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Empirical Evidence on Causality between Financial Inclusion and Economic Growth in India Using Vector Error Correction Model

Bhawna Rajput[1*], Anupama Rajput[2]

[1]Department of Commerce, Aditi Mahavidyalaya, University of Delhi, India
[2]Department of Commerce, Janki Devi Memorial College, University of Delhi, India

**Corresponding Author: simrankrish@gmail.com*

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Abstract—Financial inclusion enhances access of financial services and provides a positive impact on people's lives particularly poor people. Financial inclusion is an important aspect of inclusive and sustained economic growth. The improved and easy access of formal financial system helps to unlock the economic potential of the population. This paper attempts to examine the status of financial inclusion and the impact of economic growth and other macroeconomic variables on financial inclusion of India using annual time series data of 37 years and covers the period from 1980 to 2016. The study uses Vector Autoregressive (VAR) method consisting Johansen and Juselius multivariate approach of co integration, Vector Error Correction Model (VECM) in combination with innovation of accounting (Impulse Response Function (IRF), and Variance Decomposition (VDC) to provide empirical evidence on short-term and long-term dynamic relationship between financial inclusion and economic growth. Further, the causal relationship between financial inclusion and economic growth in India for the sample period has been analyzed using Granger causality through cointegrated Vector Autoregression methods. The analysis was carried out using multidimensional financial inclusion index based on factors such as access to financial services, penetration of the financial services and the utilization of the services. To capture the effect of the financial reform policy initiated in 1991, the shift dummy variable in 1991 is included in the cointegration test and VECM equation.The results of trace statistics of Johansen cointegrating equation indicate the existence of positive long run equilibrium relationship between economic growth and measure of financial inclusion, inflation and trade openness. In the estimation of VECM, the error correction term indicates that the system corrects its previous disequilibrium at a speed of 22.21 percent p.a. The IRF and VDC analysis shows that financial inclusion has a significant positive impact on economic growth in the long run, meaning that inclusive financial systems leads to higher economic growth. VECM Granger causality results indicate that financial inclusion causes economic growth in India. The causality runs from financial inclusion to economic growth i.e. the supply leading hypothesis is predominant in India. Financial inclusion and institutional financial reforms should be enhanced in order to promote economic growth process in India.

Keywords—Financial Inclusion, Economic Growth, Vector Autoregressive (VAR) Method, Vector Error Correction Model (VECM), Granger Causality, Phillips-Perron (PP) Test.

I. INTRODUCTION

The Financial inclusion is a process to provide an access of formal financial services to the weaker and vulnerable sections of society. It enables the accessibility of timely and adequate credit and other financial services such as insurance and equity products to vulnerable groups at an affordable cost. Globally, financial regulators, governments and banking industry have initiated various policy measures to develop an inclusive financial system and have widely recognized it as a policy priority. Financial inclusion is an important pillar to the inclusive growth process and sustainable development of the country. In fact, the financial sector acts as a facilitator and multiplier for overall economic growth and stability. The financially inclusive society promotes economic activities by mobilizing savings from the informal sector into the formal financial system. It allows mitigation of risks by offering an access to variety of social security products such as micro-savings, micro-credit, micro-insurance, and micro-pension products etc. Financial inclusion also allows improved and better sustainable social development of the country. Financial inclusion helps to achieve empowerment of the underprivileged, poor and women of the country with an aim of making them self-sufficient and well informed to take better financial decisions.It is now generally agreed that financial inclusion is important for economic growth. However, there is an ambiguity regarding the direction of causality between financial inclusion and economic development. The evidence on direction of causality can have significant policy

implications for central bankers and commercial bankers to adopt innovative approaches to enhance level of financial inclusion in India. The direction of causality between financial inclusion and economic growth can either be unidirectional or bi-directional. The unidirectional causality may support either the supply-leading hypothesis or demand-following hypothesis. The supply-leading hypothesis postulates that the economies with financially inclusive system will grow faster i.e. financial inclusion causes economic development. The demand-following hypothesis states that economic growth is a causal factor for financial inclusion since the increased economic growth increases the demand for financial services which stimulates financial inclusion.

Since 2005, The concerted efforts have been made by Government of India and the Reserve Bank of India to promote financial inclusion and has been pursued as one of the important national objectives of the country. Government of India has initiated measures such as Kisan Credit Card, Mahatma Gandhi National Rural Employment Guarantee Scheme, Aadhar Scheme, Pradhan Mantri Jan dhanYojana (PMJDY), Atal Pension Yojana (APY), Pradhan Mantri Mudra Yojana, Pradhan Mantri Suraksha BimaYojana (PMSBY), Sukanya Samridhi Yojana etc. The measures initiated by Reserve Bank of India includes SHG-bank linkage program, institutionalization of business facilitators and correspondents, easing of Know Your Customer (KYC) norms, establishment of rural bank branches and ATMs, opening and encouraging 'no-frill-accounts' and emphasis on financial literacy.

The main objective of this study is to empirically investigate the nature of relationship between financial inclusion (FI), trade openness, inflation and economic growth in India. Specifically, the study analyzes the status of financial exclusion/ inclusion and examines the short run and long run relationship between financial inclusion and economic growth in India during sample period of 1980 to 2016. Further, the empirical evidence is provided by analyzing the causality between financial inclusion and economic growth of India for the sample period.

The paper is structured as follows: the empirical literature and views expressed on financial inclusion and economic growth is provided in Section 2; Section 3 presents the theoretical model used for the study; Research model specification and its estimation procedure with details interpretation are included in Section 4; Sources of Data is provided in Section 5; Section 6 presents the empirical findings of the study and finally Section 7, draws conclusion.

