

JAM TRINITY: THE BACKBONE FOR BANKING THE UNBANKED

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Financial inclusion has been high on policy makers' agenda globally. The task becomes increasingly difficult due to the large population in countries like India. The triangle formed by Jan Dhan Bank Accounts- Aadhaar- Mobile, popularly known as the JAM Trinity is the basis of the current study. Based on state wise data, in the current research we create a financial inclusion index to examine the progress of a financial inclusion initiative by the government of India in multiple scenarios. The study employs Principal Component Analysis as the method to arrive at the results obtained. The results indicate all states have made significant improvement in increasing financial inclusion.

Key words: Financial Inclusion, Jan Dhan, Aadhaar, Mobile Telephony, JAM Trinity, India

JEL Codes: H43, H53, H54, H55, H75, I28

1. Introduction & Background

Financial inclusion is the access of financial services to all sections of society and has been at the forefront of international and economic debate in recent years. It is acknowledged as access to formal financial services, ranging from savings, payments, credit and insurance to services and resources for economically disadvantaged parts of society (RBI, 2015) without discrimination (Aduda & Kalunda, 2012) with the goal of benefiting the vulnerable majority (Demirguc-Kunt et al, 2008, Hanning & Jansen, 2010). This has also been described as an

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action technique aimed at addressing problems in the way the poor, underprivileged and marginalized parts of the population function (Aduda & Kalunda, 2012). Studies have found that financial exclusion is related to the slow growth and increased rates of poverty in a nation (Aduda & Kalunda, 2012, Sinclair et al, 2009). Despite the potential benefits provided by banking services, large part of the world's adult population had been left out of even the most basic structured financial services (Agarwal and Klapper 2013, Alberto et al., 2009; Demirguc-Kunt and Klapper 2012).

Global Findex showed that the proportion of adults without a formal financial account in developed countries is significantly higher (Demirguc-Kunt and Klapper, 2012, Agarwal and Klapper, 2013). From the Indian perspective, historically, a large proportion of the Indian population has been identified as poor and have needed support in the form of financial subsidies from the government. As per the Economic Survey (2018-19) more than 10% of the country's national expenditure has been spent on major subsidies for the poor over the past many years. Yet, financial inclusion has remained a challenge for many years. Most of the initiatives by Government of India over several years to address the issue did not yield the desired results (Chakrabarti & Goyal, 2017). Hurdles such as lack of an official proof of identity large poor population base, high corruption, manual processing, limited resources to setup the infrastructure needed for banking have been historically the reasons (Chandra 2012 & Yadav, 2014). At the same time, the income volatility in rural areas makes it unlikely that the banks will recover their fixed and operational costs (World Bank, 2003, Agarwal and Klapper, 2013) serving as a disincentive for banks to open branches in rural areas. The Economist (2012) noted that "Poverty has many causes, and no simple cure. But one massive problem in India is that few poor people can prove who they are." Things become more complicated when fake identity documents are issued which are utilised to siphon off benefits such as subsidies from the real beneficiaries (Yadav, 2014).

Two critical components were envisioned to achieve financial inclusion in India – one being mobile connectivity and two being savings account and both require an official proof of identification for participation (Chandra, 2012, Yadav, 2014). The Government of India's Unique Identity (UID) number program to give a proof of identity to India's 1.3 billion population, led to the creation an ecosystem for financial inclusion where this unique identity could be used for opening bank accounts and accessing mobile telephony based financial services (Yadav, 2014, UIDAI, 2012). The cost of providing micropayment banking services to the poor, who tend to transact in smaller amounts, was reduced by the combined use of the Unique Identity Number (Chandra, 2012) and use of newer mobile payment technology. The increasing mobile penetration and the complementing financial technologies such as e-money technology opened an additional delivery channel for basic financial services to people– a channel that is both convenient to use, accessible, affordable, flexible, and cost effective (Hanning and Jansen, 2010, Bhavnani et al. 2008). Innovative digital financial services bypasses the challenges posed by traditional financial services to push financial inclusion for the poor (Sharma and Chatterjee, 2017).

The push for the digital initiatives entailing the extensive use of technology to improve the state of implementation and governance of government responsibilities led to the

emergence of a scheme popularly known as the JAM Trinity specifically aimed to address the issue of financial inclusion. In the acronym JAM the ‘J’ stands for Jan Dhan¹ accounts, ‘A’ for Aadhaar² which is India’s Unique Identification System issuing official proof of identity to its residents and ‘M’ is for mobile. Using these three as its pillars a digital infrastructure was created enabling cashless movement of funds to and from the intended beneficiaries. While the JAM Trinity may not be the nirvana of all financial inclusion problems, it is being cited by many as a step in the right direction.

To measure financial inclusion various indices were created and executed to ascertain the level of financial inclusion within a state, region or a country. Honohan (2007), Sarma (2008), Sarma & Paes (2011) are a few of studies undertaken to examine the extent of financial inclusion across regions, or countries over the years. However, from the Indian context, while there are studies which explore the viability and achievement of the JAM Trinity, there are hardly any studies done at the state level to understand the progress made them. The focus of the current paper is to understand the extent of coverage and the success of JAM Trinity, towards the building of an inclusive financial system. The current study aims at the creation of an index incorporating the three pillars of the JAM trinity, aimed at highlighting the Indian’s states achievements towards the progress made in the path of financial inclusion by arriving at a single number indicator. The layout of the current study, to achieve the tentative outcome, will be divided into the following sections: (i) introduction & background; (ii) literature review- existing studies & indices on financial and existing studies on JAM Trinity; (iii) contribution and relevance of the study; (iv) research methodology; (v) result and analysis; and (vi) policy implications and conclusions.

2. Literature Review

The section on literature is sub-divided into two parts, with sub-section- (i) covering the existing studies and indices present and created on financial inclusion (Table 1); and (ii) existing studies in the JAM Trinity in India.

2.1 Existing Studies and Indices on Financial Inclusion

Sarma (2008)’s index is based on a measure of the distance from the ideal. The index was created using the methodology proposed by UNDP and the dimensions considered were based on data availability. It measures three aspects- banking penetration; availability of banking services; and usage of the banking system. By using the empirical scheme, the attempt in Sarma’s index is to measure financial inclusion with respect to a prevailing situation, making it a dynamic index. The index has some deficits, mainly due to lack of adequate and appropriate data. No weights have been assigned in Sarma’s index to the various dimensions.

