. Column III shows the



growth rate disparity (GRD) between the two sectors. GDP growth rate is shown in Column IV.

The Table 2 very clearly brings out in column III that the growth rate disparities (GRD) between commodity producing sectors and services sectors have widened over the last six decades i.e. from 1950s to 2000s. Growth rate disparity has been defined as the difference between the compound annual growth rate (CAGR) of commodity producing sectors and CAGR of services sector. It has increased from 0.25% to 2.7 %, from 1950s to 2000's (see Fig 1 too). It can be observed from both

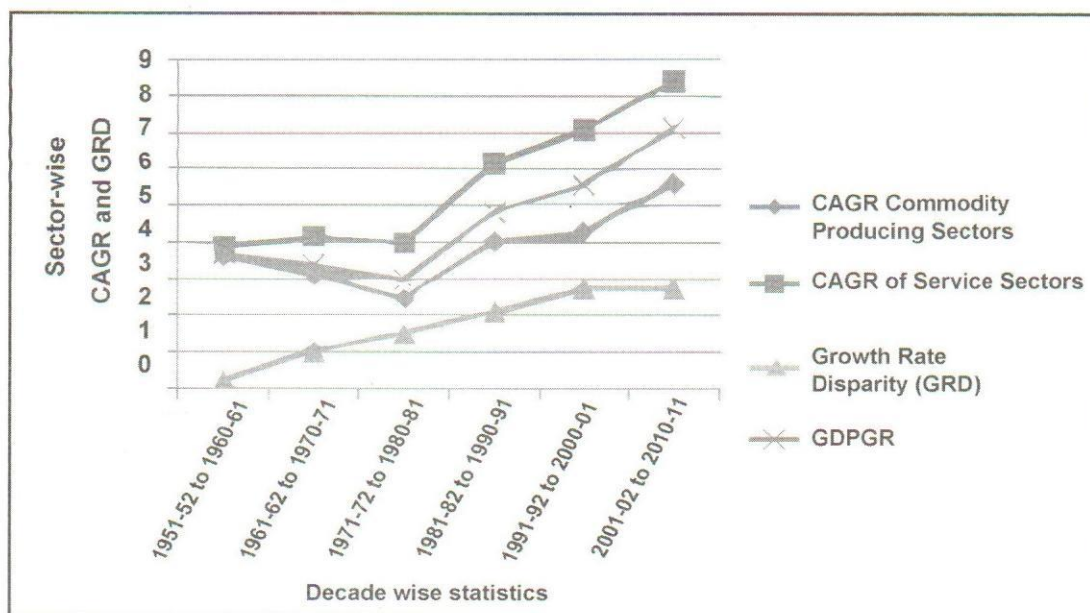
Table 2 and Fig.1 that growth rate of commodity producing sectors has been lagging compared to the growth rate of services sector over the last six decades considered in the present paper. The services sector growth rate has been higher than that of commodity producing sectors growth rate and also that of overall GDP growth rate. This has led to widening of GRD between the sectors as indicated by the upward rising shape of GRD curve. This is a cause of worry from the point of employment generation for our young labor force.

**Table 2: Decade-Wise Growth Rate Disparities between Commodity Producing Sectors and Services Sector**

Decade	CAGR Commodity Producing Sectors (Column II)	CAGR of Services (Column II)	Growth Rate Disparity (GRD) (Column III)	GDPGR (Column IV)
1951-52 to 1960-61	3.606832965	3.862250747	0.255417782	3.669023825
1961-62 to 1970-71	3.102656851	4.158781521	1.056124669	3.379482414
1971-72 to 1980-81	2.46763013	3.985128473	1.517498343	2.97269266
1981-82 to 1990-91	4.02025275	6.133154257	2.112901507	4.799862884
1991-92 to 2000-01	4.291874212	7.042255203	2.750380991	5.559280488
2001-02 to 2010-11	5.615575099	8.383042957	2.767467858	7.109182701

Note: CAGR stands for compound annual growth rate and GRD for growth rate disparity. GRD has been measured by deducting CAGR of commodity producing sectors from CAGR of services sector.

Source: Author's calculations



**Fig. 1: Decade -Wise Growth Rate Disparities between Commodity Producing Sectors and Services Sector**

Therefore, it is absolutely essential that the gap between growth rate disparities of these sectors should be narrowed down and arrested through policy interventions. In view of the widening growth disparities, it becomes absolutely essential that attempts should be made by the government to rejuvenate the manufacturing sector. Therefore, it is important to identify the factors which can be expected to influence manufacturing sector employment. This indeed can help in informed policy making. The next section attempts to identify and estimate empirically the factors which can be expected to influence the manufacturing sector employment.

### III. The Model Specification

There are some country specific studies which investigate the determinants of employment in general (Aydiner-Avsar & Onaran, 2010) and manufacturing sector employment in particular, for instance in the UK (Nickell, 1984), Kenya (House, 1976) etc. To the best of my knowledge, no study has employed a regression analysis on state level panel data to identify the determinants of manufacturing sector employment in India. The present section makes an attempt to fill this gap in literature. The study makes use of panel data for 20 states of India for three time periods 1999-2000, 2004-05, and 2011-12.

The following model has been specified to analyze the factors that are anticipated to influence the percentage of employment in the manufacturing sector.

$$MAN_{EMP} = b_0 + b_1 PCnetSDP + b_2 FLFP + b_3 SERV_{EMP} + b_4 URB + b_5 FLR + b_6 IMR$$

Where,

$MAN_{EMP}$  = Percentage of labor force engaged in the manufacturing sector

PCnetSDP = The per capita net state domestic product

FLFP = Female Labor Force Participation Rate

$SERV_{EMP}$  = Percentage of labor force engaged in the services sector

URB = Urbanization

FLR = Female literacy rate

IMR = Infant Mortality Rate

In the above referred equation,  $b_0$  is the intercept term and all the  $b_s$  are slope coefficients.  $MAN_{EMP}$  (i.e. Percentage of labor force engaged in the manufacturing sector) is the dependent variable and the remaining are

explanatory variables. We have worked out the estimated numerical values of these coefficients. For example,  $b_1$  gives the partial effect of PCnetSDP on  $MAN_{EMP}$  holding other explanatory variables constant. Each slope coefficient gives the rate of change in the dependent variable for a unit change in the value of explanatory variables.

### III.a Description of Explanatory Variables Used

#### i) *The Level of Economic Growth (PCnetSDP):*

The per capita net state domestic product (PCnetSDP) is a proxy for the level of economic growth. The inclusion of PCnetSDP is consistent with the works of structuralists such as Fisher (1935;1939), Clark (1940; 1960); Kuznets (1966, 1969, 1972); Chenery & Syrquin (1975)(1970). The structuralist hypothesis is that there is a shift from primary to secondary sector first and from secondary to tertiary sector subsequently. Accordingly, the sign of the coefficient is expected to be positive.

#### ii) *Female Labor Force Participation Rate (FLFP) :*

There are certain activities within the manufacturing sector e.g. unorganized segment of construction industry, where more women are employed as there is none to low skill requirement and labor intensity is high (Ahmed et al. 2016). The relationship between work force participation rate and  $MAN_{EMP}$  can be expected to be positive as this sector offers greater opportunities for women and teenage workers. However, manufacturing jobs in general are not women centric (Deloitte, 2015, 2017) unlike service sector jobs; therefore, the expected sign of coefficient will be negative.

#### iii) *Percentage of labor force engaged in the Services Sector ( $SERV_{EMP}$ )*

Recent changes in international business environment due to increased competition, globalization of markets, heightened consumer awareness, changing consumption pattern, manufacturing industries is becoming more service-oriented. This emerging business trend involving service infusion (Brax, 2005) in manufacturing industries has been described in literature as "servitisation" (Vandermerwe & Rada, 1988) and "tertiarization" (Leo & Philippe, 2001). In view of these developments, our hypothesis w.r.t. percentage of labor force engaged in services sector ( $SERV_{EMP}$ ) is that the increase in employment in services sector

**Table 3: Multiple Linear Panel Regression Results**

Variables	Pooled Regression	Panel Regression	
		Fixed Effect	Random Effect
Column 1	Column 2	Column 3	Column 4
PCnetSDP	0.0002 (0.006)*	0 (-0.568)	0.0001 (0.187)
URB	0.1171 (0.017)**	0.025 (-0.885)	0.164 (0.015)**
IMR	-0.0455 (-0.216)	-0.0823 (-0.178)	-0.0432 (0.281)
FLR	0.0474 (-0.519)	0.1833 (-0.192)	0.1485 (0.10)
FLFPR	-0.1638 (0.013)**	-0.0842 (-0.345)	-0.1527 (0.022)**
SERV <sub>EMP</sub>	-0.4066 (0.000)*	-0.7854 (0.000)*	-0.5351 (0.000)*
CONSTANT	34.9022 (0.000)*	47.7124 (0.003)*	34.4931 (0.000)*
R squared	0.6296	within = 0.6952	overall = 0.6471
F Stat / Wald	15.02 (0.000)*	12.92 (0.000)*	88.48 (0.000)*
Durbin-Watson	1.144		
Rho		0.8942	0.7214

Note: (i) MAN<sub>EMP</sub> (i.e. Percentage of labour force engaged in the manufacturing sector) is the dependent variable

(ii)\*\*Significant at the 0.05 level (2-tailed).

\*Significant at the 0.01 level (2-tailed).

p-values have been given in parentheses

Source: Author's estimation

is likely to lead to more employment in the manufacturing sector due to inter-sectoral linkages. The expected sign of the coefficient is positive.

**iv) Urbanization (URB)**

Numerous studies have previously found that the level of urbanization is closely correlated with the level of GDP per capita (Henderson, 2003). Theoretical studies also suggest that there is a virtuous circle between industrialization and urbanization as they usually go hand in hand (Zhang, 2002; Davis & Henderson, 2003; Xie & Zhang, 2004; Henderson, 2003, 2010). Industry and services are located in cities because of agglomeration economies, efficiency gains and consumption benefits. Consequently, it is expected that as the process of urbanization gathers momentum, the percentage of employment in the

manufacturing sector should also increase. This variable is expected to have a positive sign.

**v) Literacy/Education (FLR) and Infant Mortality Rate (IMR)**

The variable HDI measures the impact of socio-economic development on the MAN<sub>EMP</sub>. Studies (Upadhyaya, Kepplinger & David, 2014) highlight that there is a clear and strong connection between industrialization and various dimensions of human development like education and health. Since the HDI ranking for the states was not available for the three time period chosen by us, therefore, FLR (Female literacy rate) variable was used as a proxy for education and infant mortality rate (IMR) as a proxy for health. The variables are expected to yield a positive coefficient. The variable PCnetSDP has been included separately.

### III.b Empirical Results

Multiple linear panel regression [ordinary least square (OLS), fixed effect model (FEM), and random effect model (REM)] results are drawn from independent and dependent variables for sample states. The results are shown in Table 3.

Column 2 of Table 3 displays the results of pooled OLS regression for dependent variable with control variables. Variance inflation factors ranged between 1.88 and 4.36 indicating no multicollinearity amongst the independent variables. Durbin Watson statistics 1.144 signified absence of autocorrelation in the residuals. The coefficient of determination R squared ( $R^2$ ), has shown that 62.96 percent variation in the dependent variable i.e.  $MAN_{EMP}$  is explained by all independent variables at 1 percent level of significance (F statistic- 15.02, p-value 0.00). F statistic is significant at 1 percent level of significance indicating that the model fits the data well.

Column 2 of Table 3 determines that the coefficients of the variables namely PCnetSDP and  $Serv_{EMP}$  are significant at 1 percent level of significance while the coefficients of two variables URB and FLFPR are significant at 5 percent level of significance.

To identify whether OLS or Fixed effect Model will be more appropriate for the given data set the significance of the probability value of F-test was considered. It was found that F-test of joint significance of fixed effects intercepts is significant at 1 percent level of significance with p-value 0.000 and stat 6.79. This suggests using fixed-effect model (over OLS). Also, Breusch and Pagan Lagrange multiplier test for random effects appeared significant ( $\chi^2(01) = 19.23$ , p-value = 0.000) implying that OLS should not be used.

Column 2 and column 3 of Table 3 show the results of fixed effect and random effect panel regression. The Hausman test chi-square statistic is 8.86 (p-value 0.1148) showing the appropriateness of random effect model (v/s Fixed Effect Model). The results of random effect model column 3 of the above-given table have been discussed in detail.

The results of random effect model show that the coefficient of  $SERV_{EMP}$  is highly significant at 1 percent level of significance, while the coefficients of URB and FLFPR are significant at 5percent level of significance. Other control variables namely PCnetSDP, FLR,IMR are insignificant.

The  $b_i$  of URB is positive whereas  $b_i$  of FLFPR and  $SERV_{EMP}$  is negative. The coefficient of determination, R squared ( $R^2$ ) has shown that 58.27 percent variation in the dependent variable i.e.  $MAN_{EMP}$  is explained by all independent variables with a significant (1 percent) Wald statistic (88.48, p-value 0.00). Since Wald statistic is significant at 1 percent level of significance hence independent variables impact  $MAN_{EMP}$ .

Wooldridge test for autocorrelation in panel data model exhibits no first-order autocorrelation with  $F(1, 19) = 0.1700$ , p-value 0.2079. Further, Likelihood Ratio (LR) test for heteroscedasticity is insignificant at 1 percent level of significance with p-value 0.3464 ( $\chi^2(19) = 20.8281$ ) exhibiting homoscedasticity.

It can be observed from the table that in case of REM,  $R^2$  stood at 58% which implies that 58% of change in employment in manufacturing is explained by 6 explanatory variables. Out of the 6 explanatory variables, three variables viz. URB, FLFPR and  $SERV_{EMP}$  turned out to be significant at 5% or 1 % levels of significance respectively.

### IV. Conclusions and Policy Implications

From the start, it is very clear that despite the policy impetus of the Government of India (GOI) on manufacturing sectors during the planning era, this sector did not play its role well. The service sector growth has shown a uniform growth trend in post-independence era in contrast with the commodity producing sectors. But as a consequence of the inconsistent growth of the commodity producing sector, the gap between commodity sector and services sector growth has widened. This can have serious repercussions for the economy. Therefore, there arises a need for the revival of manufacturing sector growth in India through more policy interventions.

The paper also made an attempt to identify the factors which can be expected to influence manufacturing sector employment. This indeed can help in informed policy making. By carrying out different tests to identify whether OLS or Fixed effect Model or Random effect model will be more appropriate for the given data set, it was found that the random effect regression model (REM) will be suitable. The results of this last model namely, REM shows the significance of Urbanization(URB),female labor force participation rate (FLFPR) and employment in service sector( $SERV_{EMP}$ ). This implies that there is a need for the government to give a big push to urbanization if more jobs

are to be created in the manufacturing sector. 'The Smart City Project' of the present government needs to be implemented more efficiently and effectively. The negative sign of the coefficient of FLFPR variable clearly shows that manufacturing jobs are not women-centric. Therefore, this underlines the need for introducing more gender sensitive and gender friendly policies so that more women can be motivated to join this sector. This will enable the manufacturing sector to ensure more gender diversity, which is the need of the hour and also can help in boosting the GDP growth of the country. Since the coefficients of

$MAN_{EMP}$  and  $SERV_{EMP}$  are negatively correlated, it implies that both the sectors compete for the available talent pool. This highlights the shortage of skilled manpower on the one hand and that manufacturing sector is not becoming services-oriented, on the other. If the manufacturing sector becomes service-oriented, then the growth of both the sectors can go hand in hand. It points towards the need to encourage innovation, incur more R&D expenditure and public expenditure on training and skill development of Indian youth to curb skill shortages on the one hand and to tap the benefits of the Industry 4.0 on the other.

## Notes

<sup>1</sup> See Kuznets (1966,1969,1972)

<sup>2</sup> Also see Joshi, 2008 and 2018.