II. LITERATURE REVIEW

There is a vast empirical research that emphasizes the relationship between financial inclusion and economic growth. The accessibility of funds is enlarged with the presence of an inclusive financial system which broadens the economic activities and spurs the process of economic growth. Empirical evidences suggest that financial inclusion and economic growth relationship can be either supply-leading (financial inclusion causes growth) or a demand-following (growth leads to financial inclusion as growth improves the demand for financial products and services) Besides, the endogenous growth literature highlights the role of finance (Aghion & Hewitt, 1998, 2005)[1,2] in the process of economic growth.

Moise Bigirimana, XU Hongyi (2017) [30] applied ARDL approach by using annual data from 2004 to 2016 to examine the relationship between financial inclusion and economic growth of Rwanda. "The results of the study revealed that there is a long run relationship between financial inclusion and economic growth of Rwanda".

Michael Chukwunaekwu Nwafor1,Aremu Israel Yomi (2017)[29]analyzed the connection between financial inclusion and economic growth in Nigeria for the data from 2001 to 2016 using two-staged least squares regression method. The study found the significant impact of financial inclusion on economic growth in Nigeria and financial intermediation was not found to influence the level of financial inclusion during the period under study.The study recommended "better targeting of financial products to the financially excluded regions of the country so as to improve GDP per capita and economic growth of the country".

DinabandhuSethi and Debashis Acharya (2017)[14] found the existence of bidirectional causality and long run positive relationship between financial inclusion and economic growth across 31 countries. Thus, financial sector reforms promoting financial inclusion shall result in higher economic growth in the long run.

BadarAlamIqbalShaista Sami (2017)[5] emphasized the financial inclusion as the robust pillar of economic growth and development of country like India and is an important development tool to eliminate poverty and income inequalities. In fact financial inclusion is emerging as a new paradigm of economic growth in India. The study uses multiple regression models and "found significantly positive impact of number of bank branches and credit deposit ratio on GDP of the country". The growth of ATMs was found to insignificant impact on GDP of India.

Dipasha Sharma (2016)[15] has provided various dimensions of financial inclusion estimated by bank penetration, banking services availability and banking services usage and found positive and significant association between economic growth and various dimensions of financial inclusion in India. The bi-directional causality was observed between banking geographic outreach and economic development as measured by GDP and unidirectional causality between number of deposits/loan accounts and GDP of the country.

Robert Cull etc, (2014)[36] presented cross-country analysis of relationship between financial inclusion and economic growth and found positive and causal relationship between financial intermediation and growth and employment. The wider financial intermediations lower transaction costs and financial risk and allow the better distribution of capital in the financial system.There is positive effects broader access to bank deposits on financial stability.

Nwankwo, Odi., Fcib and Nwankwo and Ogonna N. O. (2014)[31] used descriptive study and content analysis to examine the financial inclusion sustainability to rural dwellers in Nigeria It was found that the financial inclusion sustainability to rural dwellers in Nigeria is the main pillar for economic growth. The proper implementation of financial inclusion in the rural areasis an important prerequisite of fast economic growth in Nigeria. The study recommended that the promotion of the collaborative efforts of Deposit Money Banks (DMBs), Microfinance Banks (MFBs) and Communication services are essential for higher degree of financial intermediation process. Financial literacy of rural dwellers allows better understanding and appreciation of importance of financial inclusion and change orientation for the use of banking services

Hariharan and Marktanner (2012)[21] found positive and high degree of positive correlation between financial inclusion (FI) and total factor productivity (TFP) and thus enables creation of capital in the country. FI enables an increase in the financial system deposits, improves intermediation efficiency, and gives spurt to entrepreneurial process which lead to the process of economic growth.

Khan (2011)[25] described that the financially inclusive society allows improved economic activities and employment opportunities for rural households which increases disposable income and savings level of rural population and channelization of greater amount of funds in the bank's deposits and investment activities that results into increased economic growth.

R Gopalan, (2010)[35] explained the importance of financial inclusion for GDP growth alleviation of poverty and inequality in any country. It allows an improved accessibility to financial resources and services by poor and micro enterprises that generate income earning and employment opportunities hence positively impact economic development of a nation. "A well-developed financial system accessible to all reduces information and transaction costs, influences saving rates, investment decisions, technological innovation, and the long-run growth rates" (Beck et al. 2008). Financial inclusion also mitigates the exploitation of vulnerable sections.

Levine (2005)[27]and Beck et. al. (2008)[7] also concluded the financial deepening positively impact the process of growth of an economy. Financial inclusion enables the availability of financial services to the wider section of society which causes spur in the economic activity of the country.

Honohan (2007 and 2008)[20] provided the cross-sectional series of financial access indicator depicting the accessibility of formal financial system by the adult population of an economy mainly by using data of household survey on financial access and information on number of bank accounts and GDP per capita across economies. As the data is based on the most recent data available for any economy so the study fails to provide the comparative analysis of different economies over time.

The perusal of the above literature exhibits that the existence of a relationship between finance and growth is incontestable; however, the direction of causality between finance and growth is debatable. There are limited studies on the causal relationship between financial inclusion and economic growth in India. The present study empirically analyze the causal relationship between financial inclusion and economic growth in India for the period 1980 to 2016 using cointegrated vector autoregression methodology.

III. THEORETICAL MODEL

Thepresent study aims to analyze the degree and causality of relationship between financial inclusion and economic growth by using the following model proposed by Demirguc-kunt& Levine (2001)[12]:

$$Y_t = \alpha + \beta_t IFI_t + \gamma_t X_t + \varepsilon_t \quad (1)$$

Where Y_t is the proxy variable for economic growth

IFI_t indicates the variable used for financial inclusion

X_t denotes the vector of control variables viz. inflation rate and trade openness.

ε_t is the error term.