¹. Jan Dhan – Jan is a hindi word which means that people and dhan is another hindi word meaning wealth/ money

² The hindi word ‘Aadhaar’ means foundation

Nathan et. al. (2008) suggests that the distance-based approach satisfies several interesting and intuitive properties of a development index, like- normalization, symmetry, anonymity, monotonicity, uniformity and signalling (NAMPUS). UNDP's HDI methodology satisfies only three of the NAMPUS's properties, while the distance-based methodology satisfies all the properties. The failure of the HDI methodology to satisfy all the properties is due to the so-called 'perfect substitutability' across dimensions under this methodology. While the UNDP methodology uses pre-fixed value for the minimum and maximum for each dimension to compute the dimensional index, his study used empirically observed minimum and maximum values for each dimension.

Kumar & Mishra (2009) analysed supply and demand side information to paint a comprehensive picture of financial inclusion in India. They looked at various indicators like- banking outreach & household level access. They employed an equal weighted average of the indicators separately and then created the final composite index which was the average of these indicators. Arora (2010) studied the extent of financial access in both developed and developing countries by following the methodology developed by UNDP for the creation of index on three dimensions- physical access; ease of transactions and cost of transaction. The weights assigned to each dimension were physical access was 2 and cost and ease of transaction were assigned 1 each. The rationale behind the assignment of weights was not explained.

Sarma & Pais (2011) attempted to examine the relationship between financial inclusion and development. The results showed that 11 out of 49 countries are high on the financial inclusion index, while 9 are medium on the IFI and the remaining are low IFI countries. Comparison of IFI with HDI shows that all the countries with high and medium IFI values belong to the group that is classified by UNDP as countries with high HDI ($HDI > 0.7$). IFI and HDI moved in the same direction. The correlation coefficient between IFI and HDI values and ranks are found to be statistically significant. Generally concluded that countries with high level of human development are also countries with a relatively high level of financial inclusion.

Gupte et al (2012) studied the determinants which measured the extent of financial inclusion and by creating a multi-dimensional variables specific to India. This index computes the extent of financial inclusion by considering the geometric mean of four critical dimensions – outreach (penetration and accessibility), usage, ease of transactions and cost of transactions, by following the methodology used by UNDP in computing the HDI. Equal weights were assigned to all the four dimensions. Chitra & Selvam (2013) employed a multi-dimensional approach similar to the one used by UNDP for the computation of HDI, HPI and GDI. Their analysis revealed that among the socio- economic factors- income, literacy and population had significant association with financial inclusion. While on the other hand, the deposit and credit penetration were found to be significantly associated with financial inclusion. Ardhendu et al (2016) considered three dimensions for creating a financial inclusion index. The dimensions were- supply side, demand side and infrastructure. Factors of supply and demand side dimensions were categorized as banks, NBFCs and insurance companies. The weights assigned were 1, 0.5 & 0.5 respectively. The assignment of weight was judgmental and intuitive in nature. In the infrastructure dimension, the real

and human factors considered were- transport, irrigation, power, female literacy and health and all of them were assigned a unit weight. Goel & Sharma (2017) created an index to give a macro view of financial inclusion in India. The index was created using three dimensions, related to the levels of access and usage of financial services and methodology followed was similar to that HPI, HDI and GDI indices. The authors further state that assignment of weight to each of the index dimensions is important and for all the three dimensions of this index, equal weight of 1 was assigned.

Yorulmaz (2013) created a multidimensional index to measure the extent of financial inclusion in Turkey. The index was created on the lines proposed by Sarma (2008) which reduces the financial inclusion to a single index number. The index followed the methodology employed in the computation of HDI, GDI and HPI. Sethy (2016) created a financial inclusion index by adopting the UNDP's HDI, Human Poverty index and Gender Development Index, investigating financial inclusion by looking at two groups of indicators- demand side and supply side of an inclusive financial system. Demand side indicators considered were banking penetration, availability of banking services, usage of banking system and banking linkage. Supply side indicators such as access to savings, access to insurance, number of loans given to small entrepreneurs and banking utilization. BIS (2017) index considers both demand and supply side information to create a composite index measuring the extent of financial inclusion at a country level, by investigating the degree of usage of financial services, barriers and access to financial system. The index was created by employing a two-stage principal component analysis (PCA). The index allows estimation at a comprehensive measure of the degree of inclusion by assigning weights endogenously- equal weights assigned in this case.

2.2 Existing studies on JAM Trinity

JAM trinity, like any other piece of development technology, is neither ideal nor suboptimal, according to Masiero (2015), but can be used to varying degrees of success. On a similar vein, Agrawal (2016) studied and evaluated the role of information, communication, and technology in expanding financial outreach to the disadvantaged and unserved in society, revealing the Indian government's and Reserve Bank of India's efforts to create an efficient environment for technology companies and banking institutions to take use of the country's high mobile density to boost their market penetration and outreach. Das and Moitra (2017) also opine, ICT technological innovations such as smart cards, biometric identification, and mobile telephony have been instrumental in ensuring that financial and social benefits reach the intended audiences in a targeted and effective manner at the lowest possible cost to the government. The way forward is to enhance and develop these technologies, making them more user pleasant for the recipients, so that the benefits of social inclusion reach India's most remote citizens. Mathur *et al.* (2019) used a variety of ICT indicators to investigate the influence of information and communication technology on financial inclusion. According to the authors, the importance of total banking automation in the Indian banking sector is growing due to a mix of regulatory and competitive factors. The authors concluded that financial reforms had a moderately beneficial impact on lowering

banking sector concentration and boosting information technology performance.

Sabharwal (2016) investigated the influence of an individual's Aadhaar identification potential and estimated the socio-economic impact of combining Aadhaar with growth, welfare-oriented subsidies, and other factors. The author advises that making Aadhaar mandatory for all Indian citizens and linking it to most events and dealings from birth to death and within, integrating it with Digital India via JAM Trinity – Jan Dhan Yojna, Aadhaar, and Mobile base (include email ID and Digi-locker) could have a massive socio-economic impact. Ghosh (2017) employed simultaneous equation methodology to examine the interlinkage among PMJDY account, Aadhaar cards and mobile telephony. Exploiting household level survey data, the findings provided a strong evidence of complementarity among these variables, with each tending to reinforce the other. This complementarity is reflected primarily in respect to PMJDY and Aadhaar, but much less so about mobile telephony.

