# IDENTIFYING SUPPLY AND DEMAND SIDE FACTORS THAT INFLUENCE FINANCIAL INCLUSION – AN APPLICATION OF ANNs[1]

Vishnuprasad Nagadevara, Indian Institute of Management Bangalore

## ABSTRACT

*Theoretically, financial development creates enabling conditions for growth through either a supply-led or a demand-pull process. Financial inclusion implies provision of affordable financial services, such as access to payments and remittance facilities, savings, loans and insurance services by the formal financial system to those who tend to be excluded. The factors that influence supply and demand side of financial inclusion are analyzed in this paper. Artificial Neural Networks are used to identify specific factors that influence different financial products on the supply side and different sources of borrowing on the demand side. These factors can be used for evolving appropriate strategies for enhancing financial inclusion.*

***Keywords****: Financial Inclusion, Artificial Neural Networks, Financial Products, Supply and Demand Side*

## 1. INTRODUCTION

Financial development creates enabling conditions for growth through either a supply-led or demand-pull factors. A large body of empirical research supports the view that development of the financial system contributes to economic growth (Rajan and Zingales, 2003). Documented evidence indicates that various measures of financial development such as stocks, bonds, access to credit, liquidity, assets and liabilities of financial institutions are positively related to economic growth (King and Levine, 1993; Levine and Zervos, 1998). Other studies establish a positive relationship between financial development and growth at the industry level (Rajan and Zingales, 1998). Even the recent literature on growth, emphasizes the special role of finance in economic development (Mohan, 2006). The need to enhance financial inclusion cannot be over emphasized in the context of economic development. Financial inclusion is delivery of financial services at an affordable cost to the vast sections of underprivileged and low income groups. Financial inclusion implies provision of affordable financial services, such as access to payments and remittance facilities, savings, loans and insurance services by the formal financial system to those who tend to be excluded. It is important to recognize that in the policy framework for development of the formal financial system in India, the need for financial inclusion and covering more and more of the excluded population by the formal financial system has always been consciously emphasized (Agrawal, 2007). Financial exclusion, defined as individuals' limited access to or use of formal financial services, is a problem all over the world. It was estimated that more than 3 billion people are financially excluded around the world. India has the second largest number of financially excluded households estimated at 135 million (Boston Consulting Group, 2007). Historically, the Government of India has been evolving various strategies for enhancing financial inclusion through increase in banking penetration starting with the creation of State Bank of India in 1955. The nationalization of commercial banks in 1969 and 1980 was one of the major policy initiatives in this direction. Bank nationalization in India marked a paradigm shift in the focus of banking as it was intended to shift the focus from class banking to mass banking. There are concerns that banks have not been able to include vast segment of the population, especially the underprivileged sections, into the fold of basic banking services (Thorat, 2007a). This led to the emergence of Financial Inclusion as a strategy to bring the excluded people into the mainstream. Although credit is the most important component, financial inclusion covers various financial services such as savings, insurance, payments and remittance facilities by the formal financial system to those who tend to be excluded (Mahendra, 2006).

The financially excluded sections largely comprise marginal farmers, landless laborers, self employed and unorganized sector enterprises, urban slum dwellers, migrants, ethnic minorities and socially excluded

groups, senior citizens and women (Thorat, 2007b). Inclusive financial system can lead to faster and more equitable growth. Such a system allows poor households to save and manage their money securely, decreases their vulnerability to economic shocks and allows them to contribute more actively to their development. With the proliferation of micro finance initiatives, there is evidence that inclusive financial systems can empower poor households socially as well.

The strategies for financial inclusion through promotion of savings need to go beyond the formal banking system. In addition to the banking products the strategies for enhancing financial inclusion will have to look at other products such as insurance, post office related small savings and long term instruments such as provident fund and pension schemes on the supply side and various sources of borrowing, including Self Help Groups (SHGs) on the demand side. These strategies need to identify the special and unique features that influence different segments of the society to get attracted to different products. These factors could vary from product to product as well as from segment to segment.

