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Index of Financial Inclusion

Ritesh Khatwani[1], Dr. Shubhra Aanand[2]
[1, 2]Symbiosis Institute of Business Management, Symbiosis International University, Pune, India

***Abstract*—** *The demand in the study of the topic 'Financial Inclusion' is of higher priority for the governments of many countries. It is very important for any economically developed nations to have financially inclusive system to all the parts of its society. Thus keeping this in mind, this study would be aimed to develop a suitable statistical tool in order to obtain Index of Financial Inclusion (IFI). The study would be based on the secondary data on some of the available influencing factors. IFI of all the districts in Uttar Pradesh (UP) would be enumerated. The main objective of the study is to provide a statistically justified weighing method for assignment of appropriate weights to the factors according to their importance and give a proper method to obtain the individual dimension indices and further combine the individual indexes and the weights to obtain The proposed index lies in between 0 to ∞, where 0 represents complete financial exclusion and ∞ indicates possibility of improvement.*

I. INTRODUCTION

Financial services are the economic services provided by the finance industry, which encompasses a broad range of organizations that manage money, including credit unions, banks, credit cards companies, insurance companies, consumer finance companies, stock brokerages, investment funds and some government sponsored enterprises.

Financial Inclusion or inclusive financing is the delivery of financial services at affordable costs to sections of disadvantaged and low income segments of society or simply the poor people in the society. Unrestrained access to public goods and services is the sine qua non of an open and efficient society. It is argued that as banking services are in the nature of public goods; availability of banking and payment services to the entire population without discrimination is the prime objective of the public policy. The term financial inclusion has gained importance since the early 2000s and is a result of findings about financial exclusion and its direct correlation to poverty. Financial inclusion is now a common objective for many central banks among the developing nations.

It can be observed that although in the well developed countries the financial system is enriched, still it is not all-inclusive, and certain parts of the population, mainly the poorer section of people are deprived of gaining the facilities. The importance of an all-inclusive financial system is very much essential for an economically developed nation and it is desired for many more reasons. Few of them can be pointed out as at first it enables efficient allocation of productive resources. Secondly, it will enhance the regular management of finance. Thirdly, it will reduce the upsurge of illegal/ informal financial sources, providing protection to the common people from being cheated. Thus an all-inclusive financial system enhances efficiency and welfare by providing avenues for secure and safe saving practices and by facilitating a whole range of efficient financial services.

Literature Review

The inter relationship between financial development and economic growth is well explained in the literatures (King and Levine, 1993; Beck *et al*., 2000; Demirgüç-Kunt and Maksimovic, 1998; Beck *et al*., 2004; Levine, 2005; Klapper *et al*., 2006; Demirgüç-Kunt *et al*., 2008). In recent years the debate expanded to include the notion of financial "exclusion" as a barrier to economic development and the need to build an inclusive financial systems (Beck *et al*., 2008). Recent empirical evidence using household data indicates that access to basic financial services such as savings, payments, insurance and credit can make a substantial positive difference in improving poor people's lives (Caskey *et al*., 2006; Dupas and Robinson 2009). For firms, especially small and medium enterprises (SMEs), access to finance is often the main obstacle to growth (Schiffer and Weder, 2001; Cressy, 2002; IADB, 2004; and Beck *et al*., 2005, 2006, and Demirguc-Kunt *et al.*2008).

There are many previous works on this topic of Financial Inclusion. Financial Inclusion is now one of the main topics of concern for Govt. of India and one of the hot topics of research. It is very much important for a well developed economy and it indicates the knowledge that common people have about the financial services that banks offer and how much they use it. Many economist and researchers have worked on this topic.

According to Mandira Sarma (2010), financial inclusion has been defined as *a process that ensures the ease of access, availability and usage of the formal financial system for all members of an economy*. So, this definition broadly classified the factors, influencing this financial inclusion as accessibility, availability and usage by the common people. The index of Financial Inclusion proposed in this paper takes value between 0 to 1 where 0 indicates complete financial exclusion and 1 indicates complete financial inclusion. In this paper a multi-dimensional approach has been followed while calculating the index. They proposed that IFI is computed by first calculating a dimension index for each dimension of financial inclusion.

According to Rabi Mishra *et al.* 2012 four methodologies were discussed to formulate the Systematic Liquidity Index (SLI) and compared them according to the variability explained by the methods. In the paper time-series data has been used and the method of Principal Component Analysis (PCA) is also one of the methods to obtain the index. Only the first principal component has been taken into consideration as the index.