Samant et al. (2017) examined the work done under the Jan Dhan Yojana in the past years considering and draws a pattern of growth using secondary data. The study brings out the problems and provides suggestions to use this trinity strategically for attaining financial inclusion and transforming the lives of many people who have the hope that they can also play a pivotal role in nation building. Chetia (2018) evaluated the JAM in terms of its effects on increasing banking access and benefits. According to him, the JAM effort is a first step toward broader financial inclusion. First, the JAM initiative has shown to be a successful financial strategy, particularly for women, in rural areas where Self-Help Groups (SHGs) and Bank Correspondents may play an essential role in expanding the JAM triad and extending credit. Second, efficient execution of the JAM project in rural regions requires internet penetration and IT growth. So far, low electricity has been a main cause of rural India's connectivity problem. Training individuals to utilize the internet is necessary to increase digital literacy in the rural economy. Unskilled or semi-skilled workers, school dropouts, and self-employed people must be made aware of how digital literacy can assist them improve their economic status by helping them grow skills and knowledge.

Jain (2018) focuses on poverty alleviation programs in five-year plans, existing program effectiveness, and the JAM scheme. According to the author, determining a UBI level is one of the most difficult aspects of implementing cash transfers. It is not a one-time exercise; inflation in the economy tends to define its real value. The obstacles include spreading financial literacy with the help of civil society, privacy, and security issues in ADHAAR, creating more branches, and strengthening bank infrastructure. Ravi (2018) used household data from the fourth round of the National Family Health Survey (NFHS-4) conducted by the Government of India (GoI) in 2015-16 to analyse the states' abilities to implement DBTs and generate a JAM readiness score. The data included the proportion of households in each state that reported possessing a mobile phone, the percentage of households in each state that reported having a bank account, and the proportion of household heads that have an Aadhaar number. The research yielded an index that was derived using household-level data rather than program-level administrative data. Second, by identifying the weakest link in the JAM process and calculating the effective state ability to roll out subsidies through DBTs, the JAM index was calculated using Michael Kremer's O-Ring Theory (1993). The

third feature of the JAM index is a “Remainder” index, which was created to assist states in focusing on the population that does not have an Aadhaar number, a bank account, or a mobile phone. This score is useful if a state wants to concentrate its efforts on filling specific gaps in JAM outreach.

Mukunthan & Agarwal (2019) discussed in detail the JAM model and found this model ensuring the last mile benefits to the marginalized sections of the Indian society. Analysis of data highlighted that the government with the implementation of the JAM trinity was able to reduce leakages and misappropriation of benefits to the tune of ₹17,000 crores annually. The bank accounts opened under this scheme benefitted at the micro level and were mostly held by women.

Goel (2020) conducted a questionnaire-based study in Delhi to obtain feedback on the level of inclusion and effectiveness of the JAM plan from 150 respondents. According to the survey, the degree of financial inclusion differs greatly among these households. Even though financial services are available in the area, they rarely use services such as passbooks, chequebooks, debit cards, and mobile banking. They are pleased with the overall scheme of JAM trinity, but they have certain reservations. Mondal (2020) examined the status of the digital financial inclusion in India by analysing various reports and other information available on the public domain published by regulators, other financial and non-financial institutions, and various stakeholders. The study employed a descriptive analytical method and found that to become more effective in upholding human development and poverty alleviation, digital financial literacy programmes should be organized in holistic ways that captures the interconnected needs of the marginalized classes.

Table 1 List of Financial Indexes proposed

Author	Year	Variables/ Dimensions	Methodology	Weights Assigned
Sarma	2008	banking penetration; availability of banking services; and usage of the banking system	UNDP methodology for HDI, HPI & GDI	None
Kumar & Mishra	2009	Banking outreach & household level access	Equal weighted average	Equal weights
Arora	2010	Physical access; cost of transaction & ease of transaction	UNDP methodology for HDI, HPI & GDI	Physical access- 2 Cost & ease of transaction- 1 each
Sarma & Pais	2011	financial inclusion and development- banking penetration; availability of banking services; and usage of the banking system	UNDP methodology for HDI, HPI & GDI	1 for the index of accessibility, 0.5 for the index of availability and 0.5 for the index of usage
Gupte et. al.	2012	outreach (penetration and accessibility), usage, ease of transactions and cost of transactions	UNDP methodology for HDI, HPI & GDI	Equal weights of 0.2 were assigned
Chitra & Selvam	2013	Literacy; rural population; unemployment, number of households	UNDP methodology for HDI, HPI & GDI	None

(Contd.)

Author	Year	Variables/ Dimensions	Methodology	Weights Assigned
Yorulmaz	2013	Banking penetration, population availability & usage	UNDP methodology for HDI, HPI & GDI	None
Ardhendu et al	2016	supply & demand side-banks, NBFCs & insurance companies and infrastructure side- real sector & human resource factor	Composite index is developed by using displaced ideal method which satisfies intuitive criteria of NAMPUS.	Banks (1), NBFCs (0.5), Insurance cos. (0.5), Real sector (1), Human resource factor (1)
Goel & Sharma	2017	levels of access and usage of financial services	UNDP methodology for HDI, HPI & GDI	Equal weights of 1
BIS	2017	usage of financial services, barriers and access to financial system	Two stage Principal Component Analysis (PCA)	Equal weights of 1

Source: Authors' own compilation

3. Contributions and relevance of the study

The financial inclusion indices are presently reported at a national level and India being a vast country will not uniform be in its financial inclusion progress. The brief overview of the literature highlights two gaps: (i) most of the indices on Financial Inclusion HDI are done at a country level and lack granularity with respect to the achievement towards financial inclusion; and (ii) the existing studies on JAM Trinity are covered from the conceptual and theoretical perspective leaving a much desired need to understand the success rate of this program since its inception. Handful of studies Ghosh (2017) & Goel (2020) conducted on the impact of JAM Trinity have not shown the progress made by each administrative unit (states). To effectively evaluate current progress and assess next steps for financial inclusion, these metrics need to at least be at the state level.