Adopting this pattern, the present study specifies the following model for estimation:

$$GDP_t = \alpha + \beta_t IFI_t + \gamma_{1t} Inf + \gamma_{2t} Trade + v_t Dummy_t + \varepsilon_t \quad (2)$$

All variables used in the study are transformed in the logarithmic form. The functional relationship into logarithmic then takes the following form:

$$\ln GDP_t = \alpha + \beta_t \ln IFI_t + \gamma_{1t} \ln Inf_t + \gamma_{2t} \ln Trade_t + v_t Dummy_t + \varepsilon_t \quad (3)$$

Where GDP_t is the real GDP per capita (a proxy for economic growth)

IFI_t is the financial inclusion proxy which is multidimensional Index offinancial inclusion (IFI) based on factors such as access to financial services, penetration of the financial services and the utilization of the services.

Inf indicates the inflation rate (as measured by the consumer price index reflect the annual percentage change).

Trade is the total trade (Export+ Import/GDP) as a percentage of GDP.

Government of India initiated financial sector reforms since 1991, primarily to create a diversified, efficient and competitive financial system in order to achieve operational flexibility, improved financial viability and institutional strengthening.The reform process has allowed significant transformation in the entire financial system. The dummy variable ($Dummy_t$) is used to capture the effect of structural break caused by the financial sector reform process.

ε_t is the error term that encompasses all other factors determining economic growth but not captured in the model.

The economic theory does not provide adequate evidence on the granger causality between financial inclusion and economic growth.It means that the GDP growth could be impacted by the level of financial inclusion and on the other hand GDP variations could also affect financial inclusion. "The division of variables into endogenous and exogenous variable is arbitrary and that Vector Autoregressive (VAR) models could avoid that by treating all variables as endogenous"(Sims C, 1972)[41].It can also allow the analysis of effects of lagged value of variables. In the present study, the vector error correction model (VECM) which is just a special case of the VAR is used. Specifically, at first place, a general VAR model is fitted to the data and subsequently based on the appropriate lag order and test of co integration an appropriate VECM is chosen. VECM is used if the original time series of variables are integrated I(1) i.e. the series have unit roots but they become I(0) by taking first difference of the variables and cointegrating relationship exists amongst the variables. The VECM enables the analysis of short and long term dynamics as it can model simultaneously variables in levels and difference. Thus, VECM models gives predictions of the short-term dynamics of adjustment (variations) and the long term (levels). The VECM can also take into account any co integrating relationships among the variables. After estimating VECM, the goodness of statistical properties of the model such as residuals normality, non-autocorrelation and homoscedasticity, and significance of VECM coefficients are also tested. The same model asgiven by equation 3 is applied to other variables namely IFI represents Index for financial inclusion, $\ln Inf_t$ representing Log of inflation rate, $\ln Trade$ is the Log of trade openness.

IV. ESTIMATION PROCEDURE

The following steps are applied in order to analyze the model**:**

4.1 ESTIMATION OF INDEX OF FINANCIAL INCLUSION (IFI)

The financial inclusion index is estimated for each year using financial inclusion index of Sarma (2010)[39].“The method uses three dimensions of financial inclusion viz. Penetration of banking services (d1), Availability of financial services (d2) and usage of financial services (d3). The index is calculated through two stages. In the first stage indices of various dimensions are constructed given by (d1), (d2) and(d3) and is computed by the following formula.

$$d_i = \frac{A_i - m_i}{M_i - m_i} \quad (4)$$

where
Ai = Actual value of dimension i
mi = minimum value of dimension i
Mi = maximum value of dimension i

In the second stage these indices are aggregated to give a composite index of financial inclusion”. Symbolically,

$$IFI = 1 - \frac{\sqrt{(1-d_1)^2+(1-d_2)^2+....+(1-d_n)^2}}{\sqrt{n}} \quad (5)$$

Since banks are the gateway to the most basic form of financial services, it is only the extent of accessibility, availability and usability of banking services that has been treated as equivalent to financial inclusion for the purpose of present work.

4.2 STATIONARY TEST:

The study uses the time series analysis to empirically model the effects of financial inclusion on economic growth. In order to estimate the relationship amongst variables, the time-series stationarity of the variables have to be evaluated. “A non stationary time series will have a time-varying mean or a time-varying variance or both”(Dao, et.al, 2013)[11]. “The regression analysis involving two or more non stationary time series may lead to the phenomenon of spurious or nonsense regression” (Gujarati, 2011)[18]. The statistical tests for the presence of a unit root are performed to test for the stationarity in the variables. The study performs Augmented Dickey- Fuller (ADF) and Philips Perron (PP) tests for the same [33].

4.3 CO INTEGRATION TEST:

The presence of cointegration between time series variables is tested to examine the long-run relations between two or more variables. The Cointegration refers to the existence of a long-run equilibrium relationship between variables. “The long-run equilibrium implies that two or more variables may wander away from each other in the short-run but move together in the long-run”(Enders W., 1995)[16].“Co integration technique made it possible to capture the information of non-stationary series without sacrificing the statistical validity of the estimated equation (Stock & Watson, 1998)”[42]. Johansen cointegration test is used in the study to figure out thelong-run relationships between the GDP per capita and financial inclusion proxy. Both Trace test and Maximum Eigen value test with null hypothesis with no cointegrationare applied in the study.The null hypothesis of no cointegration is rejectedif the test statistic value exceeds the critical value. The cointegration test requires the specification of the relevant order of lag of the model.