II. DATA AND METHODOLOGY

To obtain the financial inclusion index for UP, first it is important to know all the indicators that are going to influence financial inclusion index. Financial inclusion can be measured

from different aspects of financial system. There should be parameters from both sides which will indicate the financial inclusion for a particular district. Besides these two factors, there are some other factors those have some influence in financial inclusion, to be studied, can be thought of as the interaction between these two factors or can be treated as the factors, which is common for both the customer as well as the bank. Some factors may be independent of both the factors but have some effect on financial inclusion.

Here in this study, data on population size which is further sub-divided as male population, female population, and literacy rate, separately for male and female and overall have been taken. The number of female deposit accounts are also taken district-wise. The reason behind taking data separately for male and female for literacy and number of accounts, is to incorporate the women empowerment as a factor in the study. It will be very interesting to know how this women empowerment is related with the index of financial inclusion. These data are obtained from *CENSUS OF INDIA 2011, Website :* http://www.censusindia.gov.in. The indicators that are taken from the customer side are Number of Credit accounts, Number of deposit accounts, total amount outstanding, total amount of deposit, total amount of credit. The indicators that are taken from the banking side are Number of branches of schedule commercial banks, Number of ATMs, No of staff per branch. These factors will indicate the banking infrastructure. These data are obtained from *BASIC STATISTICAL RETURNS of SCHEDULE COMMERCIAL BANKS in INDIA Vol. 39 March 2010.* The third kind of factor which can be treated as common to both the parties is district-wise Gross State Domestic Product.

For the enumeration purpose data on number of Credit accounts, number of male deposit accounts, amount outstanding, amount of deposit, amount of credit, female deposit accounts are taken on per-capita basis by dividing them by the corresponding population size of the districts, so as to keep them in same platform such that they are comparable. There are 71 districts in UP and data on each of the above mentioned dimensions are obtained carefully and checked thoroughly before proceeding towards the enumeration part. The population figures for each of the districts are given in absolute unit. The literacy figures are given in percentage. The data on total amount outstanding are in thousand unit, the data on total deposit amount and credit amount are in lakh unit.

In this study the first priority is to assign appropriate weights to the respective factors according to their importance in getting the index of financial inclusion. In the previous papers each of the factors are assigned with arbitrary weights like equal weights to each of the factors or arbitrary weights to each of the factors without any proper justification. To overcome this drawback the following methodology has been proposed to get proper weights to the factors according to their degree of importance.

- *Methodology for Assigning Weights*

Here in this study ten variables viz. literacy rate, literacy rate for females, per-capita outstanding amount, Number of schedule commercial bank branches, per-capita credit accounts, per-capita male deposit accounts, per-capita female deposit accounts, per-capita amount of credit, per-capita amount of deposit, per-capita GSDP have been incorporated. These variables have different importance in financial inclusion and in order to get maximum information from these variables appropriate weights are to be assigned to these variables. To obtain the weights the method of Principal Component has been used.

A principal component analysis is concerned with explaining the variance-covariance structure of a set of variables through a few linear combinations of these variables. Its general objective is data reduction and interpretation. Although p components are required to reproduce the total system variability, often much of this variability is can be accounted for by a small number 'k' of the principal components. If so, there is as much information in the k components as there is in the original p variables. The k principal components can then replace the initial p variables, and the original data set consisting of n measurements of p variables, is reduced to a data set consisting of n measurements on k principal components.

An analysis of principal components often reveals relationships that were not previously suspected and thereby allows interpretations that would not ordinarily result.

Let the variables to be included in the study are x_1, x_2, …, x_p. Algebraically, principal components are particular linear combination of the p random variables x_1, x_2, …, x_p. Principal components depend solely on the covariance matrix or the correlation matrix of the variables. The basic objective is to transform the p variables to another set of variable by using an orthogonal transformation such that the resultant set of vectors becomes a set of independent vectors. Now it is known to us that if there are distinct eigen values corresponding to a symmetric matrix then the eigen vectors corresponding to the eigen values will be orthonormal to each other i.e. if we consider linear combination of the original set of variables with coefficients as the elements of the eigen vectors then the respective linear combinations will be independent to each other and the variability explained by each of the linear combination will be represented by the corresponding proportion of the eigen value. It can be noted that the sum of the proportions of all eigen values will be unity as it represents the total variability.