## 2. OBJECTIVES

There are many factors that impact financial inclusion of the population which is hitherto left out. These factors could be categorized as demand side and supply side factors. The demand and supply are defined from the point of view of the financially excluded population. Thus, various factors influencing different savings instruments are defined as supply side factors while the factors influencing the loans and borrowings are classified into demand side factors. The objectives of the study are to

1. Identify the factors that influence the supply and demand side of financial inclusion

2. Rank these factors in terms of their relative importance

3. Identify appropriate strategies for enhancing financial inclusion using these factors

## 3. METHODOLOGY

Many of the factors that were identified by previous studies such as gender, occupation, income groups, etc. are mostly either categorical or ordinal in nature. In addition, the financial inclusion itself is a categorical variable. One of the best statistical techniques available for analyzing the relationships between such variables is the Chi-square test ($\chi^2$). While the $\chi^2$ test is good for identifying the relationships between categorical and ordinal variables, it is not amicable to determine the relative importance of these variables. Consequently, the $\chi^2$ test could not be used to prioritize the factors influencing financial inclusion. Hence an alternate approach is needed to prioritize the influencing factors after identifying the same. One such technique is application of Artificial Neural Networks. The data for the study was taken from the National Data Survey on Saving Patterns of Indians. The survey was conducted with an objective of portraying the dynamics of the unorganized sector for the country as a whole. The sample covered both the rural and urban areas of the country. The data contained various demographic characteristics such gender, age, marital status, household size, education, profession etc. as well as socio-economic characteristics such as caste, job description, asset ownership, media exposure etc. In addition, it contained information on coverage with respect to various financial products such as EPF, EPS, GPS, GPF, bank deposits, insurance related products etc. and also data on different sources of loans and borrowing. This database is used to analyze access to various types of financial products and sources in order to identify the factors that have an impact on financial inclusion.

The artificial neural networks (ANN) are generally based on the concepts of the human (or biological) neural network consisting of neurons, which are interconnected by the processing elements. The ANNs are composed of two main structures namely the nodes and the links. The nodes correspond to the neurons and the links correspond to the links between neurons. The artificial neural networks are found

to be effective in detecting unknown relationships.  ANNs have been applied in many service industries such as health to identify the length of stay and hospital expenses (Nagadevara, 2004), air lines (Chatfield, 1998) and ANNs are used in this paper for predicting the categories of the members of the loyalty programs (Nagadevara, 2005).

## 4.  SAMPLE PROFILE

The dataset covered a total of 40,862 respondents.  More than 87 percent of them are male.  At the same time these respondents are evenly distributed between rural and urban areas.  Only 30 percent of the respondents belong to scheduled caste/ scheduled tribe category.   The percentage of SC/ST respondents in the rural areas is more than that of the urban areas.  More than 60 percent of the respondents had education up to "Plus Two" or graduation.  A large majority of them are proficient in their respective regional language.   As expected, the predominant occupations in the rural area are Agriculture, diary and labourer and the predominant occupations in the urban areas are trading and labourer followed by salaried employment.  A large majority of the respondents are currently married.

The database contained information on all the avenues of savings used by the respondents.  These included various instruments such as EPF, PPF, savings account, fixed deposits, recurring deposits, life insurance, National Savings Certificate, Kisan Vikas Patra etc.  All these are grouped into four categories for the purpose of analysis.  These categories are Long Term instruments (EPF, GPF, EPS, GPS, CPF, gratuity etc.), Banking Products (savings account, fixed deposits and recurring deposits), Small Savings (Post office oriented instruments) and Insurance products (life insurance, personal accident insurance, health insurance and non-life general insurance).   The factors influencing each of these different categories are likely to be different and hence each category was analyzed separately.   Similarly the dataset contained various sources of loans and borrowings.  These included private and public financial institutions, governmental agencies, cooperative banks and societies, employers, friends and relatives, money lenders etc.   These are grouped into five categories namely Cooperative Banks and Societies, Money Lenders, Private and National FIs, Relatives and Friends and Others (including SHGs, chit funds etc).  The exposure to the sample families to various instruments and sources is presented in Table 1.

Table 1. Exposure to various financial instruments and sources of borrowing

| Supply Side | | | Demand Side | | |
|---|---|---|---|---|---|
| Instrument | Number | Percentage | Source | Number | Percentage |
| Provident Fund | 6685 | 16.35% | Money Lenders | 4039 | 9.88% |
| Banking Products | 21265 | 52.02% | Private & National FIs | 2017 | 4.93% |
| Post Office | 1293 | 3.16% | Coop Bank & Societies | 1854 | 4.54% |
| Insurance Products | 11289 | 27.61% | Relatives & Friends | 3407 | 8.33% |
| | | | Others | 2185 | 5.34% |
| ALL | 40882 | 100.00% | | 40882 | 100.00% |

It is evident from the above table that the penetration of financial instruments is very meager except in the case of banking products.