4.4 VECM ANALYSIS:

“If the variables are cointegrated the error correction term has to be included in the VAR model refers to as vector error correction model (VECM) which can be seen as a restricted VAR” (Dao, et.al, 2013)[11]. VECM give the Long Run and Short Run Causality amongst variables.The Error Correction Modelsestimated for this purpose are as follows:

Model I

$$\begin{aligned}\Delta INGDP &= \beta_{1,1}(INGDP_{t-1} + a_1 InIFI_{t-1} + b_1 InInf_{t-1} + c_1 InTrade_{t-1} + v_t Dummy_t + \varepsilon_t) \\ &+ \beta_{2,1}\Delta In\ GDP_{t-1} + \beta_{3,1}\Delta In\ GDP_{t-2} + \beta_{4,1}\Delta InIFI_{t-1} + \beta_{5,1}\Delta InIFI_{t-2} + \beta_{6,1}\Delta InInf_{t-1} \\ &+ \beta_{7,1}\Delta InInf_{t-2} + \beta_{8,1}\Delta InTrade_{t-1} + \beta_{9,1}\Delta InTrade_{t-2} + \beta_{10,1}Dummy_t + \beta_{11,1} \quad (6)\end{aligned}$$

Model II

$$\Delta InIFI = \beta_{1,2}(InIFI_{t-1} + a_2 \text{InGDP}_{t-1} + b_2 \text{InInf}_{t-1} + c_2 \text{InTrade}_{t-1} + v_t \text{Dummy}_t + \varepsilon_t) + \beta_{2,2}\Delta \text{In GDP}_{t-1} + \beta_{3,2}\Delta \text{In GDP}_{t-2} + \beta_{4,2}\Delta \text{InIFI}_{t-1} + \beta_{5,2}\Delta \text{InIFI}_{t-2} + \beta_{6,2}\Delta \text{InInf}_{t-1} + \beta_{7,2}\Delta \text{InInf}_{t-2} + \beta_{8,2}\Delta \text{InTrade}_{t-1} + \beta_{9,2}\Delta \text{InTrade}_{t-2} + \beta_{10,2}\text{Dummy}_t + \beta_{11,2} \quad (7)$$

Model III

$$\Delta INInf = \beta_{1,3}(INInf_{t-1} + a_3 \text{InGDP}_{t-1} + b_3 \text{InIFI}_{t-1} + c_3 \text{InTrade}_{t-1} + v_t \text{Dummy}_t + \varepsilon_t) + \beta_{2,3}\Delta \text{In GDP}_{t-1} + \beta_{3,3}\Delta \text{In GDP}_{t-2} + \beta_{4,3}\Delta \text{InIFI}_{t-1} + \beta_{5,3}\Delta \text{InIFI}_{t-2} + \beta_{6,3}\Delta \text{InInf}_{t-1} + \beta_{7,3}\Delta \text{InInf}_{t-2} + \beta_{8,3}\Delta \text{InTrade}_{t-1} + \beta_{9,3}\Delta \text{InTrade}_{t-2} + \beta_{10,3}\text{Dummy}_t + \beta_{11,3} \quad (8)$$

Model IV

$$\Delta INTrade = \beta_{1,4}(INTrade_{t-1} + a_4 \text{InGDP}_{t-1} + b_4 \text{InIFI}_{t-1} + c_4 \text{InInf}_{t-1} + v_t \text{Dummy}_t + \varepsilon_t) + \beta_{2,4}\Delta \text{In GDP}_{t-1} + \beta_{3,4}\Delta \text{In GDP}_{t-2} + \beta_{4,4}\Delta \text{InIFI}_{t-1} + \beta_{5,4}\Delta \text{InIFI}_{t-2} + \beta_{6,4}\Delta \text{InInf}_{t-1} + \beta_{7,4}\Delta \text{InInf}_{t-2} + \beta_{8,4}\Delta \text{InTrade}_{t-1} + \beta_{9,4}\Delta \text{InTrade}_{t-2} + \beta_{10,4}\text{Dummy}_t + \beta_{11,4} \quad (9)$$

The Johansen Cointegration test and the Wald test for the models mentioned above will be used to examine the long run and short run causality relationship amongst the variables.

4.5 DIAGNOSTIC CHECK OF VECM:

The efficiency and specification quality of VECM is checked through the tests namely White heteroscedasticity test, Lagrange Multiplier (LM), the residual normality test,and stability test using Autoregressive (AR) polynomial test. A desirable model should have no heteroscedasticity effect, no serial correlation and its residual term should be normally distributed.

4.6 GRANGER TEST OF CAUSALITY:

After determining cointegration among endogenous variables used in the study Granger causality test is carried out in framework of VECM. If cointegration exists amongst variables then the Granger causality in at least one direction will exist. The direction of causality amongst variables however, is not reflected by cointegration. The Granger's causality can used to check for the direction of the linkage between proxy of financial inclusion and the economic growth in India. Traditionally, F-test statistic has been used in the Granger causality test. "The use of a simple traditional Granger causality is not sufficient if variables are I(1) and cointegrated" (Toda and Yamamoto, 1995)[44]. In this case, the F-test statistic doesn't have standard distribution. The error correction model (ECM) will give the proper statistical inference about the causality relationship amongst the variables. Thus, the Granger's causality analysis should be done in the ECM framework if the variables are I(1) andcointegrated, Granger causality should be done in the ECM as provided in the equations (6), (7), (8) and (9).

In order to evaluate the short run causality relationship between the explained variable and explanatory variables of the main

Model I, the following null hypotheses would be tested:

$\beta_{4,1} = \beta_{5,1} = 0$ financial inclusion do not cause economic growth in short run.

$\beta_{6,1} = \beta_{7,1} = 0$ Inflation do not cause economic growth in short run.

$\beta_{8,1} = \beta_{8,2} = 0$ Trade openness do not cause economic growth in short run.

Model II, III, and IV the following hypothesis would be tested:

$\beta_{2,2} = \beta_{3,2} = 0$ Economic growth do not cause financial inclusion in short run (Model II)

$\beta_{2,3} = \beta_{3,3} = 0$ Economic growth do not cause inflation in short run (Model III)

$\beta_{2,4} = \beta_{3,4} = 0$ Economic growth do not cause trade openness in short run (Model IV)

4.7 IMPULSE RESPONSE ANALYSIS:

The impulse response analysis traced the effects of changes in one variable on the current and future values of the endogenous variables in the model. i.e. the impact of shocks to one endogenous variable on the other variables in the VECM over a certain period of time. Choleskeyorthogonalization approach is used for performing impulse response analysis.