In this method at-first the correlation matrix of these variables is calculated. Now if correlation between any two factors is very close to 1, then any one of the variables can be eliminated as both the variables are giving the same information. As one increases other also increases or vice versa. After removing those particular variables now the set of variables that is to be involved in the enumeration is in hand. Then the correlation matrix of the remaining set of variables is obtained. The next step is to obtain the eigen values corresponding to the correlation matrix and then the corresponding eigen vectors are calculated for each of the eigen values of the correlation matrix. Then the first principal component is obtained by forming the linear combination of the variables with coefficients as the elements of the eigen vector corresponding to the maximum eigen value. The proportion figure of the maximum eigen value denotes the

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proportion of variability explained by the first principal component. Similarly the 2nd principal component is obtained by forming the linear combination of the variables with coefficients as the elements of the eigen vector corresponding to the eigen value which is lesser than the maximum eigen value but higher than others and so on.

In this case only the first principal component has been taken into account as the dimension is to be reduced from 9 to 1, assuming that the variables are linearly related to the measurement of financial inclusion and the first principal component explains maximum variability of the total variability. The mechanism is given in the following graphical manner.

$$\begin{pmatrix} x1 \\ x2 \\ . \\ . \\ . \\ x9 \end{pmatrix} \xrightarrow[Transformed]{Using\ an\ orthogonal\ transformation} \begin{pmatrix} X1 \\ X2 \\ . \\ . \\ . \\ X9 \end{pmatrix}$$

Where X_1 = first principal component, a function of $x_1, x_2, \ldots x_9$ say, $f_1(x_1, x_2, \ldots x_9)$, X_1 = second principal component, a function of $x_1, x_2, \ldots x_9$ say, $f_2(x_1, x_2, \ldots x_9)$ and so on.

After doing this, now the first principal component i.e. a linear combination of the variables has been obtained for the study. Now how to know which variable is more important in the measurement? To answer the question, it will be useful to look at the correlation coefficients between the variables and the first principal component as the first principal component is used to explain the maximum variability of the model. The maximum correlation will give that variable which is more important in the study and according to the correlations the variables will be obtained according to their importance. Now to get the weights it is apparent to look as the proportion of correlation coefficients of the variables and assign the proportion as weights to each of the variables. In this way the weights will be obtained and the sum of all the weights will going to be unity.

In this methodology the weights which will be obtained, will not be fixed. If data change the weights will be changed accordingly. While calculating the index one can get the appropriate weights for the data available on that particular period of time. Suppose one is calculating the index for the year 1990, when the technology was not that advanced. Then the factors like number of ATMs, number of staff will differ with the data, if it is taken in the year 2010, when the technology is very much advanced. So depending on the time period also, the importance of variables will get changed and the corresponding weights also have to be obtained accordingly. This is feasible in this methodology in comparison with the other papers where they have used fixed weights which will remain constant for all the time periods.

The above discussed methodology will be employed to obtain the weights. Following are some of the transformations that have to be used to obtain the dimension index. While calculating the weights, the actual figures should be transformed first and then the above methodology should be applied to get the weights properly. Otherwise if the weights are obtained on the basis of actual figures and then the transformation is used then the result won't be correct. The weights should be based on the figures which will be used to get the ultimate required index.

- *Methodology for Assigning Individual Dimension Index*

There are ten variables in the study. All the information, contained in those variables will have to be combined to obtain the financial inclusion index. To combine them together it is required to put them into the same platform. Otherwise those variables will not be comparable and can't be combined together. For example suppose the data on total amount of credit is available which is in lakh unit and the literacy rate which is in percentage. One cannot add 1 lakh with 1%. It will carry no meaning. Here also nine variables are present which are in different units. So immediately it cannot be combined together to obtain the index. First it is required to put the variables in the same comparable platform, which is done by making the variables unit free.

Now there are several methods to make the variables unit free, which will be discussed in the following.

Method I: The first method is the method which has been discussed in some of the earlier papers.

The i^{th} dimension index for the j^{th} district is obtained by,

$$D_{ij} = \frac{Actual\ value - Minimum\ value}{Maximum\ value - Minimum\ value},$$

Where D_{ij} is the factor index corresponding to the factor i of the district j.

In this method, the index for each dimension will lie in between 0 and 1. Higher the value of D_{ij}, higher the state of achievement for the district j in dimension i. But as discussed earlier, the index should not be bounded between zero to one, as the optimal value of index of financial inclusion can't be properly defined. Besides this $(M_i - m_i)$ quantity is nothing but the range of the variable, but range is not a good measure of dispersion. It overestimates the measure of dispersion and hence it will underestimate the index as a whole. If some outlier are present in the data, then it will influence the whole analysis. Besides this, range does not take into account any clustering of results in the data set. Thus overall this method will not work properly.