Our study is an attempt to contribute to the existing literature in the following manner: (i) to assess financial inclusion metrics at the state level; (ii) employ data on similar metrics from Intermedia's Financial Inclusion Insights Program, which is independent of the official data (released by the Govt. of India) and thus triangulates and authenticates the reported figures by the government sources; (iii) calculation of a financial inclusion index based on principal component analysis instead of the existing methodologies on Human Development Indexes for the period 2014-2018. The application of principal component analysis will capture the variances in the data at a cumulative proportion without losing out on majority of the information; and (iv) with the findings of the study at state level, they should find relevance to policy makers in deciding the course of next steps for focused and targeted policy formation and execution.

4. Research Methodology

The current study employs the Principal Component Analysis (PCA) to create the index on financial inclusion and the weights assigned to each variable considered is derived from eigenvalues obtained for each variable under each scenario. The study presents three

scenarios to highlight the changing composition of the JAM trinity and the individual contribution by each pillar to the Trinity. The current section is divided into the following sub-sections- (i) methodology- phase I- principal component analysis and phase II- Euclidean distance- as a single number indicator to highlight the level of achievement towards the goal of financial inclusion vis-à-vis the JAM Trinity; (ii) JAM Trinity Metrics- the variables considered for the current study; (iii) data sources and data normalisation.

4.1 Research Methodology

Financial inclusion studies have utilized three types of approaches: econometric based approaches (Hanohan, 2008, Beck et al, 2007, Kendall et al, 2010, Artis et al, 2011), comparison of macro and micro level financial sector outreach metrics (examples are the annual reports on the trend and progress of banking in India published by India's central bank; the Financial Inclusion Indicators developed by Superintendency of Banking, Insurance Companies and AFPs (SBS) of Peru cited in Reyes et al., 2010) and the creation of inclusion indices (Sarma, 2008, 2010, 2012, Sarma & Pais, 2011). Each of these approaches provide different insights. While the econometric approach offers insights into the relations between the variables, it offers only a one-time measure of financial inclusion and may not be useful in evaluating changes over time (Sarma, 2012). Analysis of macro and micro level financial inclusion metrics also provide interesting and useful information, but too do not provide a complete picture of financial inclusion in a system (Sarma, 2012). Thus, any one single indicator does not adequately imbibe the essence of financial inclusion.

For the current study, a series of steps are followed to arrive at a single number indicator highlighting the overall progress towards the goal of financial inclusion. The current study is carried out in two phases. In the first phase, with the utilisation of principal component analysis, the weights of the selected variables are calculated. In the second phase, the Euclidean distance is calculated from the ideal of 1 or 100% to understand the level of achievement across variables across the states for the study period 2014-18.

4.1.1. Phase 1- Principal Component Analysis (PCA)

The present study employs PCA instead of the earlier HDI methodologies. The rationale behind use of PCA is due to the ability of this method to process large datasets into smaller ones by keeping most of the information dataset intact. Secondly, a pre-requisite for PCA is the standardisation of data. Given that the current study focuses on the elements of financial inclusion (JAM Trinity), the majority of the Indian states and UTs get covered where the data is available. The process of standardisation maintains the uniqueness of the data provided by each state irrespective of the size of the state. Thirdly, the calculation of eigen values for the study period gives an insight into the changing composition and the cumulative variance of the same set of variables. Lastly, the eigen values obtained will indicate the tentative contribution of each variable to the entire model in terms of their weight. The assignment of weights becomes important for two reasons: (i) the

contribution of each JAM Trinity pillar has undergone a change during the study period; (ii) existing literature on calculation of indexes, have assigned equal weights to all the considered variables, which will not represent the real scenario. The current study will present multiple scenarios with various weights allotted to the selected variables based on: (i) Scenario 1- year wise data; (ii) Scenario 2- overall or simple average; and (iii) Scenario 3- equal weights.

4.1.2- Phase II- Euclidean Distance

The second phase of the study involves the calculation of Euclidean distance (ED) based on the normalised data and the weights assigned in each scenario. Euclidean distance is the distance of the desired metrics from an ideal value of 100% (or 1). Smaller index values are suggestive of proximity to desired goal and is preferred. While the range of values that the index can take is a maximum and minimum value of 1 and 0 respectively, 1 indicates complete exclusion as in this case the distance from the goal is maximum, and 0 indicating complete inclusion – as the distance from the goal is minimum. We put forward this index to capture a single number the multiple metrics of JAM trinity's outreach in India. While each year's ED is calculated across the proposed scenarios, for the purpose of analysis, the average ED for each state or union territory is considered for ease of understanding. Our index, based on the four identified measures of financial inclusion discussed above, is calculated as follows:

$$IFI = 1 - \frac{\sqrt{(1-BA)^2 + (1-AA)^2 + (1-AADH)^2 + (1-Mob)^2}}{\sqrt{4}}$$

where,

BA- Bank Accounts opened under the PMJDY

AA- Active Accounts of BA

AADH- Aadhaar enrolments

Mob- Mobile Subscription Data

4.2 JAM Trinity Metrics

With the section 4.1 highlighting the proposed methodology of the current study, the following sub-section on the JAM Metrics discusses the three pillars of the JAM Trinity. The variables considered for the current study and their brief descriptions are given below:

- **Jan Dhan Accounts-** are the no frill bank accounts opened under the Pradhan Mantri Jan Dhan Yojana (PMJDY). These savings bank accounts are opened for individuals who for long have been left out of the formal banking channels due to lack of identification or other such reasons. These accounts do not require the maintenance of any minimum balances, which also often acted as a hindrance for the marginalised section of the society. In the current study, this variable is denoted as BA (Bank Accounts).
- **Active Accounts-** are the second variable considered for the study. The active accounts signify the usage of the Jan Dhan accounts (BA). Financial inclusion is about both access

to and usage of financial services, hence, it becomes important to identify the active Jan Dhan accounts to get a clearer understanding on the impact created and achievement of financial inclusion goals. This variable is denoted as AA (Active Accounts) in the analysis of the data.

- **Aadhaar-** is a unique 12-digit identification number issued to the residents of India based on the demographic and biometric information, which also assists in rooting out duplicate and fake identities. This variable is denoted as AADH (Aadhaar) in the analysis of the data.
- **Mobile-** third pillar for completing the trinity of JAM, is the mobile subscription data. The spectrum for mobile services is auctioned at the circle level. Circles are geographical areas that could include individual states or a combination of states. In the current study, this variable is denoted as MOB (Mobile) for analysis purposes.