## 5.  RESULTS AND DISCUSSION

The data is analyzed using Artificial Neural Networks.  For each of the 4 categories on the supply side and 5 categories on the demand side, separate neural networks were developed.  In each case the dependent variable is whether the respondent is exposed to the specific financial instrument or borrowed from a particular source.  Given that the exposure to any particular financial product or source of borrowing is very low, there was a problem of skewed datasets.  Over sampling methodology is adopted to make sure that the minority class is not overwhelmed by the majority class (Anujkumar and Nagadevara, 2006).  After developing the neural networks as mentioned above, the relative importance

of each of the factors/variables is obtained.  These factors are arranged in the descending order of importance and the top ten are selected.  These factors with respect to the financial products (supply side) factors) are listed in Table 2 indicated by "X" in the respective column.  Similarly, Table 3 presents the top ten factors for the demand side.

Table 2. Ten  most important factors influencing the financial products (supply side)

| Item | Coop Bank and Coop Society | Money Lenders | Private & National FIs | Relatives & Friends | SHG, Chits & Others |
|---|---|---|---|---|---|
| Exposure to TV | X | | X | X | X |
| Exposure to Radio | X | | X | | X |
| Exposure to Newspaper | X | | X | X | |
| Language Proficiency [Local] | X | X | X | X | X |
| Language Proficiency [Hindi] | X | X | X | X | |
| Gender | X | | X | | X |
| Agricultural Landholding | X | | | X | |
| Marital Status | X | | | | X |
| Occupation | X | X | | X | X |
| Language Proficiency [English] | X | | X | X | X |
| Education Level | | X | X | X | |
| Annual Expenditure | | X | | | |
| Annual Investible Surplus | | X | | | |
| Awareness of Alternative Investment Options | | X | X | X | X |
| Agricultural Landholding | | X | | | |
| Primary Savings Need | | X | | | |
| Typology (Rural/Urban) | | X | | | |
| Exposure to Internet | | | | X | X |
| Marital Status | | | | X | |
| Media Exposure | | | | | X |

Table 3. Most important factors influencing the source of borrowing (demand side)

| Item | Banking Products | Insurance Products | Post Office | Provident Fund |
|---|---|---|---|---|
| Primary Savings Need | X | X | X | X |
| Occupation | X | X | X | X |
| Marital Status | X | X | X | X |
| Agricultural Landholding | X | | | |
| Language Proficiency [Local] | X | X | X | X |
| Annual Expenditure | X | | X | X |
| Annual Income | X | | X | |
| Age Group | X | | | |
| Ownership of Occupied House | X | | | |
| Annual Investible Surplus | X | X | X | X |
| Language Proficiency [English] | | X | X | X |
| Exposure to TV | | X | | |

| Item | Banking Products | Insurance Products | Post Office | Provident Fund |
|---|---|---|---|---|
| Exposure to Newspaper | | X | | |
| Language Proficiency [Hindi] | | X | X | |
| Awareness of Alternative Investment Options | | X | | X |
| Education Level | | | X | X |
| Exposure to Internet | | | | X |

One of the most important aspect that emerges from Tables 2 and 3 is that some of the factors influencing the supply and demand are very different. There are certain factors such as "annual investible surplus" and "annual expenditure" which are common for both supply and demand. On the other hand, Annual income, age group and ownership of occupied house are specific to demand side. Similarly, the factors that are specific to supply side are media exposure, typology (rural/urban), gender, exposure to radio, and marital status. Another interesting aspect is that these factors that are specific to either supply or demand side are also very specific to a certain product or source. While the commonality of the factors between supply and demand will make it easy for the policy makers to target specific segments of the population (such as based on occupation or proficiency in English language), those factors that are specific to any particular product or source can be leveraged to target the specific groups for the particular product or source. In addition, the factors such as exposure to radio can be used to leverage specific media for promoting the appropriate message.