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*"Banks can partner with fintech to build an ecosystem where the size of the pie grows for the banks and third parties."*

– Mike Henry

# Impact of Direct Institutional Credit on Agricultural Productivity in India: An Empirical Analysis

KAPPA KONDAL

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*Government provides certain direct and indirect facilities to boost the agriculture sector through different financial institutions. Credit helps the farming community to purchase modern machines, tub wells, seeds, fertiliser, pesticides and other inputs. The aim of the present study is to analyse the trends and impact of direct institutional credit on agricultural productivity in India. Secondary data have been used (1980–81 to 2017–18). Descriptive statistics and multiple natural log linear regression models have been employed. The study reveals that there was a positive growth in flow of institutional credit to agriculture sector. After new economic reforms, there was a significant progress of SCBs credit to agriculture sector compared to Cooperative Banks, RRBs. The main finding is that all the independent variables (area, credit, fertiliser and new economic reforms) are affecting positively and significantly on agriculture productivity in India.*

## Introduction

The institutional credit plays a vital role for agriculture sector development directly and indirectly in India. The credit is considered as one of the critical input for economic development when available timely in the right quantity of amount and affordable cost (low interest rate) (Nanung et al, 2013). Mainly, there are four (4) major agriculture financial institutions; such as Cooperative Banks (CBs), Scheduled Commercial Banks (SCBs) and Regional Rural Banks (RRBs) along with NABARD. The Cooperative Banks and SCBs have achieved many distinctions since their creation and have helped rural India. Among all institutional credit institutions of agriculture sector, CBs, SCBs, RRBs have been playing an important role in providing credit to agriculture farm sector. During 2016–17, the share of SCBs credit (more than 50%) was high compared to CBs and RRBs credit (RBI Handbook Statistics Report, 2017–18). Keeping this in view, let us know that, how much they are causing to increase the agricultural productivity. The present study was undertaken to analyse the impact of direct institutional credit on agriculture productivity in India.

## Objectives of the Study

1. To overview the trends of direct institutional credit to agriculture sector; and
2. To analyze the impact of direct institutional credit on agricultural productivity of food grains in India.

## Hypothesis of the Study

(Ho) There is no significant impact of direct institutional credit, area under the cultivation of food grains, fertiliser consumption and new economic reforms on agricultural productivity in India.

*Dr. Kappa Kondal, UGC-Post Doctoral Fellow, Dept. of Economics, Osmania University, Telangana State, India.*

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**Methodology of the Study:** To meet the objectives and hypothesis, the following methodology was employed.

### Sources of the Data

Owing to the complex nature of the given study, the researcher has used secondary sources of data. The secondary data collected from different sources such as NABARD reports, Ministry of Agriculture & Farmers' Welfare, Govt. of India (GoI), Commission for Agriculture Cost and Price, GoI, RBI Handbook Statistics Report (2017–18), and The Fertiliser Association of India report.

### Period of the Study

For purpose of the present study, with regard to secondary sources, the data have been collected for 38 years time series (Annual) indicating the time frame from 1980–81 to 2017–18. To know the trend of credit flow to agriculture sector, the study period was classified into different groups such as: before new economic reforms, early reforms period, 9<sup>th</sup> and 10<sup>th</sup> five year plan period, 11<sup>th</sup> and 12<sup>th</sup> (NITI Aayog) and after new economic reforms. Since the published data is not available for some years, the researcher has taken preceding and succeeding three years moving average data.

### Tools and Techniques of Analysis

Graphs, Mean, Standard Deviation, Co-efficient of Variation, and Multiple natural log linear regression model have been employed in the study.

**Coefficient of Variation (CoV):**  $CoV = \frac{s}{\bar{x}} \times 100$

Where  $s$  = Standard Deviation and  $\bar{x}$  = Mean of the variable

### Multiple Natural Log Linear Regression model:

$$\ln Y_t = \beta_0 + \beta_1 \ln X_{1t} + \beta_2 \ln X_{2t} + \beta_3 \ln X_{3t} + \beta_4 X_{4t} D + U_t$$

Where

$\ln Y_t$  = Dependent variable (Agriculture Productivity or Yield)

$\beta_0$  = Intercept or Constant

$\beta_s$  are the coefficients (Area, Credit, Fertiliser Consumption and New Economic Reforms)

$D$  = Dummy variable (After New Economic Reforms = 1 and Before New Economic Reforms = 0)

$U_t$  = Error term/stochastic term/disturbance term

### Review of Literature

1. Binswanger and Khandker (1992) found that the effect of credit was less on output directly, despite the fact that credit to agriculture sector has increased fertiliser use and private investment in modern agriculture equipment, livestock and others. Clearly, it shows high impact on inputs and modest impact on output.
2. Mohan (2006) analysed the agriculture growth and role of institutional credit in India. He pointed out that as credit increases, there was low impact on agriculture output. Due to the limitations of credit, the government might have not increased that much proportionately.
3. Golait (2007) analysed the issues in agricultural credit in India. The study revealed that the credit delivery to the agriculture sector was inadequate. It implied that the banking system was hesitant on various grounds to issue credit to the farmers. The study suggested that concerted efforts were required to augment the flow of credit to agriculture, alongside exploring innovations in product design and methods of delivery, through better use of technology and related processes, facilitating credit through processors, input dealers, NGOs, etc.
4. Sriram (2007) concluded that increased supply of credit help in the increase in agricultural production & productivity to farmers is a sub-component of the total investment. The formal credit as a proportion of total indebtedness had to go down. Finally, he argued that the meager increase in supply of credit is not going to increase productivity, unless it is accompanied by investments in other support services for agriculture development.
5. Thorat (2007a) studied the banking service to common man-financial inclusion. He stated that the banking industry has shown tremendous growth in volume and complexity during the last few decades. Banks have not been able to include vast segments of the population, especially the underprivileged sections of the society, into the fold of basic banking services.
6. Sidhu and Gill (2006) analysed the agriculture credit and indebtedness in India. They concluded that the rate of growth of institutional credit to small and marginal farmers is less than other farm size categories in the nineties.



7. Nanung et al (2013) studied the flow of institutional credit to small and marginal farmers in Ludhiana, Punjab. They suggested that the credit institutions may provide technical advice and also provide free financial counsel for the first time borrowers to low-income marginal and small farmers. It reflected on fixed and variable costs and it will help them in financial inclusion.
8. Gowhar et al (2013) studied institutional credit to agriculture sector in India. The study revealed that the institutional credit has been increased to agriculture sector from 2000–01 to 2011–12. They suggested that banks should reduce their outstanding loans than institutional credit pumped into agricultural sector.

## Analysis of Results

Figures 1 (A&B) show the loans issued through direct institutional credit to agriculture sector. There was a significant change in credit through different institutional credit to agriculture sector. Among all three, the Cooperative banks' credit was higher in agriculture sector compared to Scheduled Commercial Banks-SCBs, Regional Rural Banks-RRBs. After new economic reforms emerged, there was significant progress of SCBs credit to agriculture sector compared to Cooperative Banks, RRBs. The share of RRBs credit was also increased but share of Cooperative Banks' credit was declined in the globalization era.

Figures 2 (A&B) show the loans outstanding through direct institutional credit to agriculture sector. During the period 1980–81 to 1990–91, the SCBs' outstanding loans had increased compared to Cooperative Banks and RRBs. Year after year, the outstanding loans have been increased. SCBs has stood first place after Cooperative Banks and RRBs. After new economic reforms, there was also significant progress of SCBs outstanding compared to Cooperative Banks, RRBs. But during the period from 1999–2000 to 2003–04, the outstanding loans has decreased, later increased. However, all the institutional outstanding loans have increased in the globalization era, especially SCBs outstanding loans.

Figures 3 (A&B) show the trend in direct institutional credit to agriculture sector in India. During the periods 1980–81 to 1990–91, the Cooperative Banks' credit had increased compared to SCBs and RRBs. Cooperative Banks had stood first place in terms of providing to

agriculture sector followed by SCBs and RRBs. After new economic reforms, there was no significant progress of Cooperative Banks credit but SCBs credit has been increased along with RRBs. The share of SCBs credit was highest in the globalization era after Cooperative Banks and RRBs. However, there was exponential growth in institutional credit to agriculture sector, but there was a credit fall down from 2012–13 to 2013–14 and 2015–16 to 2016–17 (figure 3(A)) compared to its previous periods.

Table 1 shows the descriptive statistics of direct institutional credit to agriculture and allied activities (included short and long term loans) in India. As per Economic Survey 2007–08, the periods have been classified up to 9<sup>th</sup>&10<sup>th</sup> Plan. Researcher's own interests to classified the period from 2007–08 to 2017–18. On an average of the Cooperative banks, SCBs and RRBs credits were high from 2007–08 to 2017–18 compared to all other periods. During the early reforms period, the State Governments' credit was high compared to the wider technology-dissemination period. However, the study found that the Cooperative Banks, SCBs and RRBs' credit had significantly changed after introduction of new economic reforms in India. Economic reforms had positively affected the production and yield of agriculture, use of modern technologies, seeds, fertilisers, pesticides and other modern inputs which have helped to extend the area under the cultivation of food grains and non-food grains.

Table 2 shows the before and after new economic reforms-wise descriptive statistics of production, yield, area, credit, fertiliser consumption and rainfall (including short and long term loans) in India. On an average, production and yield of food grains was more after introduction of new economic reforms period compared to before economic reforms and overall period. On an averages. area under the cultivation of food grains was more before introduction of new economic reforms period compared to after economic reforms and overall period. It seems that the yield has increased due to fewer increases under the cultivation of food grains and increases credit from different institutions and more consumption of fertiliser in India. However, there is a positive impact of new economic reforms on production and yield of agriculture sector.

## Impact of Direct Institutional Credit on Agriculture Sector

Credit plays a vital role in the agriculture sector. Majorly, credit is classified into two categories. First one is

institutional credit, other one is non-institutional credit. The institutional credits are mainly Government, Cooperative Banks, Scheduled Commercial Banks and Regional Rural Banks. The Non-institutional credits are mainly money lenders, traders, landlords, relatives, friends and others who can provide credit to agriculture sector. According to the Report of the All India Rural Credit Survey Committee (1954), out of the total amount borrowed by cultivators from the different credit agencies (both formal and informal), formal agencies accounted for only 7.3 per cent. Of this, the commercial banks provided only 0.9 per cent, while government and co-operatives accounted for the rest. It means that as much as 92.7 per cent of the credit was provided by non-institutional finance was designed at different levels to facilitate the credit requirement of farmers to a greater extent. In 1981, institutional finance provided 63.2 per cent credit to agriculture sector. Year after year, institutional credit to agriculture sector has been increasing from 2000–01 (Gowhar et al, 2013). Among the three major players of institutional credit, scheduled commercial banks have been playing an important role for agriculture sector development. Presently, it is providing more than 50 per cent credit to agriculture sector (RBI Handbook Statistics, 2017–18).

There was an impact of institutional credit to agriculture production and yield in India (Binswanger and Khandker, 1992, Sriram, 2007, Mohan, 2006 and Gowhar et al, 2013). The credit delivery to agriculture sector was inadequate and distribution of credit to small and marginal farmers was low compared to others farmers (Thorat, 2007a, Golait, 2007 and Sidhu and Gill, 2006). However, the present study has taken a step forward to look at the impact of direct institutional credit along with new economic reforms on agriculture productivity from 1980–81 to 2017–18. Due to multicollinearity problem, only few variables have been taken into consideration in the regression model. Agricultural food grains' yield is taken as a dependant variable, while area under the cultivation of food grains, fertiliser consumption, direct institutional credits, new economic reforms (dummy variable) are taken as independent variables.

Table 3 shows the impact of direct institutional credit of Cooperative banks, SCBs and RRBs-short and long credit on agricultural yield. The study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.854, which

implies a one per cent increase in area, leads to increase in agricultural yield by 0.854. The coefficient of direct institutional credit to agriculture sector is low (0.046), which implies that a one per cent increase in direct institutional credit leads to increase in agricultural yield by 0.046. This shows a low impact of credit on agriculture sector. The coefficient of fertiliser is 0.251, which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.251. The coefficient of new economic reforms is 0.106. It implies that there is a positive impact of new economic reforms on agriculture yield in India by using modern equipments, high quality seeds from abroad and removed some restriction on trade of agricultural commodities. The adjusted coefficient of determination value is 0.973. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.3 per cent of the variation in the agriculture yield, keeping all other variables constant in the study area. Remaining 2.7 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

Table 4 shows the institution-wise impact of direct institutional credit of Cooperative banks, SCBs and RRBs' short and long term credit (both loans issued and outstanding) on agricultural yield. With respect to Cooperative Banks, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.794 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.794. The coefficient of Cooperative Banks' credit to agriculture sector is low (0.048) which implies that a one per cent increase in Cooperative Banks' credit leads to increase in agricultural yield by 0.048. This has a low impact of Cooperative Banks' credit on agriculture sector. The coefficient of fertiliser is 0.265 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.265. The coefficient of new economic reforms is 0.096 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.976. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.6 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 2.4 per cent is error and this per

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cent of variation is explained by some other variables which are not included in the model.

With respect to SCBs, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance but credit of SCBs significant at 0.05. The coefficient of area under the food grains is 0.794, which implies that a one per cent increase in area leads to increase in agricultural yield by 0.794. The coefficient of SCBs' credit to agriculture sector is low (0.048), which implies that a one per cent increase in SCBs credit leads to increase in agricultural yield by 0.048. This has a low impact of SCBs credit on agriculture sector. The coefficient of fertiliser is 0.265, which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.265. The coefficient of new economic reforms is 0.096, which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.970. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.0 per cent of variation in the agricultural yield, keeping all other variables constant in the study. Remaining 3 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

With respect to RRBs, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.861, which implies that a one per cent increase in area leads to increase in agricultural yield by 0.861. The coefficient of RRBs credit to agriculture sector is low (0.027), which implies that a one per cent increase in RRBs' credit leads to increase in agricultural yield by 0.027. This has a low impact of RRBs credit on agriculture sector. The coefficient of fertiliser is 0.281, which implies that a one per cent increase in fertiliser consumption leads to increase in agriculture yield by 0.281. The coefficient of new economic reforms is 0.097, which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.970. It means that the model is the best fit and all the explanatory variables have collectively explained about 97 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 3 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

However, among all the independent variables, area under the cultivation of food grains has played a significant role in determining the agriculture yield. Here, the coefficient of Cooperative banks' credit was high compared to coefficients of SCBs and RRBs.

Table 5 shows the impact of direct institutional credit of Cooperative banks, SCBs and RRBs' short and long term credit (only loans issued) on agricultural yield. With respect to Cooperative Banks, the study found that all the variables are positively and significantly affecting the agriculture yield at 0.01 level of significance. The coefficient of area under the food grains is 0.818 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.818. The coefficient of Cooperative Banks' credit to agriculture sector is low (0.045) which implies that a one per cent increase in Cooperative Banks' credit leads to increase in agricultural yield by 0.045. This has a low impact of Cooperative Banks' credit on agricultural sector. The coefficient of fertiliser is 0.266 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.266. The coefficient of new economic reforms is 0.095 which implies that there is a positive impact of new economic reforms on agricultural yield in India. The adjusted coefficient of determination value is 0.974. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.4 per cent of the variation in agricultural yield, keeping all other variables constant in the study. Remaining 2.6 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

With respect to Scheduled Commercial Banks (SCBs), the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance but credit of SCBs is significant at 0.10. The coefficient of area under the food grains is 0.859 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.859. The coefficient of SCBs' credit to agriculture sector is low (0.024) which implies that a one per cent increase in SCBs credit leads to increase in agricultural yield by 0.024. This has a low impact of SCBs credit on agriculture sector. The coefficient of fertiliser is 0.303 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.303. The coefficient of new economic reforms is 0.100 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is

0.967. It means that the model is the best fit and all the explanatory variables have collectively explained about 96.7 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 3.3 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

With respect to Regional Rural Banks (RRBs), the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.845 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.845. The coefficient of RRBs credit to agriculture sector is low (0.021) which implies that a one per cent increase in RRBs' credit leads to increase in agricultural yield by 0.021. This has a low impact of RRBs' credit on agriculture sector. The coefficient of fertiliser is 0.312 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.312. The coefficient of new economic reforms is 0.091 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.969. It means that the model is the best fit and all the explanatory variables have collectively explained about 96.9 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 3.1 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

However, among all the independent variables, area under the cultivation of food grains has played a significant role in determining the agriculture yield. Here, the coefficient of Cooperative banks' credit was high compared to coefficient of SCBs, and RRBs. It means that it has played a key role in determining the agricultural yield because the amount of credit was high. On average, its credit was more than 50 per cent from 1980–81 to 2003–04 compared to others (SCBs and RRBs), later it has come down.