Method II: To deal with the problems in the first method, another method has been proposed in the study, which is normal standardization technique.

The i^{th} dimension index for the j^{th} district is obtained by,

$$D_{ij} = \frac{\text{Actual value} - \text{mean}}{\text{Standard deviation}},$$

Where D_{ij} is the factor index corresponding to the factor i of the district j.

In this method the index will be lying between $-\infty$ to $+\infty$. The negative index should be interpreted as low value rather than a negative value in true sense. In this method the index will not be bounded and relative judgment should be given by looking at the index of financial inclusion. No value will be treated as optimum. A district will be more financially included than any other district if its index is more than that of the other district. In this method standard deviation is used as the measure of dispersion which is a good measure of

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dispersion. It takes into account the clustering of data if present and gives a reasonably good estimate of the spread in the data. The index for each dimension will not be under estimated as in the case of method I, and proper indexing will be done. Since mean of the data set is subtracted from actual observations, some of the observation will lie below the mean. Thus some of the indexes will come out to be negative. Using this method, it can also be checked by plotting the data whether it is from a normal distribution or not. It is useful to study the distribution as for further study if it is required to test for any parameter, then we the fact of normal distribution can be used.

Method III: Another method that can be taken into account for finding out this dimension index is to standardize the actual figures but taking modulus sign in the numerator.

The i^{th} dimension index for the j^{th} district is obtained by,

$$D_{ij} = \frac{|\,Actual\,value - mean\,|}{Standard\ deviation},$$

Where D_{ij} is the factor index corresponding to the factor i of the district j.

In this method the index will lie between 0 and $+\infty$. If there is any problem in interpreting the negative index then this method can be implemented, so that there will be no negative index. All the indexes will be given in positive terms. In this method also all the advantages of using the 2^{nd} method are present and also the index has no upper bound. So comparative study can be done using only the numerical figures of the index is possible but no optimum value of the index is possible as discussed earlier. But there is a serious drawback of this method. By using the modulus sign the negative values will be converted to positive values. This will result in over estimation of the indexes for some of the districts. For example, suppose for a variable one state has a very low value, which is lower than the mean. Clearly the numerator will be negative. Now if modulus sign is taken, then the numerator will become positive which becomes equivalent to another state which has value higher than the mean. Thus the index for that particular district will be over-estimated and the rank of that district will be higher with respect to other districts, which have values higher than mean but the absolute difference between the actual value and the mean is lesser. That will result in wrong conclusion. So this method will not be a proper measure to implement. Similar kind of measure can be defined by squaring the numerator. Same conclusion can be drawn on this measure also as it will also over estimate the indexes for some of the districts.

Method IV: All the three methods discussed above, there are some drawbacks in each of them. In the first method range has been used, which underestimates the individual dimension indices. In the second method where we the method of normal standardization has been used, some of the indices are coming out to be negative as some figures are less than mean. It is difficult to interpret the negative index as here no such base is present, to which the others will be compared. In the next discussed method modulus sign has been used to take care of the negative sign, but if this method is used to obtain the indexes, then some of the lower districts will be overestimated and their ranks will be much higher than what they should be in true sense.

To overcome these drawbacks, another methodology has been proposed here to obtain the individual dimension index for each of the districts.

The i^{th} dimension index for the j^{th} district is obtained by,

$$D_{ij} = \frac{Actual\,value - Minimum\,value}{Standard\ Deviation},$$

Where D_{ij} is the factor index corresponding to the factor i of the district j.

In this method the minimum value of the data set is used rather than the mean. This is the only difference between this method and the standardization method. Here standard deviation is used as the measure of dispersion, so it takes care of the drawback of the first method. Here it is assumed that the minimum value is the worst situation and the values can only be greater than this minimum value. So here the minimum value is subtracted from the actual figure as to make the minimum value to correspond zero. Here the index will lie between 0 to $+\infty$. That implies that there is no upper limit of the index which is as desired since the optimum situation in the case of financial inclusion can't be achieved in practice. There is always a scope of improvement regarding financial inclusion. But all the indexes will be positive. So the drawback of the 2^{nd} method is also taken care of. The value zero is interpreted as the worst situation, where there is complete financial exclusion, which is a hypothetical situation, and any district with positive index will be treated as better than the worst situation. But complete financial inclusion is not achievable practically. So there is no upper bound. And the third thing is it does not assign some of the lower districts with higher ranks as the districts will be ranked according to their actual value, which takes care of the drawback of the third method also.