## 6. SUMMARY AND CONCLUSIONS

There is a general agreement among economists that financial development is a major factor influencing economic growth. Theoretically, financial development creates enabling conditions for growth through either a supply-led or a demand-pull process. Financial inclusion implies provision of affordable financial services, such as access to payments and remittance facilities, savings, loans and insurance services by the formal financial system to those who tend to be excluded. The factors that influence supply and demand side of financial inclusion are analyzed in this paper. The supply side of financial inclusion is characterized by four different categories of financial products and similarly, the demand side is characterized by five different sources of borrowing. Artificial Neural Networks have been used to identify the specific factors that influence these products and sources. While some of these factors are common for both supply and demand, some other factors are specific to supply side and demand side of financial inclusion. Even within the supply and demand categories, there are certain factors that are very specific to a particular product or source. Specific strategies can be developed for enhancing financial inclusion by targeting different segments by leveraging the factors. Identification of these factors can also help the strategists to decide on the appropriate media for promoting the suitable messages. Thus it is possible to develop specific strategies based on these factors to bring a larger segment of the financially excluded population into the ambit of various savings instruments thereby enhancing the financial inclusion.

## 7. REFERENCES

Agrawal, R. (2007). 100 % Financial Inclusion : A Challenging Task Ahead, Paper presented at the Conference on Global Competition & Competitiveness of Indian Corporate, IIM Kozhikode, Available at http://dspace.iimk.ac.in/bitstream/2259/485/1/271-286+.pdf, Last Accessed June 28, 2008.

Anujkumar and Vishnuprasad Nagadevara (2006), Development of Hybrid Classification Methodology for Mining Skewed Data Sets – A Case Study of Indian Customs Data", Proceedings of the 4th ACS/IEEE International Conference on Computer Systems and Applications, Mar 8-10, 2006, Sharjah, UAE

Chatfield, C. (1998) 'Time Series Forecasting with Neural Networks: A Comparative Study using the Airlines Data', *Applied Statistics,* 47, Part 2, pp. 231-250

Boston Consulting Group (2007), The next Billion Consumers: a Road Map for Expanding Financial Inclusion in India, Nov 2007.

Fisher and Shriram (2002) Beyond Micro Credit, Vistaar Publications. 2002.

Karmakar, K.G. (2002) Micro finance revisited, Financing Agriculture, Vol.34, No.2, April-June 2002.

King, R.G. and R. Levine (1993), Finance and Growth: Schumpeter might be right, Quarterly Journal of Economics 108, 717-37.

Levine, R. and S. Zervos (1998). Stock Markets, Banks and Economic Growth, American Economic Review 88, 537-58.

Mahendra Dev S (2006) Financial Inclusion: Issues and Challenges, Economic and Political Weekly, Vol. 41, No. 41 October 14-October 20.

Mohan, Rakesh (2006). Economic Growth, Financial Deepening, and Financial Inclusion,  Address at the Annual Bankers' Conference 2006, at Hyderabad on Nov 3, 2006.

Nagadevara, V. (2004). Application of neural prediction models in healthcare. Paper presented at the Second International Conference on e-Governance, Colombo, Sri Lanka.

Nagadevara V,. (2005) "Improving the Effectiveness of Hotel Loyalty Programmes through Data Mining", Proceedings of the "International Conference on Services Management, Mar 11-12, 2005, New Delhi,

Rajan, R.G. and L. Zingales (1998), Financial Dependence and Growth, American Economic Review 88, 559-86.

Rajan, R.G. and L. Zingales (2003), Saving Capitalism from Capitalists, Crown Business, New York.

Rajshekar D. (2004), Micro Finance, Poverty, and Empowerment of Women: A case study of two NGOs from Andhra Pradesh and Karnataka, ISEC publications, Bangalore, 2004.

Thorat, Usha (2007a), Taking Banking Services to the Common Man – Financial Inclusion, Deputy Governor, Reserve Bank of India at the HMT-DFID Financial Inclusion Conference 2007, Whitehall Place, London, UK, June 19.

Thorat, Usha (2007b), Financial Inclusion – The Indian Experience, Text of speech by Deputy Governor, Reserve Bank of India at the HMT-DFID Financial Inclusion Conference 2007, Whitehall Place, London.

Dr. Vishnuprasad Nagadevara obtained his Ph D from Iowa State University, Ames Iowa.  He is currently Professor in the Quantitative Methods and Information Systems Area at the Indian Institute of Management Bangalore.   His current research interests are Data Mining, Application of OR Techniques to Management.