4.8 VARIANCE DECOMPOSITION:

The variance decomposition is used to determine the proportion of the variance in a series of a variable due to its own shock/variations and other identified shocks/variations from other variables. In the other words, this alternative technique measures the proportion of forecast error variance in one variable explained by variations in itself and the other variables. For this purpose, the Choleskeyde composition method is used in the study.

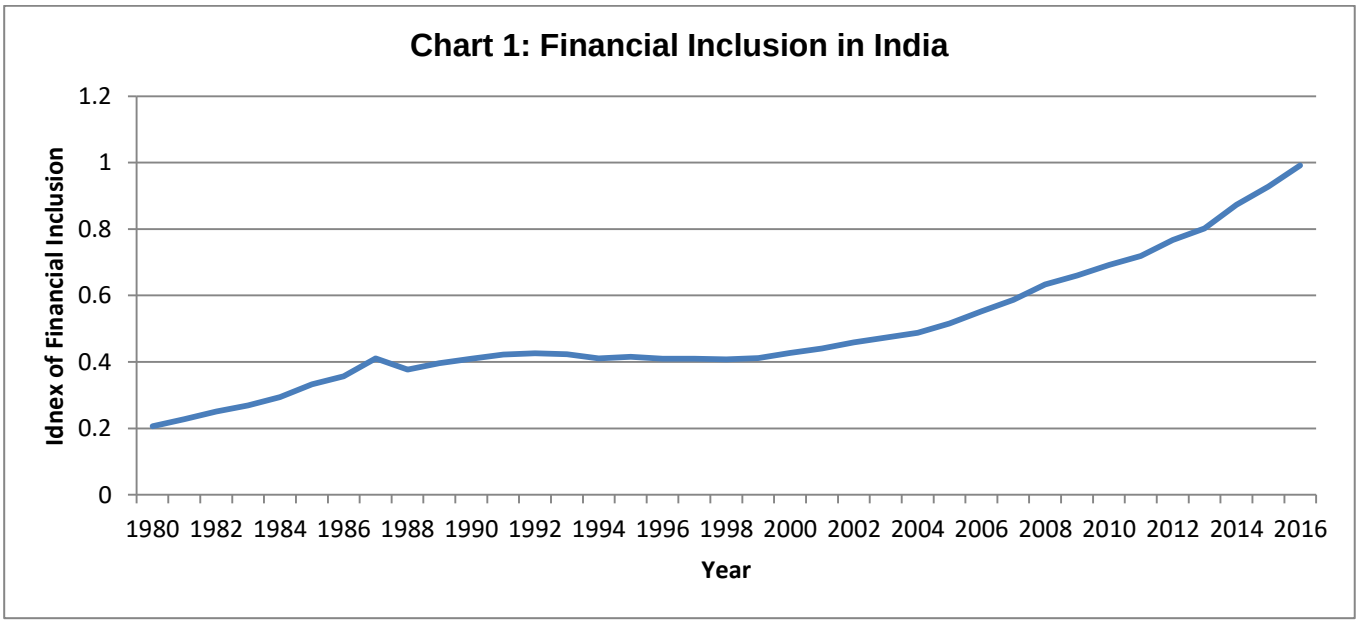
V. DATA

The present study uses annual time series data of 37 years and covers the period from 1980 to 2016. The data are sourced from different issues of the Statistical Tables Relating to Banks in India published by Reserve Bank of India, Handbook of Statistics on Indian Economy, Report on Currency and Finance, NABARD Annual Report.

VI. EMPIRICAL ANALYSIS

6.1 INDEX OF FINANCIAL INCLUSION INDEX (IFI):

The trends of Index of financial inclusion (IFI) are depicted through chart 1. It is evident that the there is a paradigm shift in the agenda of India's financial inclusion over the last decade a with a emphasis on comprehensive approach of providing financial services (e.g., opening bank accounts and offering basic financial products, such as insurance) instead of credit to the larger section of society. This shift has been partly driven by the need to target the beneficiaries of government welfare progrommes by direct cash transfer instead of product subsidies that requires the existence of bank account of beneficiaries. Further, the concern for the fall of financial savings due to inadequate bank penetration has also been major driver.



Source: Author's Own Calculations

6.2 UNIT ROOT TEST:

The Augmented Dicky-Fuller (ADF) method and PP method are used to test for the stationarity of the time series data of the variables used in the study. The results are reported in (Table 1). The results indicate that real Log GDP percapita,trade openness, financial inclusion proxy, and inflation are non stationary in their level. All series become stationery at first difference which indicates that all variables are integrated of order one *I*(1).

Table1: Results of Stationarity Test

	I(0)	I(0)	I(1)	I(1)	Decision
Variables	**Augmented Dicky-Fuller (ADF)**	**Phillips-Perron (PP)**	**Augmented Dicky-Fuller (ADF)**	**Phillips-Perron (PP)**	
Log Real GDP	3.514666	5.678099	-6.837486***	-6.649147***	I(1)
IFI	0.494798	-0.684454	-3.442595***	-3.500702***	I(1)
INF	-1.580072	-1.530872	-3.953951***	-4.023072***	I(1)
Trade	-0.601831	-0.708771	-4.937843***	-5.068407***	I(1)

Source: Author's Own Calculations

6.3 COINTEGRATION TEST:

Since all variables were integrated of order one I (1) as explained in Table 2 the test todetermine if the variables were cointegrated or not are required. The studyuses, Johansen approach which is a multivariate autoregressive model to test the cointegration amongst the variables. The possibility of the existence of more than one co integrating vector can be evaluated by using the Johansen technique. It is advancement over the single equation estimation technique. The technique, also allows the estimation of long-run and short run relationship amongst variables simultaneously.The choice of lag length causes variation in the cointegrationtests results. The order of lag of VECM should be specified prior to the performance of cointegration test. The resultsof LR, FPE and AIC indicate that the optimal lag order is 2 as shown in Table 2.