4.3 Data Sources & Normalisation

The objective of the current is to undertake a state wise progress of the JAM Trinity. Therefore, the relevant measures for analysis would be data on Jan Dhan accounts, Aadhaar and mobile. For the study the data from Intermedia's Financial Inclusion Insights Program was employed. This survey collects state wise data on multiple financial inclusion metrics from the Indian states and union territories. The Indian sample size of the survey over the period of our study has ranged from 45,087 to 48,027 over the period of this study. For the Intermedia data, the corresponding variables that related to the JAM measures were identified, alongwith the availability of data on usage of bank services for the study period 2014-19. Previous studies have alluded to the unreliability of the data from official sources. In order address the concerns on authenticity of data, the current study evaluated the data measuring similar metrics from Intermedia's Financial Inclusion Insights Program. While Intermedia collects data for many countries globally (Hove and Dubus, 2017, Osabuohien and Karakara, 2018), the current study used the data on India. Indian states where the data was not reported by Intermedia have not been included in the analysis of the survey results. As stated earlier, since the data source is independent of the govt. data and figures reported, the current study triangulates the achievements of the JAM trinity by analysing the data from Intermedia and corroborating the results with the government reports.

Normalisation is the process of bringing the data into a standardised format without losing out on their uniqueness. To normalize the data on population, the obtained data was divided by that state's rural or total population depending on which group the data was relevant for. Aadhar data was normalised by dividing the total Aadhar numbers issued with the respective state's population. Since the mobile data was available at a circle level, it was normalized by the circle population; Jan Dhan information was available for rural population and was normalized by the rural population. The estimates for the total and rural state population were taken from 'population projections for India and states' publication. The state of Telangana was created by bifurcating Andhra Pradesh, the analysis of these two states is presented in a combined manner since all the data required for our analysis was not available separately for both the states for the period of our study.

Table 2 Principal Component Analysis- Year Wise & Overall Data Period

	2014			2015			2016			2017			2018			Overall	
	EV	Var	Wt.	EV	Var	Wt.	EV	Var									
BA	3.353	83.82	.84	3.388	84.70	.85	2.875	71.88	.72	3.127	78.17	.78	1.96	49	.5	3.086	77.14
AA	.406	10.16	.10	.412	10.31	.10	.626	15.65	.16	.578	14.45	.15	.897	22.43	.22	.454	11.4
AADH	.142	3.55	.04	.137	3.432	.03	.377	9.42	.09	.216	5.39	.05	.773	19.32	.19	.344	8.60
MOB	.099	2.47	.02	.062	1.557	.02	.122	3.046	.03	.079	1.98	.02	.370	9.26	.09	.116	2.88

Source: Authors' own calculation; EV- Eigenvalues obtained through PCA; Var – Variance contribution of each component; Wt.- Weight assigned based on the cumulative variance obtained (as given in the previous table 1)- rounded off to the nearest decimal to add up to 1.

Tabular presentation of Data metrics and sources

Metric	Normalised by	Period	Source
Bank Account opened under PMJDY (BA)			
Respondents with bank accounts	State population	2014-18	Intermedia Survey*
Bank Account Usage- Active Accounts (AA)			
Respondents who actively use their bank account	Population of BA	2014-18	Intermedia Survey*
Aadhaar (AADH)			
Respondents with Aadhar Cards	State Population	2014-18	Intermedia Survey*
Mobile Subscription Data (Mob)			
Mobile Subscription (circle wise)	State Population	2014-18	Intermedia Survey*

Intermedia survey: Jammu and Kashmir data unavailable; Northeast states combined for the period 2014-17*

5. Results and Analysis

Phase I- Principal Component Analysis

Scenario 1: Year wise Data & Weights

In the first phase of the analysis, where principal component analysis is employed, it is interesting to note the changes in the variance contribution of each variable during the study period. In the first scenario, where the year wise data is utilised to calculate the weights of each variable, it is seen that the variable BA (Jan Dhan accounts) had the highest contribution to the entire ecosystem of the JAM Trinity. However, a closer look at the inter year comparisons of the weights for BA shows a gradual decline to 0.5 in 2018 from 0.85 in 2015 (Table 2 & 3). This change in variance contribution by BA is corroborated with the heavy push by the GoI and the regulators to open the Jan Dhan accounts in the initial years, to ensure accessibility of financial services to the targeted population. As of April 2017, 28 crore Jan Dhan accounts were opened, while till December 2019, a total of 37.74 crores of these accounts were opened (PMJDY, 2019). The gradual decline in the rate of accounts being opened gets reflected in the weights allotted to BA during the study period.

The usage of financial services through the JAM Trinity is highlighted in the current study with the variable AA (active Jan Dhan accounts). The year wise data on the active accounts shows the variance contribution increased to 0.22 during 2018 from 0.10 in 2014 (Table 2 & 3). The shift in the increased weights over the years suggests the increased usage of these accounts to avail the schemes and benefits launched by GoI. During December 2019, a total of ₹1,09,141.66 crores was the deposit in these accounts, while access to these accounts was ensured through Rupay debit cards, which stood at 29.69 crores during the same time (PMJDY, 2019). The reported numbers of deposit in Jan Dhan accounts was ₹62,972 crores in March 2017 and issued Rupay debit cards for these accounts stood at 2.19 crores (PMJDY, 2019). The deposits in these accounts highlight a near two fold increase implying active usage of these accounts not only for the personal usage of the account holders but also that these accounts were able to transfer the benefits of government schemes to the targeted population.

The third variable in the current study is the Aadhaar enrollment (AADH) which is linked to the Jan Dhan accounts (BA & AA). The year wise data and the weights estimated for the variable shows the variance contribution rising to 0.19 in 2018 from 0.04 in 2014 (Table 2&3). The steepest rise in the Aadhaar seeding with the Jan Dhan accounts took place during 2017-2018. The weights assigned in 2017 stood at 0.05 while in 2018 it was 0.19. As per 2018-19, annual report published by UIDAI, the cumulative Aadhaar enrolments stood at 61.01 crores in 2014-15 and 123.57 crores in 2018-19. This extensive coverage of the country's large population with the least biometric and demographic details, assuaging the privacy concerns, has given a strong a strong boost to the linking of the Jan Dhan accounts and its usage.