Here all the four methods discussed above have been taken into account, in order to obtain the index of financial inclusion, and a comparative study has been done, which is given later. But from my personal point of view, if negative index can be interpreted properly, then the 2^{nd} method and the 4^{th} method are comparatively better methods to employ in this situation. If negative index can't be comprehended properly, then 4^{th} method is the best among all the four methods discussed.

- *Methodology for Getting the Indexes*

After getting the individual dimension indexes for each of the districts and the corresponding weights according to their importance in the study of financial inclusion, it is needed to combine them into a single index that will reflect the status of financial inclusion of a particular district of Uttar-Pradesh. Here the weighted arithmetic mean will be used to obtain the indices. In the previous methodology, it has already been discussed the importance of making the factors, influencing the index of financial inclusion, unit free. Otherwise two quantities with different units cannot be combined together.

After making all the factors unit free by using any of the above mentioned methods, now for a particular district j, the dimension indexes are D_{1j}, D_{2j}, ….., D_{9j} and the corresponding weights as w_1, w_2, ….., w_9 are available. Now for a particular district j the index for financial inclusion is given by,

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$$IFI_j = [(D_{1j}*W_1) + (D_{2j}*W_2) + \dots + (D_{9j}*W_9)] / (W_1 + W_2 + \dots + W_9) \quad \dots (\#)$$

In this case the sum of the weights is unity i.e. $(W_1 + W_2 + \dots\dots + W_9) = 1$, so the exact formula for obtaining the index is,

$$IFI_j = \sum_{i=1}^{9} (D_{ij} * w_i)$$

Weighted average is a simple measure and simple to interpret. Any layman also can comprehend this index and no complex calculation has to be done for using this methodology.

Using (#) indexes for financial inclusion can be obtained for each of the districts and then comparing all the indices, the district which is most financially included can be obtained and then all the districts can be ranked on the basis of the obtained indices. Now this over-all methodology can be used for other states also to obtain the status of financial inclusion.

III. Analysis

To start with the analysis, at first it is important to have at-least an outline idea about how the variables are related with each other. To get knowledge on this fact it will be useful to look at the correlation coefficients which give partial information on the linear relationships between the variables based on the obtained data. Before proceeding further it should be clearly stated that here it is assumed that all the factors are linearly related to each other.

The following tables contain the correlation coefficients of all the variables with each other.

TABLE I. Correlation coefficient between number of offices and other variables.

	Correlation coefficients with 'No of offices'
Per-Capita female deposit accounts	0.566
Per-Capita male deposit accounts	0.710
Per-Capita deposit amount	0.548
Male literacy per person	0.185
Female literacy per person	0.425
Per-Capita credit accounts	0.177
Per-Capita amount outstanding	0.524
Per-Capita credit amounts	0.612
Per-Capita GSDP	0.387

From the above table it can be noted that correlation between number of bank offices and per-capita male deposit account is high but the correlation with per-capita female deposit account is relatively lower. So as branches open males have more tendency than females to open accounts. The correlation between deposit amount and no of offices is not so high implying people have accounts irrespective of the amount they are depositing, which is a indicating financial inclusion. Correlation between the number of offices and per-capita credit account is very low but with credit amount it is relatively high. This may imply that the banks are providing credits to a small segment of people with higher credit amount. So people in poor society are deprived of getting credit facilities. There is no significant relationship between the number of offices and the literacy rates which is obvious. There is not much reasonable correlation between number of offices and per-capita GSDP also.

TABLE II. Correlation coefficient between per-capita female accounts and other variables.

	Correlation coefficient with Per-Capita female accounts
Per-Capita male deposit accounts	0.7605
Per-Capita deposit amount	0.7174
Male literacy rate per person	0.3402
Female literacy per person	0.5187
Per-Capita credit accounts	0.3667
Per-Capita amount outstanding	0.7013
Per-Capita credit amounts	0.7139
Per-Capita GSDP	0.5917

** Author's own calculation

The correlations between female accounts and male accounts are high implying that as male account increases female account also increases but the rate is slower in case females than the males. Same can be said about deposit amount. Correlation between female account and female literacy is not so high implying that although the literacy rate is high, women are either not willing to open bank account or they could not get available facilities from the bank. The other relationships with female accounts are not that significant for this study.