The Johansen and Juselius multivariate cointegration test is employed to test the null hypothesis of presence of no cointegrating vector. Table3 shows that a long-run equilibrium relationship amongst the variables at the 5% level on the basis of bothtrace and Eigenvalue criteria. The null hypothesis of non-cointegrating vector is rejected by both tests against the alternative of at most one cointegrating vector. Thus, the results are indicative of the long-run relationships amongst the variables used in the study (i.e. amongst real GDP per capita, financial inclusion, Trade openness and inflation).

Table2 : VAR Lag Order Selection Criteria

Endogenous variables: LRGDPERCAPITA FII LINF LTRD

Exogenous variables: DUMMY

Included observations: 37

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-108.589	-	0.005166	6.085883	6.260036	6.14728
1	252.0499	623.8075	4.22E-11	-12.5432	-11.67247*	-12.23625*
2	270.0051	27.17542*	3.93e-11*	-12.64892*	-11.0815	-12.0964
3	280.1173	13.11863	5.88E-11	-12.3307	-10.0667	-11.5325

*** reflects the selection of lag order by the specified criterion at 5% significance level**

LR: sequential modified LR test statistic

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Author's Own Calculation

Table 3: Results of Cointegration Rank Test

Hypothesized No. of CE(s)*	Test Statistic	5% Critical Value	P- Value**
Trace statistic			
None	59.95021	47.85613	0.0025
At most 1	26.21625	29.79707	0.1223
Maximum Eigenvalue Statistic			
None	33.73396	27.58434	0.0071
At most 1	13.55137	21.13162	0.4029

* depicts null hypothesis rejection at 5% level. **MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Own Calculation

6.4 COITEGRATION RESULTS (LONG RUN ESTIMATION):

The presence of a single cointegrating vector points to estimate the long run equation withits associated coefficients andshort run parameters. The evidence of co integration ruled out the possibility of spurious correlation.The corresponding longrun coefficientsvector is reported in Table 4.

Table 4: VECM RESULTS (LONG RUN COEFFICIENTS)
DEPENDENT VARIABLE: LRGDPERCAPITA

Variables	Long Run Coefficients	ECM
LRGDPERCAPITA(-1)	1	-0.22217***
IFI(-1)	-1.58096** (-0.161) [-9.81974]	(-0.05696) [-3.90016]
LINF(-1)	0.223117** (-0.03375) [6.61168]	
LTRD(-1)	-0.72609** (-0.04944) [-14.6864]	
C	-7.81938	

Standard errors in ( ) & t-statistics in [ ]. ***,** Significant at 1%&5% level of significance.

Source: Author's Own Calculation

The results of the Johansen Cointegration Test in the above table, reveals that all the variables are co integrated and have a long run relationship at 5% significance level.The coefficient of the ECT of Model I of real GDP per capita is negative and significant at 1% level of significance meaning that there is a long run causality relationship flowing from financial inclusion, trade openness and inflation to real GDP per capita.The result of long run equation for economic growth (LRGDP per capita) in the above Table 4 indicates that financial inclusion and trade openness has positive long run effects on economic growth. Inflation on the other hand has negative long run effects on economic growth.

6.5 SHORT RUN DYNAMICS OF VECM:

As stated earlier the speed of adjustment parameter (coefficient of ECT) for the adjustment coefficient of economic growth (real GDP per capita) has the desirable negative sign which is also significant at 1 percent level of significance and shows that the system corrects its previous disequilibrium at a speed of 22.21% p.a.(Table 4).

The Wald test results to investigate the short run causality relationship between the dependent variable and the independent variables of the main model 1 are provided in Table 5.

Table 5: Short-Run Causality Test Results

Hypothesis	Wald Test/ χ^2 Statistic	p-value	Conclusion of Short run Causality test (Wald Test) at 5% level of significance
$\beta_{4,1} = \beta_{5,1} = 0$	6.856184*	0.0324	Financial inclusion causes economic growth in short run (Model I).
$\beta_{6,1} = \beta_{7,1} = 0$	8.939478*	0.0115	Inflation cause economic growth in the short run (Model I).
$\beta_{8,1} = \beta_{8,2} = 0$	7.041205*	0.0296	Trade openness causes economic growth in the short run (Model I).
$\beta_{2,2} = \beta_{3,2} = 0$	5.899453	0.0524	Economic growth does not cause financial inclusion in the short run (Model II).
$\beta_{2,3} = \beta_{3,3} = 0$	7.23637	0.0268	Economic growth causes inflation in the short run (Model III).
$\beta_{2,4} = \beta_{3,4} = 0$	1.75996	0.4148	Economic growth does not cause trade openness in the short run (Model IV).

Source: Author's Own Calculation

The results clearly indicate that the direction of causality between financial inclusion and economic growth is unidirectional. It also suggests that financial inclusion and economic growth nexus follows the supply- Leading hypothesis. The states with greater financially inclusive system will grow faster i.e. financial inclusion causes economic development.

6.6 DIAGNOSTIC TEST RESULTS:

The results of the diagnostic tests of VECM are reported in Table 6 &7. It is evident that the problem of autocorrelation is not found in the models used in the study. The validity of homoscedasticity assumption is depicted by VEC Heteroscedasticity test. The assumption of normality of the residual was also found to be true. The results of the above tests depicts that the VECM is specified correctly and is well performed.