Table 6 shows the impact of direct institutional credit of Cooperative banks, SCBs and RRBs' short and long term credit (only loans issued) on agricultural yield. With respect to Cooperative Banks, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.955 which implies that a

one per cent increase in area leads to increase in agricultural yield by 0.955. The coefficient of Cooperative Banks' credit to agriculture sector is moderate (0.302) which implies that a one per cent increase in Cooperative Banks' credit leads to increase in agricultural yield by 0.302. This has a moderate impact of Cooperative Banks' credit on agriculture sector. The coefficient of fertiliser is 0.220 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.220. The coefficient of new economic reforms is 0.084 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.975. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.5 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 2.5 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

With respect to SCBs, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance but credit of SCBs is significant at 0.10. The coefficient of area under the food grains is 0.790 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.790. The coefficient of SCBs' credit to agriculture sector is low (0.031) which implies that a one per cent increase in SCBs credit leads to increase in agricultural yield by 0.031. This has a low impact of SCBs credit on agriculture sector. The coefficient of fertiliser is 0.272 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.272. The coefficient of new economic reforms is 0.109 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.972. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.2 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 2.8 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

With respect to RRBs, the study found that all the variables are positively and significantly affecting the agricultural yield at 0.01 level of significance. The coefficient of area under the food grains is 0.878 which implies that a one per cent increase in area leads to increase in agricultural yield by 0.878. The coefficient on RRBs credit

to agriculture sector is low (0.032) which implies that a one per cent increase in RRBs credit leads to increase in agricultural yield by 0.032. This has a low impact of RRBs credit on agriculture sector. The coefficient of fertiliser is 0.261 which implies that a one per cent increase in fertiliser consumption leads to increase in agricultural yield by 0.261. The coefficient of new economic reforms is 0.100 which implies that there is a positive impact of new economic reforms on agriculture yield in India. The adjusted coefficient of determination value is 0.971. It means that the model is the best fit and all the explanatory variables have collectively explained about 97.1 per cent of the variation in the agriculture yield, keeping all other variables constant in the study. Remaining 2.9 per cent is error and this per cent of variation is explained by some other variables which are not included in the model.

However, among all the independent variables, area under the cultivation of food grains has played a significant role in determining the agriculture yield. Here, the coefficient of Cooperative banks' credit was high compared to coefficients of SCBs and RRBs. It means that it has played a key role in determining the agricultural yield because the amount of credit was high.

## Conclusion and Suggestions

The performance of agriculture sector is depending upon many factors; credit is one of the important factors among them. The study revealed that the flow of direct institutional credit to agriculture has changed over time. It reflects that the role of non-institutional credit has come down due to high rate of interest. After new economic reforms, there was a significant progress of SCBs credit to agriculture sector compared to Cooperative Banks and RRBs. All the independent variables (area, credit, fertiliser consumption and new economic reforms) are affecting agricultural yield positively and significantly. There is a low yet positive impact of credit on agriculture yield. The present study's results are close to Binswanger and Khandker (1992) and Mohan (2006). There is a reason for low impact of credit on yield that might have diversification of credit to other activities. Some farmers might have spent credit for other activities and some of them might have purchased inputs such as seeds, fertilisers, pesticides, other modern technologies, adoption of modern methods to cultivate etc. During the study period, the fertiliser's coefficient value is higher than credit. It means that most of the credit was utilized for fertiliser consumption in order to increase the agriculture production and yield, and fertiliser cost has

also been increasing year by year. The hypothesis is rejected. It means that there is a significant impact of direct institutional credit on area under the cultivation, fertiliser consumption and new economic reforms on agriculture productivity in India.

The study suggests that when credit distribution is on time, and adequate amount of credit is provided, the farmers will utilize the credit as per their requirement for development of farm and get more production and yield. As per farming community's requirement, the government and banks should provide adequate amount of credit on time, and at the same time the banks should reduce the outstanding credit, which will further push the agriculture sector. As economic reforms have a positive impact on agricultural yield, remove some restrictions or barriers on agricultural exports. After that, the agriculture sector will improve in terms of production and yield, and finally improve the welfare of the agriculture community in India.

## Acknowledgement

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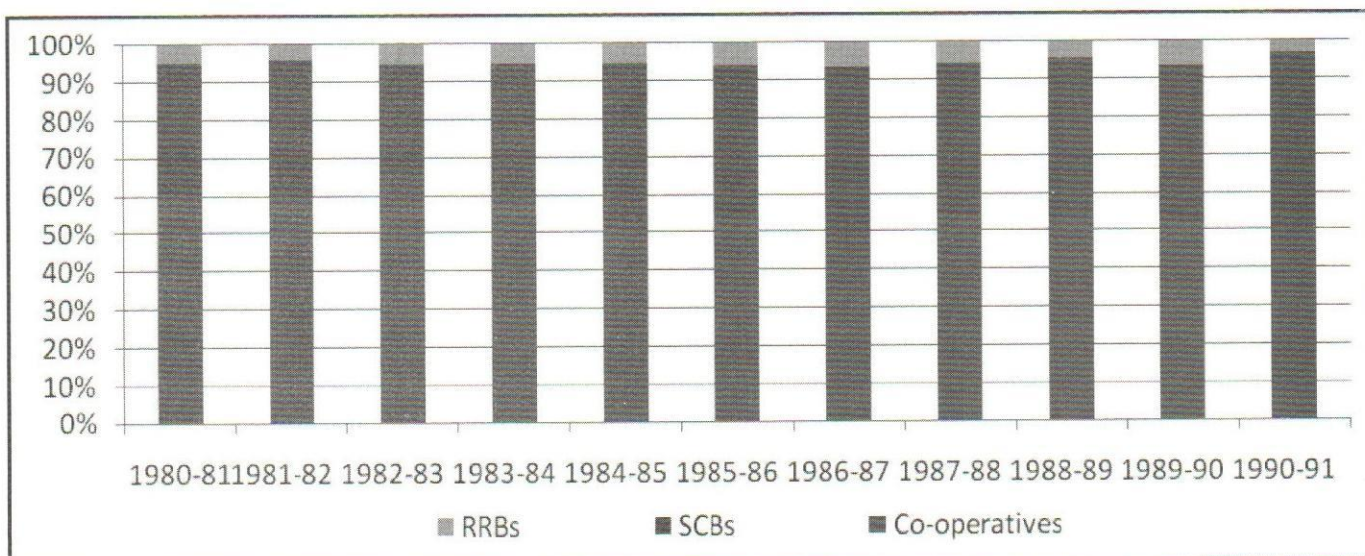
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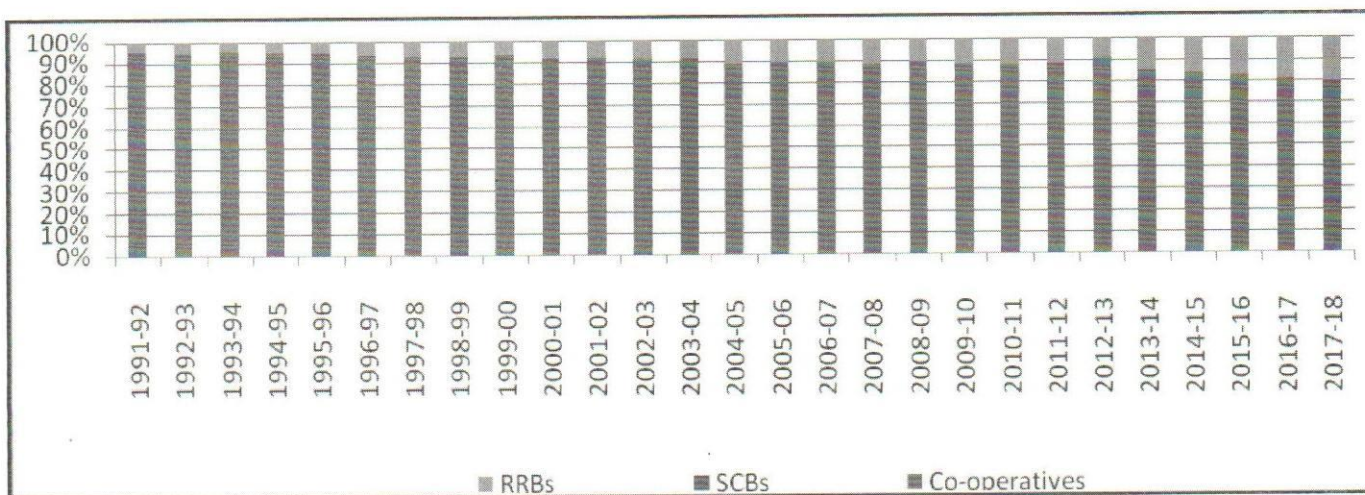
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## Appendices (Tables and Figures)



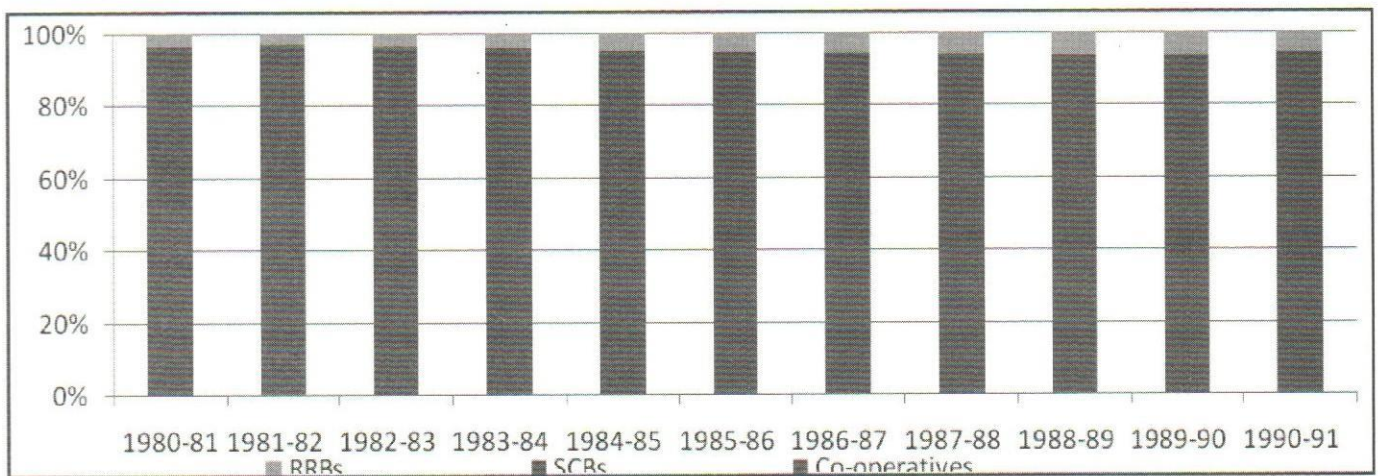
Source: RBI Handbook Statistics and NABARD Reports.

**Figure: 1(A) Loans Issued through Direct Institutional Credit to Agriculture Sector in India (1980-81 to 1990-91)**  
(Values in Billion on Y-axis)



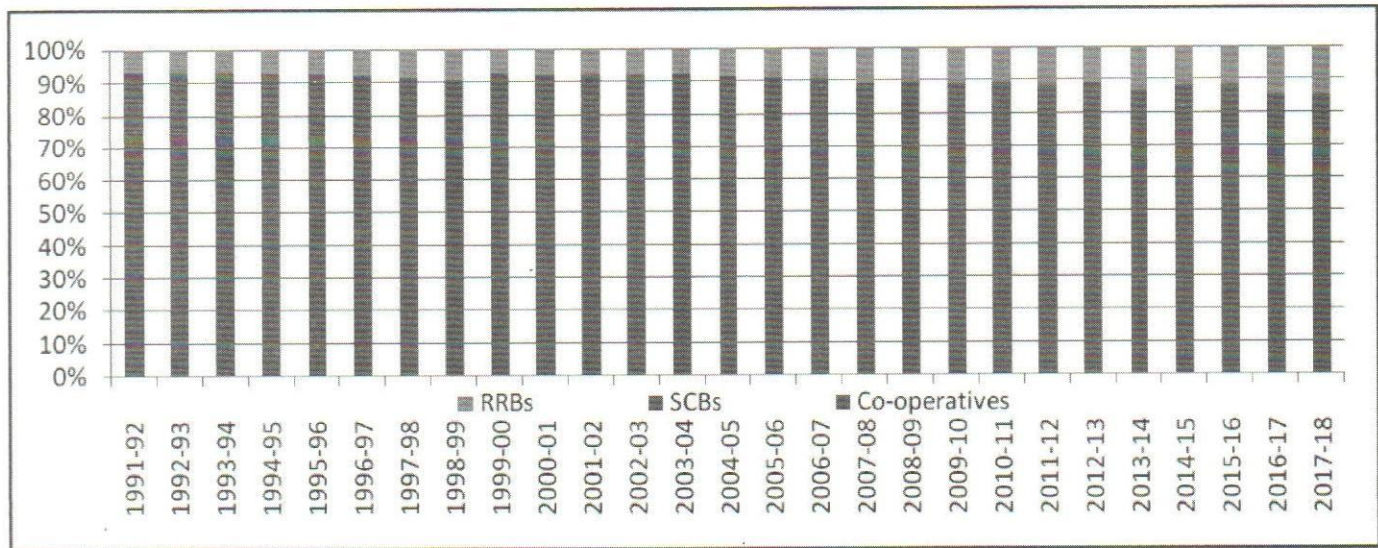
Source: RBI Handbook Statistics and NABARD Reports.

**Figure: 1(B) Loans Issued through Direct Institutional Credit to Agriculture Sector in India (1991-92 to 2017-18)**  
(Values in Billion on Y-axis)



Source: RBI Handbook Statistics and NABARD Reports.

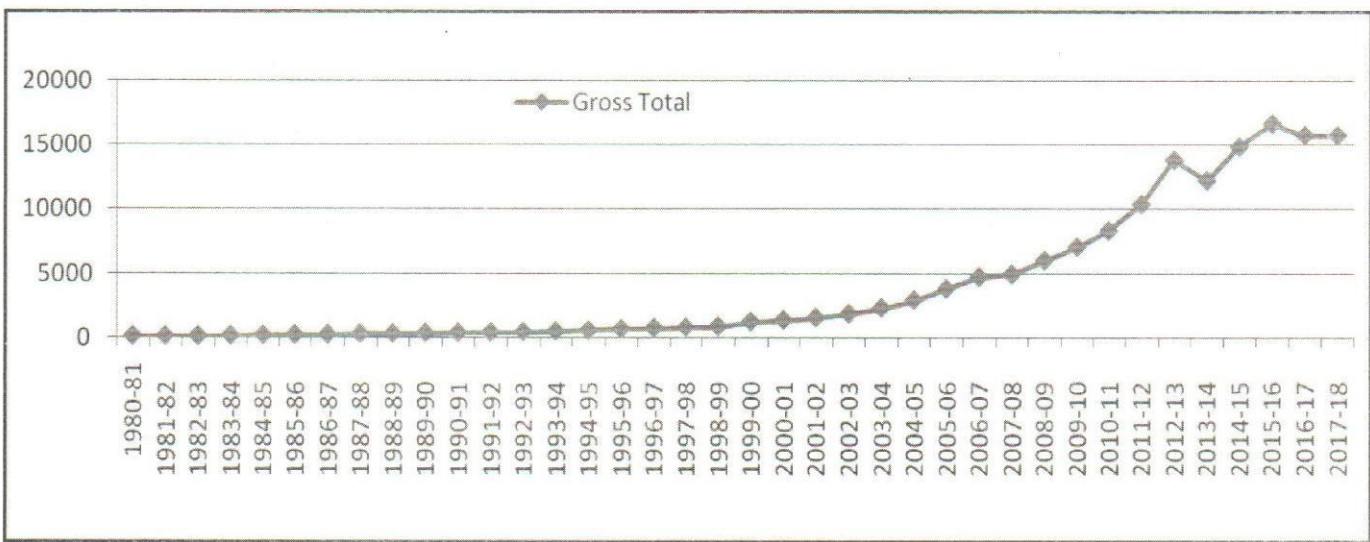
Figure: 2(A) Loans Outstanding of Direct Institutional Credit to Agriculture Sector in India (1980-81 to 1990-91) (Values in Billion on Y-axis)



Source: RBI Handbook Statistics and NABARD Reports.