TABLE III. Correlation coefficient between per-capita male deposit accounts and other variables.

	Correlation coefficient with Per-Capita male deposit accounts
Per-Capita deposit amount	0.8444
Male literacy per person	0.4792
Female literacy per person	0.5836
Per-Capita credit accounts	0.3562
Per-Capita amount outstanding	0.8141
Per-Capita credit amounts	0.8189
Per-Capita GSDP	0.5490

From table III it can be noted that the correlation between male deposit account and deposit amount is quite high which is quite obvious. Correlations between male deposit account and amount outstanding is also very high and same for credit amount also. Correlation with literacy rate is not that high implying literacy rate does not depend on male deposit accounts as such.

TABLE IV. Correlation coefficient male literacy rate per person and other variables.

	Correlation coefficient with male literacy rate per person
Per-Capita deposit amount	0.3104
Female literacy per person	0.8870
Per-Capita credit accounts	0.0348
Per-Capita amount outstanding	0.3633
Per-Capita credit amounts	0.2665
Per-Capita GSDP	0.2235

Correlation between male literacy and female literacy is quite high which is a good indication. Female literacy rate is taken into this study as it can be used as an indicator of women empowerment. The other correlations are not of much importance. It can be noted that the correlation between male literacy and credit accounts is very low, implying that banks are not giving credits to all the people irrespective of literacy.

TABLE V. Correlation coefficient female literacy rate per person and other variables.

	Correlation coefficient with Female literacy per person
Per-Capita deposit amount	0.4395
Per-Capita credit accounts	0.1039
Per-Capita amount outstanding	0.4179
Per-Capita credit amounts	0.4412
Per-Capita GSDP	0.3685

TABLE VI. Correlation coefficient per capita credit accounts and other variables.

	Correlation coefficient with Per-Capita credit accounts
Per-Capita deposit amount	0.4258
Per-Capita amount outstanding	0.4953
Per-Capita credit amounts	0.5105
Per-Capita GSDP	0.6364

TABLE VII. Correlation coefficient per capita amount outstanding and other variables.

	Correlation coefficient with Per-Capita amount outstanding
Per-Capita deposit amount	0.9827
Per-Capita credit amounts	0.9858
Per-Capita GSDP	0.8494

Here it can be noted that the correlation of amount outstanding with deposit amount and credit amount, both are very high implying if deposit amount increases amount outstanding also increases and same with credit amount. It may be stated that both the amount outstanding variable and credit amount variable are denoting the same thing. In this study thus the variable amount outstanding can be eliminated and the variable credit amount is taken into consideration as it is one of the main factors influencing IFI.

TABLE VIII. Correlation coefficient per capita credit amount and other variables.

	Correlation coefficient with Per-Capita credit amounts
Per-Capita deposit amount	0.9741
Per-Capita GSDP	0.8305

TABLE IX. Correlation Coefficient per capita GSDP and other variables.

	Correlation coefficient with Per-Capita GSDP
Per-Capita deposit amount	0.798

From table VIII the correlation between deposit amount and credit amount is 0.97, which is very high, implying that if the banks are able to mop up large amount of deposits they are providing higher credits. But from table VI the correlation between credit account and deposit amounts is 0.4258 which is very low, showing that banks are providing credits to only a smaller section of the society, having sound repayment capacity so as to avoid Non Performing Assets (NPAs). It reflects willingness of banks for providing credits to all the people is lacking and hence resulting in financial exclusion. From table IX the correlation between GSDP and deposit amount is moderately high, which is also quite obvious.

Hence based on the above study only on correlations it can be concluded that the main obstacle for financial inclusion is the bank itself, who are either not willing to provide credit facilities to all the people in the society or unable to percolate proper information to all the people. The improvement should be on the part of the banks and proper banking awareness should be spread to all people.

After studying this correlation part now the important variables that will be incorporated in the study are Number of bank branches, per-capita male deposit accounts, per-capita deposit amounts, per-capita credit accounts, per-capita credit amounts, male literacy per person, female literacy per person, per-capita female accounts and per-capita GSDP. Now the next thing will be to standardize the variables so that they can be combined together, and based on the figures the appropriate weights will be obtained and the indices will be calculated henceforth.

Now the appropriate weight for each of the factors will be obtained using principal component method on the standardized values of all the variables. So at first the data is standardized using all the four methods discussed in the methodology part and then principal component method is applied to get the weights.