Table 6: Serial Correlation LM Tests of VEC ResidualH_0 : no serial correlation at Lag Length (h)

Lag Length (h)	LM Stat	P-Value
1	22.96297	0.1147
2	20.06534	0.2173

Source: Author's Own Calculation

Table 7: Post Estimation Tests Results of the VECM

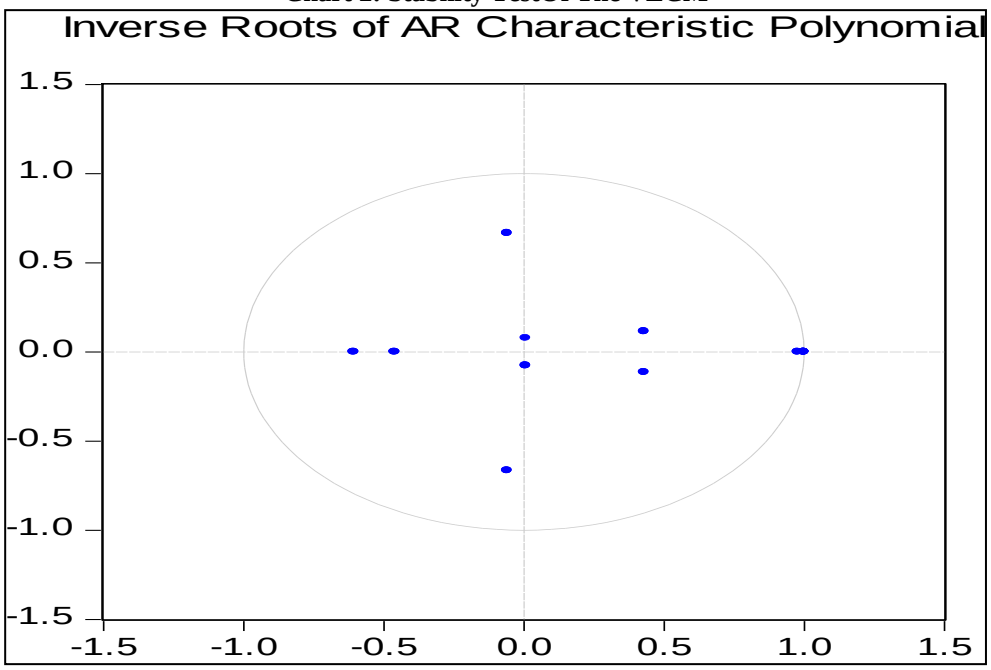
VEC Residual Normality Test - Null-hypothesis: Residuals are normal	
Jarque-Bera Statistic	Jarque-Bera Statistic
Probability Value	Probability Value
VEC Residual Heteroscedasticity Test –Null-hypothesis: No Heteroskedasticity	
Chi-Squre	Chi-Squre
Probability Value	Probability Value

Source: Author's Own Calculation

6.7 STABILITY OF VECM ESTIMATION

VECM stability analysis is examined by checking the roots of characteristic polynomial. It is clear from the table that all roots are less than unity and lie within the unit circle (Chart 2). Thus the estimated models are stable or stationary. If the system of VECM is not stable then results such as impulse response standard errors would not be valid.