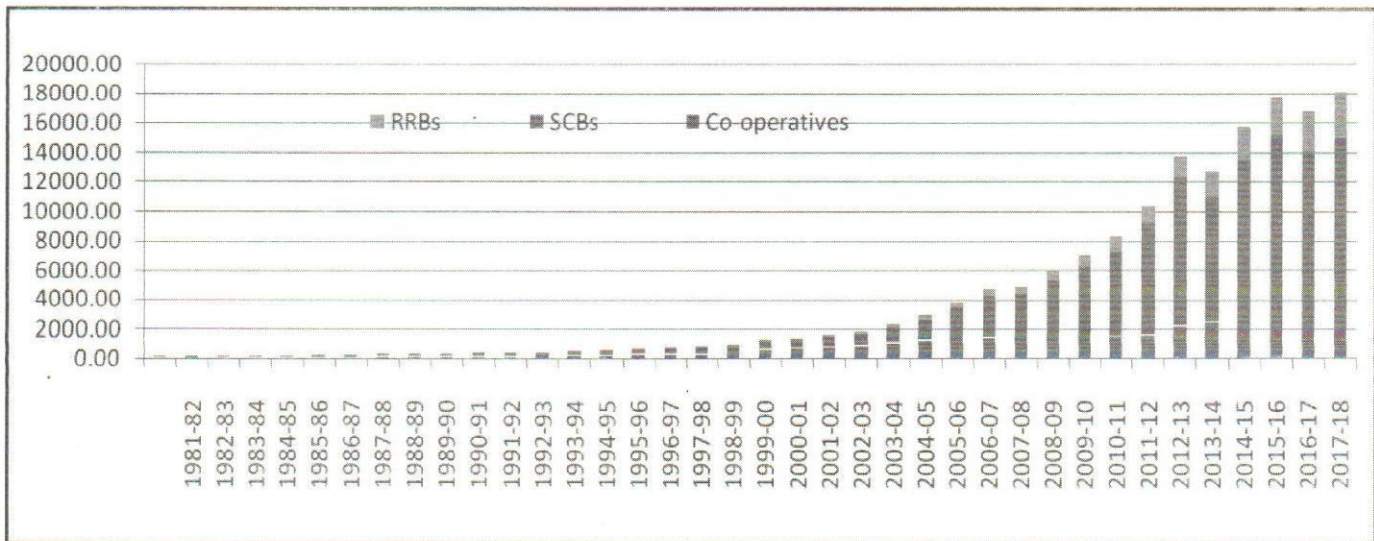
Figure: 2 (B) Loans Outstanding of Direct Institutional Credit to Agriculture Sector in India (1991-92 to 2017-18) (Values in Billion on Y-axis)





Source: RBI Handbook Statistics and NABARD Reports.

**Figure: 3 (A) Trend in Direct Institutional Credit to Agriculture Sector in India (Both Loans Issued and Loans Outstanding) (1980–81 to 2017–18) (Values in Billion on Y-axis)**



Source: RBI Handbook Statistics and NABARD Reports.

**Figure: 3(B) Trend in Direct Institutional Credit to Agriculture Sector in India-Institution Wise (Both Loans Issued and Loans Outstanding) (1980–81 to 2017–18) (Values in Billion on Y-axis)**

**Table 1: Descriptive Statistics of Direct Institutional Credit to Agriculture and Allied Activities (Included Short-term and Long-term loans) (1980-81 to 2017-18)**

Time Period		DIRECT INSTITUTIONAL CREDIT FOR AGRICULTURE AND ALLIED ACTIVITIES -TOTAL (Short-term and Long-term)										
		Values (Billion) for Mean and SD, not for CoV (CoV values are in percentage)										
		Loans Issued					Loans Outstanding					
		Cooperative Banks	State	SCBs	RRBs	Total	Cooperative Banks	SCBs	RRBs	Total	Gross Total	
1980-81 to 1990-91 (Wider Technology dissemination & Before New Economic Reforms)	Mean	37.44	2.65	28.11	3.59	71.78	73.25	89.32	9.67	172.24	244.02	
	SD	10.42	1.00	11.98	1.43	24.03	21.24	46.89	5.74	73.75	97.49	
	CoV	27.83	37.69	42.63	39.98	33.47	28.99	52.50	59.38	42.82	39.95	
1991-92 to 1996-97 (Early Reform Period)	Mean	93.96	4.55	70.87	10.43	179.82	162.92	208.43	28.77	400.12	579.94	
	SD	30.63	1.28	24.63	4.51	60.54	31.86	34.98	7.82	74.36	134.68	
	CoV	32.60	28.04	34.75	43.23	33.67	19.55	16.78	27.19	18.59	23.22	
1997-98 to 2006-07 (9 <sup>th</sup> and 10 <sup>th</sup> Plan)	Mean	334.04	NA	383.32	76.62	796.71	564.84	697.13	119.25	1381.22	2177.93	
	SD	134.63	NA	343.35	61.51	523.90	240.99	486.81	76.31	783.53	1305.05	
	CoV	40.30	NA	89.57	80.27	65.76	42.67	69.83	63.99	56.73	59.92	
2007-08 to 2017-18 (11 <sup>th</sup> and 12 <sup>th</sup> Plan & NITI Aayog)	Mean	1056.44	NA	3055.56	741.49	4394.37	1252.31	4991.33	900.46	7048.12	11442.49	
	SD	378.28	NA	1171.28	418.96	1488.47	660.95	2040.91	476.19	2952.95	4275.73	
	CoV	35.81	NA	38.33	56.50	33.87	52.78	40.89	52.88	41.90	37.37	
1991-92 to 2017-18 (After New Economic Reforms)	Mean	575.00	NA	1402.58	332.79	2125.34	755.61	2338.02	417.41	3471.93	5597.27	
	SD	485.06	NA	1591.66	434.41	2162.98	622.70	2597.10	506.95	3582.85	5690.85	
	CoV	84.35	NA	113.48	130.53	101.77	82.41	111.08	121.45	103.19	101.67	

Source: Author's Calculations on the basis of RBI Handbook Statistics Reports.

Note: CoV values are expressed in terms of percentage. NA: Data is Not Available

**Table 2: Before and After New Economic Reforms wise Descriptive Statistics of Production, Yield, Area, Credit, Fertiliser and Rainfall (Included Short-term and Long-term loans) (1980–81 to 2017–18)**

Year (Before & After NER)	Descriptive Statistics	Food grains Production (MT)	Area under Food grains (MHect)	Yield (MT/M Hect)	Direct Institutional Credit (Short and Long term) (Billions)	Fertiliser Consumption (000 tonnes)	Rainfall (MM)
1980–81 to 1990–91	Mean	149.26	126.90	1.18	244.02	8633.01	10672.82
	SD	16.75	2.85	0.13	97.49	2282.16	941.78
1991–92 to 2017–18	Cov	11.22	2.25	10.84	39.95	26.44	8.82
	Mean	218.69	123.08	1.77	5597.27	20080.36	10626.02
	SD	32.74	2.81	0.24	5690.85	5431.14	890.40
Overall Period (1980–81 to 2017–18)	Cov	14.97	2.28	13.68	101.67	27.05	8.38
	Mean	198.59	124.19	1.60	4047.65	16766.65	10639.57
	SD	42.98	3.29	0.35	5367.83	7058.07	892.91
	Cov	21.64	2.65	21.76	132.62	42.10	8.39

Source: Author's Calculations on the basis of RBI Handbook Statistics, NABARD, The Fertiliser Association of India and Ministry of Agriculture and Farmer's Welfare, Govt. of India, IMD Reports.

**Table 3: Impact of Direct Institutional Credit on Agriculture yield in India (1980–81 to 2017–18)**

(Cooperative Banks, SCBs, RRBs-Short and Long term loans issued and Outstanding)		
Variables	Coefficient	t-statistic
Constant	-6.497* (1.372)	-4.734
Area under the Cultivation	.854* (.280)	3.049
Direct Institutional Credit	.046* (.014 )	3.332
Fertiliser Consumption	.251*(.055 )	4.580
New Economic Reforms (Dummy Variable)	.106*(.028)	3.836

R<sup>2</sup>= 0.975    Adjusted R<sup>2</sup>= 0.973    DW=1.25    N=38

Source: Author's Calculations on the basis of RBI Handbook Statistics, NABARD, The Fertiliser Association of India and Ministry of Agriculture and Farmer's Welfare, Govt. of India Reports.

Note: Standard Errors of coefficient values are in bracket.

\*, \*\* and \*\*\* indicates that p value is significant at 0.01, 0.05 and 0.10 respectively.

**Table 4: Institution-wise Impact of Direct Institutional Credit on Agriculture yield in India**

(Both Loans Issued and Loans Outstanding-Short and Long term loans) (1980-81 to 2017-18)						
Variable	Cooperative Banks		SCBs		RRBs	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-6.273* (1.283)	-4.888	-6.406* (1.465)	-4.373	-6.585* (1.435)	-4.589
Area under Food grains	.794* (.262)	3.029	.816* (.293)	2.785	.861* (.291)	2.955
Credit	.048* (.011)	4.181	.030** (.011)	2.716	.027* (0.01)	2.786
Fertiliser Consumption	.265* (.042)	6.244	.277* (.057)	4.877	.281* (.055)	5.134
New Economic Reforms	.096* (.025)	3804	.106* (.029)	4.877 4.877	.097* *(.028)	3.429
	R <sup>2</sup> = 0.979 Adjusted R <sup>2</sup> = 0.976 DW=1.44 N=38		R <sup>2</sup> = 0.973 Adjusted R <sup>2</sup> = 0.970 DW=1.22 N=38		R <sup>2</sup> = 0.973 Adjusted R <sup>2</sup> = 0.970 DW=1.248 N=38	

Source: Author's Calculations on the basis of RBI Handbook Statistics, NABARD, The Fertiliser Association of India and Ministry of Agriculture and Farmer's Welfare, Govt. of India Reports.

Note: Standard Errors of coefficient values are in bracket.

\*,\*\* and \*\*\* indicates that p value is significant at 0.01, 0.05 and 0.10 respectively.

**Table 5: Institution-wise Impact of Direct Institutional Credit on Agriculture yield in India**

(Loans Issued only-Short and Long term loans) (1980-81 to 2017-18)						
Variable	Cooperative Banks		SCBs		RRBs	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-6.356* (1.324)	-4.800	-6.800* (1.527)	-4.454	-6.585* (1.456)	-4.646
Area under Food grains	.818* (.270)	3.030	.859* (.307)	2.798	.845* (.297)	2.843
Credit	.045* (.012)	3.802	.024** (.013)	1.930	.021 (0.01)	2.478
Fertiliser Consumption	.266* (.042)	6.244	.303* (.057)	4.877	.312* (.055)	6.361
New Economic Reforms	.095* (.026)	3804	.100* (.030)	3.269	.091* *(.029)	3.185
	R <sup>2</sup> = 0.977 Adjusted R <sup>2</sup> = 0.974 DW=1.36 N=38		R <sup>2</sup> = 0.971 Adjusted R <sup>2</sup> = 0.967 DW=1.134 N=38		R <sup>2</sup> = 0.972 Adjusted R <sup>2</sup> = 0.969 DW=1.229 N=38	

Source: Author's Calculations on the basis of RBI Handbook Statistics, NABARD, The Fertiliser Association of India and Ministry of Agriculture and Farmer's Welfare, Govt. of India Reports.

Note: Standard Errors of coefficient values are in bracket.

\*,\*\* and \*\*\* indicates that p value is significant at 0.01, 0.05 and 0.10 respectively.

**Table 6: Institution-wise Impact of Direct Institutional Credit on Agriculture yield in India**

(Loans Issued only-Short and Long term loans) (1980–81 to 2017–18)						
	Cooperative Banks		SCBs		RRBs	
Variable	Coefficient	t-value	Coefficient	t- value	Coefficient	t- value
Constant	-6.809* (1.288)	-5.285	-6.222* (1.432)	-4.454	-6.488* (1.424)	-4.557
Area under Food grains	.955* (.270)	3.543	.859* (.286)	2.763	.845* (.288)	3.048
Credit	.302* (.078)	3.875	.031*** (.010)	3.089	.032 (.011)	2.943
Fertiliser Consumption	.220* (.056)	3.959	.272* (.053)	5.175	.261* (.058)	4.498
New Economic Reforms	.084* (.026)	3.258	.109* (.028)	3.818	.100* *(.028)	3.558
	R <sup>2</sup> = 0.977 Adjusted R <sup>2</sup> = 0.975 DW=1.29 N=38		R <sup>2</sup> = 0.975 Adjusted R <sup>2</sup> = 0.972 DW=1.28 N=38		R <sup>2</sup> = 0.974 Adjusted R <sup>2</sup> = 0.971 DW=1.2267 N=38	

*Source:* Author's Calculations on the basis of RBI Handbook Statistics, NABARD, The Fertiliser Association of India and Ministry of Agriculture and Farmer's Welfare, Govt. of India Reports.

*Note:* Standard Errors of coefficient values are in bracket.

\*,\*\* and \*\*\* indicates that p value is significant at 0.01, 0.05 and 0.10 respectively.

*"Blockchain also offers resilience against a denial of service attack."*

*– Greg Wolfond*

# Agrarian Distress and Indebtedness of Farmer Households in Rural Uttar Pradesh: Emerging Issues and Challenges

NOMITA P. KUMAR

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*This paper discusses some of the dimensions of agrarian distress in Uttar Pradesh that is leading to the collapse of the farmer's economy. The paper draws upon the fact that U.P.'s economy is still predominantly rural. Agriculture remains the main source of livelihood and accounts for the highest share in the total workforce but is accompanied by decline in the share of national product. This paper is divided into four prominent sections. The crisis is observed to impinge upon the increasing marginalization of holdings leading to the emergence of small – marginal holdings as a numerically dominant group. Another section focuses on the growing resource crunch experienced in agriculture and the resultant indebtedness. The fifth section deals with the credit availability and their impact on the farming community. The final section is devoted to conclusion and discussion of alternative strategies to overcome the current crisis to launch agriculture on the path of accelerated growth and development.*

## I. Introduction

Challenges facing the agricultural sector in Uttar Pradesh after the mid-1990s have been multidimensional in character, having both long-term structural and institutional as well as short-term manifestations. The long-term structural features result in a sharp decline in the share of agriculture in Gross State Domestic Product (GSDP), accompanied by a very low rate of labour force diversification away from agriculture, which leads to declining relative productivity of agriculture vis-à-vis non-agricultural sector. About 70 per cent of the population is dependent on agriculture, out of which more than 90 per cent goes to small and marginal farmers. The State has 216.68 lakh agricultural farmers out of which 166.59 lakh marginal farmers have less than one hectare of land and 29.83 lakh small farmers have between one and two hectares of land. Similarly, in the agriculture sector, there are 49.7 lakh agricultural labourers (Twelfth Five Year Plan).