Using method-I, all the variables are standardized by the method discussed in the previous papers i.e. by subtracting the minimum value from the actual figures and then by dividing it by the range for each variable. After standardizing, the eigen values of the correlation matrix of the standardized variables are given as follows.

TABLE X. Eigen values of the correlation matrix.

Eigen-values	**Difference**	**Proportion**	**Cumulative**
5.305	3.745	0.5895	0.5895
1.560	0.665	0.1734	0.7629
0.894	0.423	0.0994	0.8623
0.472	0.113	0.0524	0.9148
0.358	0.084	0.0399	0.9546
0.274	0.194	0.0305	0.9851
0.079	0.035	0.0089	0.9939
0.044	0.035	0.0050	0.9989
0.009		0.0011	1.000

In this study it is required to make the dimension unity so that the new variable explains maximum variability. Here only the first principal component is taken into consideration as it explains 59% of the total variability. The first principal component is obtained by getting the eigen vector corresponding to the maximum eigen value.

TABLE XI. Eigen vector corresponding to the first eigen value.

Standardizes variables	**Principal component-1**
Number of offices	0.299025
per-capita female deposit accounts	0.361333
per-capita male deposit accounts	0.394476
per-capita deposit amount	0.398821
per-capita male literacy	0.218471
per-capita female literacy	0.288808
per-capita credit accounts	0.223183
per-capita credit amount	0.404313
per-capita GSDP	0.347756

Now for each of the districts the First Principal Component (FPC) is obtained and correlation between the FPC and the other variables are obtained and based on the proportion of the correlation coefficients the weights corresponding to each of the variables are obtained.

TABLE XII. Correlations between FPC and other variables and the weights.

Variables	Correlations	Weights
Number of offices	0.68541	0.1011
per-capita female deposit accounts	0.83151	0.1227
per-capita male deposit accounts	0.91003	0.1342
per-capita deposit amount	0.89869	0.1326
per-capita male literacy	0.54375	0.0802
per-capita female literacy	0.69832	0.1030
per-capita credit accounts	0.51598	0.0761
per-capita credit amount	0.91185	0.1345
per-capita GSDP	0.78335	0.1156

Based on the obtained weights, as given in table XII, the index would be calculated by taking weighted mean of the standardized figures of the variables with the obtained weights.

Based on table XIII, Gautam Buddha Nagar has got the maximum index .91, implying to be most financially included. In this methodology index 1 means maximum financial inclusion and GB Nagar is quite close to the optimal figure. After GB Nagar, Lucknow, Kanpur Nagar, Ghaziabad follow with respective indices as 0.73, 0.50, 0.46. The least financially included district is Balrampur with index 0.06.

TABLE XIII. Financial inclusion index based on method-I.

District	Index	Rank	District	Index	Rank
GAUTAM BUDDHA NAGAR	0.91	1	BARA BANKI	0.23	36
LUCKNOW	0.73	2	MORADABAD	0.22	37
KANPUR NAGAR	0.50	3	UNNAO	0.22	38
GHAZIABAD	0.46	4	JYOTIBA PHULE NAGAR	0.22	39
MEERUT	0.43	5	BAREILLY	0.22	40
KANPUR DEHAT	0.38	6	MIRZAPUR	0.22	41
VARANASI	0.38	7	ETAH	0.22	42
AGRA	0.36	8	FIROZABAD	0.22	43
JHANSI	0.36	9	KANAUJ	0.22	44
ALLAHABAD	0.31	10	MAHOBA	0.21	45
MATHURA	0.31	11	FARRUKHABAD	0.21	46
SAHARANPUR	0.29	12	DEORIA	0.21	47
GORAKHPUR	0.28	13	SANT RAVIDAS NAGAR	0.20	48
MUZAFFARNAGAR	0.28	14	CHITRAKOOT	0.19	49
AZAMGARH	0.27	15	CHANDAULI	0.19	50
ALIGARH	0.27	16	LALITPUR	0.19	51
MAHAMAYANAGAR	0.26	17	FATEHPUR	0.19	52
JALAUN	0.26	18	SITAPUR	0.19	53
BIJNOR	0.25	19	BASTI	0.19	54
SULTANPUR	0.25	20	SONBHADRA	0.18	55
BAGHPAT	0.25	21	HARDOI	0.18	56
ETAWAH	0.25	22	SHAHJAHANPUR	0.18	57
JAUNPUR	0.25	23	PILIBHIT	0.18	58
HAMIRPUR	0.25	24	KHERI	0.16	59
BULANDSHAHR	0.24	25	KUSHI NAGAR	0.15	60
GHAZIPUR	0.24	26	SANT KABIR NAGAR	0.15	61
FAIZABAD	0.24	27	GONDA	0.14	62
BALLIA	0.24	28	RAMPUR	0.14	63
RAI BARELI	0.24	29	MAHARAJGANJ	0.13	64
PRATAPGARH	0.24	30	KANSHIRAM NAGAR	0.13	65
AMBEDKAR NAGAR	0.23	31	SIDHARTHANAGAR	0.12	66
MAU	0.23	32	KAUSHAMBI	0.12	67
MAINPURI	0.23	33	SHRAVASTI	0.12	68
BANDA	0.23	34	BUDAUN	0.10	69
AURAIYA	0.23	35	BAHRAICH	0.07	70
			BALRAMPUR	0.06	71