Chart 2: Stability TestOf The VECM

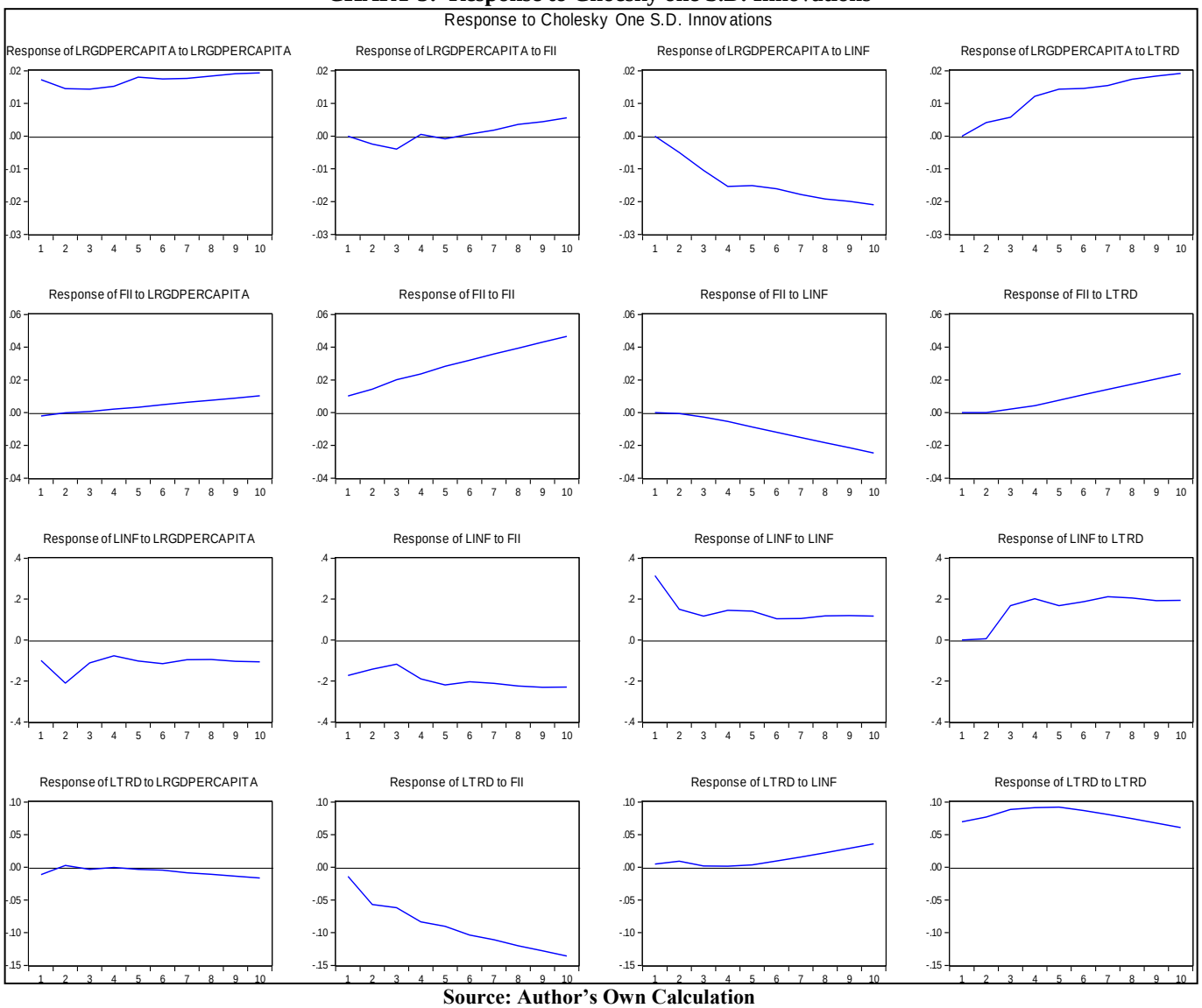


Source: Author's Own Calculation

6.8 EMPIRICAL ANALYSIS OF IMPULSE RESPONSE FUNCTION & VARIANCE DECOMPOSITION:

The results of the impulse response function (IRF) are reported in Chart3, the diagram shows thatinitially, financial inclusion has insignificant effects on per capita income from the results of the IRFs. It is entirely possible that the initially the access to finance is associated with a less productive use say for household purpose rather than for business or entrepreneurial activity. However, in the long run the increased financial inclusion has positive impact on improving per capita income. Since it stimulate entrepreneurship and increased productive investments and facilitate economic growth process.On the other hand, economic growth contributes positively to financial inclusion in the long run. That is, higher per capital incomes is associated with higher levels of financial inclusion in India. The response of inflation is negative due to forecast error stemming in economic growth. The response of trade is positive in economic growth.

CHART 3: Response to Choesky one S.D. Innovations



Source: Author's Own Calculation

6.9 Empirical Analysis of Variance Decomposition:

Table 8 shows the variance decomposition to analyze the influence of random shocks of economic growth measured by real GDP per capita upon itself and proxy of financial inclusion. The results shows that the percentage of variance contributed by its own shocks or variations for economic growth is 40.57 and one standard deviation shock in financial inclusion explains economic growth by 1.22 percent while inflation contribute 32.65 percent and the support of trade openness to economic growth is 25.54 percent.

Table 8: Variance Decomposition of LRGDPERCAPITA

Period	S.E.	LRGDPERCAPITA	IFI	LINF	LTRD
1	0.017227	100	0	0	0
2	0.023563	91.2722	1.062749	4.545716	3.119335
3	0.030312	77.60929	2.323804	14.60657	5.460341
4	0.039165	61.56979	1.408263	24.04819	12.97377
5	0.047902	55.34395	0.968972	26.03858	17.6485
6	0.055401	51.27888	0.735769	27.89474	20.09061
7	0.062786	47.82392	0.654871	29.81192	21.70929
8	0.070446	44.76253	0.784783	31.1391	23.31359
9	0.077982	42.5284	0.954275	31.93834	24.57898
10	0.085394	40.57318	1.228943	32.65589	25.54198

Source: Based on Author's Own Calculations

Table 9: Variance Decomposition of IFI

Period	S.E.	LRGDPERCAPITA	IFI	LINF	LTRD
1	0.010424	3.710906	96.28909	0	0
2	0.017672	1.291901	98.57085	0.134415	0.002836
3	0.027004	0.62671	97.78925	0.990181	0.593856
4	0.036644	0.672673	94.9465	2.680921	1.69991
5	0.047887	0.859801	90.68277	4.925152	3.532273
6	0.060032	1.215437	86.09516	7.102156	5.587243
7	0.073214	1.546412	81.85373	9.05671	7.543152
8	0.087249	1.851836	78.05008	10.80161	9.296471
9	0.102174	2.117434	74.69975	12.31882	10.864
10	0.117831	2.357784	71.77868	13.6191	12.24444

Source: Author's Own Calculation

As indicated in Table 9, The GDP per Capita explains financial inclusion to the extent of 2.3 percent. While the contribution of inflation and trade openness to explain financial inclusion is 13.61 percent and 12.24 percent respectively. The fluctuation of financial inclusion is accounted by financial inclusion by financial inclusion itself with 71.77 percent. Table 10 exhibits that trade openness is explained by economic growth to the extent of only 0.5 percent. While financial inclusion contributes around 58.43 percent of trade openness.

Table 10: Variance Decomposition of LTRD

Period	S.E.	LRGDPERCAPITA	FII	LINF	LTRD
1	0.072199	2.454639	3.73601	0.472159	93.33719
2	0.120344	0.940246	23.89155	0.752683	74.41552
3	0.161878	0.55787	27.82802	0.430839	71.18327
4	0.203714	0.352284	34.3674	0.279923	65.0004
5	0.241148	0.27008	38.5122	0.225216	60.99251
6	0.27665	0.229422	43.29701	0.299668	56.1739
7	0.309306	0.254314	47.45723	0.494403	51.79406
8	0.340923	0.306654	51.47946	0.832473	47.38141
9	0.371642	0.394728	55.10044	1.308092	43.19674
10	0.402277	0.50506	58.437	1.911811	39.14613

Source: Author's Own Calculation

VII. CONCLUSIONS

The impact of financial inclusion on economic growth is determined in India using annual time series data of 37 years and covers the period from 1980 to 2016 by applying VECM, Cointegration analysis and granger causality. The results indicate that there is a long-run causal relationship between economic growth and measure of financial inclusion, inflation and trade openness. It also indicates that financial inclusion and economic growth adjusts to their long-run equilibrium relationships. The magnitude of significantly negative coefficients of the ECM indicates the speed of adjustment to the long-run equilibrium relationship. The results show that the system corrects its previous disequilibrium at a speed of 22.21 percent p.a.The short run causality results depicts that the financial inclusion causes economic growth and thus the supply leading hypothesis is predominant in India.

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