The agrarian crisis that has rampaged through the rural economy in U.P. has been associated very prudently with a rising burden of indebtedness among farmers and subsequent suicides by them. The inability to repay past debt—and therefore to access fresh loans—has been widely accepted as the most significant proximate cause of farmers' suicides that were so widespread in several States—Andhra Pradesh, Karnataka, Maharashtra, Kerala, Punjab, Rajasthan (Chandrasekhar and Ghosh, 2005) and parts of Uttar Pradesh. The deterioration in the functioning of the rural cooperative credit institutions and the decline in access to institutional credit resulted in growing dependence on non-institutional sources of credit at very high rates of interest. Problems of repayment arise due to the difficulties of cultivation associated with rising input prices and volatile output prices, further compounded by the higher interest rates charged by these informal sources

*Dr. Nomita P. Kumar, Assistant Professor, Giri Institute of Development Studies, Lucknow*

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leading to strenuous conditions of the farming community. It is only recently that some efforts have been made to rejuvenate the credit system in the economy. Except for wheat and rice, the procurement system does not ensure minimum prices to agricultural producers in many parts of the country.

The crisis further gets exacerbated due to rapid environmental degradation and plateauing of the existing agricultural technology. Even liberalization failed to give a push to agricultural exports and to increase income and employment in agriculture sector. The gradual withdrawal of the state from development activities has resulted in a steep decline in public investment in agriculture. All this boils down to impinge adversely on the production potential of the agricultural sector; thus, deceleration is noticeable during the post-reform period. The slowing down and stagnation of agricultural growth has adversely affected the income and employment of a vast majority of rural people dependent on agriculture.

Agrarian distress in the present context is mainly in terms of low agricultural prices and consequently, poor farm incomes (Rangarajan and Dev, 2019). Low productivity in agriculture and related supply side factors stands important which are associated with declining average size of farm holdings and the viability of this size for raising farm incomes. The agricultural development crisis is reflected in reduced overall growth accompanied by declining productivity and profitability which has accentuated the general adversity in the livelihoods of small and marginal farmers; for the latter, the root cause lies in relatively high dependence of the population on agriculture and the resulting agrarian distress. "Agrarian crisis" is structural and institutional in nature as could be seen in the growing marginalization and failure of support systems whereas, "agricultural crisis" on the other hand refers to performance of production in relation to the problems associated with access and use of inputs and realization of returns. What is more important is that the complexity of the prevailing crisis needs to be seen through the lens of inter-relatedness between agrarian crisis and agricultural crisis and the analyses thereof.

Despite this, apart from the reports from the field through media coverage, there exists nothing in the shape of aggregate data that gives insight into the extent of rural indebtedness (Chandrasekhar and Ghosh, 2005). Until NSSO report of 2003, however, there had been no way of verifying these perceptions as "...five decades after independence and India still lacks a credible database on

farmer households..." report Deshpande and Prabhu (2005). The Report of National Sample Surveys' 59th Round (July-December 2003), is particularly important, since it provides the first systematic evidence on the causes, extent and sources of farmers debt which is a part of the Situation Assessment of Farmers' survey, carried out only in the rural sector where 'farmer' was defined as a person who possesses and operates some land and is engaged in agricultural activities. In this survey, farmers were captured through households having at least one family member as 'farmer'. In all, 51,770 households spread over 6,638 villages were surveyed in the central sample. The survey did not cover landless workers. Similar 'Situation Assessment Survey of Agricultural Households' was repeated in its 70<sup>th</sup> round (January - December 2013), and conducted in 4,529 villages covering 35,200 households. Possession of land as an eligibility criterion of a farmer was dispensed with, replacing it with the concept of 'agricultural production unit' that produces crops, rears livestock or receives some value of produce from other specified agricultural activities. This survey also aimed at capturing the condition of agricultural households in the rural areas of the country, in the context of policies and programmes of Government of India (NSSO, 2013).

In section two, this paper discusses some of the dimensions of agrarian distress in Uttar Pradesh that is leading to the collapse of the farmer's economy. The next section draws upon the fact that U.P.'s economy is still predominantly rural, and agriculture remains to be the main source of livelihood accounting for the highest share in the total workforce but accompanied by decline in the share of national product. The next section impinges upon the increasing marginalization of holdings leading to the emergence of small-marginal holdings as a numerically dominant group. Yet another section focuses on growing resources crunch experienced in agriculture. The fifth section deals with the credit availability and their impact on the farming community. Final section is devoted to conclusion and discussion of alternative strategies to overcome the current crisis to launch agriculture on the path of accelerated growth and development.

## II. Agrarian Crisis in Uttar Pradesh—Why?

### *(i) Structural Changes and Resource Crunch in the State Economy*

Uttar Pradesh's economy is predominantly agrarian and performance of agriculture and allied activities such as horticulture, animal husbandry, dairying and fisheries are

critical in determining the growth rate of the State. It also plays a dominant role in securing the nation's food and nutritional security programs as about 17 per cent of the total food grain production of the nation comes from this State. Despite all advantages, the farmers in UP are not in very good condition which is clearly reflected in the existing inter-state variation in income of agricultural households (Figures A&B) (Tripathi, 2017). The average monthly income of an agricultural household in U.P. was about Rs. 4900, as per the latest 70th Round of National Sample Survey. On the other hand, the agricultural household in Punjab and Haryana earned Rs. 18,000 and 14,400 per month respectively. Similarly, average monthly income from farming and animal husbandry in U.P. was much lower than that in Punjab and Haryana. U.P. is famous for being the most populous state in India and each fourth farmer in the country came from this state. Hence, one cannot expect farmers' welfare in India without considering the farmers in U.P. (Tripathi, 2017).

Further, a relative sectoral assessment of the state economy shows that the only sector that appears to have recorded a mild rise in growth rate is the primary sector, wherein the rate went up from 3.06 per cent in the 1980s to 3.44 per cent in the 1990s. But the structure of the state economy has undergone a radical change. For instance, in 1980–81, the primary sector alone contributed almost half of the total SDP, but this share then declined sharply, and in 1999–2000, its contribution was only around one-third of the GSDP (34.68 per cent) (Bhattacharya et al, 2004). While a sharp fall in the share of agriculture in the economy has taken place in the state over the last decade but remained more important than industry in the state. Nevertheless, 31.55 per cent of GSDP originated from primary sector in 2005–06 but has declined to 23.26 per cent in 2015–16 calculated at 2011–12 constant prices (Table 1).

**Table 1: Share of Different Sectors in NSDP in Uttar Pradesh (at 2011–12 Prices)**

Year	Agriculture (%)	Primary (%)	Secondary (%)	Tertiary (%)
2005–06	27.24	31.55	21.38	47.08
2006–07	25.39	29.40	22.99	47.60
2007–08	25.17	28.97	23.11	47.92
2008–09	27.62	31.03	21.27	47.70
2009–10	26.73	30.04	21.44	48.52
2010–11	25.93	29.24	21.38	49.38
2011–12	27.09	30.72	19.70	49.58
2012–13	27.72	31.18	18.83	50.00
2013–14	26.68	29.99	18.33	51.68
2014–15	27.60	30.79	17.32	51.89
2015–16	22.26	23.27	23.84	44.95

Source: Calculated from Central Statistical Organisation (CSO).

To assess the performance of the agricultural sector, after the economic reforms in 1991, growth in agricultural (except forestry and fishing) accounted for about 22.26 per cent of the State's GDP. However, with around 50 per cent of the population still depending on agriculture for its

livelihood, the sector continues to play a vital role through its multiplier impact on the economy (Ministry of Agriculture and Farmers' Welfare, 2014–15).

One major factor to which this high volatility may be attributed to is the continued dependence on the vagaries



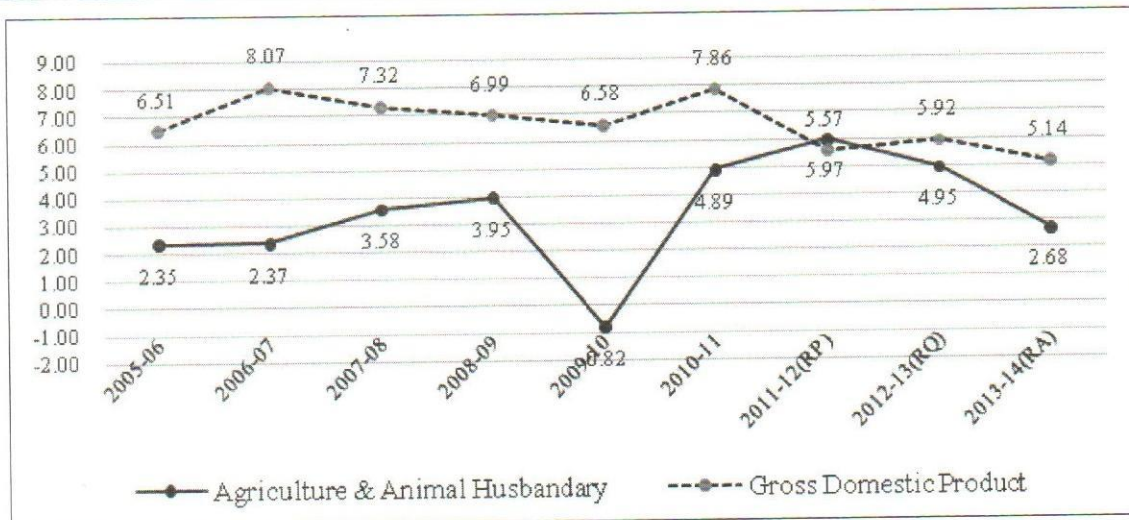


Figure 1: Agricultural GDP Growth Rate at Constant (2004-05) Prices in Uttar Pradesh

of the monsoon. The preponderance of small and marginal holdings makes this high volatility even more worrisome for policy makers, as small and marginal farmers are highly vulnerable to adverse climatic conditions. Agricultural growth in Uttar Pradesh has slowed down from 2.35 per cent in 2005–06 to a negative growth of -0.82 per cent in 2009–10, but further increase could be seen to peak in 2011–12 to 5.57 per cent and declined to 2.68 per cent in 2013–14 according to revised estimates (see Figure 1). This decline is due to the slowdown in crop sector and reflects upon the percolating distress in the agriculture sector.

### (ii) Prices and Income

Prices play a significant role in affecting the incomes of farmers. Agriculture price policy tried to resolve the impact of any undue rise in prices on the vulnerable sections of the population and ventured into maintaining interest of both the consumers and producers. Thus, Agricultural Price Commission was formed with the novel intention of maintaining the balance between demand and supply side of the economy. Recently, inflation in agriculture was much lower than overall inflation, as noted by Rangarajan and Dev (2019).

Farmers are confronted with instability in incomes and price uncertainties due to fluctuations in demand and supply owing to bumper or poor crop production, along with speculation and hoarding by traders. Agricultural price policy's repercussion of enjoying margins facilitates farmers to invest more on yield increasing technology and in increasing production and enabling enough procurement.

An ideal environment for such a scenario is when market prices are higher than support prices. When new crop comes to the market, it will be sold at market prices while the surplus is left for farmers after fulfilling the needs of consumers and industry. This is probably due to the fact that production outpaced demand, which results in a glut in the market, crashing prices of agricultural produce to the minimum. Such an apprehension leads government to take over and ideally intervene and purchase unsold stocks. Apart from MSPs, the Centre often announces additional bonuses on the crops. Even the state government declares additional bonus over the MSP, only to aggravate the existing problems. Recently, the government took steps by limiting procurement from states that declare additional bonus to the level of requirement of PDS and other schemes. Not all quantity offered will be brought now.

The price risks emanating from an inefficient APMC market are severe for farmers since they have very low resilience because of the perishable nature of their produce, their inability to hold it, hedge in surplus-shortage scenarios or insure against losses (Vasudeva, 2017). Economic theory extols that if output increases well beyond the market demand at a price remunerative to producers, market prices decline and in the absence of an effective price support mechanism, farmers get lower income. The 'farm distress' has been partly on account of this situation, as the ability of small farmers to absorb the loss is beyond their ability.

Few schemes have been suggested to address the problem of managing declining output prices when output increases significantly viz; firstly, the scheme of 'price deficiency compensation'—direct benefit transfer—which

is similar to Bhavanta Bhugtan Yojana of Madhya Pradesh under which the difference between MSP and market prices is paid to the farmer directly, as recommended by Gulati. This option rests with private procurement, and stockist scheme with private players procuring at MSP that enjoy some policy and tax incentive by the government. Secondly, the 'open procurement system' that has been in vogue quite effectively in the case of rice and wheat, where procurement is open ended at the MSP. Thirdly, there is a middle way that may be effective for some crops and had suggested the option of limited procurement for price stabilisation. The suggested 'limited procurement system' will not work if the MSP is fixed at a level to which the market price will never rise. States have introduced farm support schemes, like Rythu Bandhu Scheme in Telangana and the Krushak Assistance for Livelihood and Income Augmentation (KALIA) scheme in Odisha. One problem with the Telangana model is that it does not cover tenants, who are the actual cultivators. These are income-support schemes, which will be in operation year after year.

Pricing is one part of the story while delivery is the more important angle that needs radical change in farm products' marketing scenario. Mandi system is opaque and market prices are normally higher than MSP, and procurement, storage, and disposal being weak, lead to price intervention. To begin with, it would be necessary to create structures where the Government (Central or State) gets involved with procurement of crops. Therefore, organisations for procurement must be identified to have collection centres across all the markets. Ideally, they should be located at all mandis where the crops are sold. Second, procurement would require some grading and assaying to ensure that sale takes place to the government. For rice and wheat, the manual inspection system has been established; the same must be developed for other crops too. Third, the government should be able to have warehouses ready to store the produce as even today the handling of rice and wheat stocks face several challenges. Fourth, once procured, disposal becomes important. In the case of rice and wheat, there is direct linkage with PDS and buffer stock, and hence a system has been established.

The move to increase the minimum support price (MSP) is a game changer and its success in Uttar Pradesh is a matter of intense debate (Mishra, 2018). Reason put forth is that barring paddy, the other crop that the U.P. government purchases on a large scale is wheat, which is

a rabi crop, and recently a policy is being framed to incorporate crops like pulses and grams in the list. According to U.P.'s agriculture minister, a beginning has been made in the state and soon changes in the policy will be made. Increased MSP would encourage farmers to venture into newer field of production, but apprehension prevails about its procurement by the government. Moreover, many economists have suggested the government to back its measures with few institutional and technical reforms by venturing into non-price interventions on irrigation, infrastructure and reforms in APMC market. Which path the government would venture into, keeping the agony of farmer's distress, would be something to be watched.

### **(iii) Crop Production**

Uttar Pradesh is the largest food grain producing state of the country contributing about 17 per cent of the total food grains of the country. It is the highest producer of wheat and third highest producer of rice (Table 2). U.P is the second largest sugarcane producer of India after Maharashtra. For wheat, rice and sugarcane, the share of Uttar Pradesh varies from 31.98 per cent, 13.27 per cent and 46.9 per cent of the country's production.

Agriculture output growth in U.P. has always been lower than the all-India average since 1980s (Tripathi, 2017), even though it has a strong agriculture base. It is the largest producer and ranks first in the production of sugarcane (177.06 million tonnes), wheat (31.98 million tonnes) and even rice (13.27 million tonnes) (Table 3). The State is the contributor of 17.99 per cent of foodgrains to the nation's kitty.