The fourth variable of the current study is the mobile (MOB), which is the third pillar of the JAM Trinity. The weights assigned to this variable based on the year wise data does not show much change for the period 2014-17, which ranged between 0.02 in 2014 and 0.03 in 2016. However, in 2018, the variance contribution of Mobile subscribers was 0.09 (Table 2&3). The Telecom statistics of 2019, show that during the period 2014-19, the overall mobile subscribers increased to 116.17 crores in 2019 as against 90.45 crores in 2014. The outreach of mobile subscribers also increased to 93.27 per 100 inhabitants in 2018 as compared to 75.23 per 100 inhabitant in 2014.

Table 3 Weights Assignment- Principal Component Analysis

Component	Total	Only 2014 Data					
		% of Variance	Initial Eigenvalues	Cumulative %	Extraction Total	Sums of Variance	Squared Loadings Cumulative %
BA	3.353	83.819	83.819	83.819	3.353	83.819	83.819
AA	.406	10.160	93.980				
AADH	.142	3.553	97.533				
MOB	.099	2.467	100.000				
Only 2015 Data							
BA	3.388	84.703	84.703	84.703	3.388	84.703	84.703
AA	.412	10.308	95.011				
AADH	.137	3.432	98.443				
MOB	.062	1.557	100.000				
Only 2016 Data							
BA	2.875	71.883	71.883	71.883	2.875	71.883	71.883
AA	.626	15.648	87.531				
AADH	.377	9.423	96.954				
MOB	.122	3.046	100.000				
Only 2017 Data							
BA	3.127	78.176	78.176	78.176	3.127	78.176	78.176
AA	.578	14.449	92.625				
AADH	.216	5.390	98.015				
MOB	.079	1.985	100.000				
Only 2018 Data							
BA	1.960	48.991	48.991	48.991	1.960	48.991	48.991
AA	.897	22.427	71.418				

Component	Total	Only 2014 Data			
		Initial Eigenvalues		Extraction Sums of Squared Loadings	
		% of Variance	Cumulative %	Total	% of Variance
AADH	.773	19.326	90.744		
MOB	.370	9.256	100.000		
Overall Data (2014-2018)					
BA	3.086	77.148	77.148	3.086	77.148
AA	.454	11.361	88.509		
AADH	.344	8.604	97.112		
MOB	.116	2.888	100.000		

Source- Authors' own calculation; Extraction Method: Principal Component Analysis

Scenario 2: Weights Based on Overall Data

The scenario 2 presents the overall weight of each variable selected in the current study based on the simple average of their respective year wise data. In this scenario, the variable BA has the weight of 0.77 (Table 2 & 3) which is the highest, followed by AA at 0.11 (Table 2 & 3), then AADH at 0.09 (Table 2 & 3) and lastly, MOB at 0.03 (Table 2 & 3). The scenario 2, with the overall weights presents a smoothed effect of the entire study period. This scenario gives information at a glance on the variance contribution of each variable.

Scenario 3: Equal Weights

The scenario 3, is fairly simple and intuitive in nature, where the weights assigned to each variable are equal at 0.25. This approach of weight assignment has been followed in the past studies (Kumar & Mishra, 2009; Gupte et.al, 2012; Goel & Sharma, 2017; BIS 2017). A big drawback of this method of weight allocation is that it does not represent the information given by the data. As in Scenario 1, the variance contribution to the entire JAM ecosystem by each variable has undergone a change and also gets reflected and corroborated with the dataset.

B. Phase II- Euclidean Distance

Scenario 1: Years wise weights

In this scenario, the year wise weights are utilised to calculate the ED for each state and union territory (Table 4&7). A look at the numbers show that Himachal Pradesh gets ranked first in terms of coverage and outreach of JAM Trinity, followed by Punjab (2nd), Goa (3rd), Assam (4th) and Karnataka (5th). While on the other end of the rankings, the states of Odisha (22nd), Bihar (23rd) and Haryana (24th) had more than 85% of coverage across all the selected variables for the study. It is important to highlight here that the range of ED for the states and union territories ranged from 14.73% as the highest to 10.34% as the lowest, where the data for all the years was available. With most of the ED being lower than 15% of the desired level of 100%, the scenario 1 presents an encouraging path for the government and regulators towards the achievement of financial inclusion.

Table 4- Scenario 1: Year Wise Weights & Corresponding ED

State	2014	2015	2016	2017	2018	Average
Andhra Pradesh & Telangana	-4.36%	13.96%	15.19%	19.87%	18.80%	12.69%
Arunachal Pradesh	7.28%	12.73%	14.25%	13.28%	19.45%	13.40%
Assam	14.10%	9.72%	10.74%	12.31%	12.12%	11.80%
Bihar	13.70%	10.41%	13.48%	18.35%	17.57%	14.70%
Chhattisgarh	14.45%	5.54%	9.14%	19.30%	15.70%	12.82%
Dadra & Nagar Haveli	NA	NA	NA	NA	17.98%	NA
Daman & Diu	NA	NA	NA	NA	17.37%	NA
Delhi	-3.63%	14.51%	14.02%	18.08%	16.70%	11.94%
Goa	-10.37%	14.79%	16.12%	15.83%	21.89%	11.65%
Gujarat	8.46%	11.44%	9.92%	16.55%	16.67%	12.61%
Haryana	12.06%	12.30%	13.61%	18.94%	16.75%	14.73%
Himachal Pradesh	-18.40%	15.39%	15.55%	20.59%	18.58%	10.34%
Jharkhand	11.07%	10.48%	13.81%	17.73%	16.75%	13.97%
Karnataka	-2.15%	11.95%	12.59%	19.02%	18.12%	11.91%
Kerala	6.33%	13.86%	15.82%	16.62%	18.49%	14.22%
Madhya Pradesh	11.87%	9.36%	11.99%	18.01%	16.49%	13.54%
Maharashtra	-2.45%	13.65%	14.70%	19.10%	17.74%	12.55%
Manipur	7.28%	12.73%	14.25%	14.79%	16.56%	13.12%
Odisha	9.55%	12.67%	14.62%	18.69%	17.81%	14.67%
Puducherry	NA	NA	NA	NA	19.96%	NA
Punjab	-8.40%	13.26%	10.45%	18.81%	17.88%	10.40%
Rajasthan	2.94%	13.90%	11.50%	18.65%	18.76%	13.15%
Tamil Nadu	-8.19%	14.66%	14.67%	20.06%	18.48%	11.94%
Tripura	7.28%	12.73%	14.25%	15.32%	17.77%	13.47%
Uttar Pradesh	2.61%	13.09%	14.78%	18.71%	16.58%	13.15%
Uttarakhand	-3.99%	13.33%	15.26%	19.29%	19.48%	12.67%
West Bengal	6.56%	11.82%	13.17%	18.31%	17.94%	13.56%