(Given in decreasing order)

IV. CONCLUSION

The main objective of this study is to provide a suitable statistical technique to compute the index of financial inclusion in all the districts of Uttar-Pradesh. The idea is to give proper justification of whatever has been done in the methodology in order to get the index and for layman it should be easily comprehendible and simple. The issue of financial inclusion is now as one of the hot topics of research and development. It is one of the desired indexes by every economically enriched nation. So computation of such index should be done in a proper way such that it can be used by other states as well as other countries also.

The primary aim of this study is to develop a proper weighing technique so that the variables or factors, influencing the index, can be incorporated in the computation according to their importance. Principal component method is used and further some statistical techniques have been used to obtain a statistically justified tool to get the appropriate weights. After that, the main importance is on the methods of getting individual dimension indices. For that four methods have been discussed. After that weighted average is used to get the final index for each of the districts of UP. Among all the four methods discussed, method-4 comes out to be more satisfactory than the other as it removed all the previous drawbacks of this study. It takes into account the fact that IFI

can't be bounded by any number since fully financial inclusion is not practical and it is a hypothetical situation.

After implementing the above discussed measures to the available data the IFIs for all the districts of UP are obtained and Gautam Buddha Nagar came out to be the most financially included district in UP, followed by the capital Lucknow, Kanpur Nagar and so on. Balrampur came out to be the least financially included district among the others. Further in this study the women empowerment factor also have been taken into consideration so as to look whether it has any effect in finding the index. It has been noted that women empowerment has a positive relation with IFI.

From the policy makers' point of view it is interesting to see which district is lacking behind in which factor. If it is known that which factor in which district is lacking behind, then correspondingly improvement on that particular factor may be incorporated in order to improve the situation of financial inclusion. According to the assigned weights, the factors per-capita credit amount, per-capita deposit amount, per-capita female deposit accounts and per-capita GSDP are the most important factors which influence IFI.

It may be concluded that the methodology discussed in the paper is globally defined and not only at the district level, even it can be used at the state level as well as at the country level also. Further if some more factors are included, it can be easily incorporated in the study. The proposed methodology gives the IFI in such a way that the index can be calculated for any point of time and further updating of the index is possible at any point of time. It gives an index of a region for a given time point rather that any relative index with respect to some past time point for which data may be difficult to get or data may be out dated.

And finally it can be said that the proposed methodology is simple and easy to comprehend and the index will lie in between zero to infinity, where zero represents complete financial exclusion and infinity indicates that improvement is always possible regarding financial inclusion.

V. Further Possible Works

This study is mainly based on the secondary data available on some of the factors. But whatever factors that have been incorporated in this study are not adequate. So it is possible to collect data on the other variables that haven't been included in the study and do this study once again so that the index will be accurate based on the data. Further this study can be extended by framing a questionnaire, containing questions regarding all the factors in the study and a survey can be conducted in each of the districts so as to verify the results obtained so far. The method of cross-validation can be used to check whether the proposed method is doing fine or not. Of course if possible, further improvements and technical innovations are always welcome. For this kind of studies the main obstacle is the data availability. So based on some survey schedule if data can be obtained from the field itself it will showcase more finer and accurate picture of financial inclusion.

From the results it can be seen that most of the districts which are at the top of the table XIII i.e. the more financially included districts are urbanized whereas the lower financially included districts are not urbanized, which is quite reasonable. So it will be better if there is a factor based on which the districts can be categorized as urbanized and not urbanized. Then the same methodology can be applied to each group of districts to obtain more realistic and informative picture of financial inclusion.

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