The State, with a production of 557 lakh MT of food grains during 2016–17, accounted for about 17.9 per cent of the country's production. The major crops grown are wheat (349.7 lakh MT), paddy (143.9 lakh MT), pulses (24 lakh MT) and oilseeds (10 lakh MT). The production of sugarcane was 1569.48 lakh MT, accounting for 46.2 per cent of the country's total production during 2016–17. As per the budget document 2015–16 of the State, a target of 626.64 lakh MT of food grain production and 13.03 lakh MT of oilseeds production had been set for the year 2015–16 for the development of agriculture sector but the data shows that only 436.5 lakh MT of food grain, and 8.46 lakh MT of oilseeds were produced, thus pointing towards the fact that the target set fell short of the expectation. For the period from 2005–06 to 2016–17 the compound annual growth rate of production of rice was 2.17 per cent,

**Table 2: Three Largest Producing States of Major Crops during 2017-18**

Crops	States	Total Production) (Million Tons)	% Share to All India
Sugarcane	Uttar Pradesh	177.06	46.98
	Maharashtra	83.13	22.06
	Karnataka	28.26	7.5
Wheat	Uttar Pradesh	31.98	31.88
	Punjab	17.85	17.9
	West Bengal	14.97	13.26
	Madhya Pradesh	15.91	15.96
Rice	Uttar Pradesh	13.27	11.75
	Punjab	13.38	11.85
	West Bengal	14.97	13.26
Total Food grains	Uttar Pradesh	51.25	17.99
	Punjab	31.71	11.13
	Madhya Pradesh	33.45	11.74

Source: Pocket Book of Agricultural statistics-2018 (Table 5.3)pp.29.

**Table 3: Agricultural Production from 2005-06 to 2017-18 (in '000 tonnes)**

Years	Rice	Total Kharif Food Grain	Wheat	Total Rabi Food Grain	Total Food Grain	Oilseeds	Pulses	Sugarcane
2005-06	11133	13990	23574	25944	39934	788	2231	120960
2006-07	10912	13883	26027	28224	42107	754	2056	130992
2007-08	11780	14711	25679	27813	42524	841	2011	128736
2008-09	13097	16067	28554	30663	46730	859	1998	111033
2009-10	11794	14855	27777	29794	44649	808	1906	118957
2010-11	11992	15294	30001	31956	47250	903	1987	116877
2011-12	14022	17580	31892	34303	51883	935	2403	126110
2012-13	14416	18208	31332	33702	51910	1028	2332	134846
2013-14	14632	18209	30381	32079	50502	843	1501	141797
2014-15	13242	16651	20055	21268	38163	691	1248	145831
2015-16	12434	15614	26874	28036	43650	846	1112	145384
2016-17	14396	18025	34971	37455	55746	1029	2395	156948
CAGR (%)	2.17	2.15	1.28	0.97	1.47	1.15	-3.00	2.25

Source: Directorate of Agriculture, Government of Uttar Pradesh.

**Table 4: Crop Productivity in Uttar Pradesh (quintals/ha)**

Crop	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	19.96	18.7	20.57	21.77	20.96	21.22	23.58	24.54	18.96	22.67	21.30	24.13	26.18
Total Kharif Food grain	46.18	46.64	47.78	45.89	45.44	45.86	45.92	45.82	21.99	20.39	19.05	21.38	23.22
Wheat	25.86	27.72	27.99	29.97	28.54	31.11	32.83	32.17	31.1	20.37	27.86	35.38	36.55
Total Rabi Food grain	50.41	49.78	48.57	50.52	51.05	50.64	50.30	50.39	27.48	18.14	25.64	25.73	33.06
Total Food grain	20.24	21.05	21.88	23.63	22.36	23.91	25.84	25.98	25.11	19.01	22.81	27.25	28.82
Oilseeds	9.34	7.70	7.54	8.87	7.24	8.36	8.37	9.17	7.32	6.13	6.54	9.35	10.54
Pulses	12.13	9.79	8.62	9.86	9.73	10.12	11.82	10.53	7.36	5.31	5.91	9.55	9.73

Source: District wise Development Indicators, GOUP.

but for wheat and oilseeds it was 1.28 per cent and 1.15 per cent respectively, and this affected the overall growth rate of production of food grains, which was 1.47 per cent during this period. The growth rate of production of pulses was (-)0.00 per cent and for cash crops like sugarcane it was 2.25 per cent respectively.

Even with respect to crop productivity, it is apparent from data in the Table 4 that there is virtual stagnation with the highest yield of paddy being reached to 24.54 in 2012-13 and then declined highlighting the crisis laden situation in the agriculture sector as productivity declined to 18.96 per cent in 2013-14 but rose to an all-time high productivity of 26.18 in 2017-18. The productivity of wheat was 25.86 in 2005-06, increased to 32.83 in 2011-12, only to fall once again in 2012-13 further to all-time low in 2014-15, but then increased to 36.55 in 2017-18. In case of some crops, like rice, the growth in acreage was substantial. Growth in acreage under total kharif food grains, total rabi foodgrains, and pulses all followed a downward trend (Table 6).

#### (iv) Changing Land Use Pattern

The State under its land use has a net sown area of 68.64 per cent; among the rest, 12.58 per cent is under land put to non-agricultural use, 6.83 per cent under forest, 1.70 per cent under cultivable wasteland, 4.72 per cent under current fallow, 1.28 per cent under miscellaneous category during 2014-15. This relatively large per centage of land is put to non-agricultural use and shows a continuous increase. Almost the current fallow category has magnetic characteristics as we find that land put under this category

has increased from just 0.53 per cent in 1960-61 to highest level of 5.03 per cent in 2010-11 but declined there after (Table 5).

In 2014-15, net area sown was 165.96 lakh hectares, while it was 168.12 lakh hectares in 2001-02, so during the period from 2001-02 to 2014-15 net area sown decreased by 1.6 per cent. The decline in forest cover hinges on environmental degradation condition, which ultimately affects rainfall condition resulting in drought like situation. Huge amount of land put to non-agricultural usage also result in deepening crisis.

#### (v) Increasing Marginalisation

The main reason for agrarian crises is the rising pressure of population on farming and land assets, which relates to the shrinking size of farms, which is also responsible for low incomes and farmers' distress. Several academicians have pointed out that the major factor in the deepening agrarian crisis in the State has been the continuous decline in the size of holdings and growing marginalization (Reddy and Mishra, 2009; Singh, 2012). Over the period 1971-72 to 2012-13, the proportion of marginal holdings went up (from 73.1 per cent to 83.52 per cent); the proportion of medium and large holdings declined (from 3.46 per cent to 0.99 per cent), the per centage of operated area by marginal farmers increased markedly (from 20.23 per cent to 42.61 per cent) and area under smallholdings increased significantly (from 21.84 per cent to 24.07 per cent) at the state level. On the other hand, there was a sharp decline in the area operated by medium holdings (from 22.97 per cent in 1971-72 to 12 per cent in 2012-13) and large

Table 5: Land Utilisation in Uttar Pradesh (Lakh Hectares)

Category	1960–61	1970–71	1980–81	1990–91	2000–01	2010–11	2013–14	2014–15
Forest	37.1 (12.62)	49.5 (16.62)	51.3 (17.25)	51.6 (17.33)	16.9 (6.81)	16.6 (6.86)	16.6 (6.86)	16.5 (6.83)
Barren and Uncultivable land	25.7 (8.76)	14.2 (4.76)	11.4 (3.84)	10.3 (3.47)	6.2 (2.49)	4.9 (2.01)	4.8 (1.98)	4.6 (1.90)
Land put for non-Agricultural Use	19.3 (6.57)	20.3 (6.82)	22.8 (7.67)	24.5 (8.21)	25.4 (10.25)	28.4 (11.73)	28.9 (11.97)	30.4 (12.58)
Permanent pastures	0.5 (0.16)	0.8 (0.26)	3.0 (0.99)	3.0 (1.02)	0.7 (0.28)	0.7 (0.27)	0.7 (0.27)	0.6 (0.25)
Land Under Misc	8.5 (2.91)	10.6 (3.56)	6.4 (2.15)	5.5 (1.83)	3.4 (1.37)	3.5 (1.46)	3.5 (1.45)	3.1 (1.28)
Cultivable Waste	16.1 (5.46)	13.4 (4.51)	11.5 (3.86)	10.3 (3.47)	5.3 (2.16)	4.3 (1.76)	4.2 (1.75)	4.1 (1.70)
Current Fallow	1.5 (0.53)	8.7 (2.92)	11.7 (3.93)	10.8 (3.64)	10.5 (4.22)	12.1 (5.03)	12.0 (4.97)	11.4 (4.72)
Other Fallow	12.1 (4.13)	5.4 (1.83)	7.2 (2.41)	8.8 (2.97)	6.4 (2.59)	5.4 (2.23)	5.4 (2.22)	5.1 (2.11)
Net sown area	172.9 (58.81)	173.0 (58.06)	172.2 (57.91)	173.0 (58.06)	168.3 (67.84)	165.9 (68.65)	165.6 (68.53)	165.9 (68.64)
Total Geographical area	294.0 (100.00)	298.1 (100.00)	297.4 (100.00)	297.9 (100.00)	248.0 (100.00)	241.7 (100.00)	241.7 (100.00)	241.7 (100.00)

Source: Statistical Abstract U.P. 2014.

holdings (from 9.75 per cent to 0.78 per cent). Thus, marginal and smallholdings accounted for 91.8 per cent of the operated holdings in 2012–13, and this predominance of small operational holdings is a major limitation to reaping the benefits of economies of scale. Since marginal and small farmers have little marketable surplus, they are left with low bargaining power and no say over prices, thus pointing towards the issue of viability is a major challenge.

Research studied have suggested that small farmers are efficient in production, but productivity fluctuations resulting in loss of production and returns to agriculture are the major source of distress among the small farmers who are unable to manage agricultural risks when they exceed the self-resilient limit (Barah, 2011). The farmer usually manage the risks, first with their own means, but once the self-adjustment mechanisms are exhausted, crisis becomes inevitable. On the one hand, decline in net returns to farming and on the other hand escalating cost of production at a rate faster than the value of output affected the rural livelihood, which deepened the distress.

#### **(vi) Increasing Stress on Irrigation Potential**

Yet another serious problem is the unequal availability of irrigation across the state and increasing stress on

available irrigation resources. Agriculture in the state is supported by three major sources of irrigation, namely, canals (major irrigation), tanks (minor irrigation) and tube wells and other (ground water irrigation). It is well known that Uttar Pradesh is not in an enviable position in the matter of irrigation resources. The irrigated area under different sources is provided in Figure 2. A perusal of the trends in irrigation in 2014–15 conveys us three things: first, that 86.25 per cent of irrigation comes from tanks and tube-wells, while 18.29 per cent irrigation is provided by government canals. Thus, the major portion of irrigation comes from a source, which is highly dependent on rainfall. Secondly, the addition to surface irrigation through canals has been modest in the last decade. Thirdly, there is fall in tank irrigation and a steep rise in well irrigation with the arrival of submersible pump set, and vigorous implementation of rural electrification schemes in the State.

#### **(vii) Declining Profitability vis-à-vis Net Income in Agriculture**

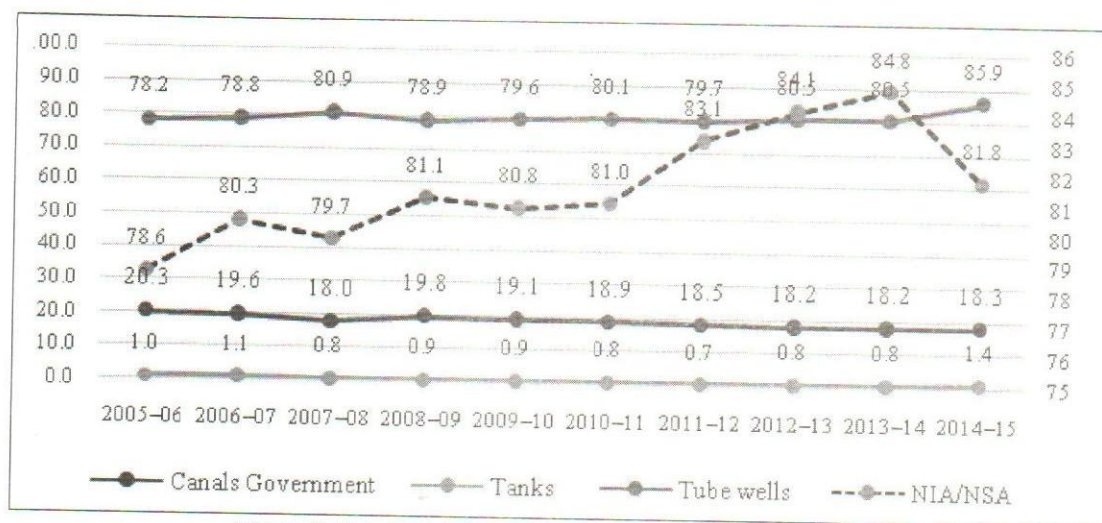
The most important manifestations of the crisis are deceleration of agricultural growth combined with increasing inefficiency in input use, thereby adversely

**Table 6: Trends in Distribution of Land Holding by Size in Uttar Pradesh**

Year	Marginal	Small	Semi-Medium	Medium	Large	All
						Percentage of Households
1971-72	73.13	11.39	6.75	3.00	0.46	100.00
	(11433)	(1781)	(1055)	(469)	(72)	(15634)
1982	81.85	10.89	4.95	2.16	0.16	100.00
	(14580)	(1940)	(882)	(385)	(29)	(17813)
1992	87.13	8.01	3.81	0.92	1.11	100.00
	(17490)	(1608)	(765)	(185)	(223)	(20074)
2003	81.00	12.30	4.80	1.60	0.10	100.00
	(17551)	(2665)	(1040)	(347)	(22)	(21668)
2013	83.52	8.36	3.81	0.96	0.03	100.00
	(16098)	(1611)	(734)	(185)	(6)	(19274)
Percentage of Area Owned						
1971-72	20.23	21.84	25.21	22.97	9.75	100.00
	(3673)	(3965)	(4577)	(4170)	(1770)	(18156)
1982	23.57	27.24	23.53	20.94	4.71	100.00
	(4236)	(4895)	(4229)	(3763)	(846)	(17971)
1992	33.28	26.24	24.15	12.15	4.18	100.00
	(5986)	(4720)	(4344)	(2185)	(752)	(17986)
2003	34.89	27.38	20.74	14.65	2.34	100.00
	(6274)	(4924)	(3730)	(2635)	(421)	(17983)
2013	42.61	24.07	20.37	12.16	0.78	100.00
	(5274)	(2979)	(2521)	(1505)	(97)	(12377)

Source: Some Aspects of Operational Land Holdings in India, Various rounds. NSS Report No. 571: Household Ownership and Operational Holdings in India, Table 31, Appendix A.

Note: Data in parenthesis reports absolute data. (Number of Operational Holdings are in '000, and Area Owned in '000 hectares)



**Figure 2: Net Area Irrigated by Different Source in Uttar Pradesh**

affecting the profitability of agricultural production (GOI, 2007). Knowing that the cost of inputs has increased faster than the output prices, the capital investments have reached a high intensity where the cost of capital replacement has increased manifold and the drag on natural resources is beyond limits, adding another drag on farmer incomes (Singh, 2009). It is quite interesting to highlight the recent changes in trends in the overall profitability, which the farming community faces at the helm of tough competition in the market economy. The profitability is calculated in terms of value of output per rupee of input. This has been carried out for 2005–06 to the recent available data for wheat and paddy, the most

important crops of the state. It is pertinent to raise the issue of profitability amongst the farming community, as they are the one braving the onslaught of agrarian crisis that pervades the state economy. There was only a marginal increase in profitability of wheat cultivation i.e. only 0.69 per cent over the years 2005–06 to 2015–16, this ratio increased from 0.91 in 2005–06 to 1.02 in 2013–14 but then declined to 0.85 in 2015–16 (Table 7). Increase in profitability in terms of operational cost was a bit higher i.e. 1.72 per cent in 2013–14 but then declined to 1.16 and 1.41 per cent in the next two years i.e. 2014–15 and 2015–16 respectively.