NA: Not available; Source- Authors' own calculation

Scenario 2: Overall Weights

In this scenario, the result reveal that the states of Assam, Chhattisgarh and Madhya Pradesh were able to reach the desired level of 100% inclusion and more than that. A look at their year wise ED shows that for Assam for the period 2014-18, the state was able to effectively reach out and implement the JAM Trinity successfully achieve more than 100% level of achievement (Table 5&7). For the states of Chhattisgarh & Madhya Pradesh similar levels were achieved during the period 2014-17. The lowest ranked states in terms of the highest ED were Tamil Nadu (22nd), Goa (23rd) & Himachal Pradesh (24th). A look at their year wise ED based on overall weights, show that these states were in the range of 3.20%-4.14% short in their level of outreach vis-à-vis 100% desired level. In this scenario, the ED ranged between a low of -1.91% to the high of 4.14%, suggesting the wider outreach of the JAM Trinity in most of the states & union territories.

Table 5 Scenario 2: Overall Data Weights & Corresponding ED

State	2014	2015	2016	2017	2018	Average
Andhra Pradesh & Telangana	0.69%	2.75%	2.78%	4.47%	4.33%	3.00%
Arunachal Pradesh	-0.10%	1.64%	2.15%	-0.35%	4.72%	1.61%
Assam	-6.04%	-2.56%	-1.29%	-0.27%	0.62%	-1.91%
Bihar	-4.19%	-1.17%	0.94%	3.00%	3.27%	0.37%
Chhattisgarh	-5.57%	-5.31%	-3.05%	3.73%	1.90%	-1.66%
Dadra & Nagar Haveli	NA	NA	NA	NA	3.61%	NA
Daman & Diu	NA	NA	NA	NA	3.28%	NA
Delhi	1.38%	3.81%	1.82%	2.75%	2.24%	2.40%
Goa	3.63%	4.24%	3.89%	0.89%	6.61%	3.85%
Gujarat	-1.13%	0.13%	-2.26%	1.39%	2.66%	0.16%
Haryana	-1.33%	1.04%	1.39%	3.66%	2.70%	1.49%
Himachal Pradesh	3.46%	4.88%	2.92%	5.24%	4.17%	4.14%
Jharkhand	-1.69%	-0.98%	1.28%	2.35%	2.76%	0.74%
Karnataka	1.55%	0.79%	0.30%	3.74%	3.89%	2.05%
Kerala	0.08%	2.83%	3.39%	1.39%	4.08%	2.35%
Madhya Pradesh	-2.79%	-2.04%	-0.38%	2.60%	2.53%	-0.02%
Maharashtra	1.23%	2.74%	2.32%	3.82%	3.52%	2.73%
Manipur	-0.10%	1.64%	2.15%	0.14%	2.33%	1.24%
Odisha	-1.71%	1.02%	2.06%	3.16%	3.65%	1.63%
Puducherry	NA	NA	NA	NA	5.36%	NA
Punjab	1.92%	2.30%	-1.79%	3.38%	3.65%	1.89%
Rajasthan	-0.40%	2.87%	-0.72%	3.18%	4.43%	1.87%
Tamil Nadu	1.31%	3.62%	2.26%	4.88%	3.92%	3.20%
Tripura	-0.10%	1.64%	2.15%	0.65%	3.31%	1.53%
Uttar Pradesh	-1.83%	1.43%	2.24%	3.37%	2.63%	1.57%
Uttarakhand	-0.15%	2.04%	2.87%	3.87%	4.79%	2.68%
West Bengal	-1.02%	0.35%	0.70%	2.97%	3.78%	1.35%

NA: Not available ;Source- Authors' own calculation

Scenario 3: Equal Weights

In this scenario, where equal weights are assigned to each of the variable, irrespective of their contribution to the JAM ecosystem, it is seen that states of Assam, Chhattisgarh and Bihar had the lowest ED and were ranked 1st, 2nd, and 3rd respectively (Table 6 & 7). The lowest ranked were the states of Tamil Nadu, Goa & Himachal Pradesh at 22nd, 23rd & 24th respectively (Table 6&7). The range of ED in this scenario was from the high of 18.42% to the low of 8.70%. with more than 80% of outreach across the states on each of the JAM Trinity pillar, this scenario again highlights that while JAM Trinity may not be the end solution to achieve the goal of financial inclusion, however, it is a step in the right direction.