**Table 7: Trends in Profitability of Wheat in U.P.**

Year	Value of Main Product Hac. (Rs.)	Cost of Cultivation (Rs./Ha)		Profit		Operational Cost Rs./Ha	Ratio	
		Total Cost (C2) Rs./Ha	(C3) Rs./Ha	VOP-C2	VOP-C3		Profitability Ratios VO P/TC	Profitability Ratios VO P/OC
2005–06	20703.17	23104.73	23104.73	-2401.56	-4712.03	14228.46	0.90	1.46
2006–07	27706.91	25115.06	25115.06	2591.85	80.34	15640.67	1.10	1.77
2007–08	33278.12	25863.87	25863.87	7414.25	4827.86	16600.12	1.29	2.00
2008–09	35095.75	32439.37	32439.37	2656.38	-587.56	18315.86	1.08	1.92
2009–10	34348.58	33964.45	33964.45	384.13	-3012.32	19642.09	1.01	1.75
2010–11	39529.38	36650.74	36650.74	2878.64	-786.43	21287.69	1.08	1.86
2011–12	42843.28	43113.10	43113.10	-269.82	-4581.13	24770.01	0.99	1.73
2012–13	44596.63	44383.07	44383.07	213.56	-4224.75	26527.78	1.00	1.68
2013–14	47411.77	46415.97	46415.97	995.8	-3645.80	27501.27	1.02	1.72
2014–15	35426.16	51634.20	51634.20	-16208.04	-21371.46	30543.85	0.69	1.16
2015–16	47768.58	56205.93	**	-8437.35	47768.58	33763.37	0.85	1.41
<b>CAGR (%)</b>	<b>6.50</b>	<b>9.46</b>				<b>9.01</b>	<b>0.69</b>	<b>0.72</b>

Source: Ministry of Agriculture, Govt. of India.

Trends in net returns can be compared with trends in production, which is shown in Figures 3 and 4. Now turning to cultivation of paddy we find that here too profitability has registered a negative trend to the tune of (-) 2.06 per cent (VOP/OC) and a marginal increase when we take into account VOP in terms of total input costs (-) 1.55 per cent. The increase in profitability requires same amount of increase in volume of business to keep the present level of income stagnant, to keep up with the hard times ahead. But just in case the business does not do well it means a strain on the farmer's income to keep pace with the cost of living and falling into the virulent crisis. Rising costs are seen to squeeze the farmer's

margins from Rs. (-)1475.2 per hectare in 2005–06 to a rise in margin of Rs.-13536.67 per hectare in 2013–14, but further negative margins in subsequent years i.e. -12131.92 and -15572.70 for 2014–15 and 2015–16 respectively. We could see that the net margins are negative, showing losses to the farmers in cultivation of paddy in Uttar Pradesh (Table 8).

The reduction in net margins in cultivation of wheat and paddy shows that the plight of farmers has increased due to losses incurred by them with increase in input costs and reduced output prices/or bad crops—thus leading to a mounting crisis on the agrarian front in the state of U.P.

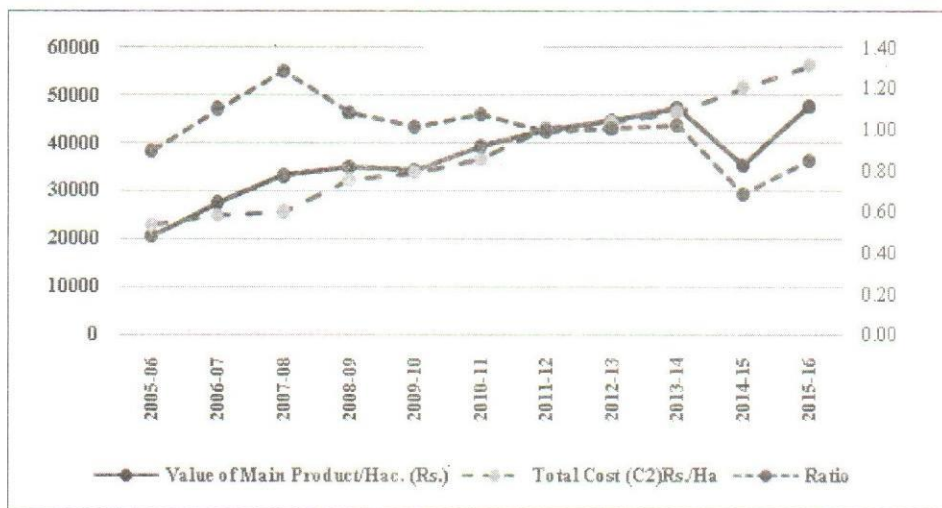


Figure 3: Profitability in Wheat Cultivation in Uttar Pradesh

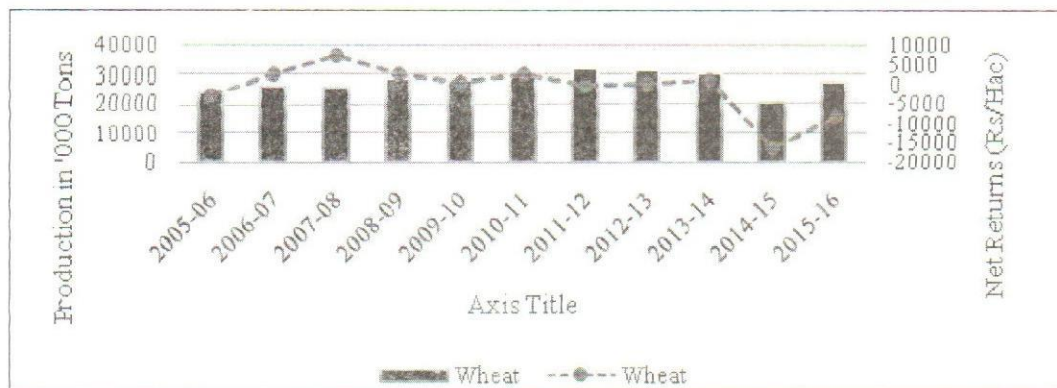


Figure 4: Trends in Net Returns Vs Trends in Wheat Production in Uttar Pradesh

Table 8: Trends in Profitability of Paddy in U.P.

Year	Value of Main Product Hac. (Rs.)	Cost of Cultivation (Rs./Ha)		Profit		Operational Cost Rs./Ha	Ratio	
		Total Cost (C2) Rs./Ha	(C3) Rs./Ha	VOP-C2	VOP-C3		Profitability Ratios VO P/TC	Profitability Ratios VO P/OC
2005-06	19385.75	20860.95	22947.05	-1475.2	-3561.30	13319.99	0.93	1.46
2006-07	19278.83	20338.4	22372.24	-1059.57	-3093.41	13719.84	0.95	1.41
2007-08	26109.68	22301.17	24531.29	3808.51	1578.39	15086.71	1.17	1.73
2008-09	33728.05	30004.2	33004.62	3723.85	723.43	16460.18	1.12	2.05
2009-10	36978.26	33297.59	36627.35	3680.67	350.91	20898.49	1.11	1.77
2010-11	36459.18	32299.35	35529.29	4159.83	929.90	20808.28	1.13	1.75
2011-12	39065.35	40299.68	44329.65	-1234.33	-5264.30	27054.58	0.97	1.44
2012-13	48464.6	43620.87	47982.96	4843.73	481.64	28532.37	1.11	1.70
2013-14	59154.1	45617.43	50179.17	13536.67	8974.93	29915.39	1.30	1.98
2014-15	46850.41	58982.33	64880.56	-12131.92	-18030.15	39481.03	0.79	1.19
2015-16	43843.74	59416.44	**	-15572.70	43843.74	40095.90	0.74	1.09
<b>CAGR (%)</b>	<b>10.38</b>	<b>12.11</b>				<b>12.70</b>	<b>-1.55</b>	<b>-2.06</b>

Source: Ministry of Agriculture, Govt. of India.



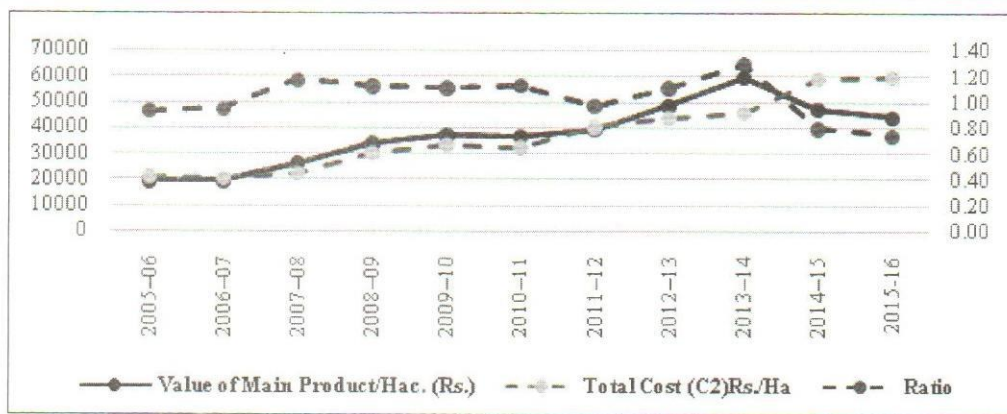


Figure 5: Profitability in Paddy Cultivation in Uttar Pradesh

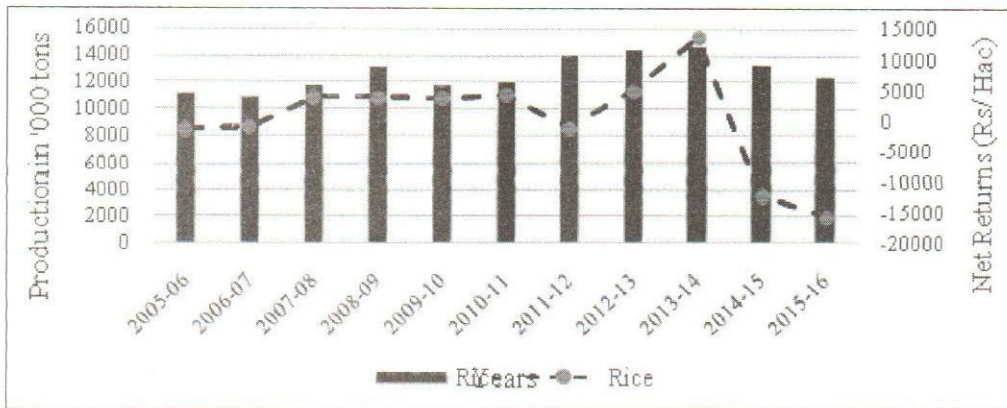


Figure 6: Trends in Net Returns Vs Trends in Paddy Production in Uttar Pradesh

(see Figures 5 and 6). These declining margins in crop production/bad crop due to drought shows an erupting agrarian crisis that had perhaps led to deaths in Bundelkhand region, which has been taken cognizance of by the National Human Rights Commission.

### III. Farmers Plight due to Indebtedness

The NSSO survey collected information on various aspects of farming such as farming practices and preferences, availability of resources, awareness of technological developments and access to modern technology in the field of agriculture, and level of living—measured in terms of household consumer expenditure income and indebtedness from the agricultural households—in rural areas. As farmers have been demanding “freedom from debt and remunerative prices” through several platforms, they carry on fighting risks in production, weather and disaster, price, credit, market and those in policy (Vasudeva, 2017). It is understood that the production of crops is always uncertain because of pests, shortage of inputs like seeds and irrigation, which could result in low

productivity and declining yield—lower than the remunerative price in the absence of marketing infrastructure and profiteering by intermediaries—all these add to the financial distress of farmers. Also, the predominance of informal sources of credit, mainly through moneylenders, and lack of capital for short-term and long-term loans have resulted in the absence of stable incomes and profits.

Further, it leads to defaults and indebtedness. Uncertainty in policies such as those of the Agricultural Produce Market Committee (APMC Act), besides low irrigation coverage, droughts, flooding and unseasonal rains, are some other factors that hit farmers hard. Providing farmer access to institutional credit has been the main rural policy goal as usury has been the major issue leading to serious and perpetual indebtedness of farmers (Satyasai, 2015). Credit is considered one of the most basic inputs for conducting agricultural development in any agrarian economy. Recognising the importance of credit in agricultural development, the Government of India passed several important Acts, namely, the Land

**Table 9: Farmer Households, Uttar Pradesh, 2012–13: Average Monthly Income from Different Sources for each size class of land possessed (ha)**

Land Size Class in Ha	Income from wages/ Salary (Rs.)	Net Receipt from Cultivation	Net Receipt from farming of animals	Net Receipt from Non-Farm Business
Landless (<=0.01)	2358	-7	513	819
Marginal (0.01–0.400)	1143	851	377	354
Small (0.41–1.00)	1067	2860	416	262
Semi-Medium (1.01–2.000)	992	5892	976	542
Medium (2.01–4.00)	1025	12591	1711	533
4.01–10.00	1219	19564	1743	439
Large (>10.00)	5231	56014	19	341
All Sizes	1150	2855	543	376

Source: Some Aspects of Operational Land Holdings in India, NSS 70<sup>th</sup> Round.

**Table 10: Income, Expenditure, Net Investment in Productive Assets in UP**

Land Size Class in Ha	Total Income (Rs.)	Total Consumption	Net Investment in Productive Assets (Rs.)	Estimated No. of Agricultural Households
Landless (<=0.01)	3683	5137	93	7012
Marginal (0.01–0.400)	2724	4911	36	87536
Small (0.41–1.00)	4605	6976	406	53974
Semi-Medium (1.01–2.000)	8402	7684	140	21012
Medium (2.01–4.00)	15861	10525	-3141	8446
4.01–10.00	22964	12233	2254	2309
Large (>10.00)	61605	17417	26315	199
All Sizes	4923	6230	70	180489

Source: Some Aspects of Operational Land Holdings in India, NSS 70<sup>th</sup> Round.

Improvement Act (1871), the Land Improvement Loans Act (1833), the Agriculturists' Loans Act (1884) and so on and so forth (Dandekar and Wadia, 1989). To protect farmers from the clutches of exploitative moneylenders, the cooperative movement was started in India through the passage of the Cooperative Credit Societies Act, 1904 that received a boost following the recommendations of the Maclagan Committee (1915). Finally, the Reserve Bank of India, with a separate agricultural credit department, was established in 1935 that recognized the importance of institutional credit for agricultural development.

Recent policy changes and the agricultural development strategies have led to a visible revolution in the formal lending to the farm sector. Commercial bank lending were raised with its nationalization taking place, priority sector lending was mandated and monitored, regional rural banks were established with the objective of reaching to the farming community, NABARD was constituted with wide networking of banking sector to net all the rural sector. But to our surprise, the precarious condition of the farming communities remain.

Table 11: Average monthly income from all sources and consumption per farmer households 2002–03 & 2012–13 in Uttar Pradesh.

Size Class of Land Possessed	U.P. (Rs.)				India (Rs.)			
	2002–03		2012–13		2002–03		2012–13	
	Income	Consumption	Income	Consumption	Income	Consumption	Income	Consumption
<0.01	1150	2235	3683	5137	1380	2297	4561	5108
0.01–0.040	1148	2354	2724	4911	1663	2390	4152	5401
0.40–1.00	1278	2831	4605	6976	1809	2672	5247	6020
1.01–2.00	2428	3728	8402	7684	2493	3148	7348	6457
2.01–4.00	3978	4948	15861	10525	3589	3685	10730	7786
4.01–10.00	7974	6732	22964	12233	5681	4626	19637	10104
10.00+	7850	6776	61605	17417	9667	6418	41388	14447
All Sizes	1633	2899	4923	6230	2115	2770	6426	6223

Source: Bhalla, 2006 & NSSO 569 Report 2012–13.

**“Peasantry in fetters and Peasant households in deficit”** is the hallmark of agrarian economy of Uttar Pradesh too. Even as we note the positive effect of earlier spells of increased public expenditure, we also need to note certain underlying negative features of U.P.’s agrarian scene, which appear resilient even to periodic bouts of higher growth. Data from the 70<sup>th</sup> Round of the National Sample Survey (2012–13) show that the average farmer household income from all sources was Rs 4,923 per month, of which Rs 1,150 came from wages, and Rs 376 from non-farm business; the rest came from cultivation and farming of animals. For almost 82.3 per cent of farmer households, total income from all sources was less than consumption expenditure thus pointing towards the deplorable condition of their existence (Table 9).

Table 10 shows that farm income alone (from cultivation and farming of animals) was less than consumption expenditure in the case of 93 per cent of farmer households. On the other hand, households with 4–10 hectares had an income of Rs 22,964 per month, and households with more than 10 hectares had an income of Rs 61,605 per month. These households had sizeable savings after incurring consumption expenditure.

Table 11 highlights a comparative picture of income of farmer households from all sources and their consumption by size class of holdings in Uttar Pradesh during 2002–03 and 2012–13. At the State level, the average consumption expenditure per farmer household

was Rs. 2899 per month, which was significantly higher than the average income of Rs. 1633 p.m. indicating that on an average the farmer households are running into deficit situation. One more thing that emerges is that, there was a rapid rise in average consumption expenditure as one moves from lowest class ‘< 0.01 hac’ to the class ‘4 – 10hac’ and the average consumption expenditure was seen to increase three times in U.P. In land size between 4 and 10 hac, surplus could be observed in income over consumption. This situation of more consumption expenditure over the earnings might lead to the farmer households to take refuge into cash loans.

The data released by NSSO also provides useful insight that in U.P., out of 17.16 million farmer households, 6.92 million (40.3 per cent) were reported to be indebted while for the country as a whole, 48.6 per cent (43.42 million) of 89.35 million farmer households were reported to be indebted (Table 12). In U.P., households with one hectare or less land accounted for 74 per cent of all farmer households and about 39 per cent of them were indebted. It is obvious that due to the change in coverage and differences in concepts and definitions followed in the two rounds, the results are not strictly comparable, yet the data can provide a feel of the direction of change (Table 12).

As per the latest survey reports in 2012, about 43.8 per cent of agricultural households were indebted as compared to 40.3 per cent in 2002 (see Figure 7). Between

**Table12: Estimated Number of Rural Households and Indebted Farmer Households in Uttar Pradesh**

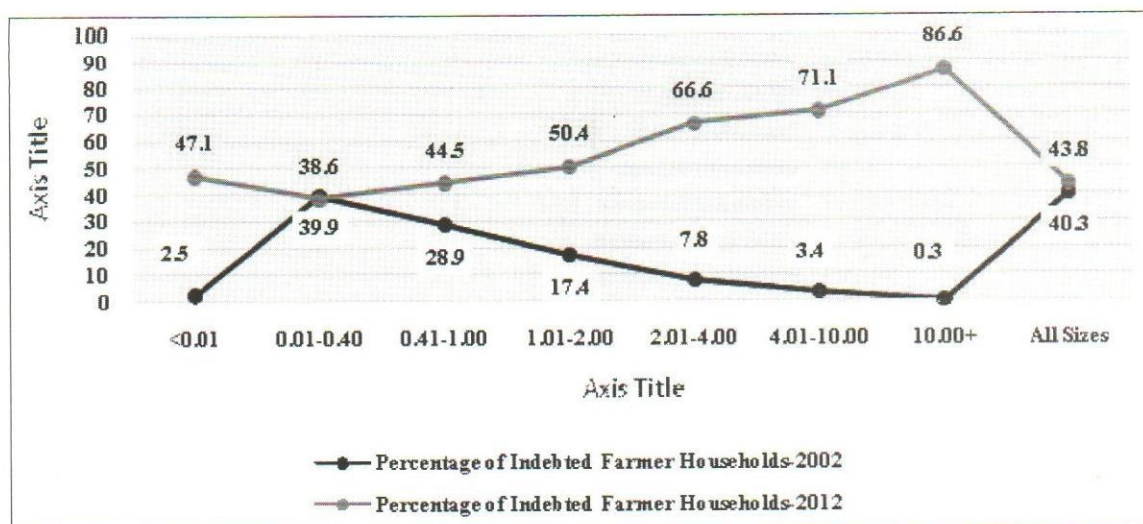
States/UTs	Estimated Number of Rural Households ('00)	Estimated Number of Farmer Households ('00)	Estimated Number of Indebted Farmer Households ('00)	Percentage of Farmer Households Indebted
<b>Uttar Pradesh</b> (2002-03)	2214199	171575	69199	40.3
(2012-13)	241328	180486	79081	43.8
<b>India</b> (2002-03)	1478988	893504	434242	48.6
(2012-13)	1561442	902011	468481	51.9

Source: Lok Unstarred Question No. 1217, dated 01.08.2005& NSSO, 569 Report, 2012-13.

**Table13: Percentage Distribution on Average amount of Loan (RS.) Taken by Farmer Households by Source and farm size**

Sources	<0.01		0.01-0.040		0.40-1.00		1.01-2.00		2.01-4.00		4.01-10.00	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
<b>Institutional</b>	20.2	17.1	29.8	29.0	56.7	63.9	68.5	72.7	79.8	92.9	88.5	91.7
<b>Government</b>	0.4	0.4	3.3	2.5	1.8	3.3	3.9	1.4	2.6	2.9	0.1	0.7
<b>Co-op. Society</b>	0.6	0.3	1.9	1.7	6.9	5.4	8	4.2	11.3	7.9	8.6	2.1
<b>Bank</b>	19.2	16.4	24.6	24.8	48	55.2	56.6	67.1	65.9	82.1	79.8	88.9
<b>Non-Institutional</b>	79.90	82.50	70.20	70.60	43.40	35.40	31.40	27.30	20.20	7.00	11.50	8.10
<b>Agri./Professional Money Lender</b>	42.8	51.5	34.3	46.7	22.7	19.6	14.3	10.8	10.3	3.2	1.5	3.6
<b>Trader</b>	1.7	1	3.6	2	4.7	1	2.4	0.9	1.4	0.3	0.9	0
<b>Relatives &amp; Friends</b>	33.5	23.6	24.3	20.1	13.4	13.9	12.8	5.6	6.6	3.3	4.3	4.3
<b>Others</b>	1.9	64	8	18	2.6	9	1.9	100	1.9	2	4.8	20
<b>All</b>	100	100	100	100	100	100	100	100	100	100	100	100

Source: NSSO, 70<sup>th</sup> Round, report no.569, and NSSO 59<sup>th</sup> Round, report no. 498.



**Figure 7: Proportion of Indebted Agricultural Households within each farm Size in Uttar Pradesh**

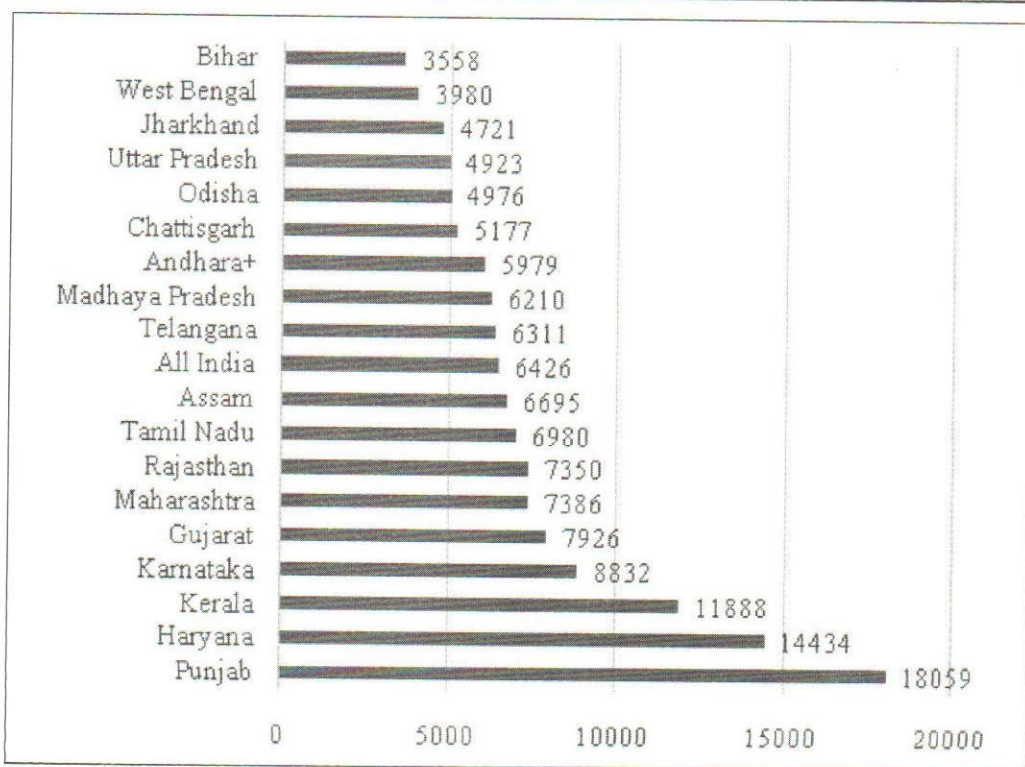


Figure A: Average Monthly Income (in Rs) of Agricultural Households during 2012-13 for Major States

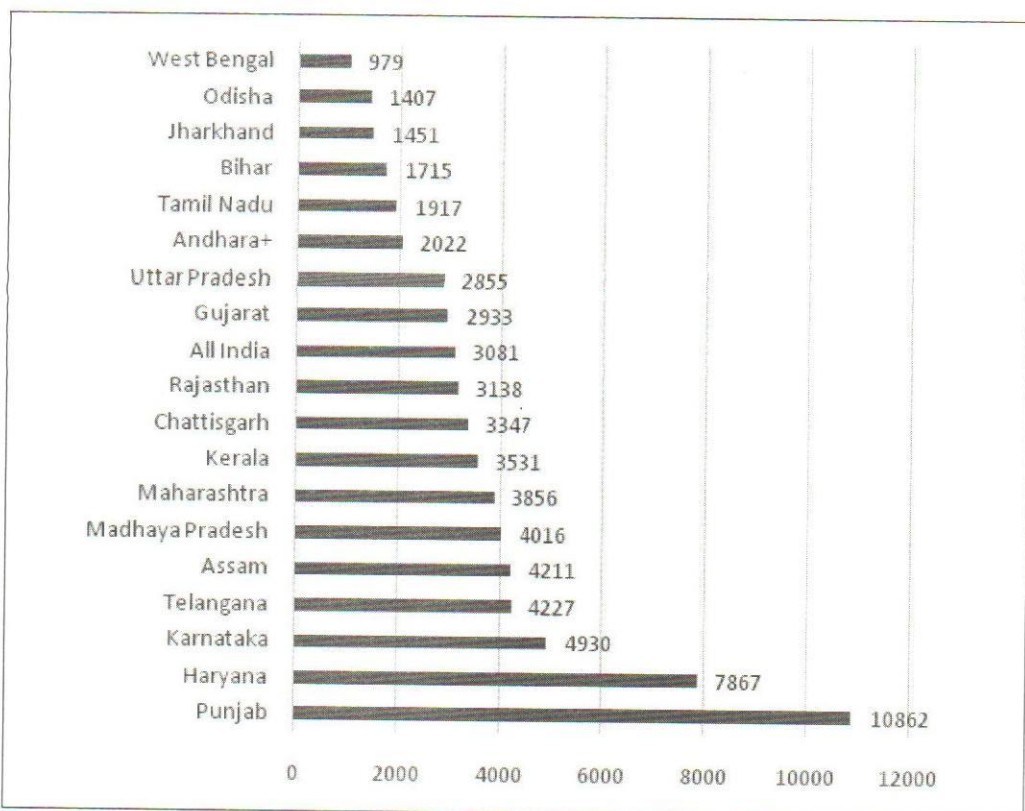


Figure B: Average Monthly Net Income (in Rs) from Cultivation of Agricultural Household during 2012-13 for Major States

these years we find that most of policy and institutional interventions had taken shape in terms of doubling the credit facilities to the agricultural sector, loan waivers, banking facilities being extended, financial literacy being included and recapitalizing the cooperatives and regional rural banking services and so on. The issue that needs attention is that the proportion of households who borrow increased as one moves up the ladder from small holding size to large holdings.

#### **IV. Institutional Credit – A Remedy for Indebtedness**

As we know that about 90 per cent farmers in the state are small and marginal farmers, and it is understood that their outreach to credit institutions whether commercial banks or cooperative institutions, is very low. Out of two crore farmers in the state, the actual coverage of farmers would be less than 20 per cent. Direct credit to farmers provided in the state by institutional setup in the last four years has been indicated in Table 13. Successive All India Debt and Investment Surveys showed that the proportion of institutional credit facilitators in the total debts of agricultural households have increased over time thus becoming a feather in the policy formulators' cap. The 2012 survey shows that the share of institutional credit increased to 61.5 per cent from 60.3 per cent in 2002. The increase, though, is just a ray of hope that policies of agricultural sector if implemented in full swing will result in a positive note.

Data released by NSSO further reveals that cooperative societies, which used to play a key role in disbursement of agricultural credit and other agri-inputs, do not serve more than 6.7 per cent of farmer households in Uttar Pradesh in 2002–03 but declined to 4.3 per cent in 2012–13 (Table 13). Most of these households availed themselves of either credit facilities or services related to seeds or fertilizers.

#### **V. Conclusion**

It is found that agricultural growth in Uttar Pradesh has slowed down from 3.57 per cent in 2005–06 to a mere 0.97 per cent in 2015–16. This decline is due to slowdown in crop sector. Agricultural production also shows sharp fluctuations over the years.

The analysis shows that operational cost of paddy and wheat increased which led to decline in net income of farmers. There was only a marginal increase in profitability of wheat cultivation i.e. only 0.69 per cent over the years

2005–06 to 2015–16. This ratio increased from 0.90 in 2005–06 to 1.02 in 2013–14, but declined to 0.85 in 2015–16. Increase in profitability in terms of operational cost was a bit higher i.e. only 0.72 per cent over the same period. In case of paddy too, profitability has registered a decline to the tune of -2.06 per cent (VOP/OC) and a bit less when we take VOP in terms of total input costs (-1.55 per cent). The reduction in net margins in cultivation of wheat and paddy shows that the plight of farmers has increased due to losses incurred by them with increase in input costs and reduced output prices/ or bad crops – thus leading to mounting crisis on the agrarian front in the state of U.P. too.

Analysis reveals high levels of indebtedness in rural areas. Average outstanding loan per farmer household in Uttar Pradesh was Rs. 6706 as per NSS. The cooperative societies which used to play a key role in disbursement of agricultural credit and other agri-inputs, do not serve more than 13 per cent of farmer households in Uttar Pradesh. The outreach of credit institutions, whether commercial banks or cooperative institutions, is very low. Out of two crore farmers in the state, the actual coverage of farmers would be less than 20 per cent. However, in recent years, institutional credit to agriculture has sharply increased. Strengthening of these institutions, along with the conventional cooperatives, is essential for improving the institutional credit flow as well as better accessing of appropriate technology, extension services and improved marketing capability.

Comprehensive measures are required to address the numerous problems associated with agrarian crisis. In the short run, concrete measures have to be undertaken to make available timely and adequate institutional credit at reasonable rates of interest for undertaking productive expenditure, including basic consumption needs in the lean period, and to reduce the debt burden of vulnerable sections of peasantry. A suitable system of agricultural insurance to face growing risks, and relief and rehabilitation through programmes to meet the felt needs of farm households in diverse agro-economic conditions, besides remunerative price and market support. In the long-run, rejuvenation of the Indian agriculture lies in addressing basic structural, institutional and technological factors, as much as restructuring public support systems in the face of growing exposure to local and global market forces. In the context of rapid marginalisation of agricultural holdings, the focus of strategy for revival of agriculture should be on the small-farmer economy.

Land reforms, particularly tenancy reforms, with a view to reducing landlessness and to strengthening small cultivators, are still relevant. A time has come to encourage formation and institutionalisation of farmers' groups to enable small and marginal farmers to overcome their disabilities in accessing assured credit, appropriate technology, favourable market prices and insurance against growing risks. Small and marginal farmers must be organised in the form of collectives and self-help groups in order to respond effectively to the current agrarian crisis. Finally, there is no way that small and marginal farmer households can improve their living standards by depending solely on agricultural income by diversification into off-farm and non-farm activities, which should increasingly account for their household income. Hence, we can conclude by saying that the agricultural situation of the state is deteriorating and emphatically needs special attention from the government.

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