Table 6 Scenario 3: Equal Weights & Corresponding ED

State	2014	2015	2016	2017	2018	Average
Andhra Pradesh & Telangana	14.37%	17.56%	16.83%	17.81%	18.94%	17.10%
Arunachal Pradesh	13.11%	15.41%	16.11%	12.80%	20.70%	15.62%
Assam	5.07%	8.79%	8.75%	9.91%	10.98%	8.70%
Bihar	8.04%	12.33%	14.63%	16.34%	18.03%	13.87%
Chhattisgarh	8.20%	11.52%	12.66%	18.13%	15.78%	13.26%
Dadra & Nagar Haveli	NA	NA	NA	NA	18.20%	NA
Daman & Diu	NA	NA	NA	NA	17.35%	NA
Delhi	16.40%	19.54%	14.39%	15.43%	18.33%	16.82%
Goa	19.33%	20.15%	16.56%	13.01%	23.06%	18.42%
Gujarat	12.60%	14.54%	13.24%	14.87%	16.87%	14.42%
Haryana	13.92%	15.34%	15.96%	17.47%	16.95%	15.93%
Himachal Pradesh	19.35%	20.20%	15.80%	17.65%	19.12%	18.42%
Jharkhand	11.99%	12.91%	15.78%	16.28%	16.44%	14.68%
Karnataka	16.18%	15.56%	15.22%	16.65%	18.17%	16.35%
Kerala	15.74%	18.74%	16.08%	14.15%	19.17%	16.78%
Madhya Pradesh	10.52%	12.46%	14.85%	16.67%	16.75%	14.25%
Maharashtra	15.32%	17.68%	15.88%	16.34%	17.98%	16.64%
Manipur	13.11%	15.41%	16.11%	13.91%	17.57%	15.22%
Odisha	11.09%	13.81%	16.34%	17.08%	17.46%	15.16%
Puducherry	NA	NA	NA	NA	20.43%	NA
Punjab	16.48%	16.70%	13.19%	16.42%	18.12%	16.18%
Rajasthan	12.92%	17.32%	14.46%	16.53%	18.70%	15.98%
Tamil Nadu	15.26%	18.27%	15.66%	17.81%	19.45%	17.29%
Tripura	13.11%	15.41%	16.11%	15.06%	18.71%	15.68%
Uttar Pradesh	9.28%	14.25%	16.12%	16.94%	16.29%	14.57%
Uttarakhand	11.62%	15.74%	16.13%	17.17%	20.12%	16.16%
West Bengal	11.98%	13.61%	14.84%	16.64%	17.84%	14.98%

NA: Not available ;Source- Authors' own calculation

Table 7 Rankings- State & Scenario wise

State	Year Wise			Equal Weights		
	ED	Rank	Overall ED	Rank	ED	Rank
Andhra Pradesh & Telangana	12.69%	11	3.00%	21	17.10%	21
Arunachal Pradesh	13.40%	16	1.61%	12	15.62%	11
Assam	11.80%	4	-1.91%	1	8.70%	1
Bihar	14.70%	23	0.37%	5	13.87%	3
Chhattisgarh	12.82%	12	-1.66%	2	13.26%	2
Dadra & Nagar Haveli	NA	25	NA	25	NA	25
Daman & Diu	NA	26	NA	26	NA	26

State	Year Wise		Equal Weights			
	ED	Rank	Overall ED	Rank	ED	Rank
Delhi	11.94%	6	2.40%	18	16.82%	20
Goa	11.65%	3	3.85%	23	18.42%	23
Gujarat	12.61%	9	0.16%	4	14.42%	5
Haryana	14.73%	24	1.49%	9	15.93%	13
Himachal Pradesh	10.34%	1	4.14%	24	18.42%	24
Jharkhand	13.97%	20	0.74%	6	14.68%	7
Karnataka	11.91%	5	2.05%	16	16.35%	17
Kerala	14.22%	21	2.35%	17	16.78%	19
Madhya Pradesh	13.54%	18	-0.02%	3	14.25%	4
Maharashtra	12.55%	8	2.73%	20	16.64%	18
Manipur	13.12%	13	1.24%	7	15.22%	10
Odisha	14.67%	22	1.63%	13	15.16%	9
Puducherry	NA	27	NA	27	NA	27
Punjab	10.40%	2	1.89%	15	16.18%	16
Rajasthan	13.15%	14	1.87%	14	15.98%	14
Tamil Nadu	11.94%	7	3.20%	22	17.29%	22
Tripura	13.47%	17	1.53%	10	15.68%	12
Uttar Pradesh	13.15%	15	1.57%	11	14.57%	6
Uttarakhand	12.67%	10	2.68%	19	16.16%	15
West Bengal	13.56%	19	1.35%	8	14.98%	8

NA: Not available ; Source: Author's own compilation based on result analysis

6. Conclusion and Policy Implications

The current research attempts to examine the progress of a financial inclusion initiative by the government of India. The research examines this objective by examining the achievement of the pillars of JAM trinity. The results revealed a huge push or boost given by the Indian government and the various stakeholders towards the opening of Jan Dhan accounts in the initial years followed by an extensive coverage in terms of mobile subscriptions & network coverage. Finally the issuance of Aadhaar numbers to the majority of the population led to the implementation the JAM trinity and successful transfers of subsidies and other benefits to the intended beneficiaries. From an overall perspective, all the states & UTs across the study period of 2014-18, have done well across all the three pillars of the Trinity. At the state level wise achievements, it was seen that Assam was able to keep its ranking within the top five ranks across all the elements of the JAM Trinity. The state of Assam was followed by Chhattisgarh from an overall perspective across all the scenarios. Chhattisgarh was ranked 2nd in two of the three scenarios, while in the year-wise data scenario the state was ranked 12th. On the other end of the spectrum, it was seen that the state of Kerala consistently ranked below 15th across all the scenarios, suggesting a lack of focused implementation on the part of the involved stakeholders.

This study finds that efforts made by all stake holders viz. regulator, government and banks towards financial inclusion have yielded positive results. The current study demonstrates a different methodology to build a financial inclusion index and evaluate the overall performance of financial inclusion in India. By combining metrics into a single index enabled the progress analysis of the country's overall financial inclusion metrics. While the progress in the effort is visible with the decrease in the Euclidean distance from the goal, it is worrisome that the states that were furthest away from the goal in 2014, remained furthest away in 2018 as well (Table 7).

The results from this study assume greater importance for policymakers in the context of the recent Covid-19 global pandemic. Using JAM infrastructure, the government has been able to provide money to the marginalized groups of the country. The findings of this study identify the states and the particular attributes that require additional attention of the policy makers. The policy focus on these gaps in this infrastructure will further financially include the marginalized citizens of the country. As a next step policy maker need to create and implement policy interventions that would decrease the Euclidean distance and also decrease the gap in this distance between the states to bring the states at par with each other. India's significant progress of the financial inclusion infrastructure provides many opportunities. With the large number of Jan Dhan accounts that are added to bank portfolios, banks could provide technology enabled products and services to this new customer base increasing the potential for business.

While the current study is an attempt to outline the impact of JAM Trinity, the study could have more value if it were at a more granular level. However, as the data for the metrics being analysed is only available at the state level, in our research we were constrained by the availability of data. Further work needs to be undertaken to focus on other aspects of financial inclusion such as access mechanisms (bank branches vs business correspondents), male vs female, insurance, pension scheme credit offering & usage, and finally the non-performing loans that may arise out of this.

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