

EXAMINATION OF TRENDS IN DEPOSIT MIX DATA OVER TIME IN A LARGE SIZED PUBLIC SECTOR BANK IN INDIA

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ABSTRACT

Deposits in a Commercial Bank may be either in the form of Demand Deposit or Term Deposit. Demand Deposits include Savings Bank Account Deposits and Current Account Deposits, while Term Deposits include Recurring Deposits and/or Fixed Deposits of various flavor. Term Deposit usually carries much higher rate of interest than Demand Deposit and if the Deposit mix is heavily tilted towards Term Deposit, bank will feel the heat in the Profitability. Unfortunately, Deposit Mix of most of the commercial banks are having adverse Deposit Mix, resulting in pressure in the bottom lines. The research paper is an attempt to undertake an analytical study to reveal the movement of Univariate Time Series Data in respect of three significant financial variables namely, Demand Deposit, Time Deposit and Aggregate Deposit, over time of a large Sized Public Sector bank in India, i.e. Punjab National Bank. The techniques of regression diagnostics have been employed to judge the validity of the models. The best fit model has been identified by considering R², Adjusted R², Significance of F test, Box plot, Shapiro – Wilk statistics while, for forecasting Mean Absolute Percentage Error (MAPE) is computed and considered. The analyses reveal that all dependent variable exhibit non-linear trends i.e. AD exhibits 'Quadratic' while both DD and TD exhibit 'Exponential' trend. Finally, the best forecasting model for each variable has been identified and forecasting for 2 years in advance has been computed based on best model.

Keywords: *Deposit Mix, Demand Deposit, Time Deposit, Aggregate Deposit, Parametric Models, Curve Estimation Technique, Forecasting Model, Public Sector Banks in India, Time Series Data.*

INTRODUCTION

In a developing country like India, banking sector has to essentially develop dynamism and potentiality for adaptation for adjusting itself to the sweeping changes in the economy (Sharma, 1985). The evolution of Indian financial system, since the mid-eighties in general, with the launching of the economic policy in 1991 has been characterized by profound transformation as a result of prolonged and effective reform initiatives by Reserve Bank of India (RBI). The fundamental philosophy of the development process in India has shifted from closed and highly regulated regime to free market economy and the consequent liberalization, deregulation and globalization of the economy. Changes in the major economic policy such as macro-economic stabilization, de-licensing of industries, trade liberalization, currency reforms, reforms in financial sector, capital market and banking sector, disinvestment in the public sector units have far-reaching impact on the development process in Indian economy.

Commercial Banks in India, particularly Public Sector Banks (PSBs), despite having completed more than two and half decades of reforms era, are exposed to pressure in the bottom lines, i.e., profitability, which is a matter of great concern for the industry in general

with its regulators. Apart from macro environmental factors like, global recession, economic slowdown, rising inflation and inadequate legal frame work, micro banking factors, including mounting Non-Performing Assets (NPA), inappropriate Deposit Mix, Pressure from industry and populist Government Policy towards reducing lending rates, rising overheads have also dampened pivotal element of existence and growth in the (PSBs) in India.

(A) Definition of Terms

Deposit in Banks:

One of the Primary Functions of a Commercial Bank is to accept deposit from the public. Deposit constitute more than 85% source of funds for any banking institutions. Apart from deposits other major source of funds includes capital and borrowing. Individual as well as business units keep their surplus with a bank as deposit primarily with three motives: safety motive, liquidity motive and earning motive. Depending on the purpose of parking fund, a deposit account may be termed as either a Savings Bank (SB) Deposit account, a Current Deposit (CD) account, Fixed Deposit (FD) account and Recurring Deposit (RD) account.

Current Deposit accounts are essentially for the

business financial transactions and do not carry any interest on the balance. Unlike a SB account, no limits are fixed by banks on the number of transactions permitted in the account. Banks generally insist on a higher minimum balance to be maintained in current account. Considering the large number of transactions in the account and volatile nature of balances maintained overnight, banks generally levy certain service charges for operating a CD account.

A **Savings Bank** Deposit account is essentially for the purpose of parking temporary savings for the individuals including household and provides nominal rate of interest, say 3.5% to 4% per annum. The main objective of such account is to promote savings. Such accounts have few restrictions like number and amount of cash transaction etc. Such account is of continuing nature. There is no maximum period of holding. A minimum balance has to be kept on SB to keep it functioning.

A **Fixed Deposit** account implies funds parked for a definite length of time as per requirement of the customer. Such deposits encourage savings habit for a longer period. The main purpose of FD account is to enable the individuals to earn a higher rate of interest on their surplus funds, which presently varying between 6-8% p.a. FD accounts have also been popularized by banks under various schemes like re-investment deposit account, double deposit account etc. The period of fixed deposits range between 15 days to 10 years and is repayable only after the specific period is over. However, in case of emergency, banks allow to close the fixed account prior to maturity date, subject to deduction of penal charges of 1% to 2% from the interest payable as on that date. The depositor can get loan facility from the bank.

Recurring Deposit account is a term deposit account where a customer keeps fixed amount of money at monthly interval for a definite length of time and carries a higher rate of interest, presently between 6-8% per annum. Main objective of such account is encouraging regular savings habit among the people by providing them a saving avenue of smaller amount of money in monthly installment. In RD account certain fixed amount is accepted every month for a specified period and the total amount is repaid with interest at the end of the fixed period. The period of deposit is minimum six months and maximum ten years.

(B) Deposit Mix:

Deposits in a Commercial Bank may be either in the

form of Demand Deposit (DD) or Term Deposit (TD). DD include SB accounts and CD accounts, popularly known in banking parlance as CASA, while TD include Recurring Deposit (RD) and Fixed Deposit (FD) of various flavor.

Deposit mix refers to the combination of various types of deposits (as above) and their share in total deposits. Interest payment obligation for CD account is nil and for SB deposit accounts is very low and statutorily fixed at 4% p.a. and hence source of low-cost fund.

Long term survival model of any business is to have good margins by following the principle of 'buy low sell high' and the same holds good for a commercial bank too. Major source of profit for any commercial bank is its 'Net Interest Margin (NIM)' which implies difference between interest earned on advances and investments and interest paid on deposits and borrowings. The difference between NIM and administrative expenses and other operating cost of a bank constitute operating profit. Hence higher the NIM, higher is the operating profit. Thus, cost of acquisition of funds is critical determinant in profitability of a commercial bank.

As a commercial bank is exposed to severe competition by market dynamics, it cannot raise the rate of interest on advances unilaterally and therefore percentage of Yield on Advances remaining constant. With greater share of low-cost funds (CASA), a bank may make good profits. Thus, deposit mix plays a very important role in deciding the profitability of a bank. Therefore, one of the most significant strategies for a bank towards improving profitability is to increase share of CASA in total deposits. TD usually carries much higher rate of interest than DD and if the Moreover, as primary motive of a commercial bank is to support working capital finance to needy sector, greater reliance TD may lead to long term mismatch of flow of funds, thereby leading to serious liquidity imbalances.

LITERATURE REVIEW

In view of the seriousness of the problem, numerous research studies have been conducted on different issues concerning liability management in banks including Deposit Mix. However, empirical works on Deposit Mix problems in PSBs are inadequate.

Shrivastava (1980) in his book, 'Management of Banks' observed that proper Deposit Mix has a direct impact on the profitability of a bank and therefore should be given due importance by mobilization of low-cost source of deposit.

Desai (2007) examined various factors influencing

profitability and observed that apart from management of NPA, ratio of CASA to Deposit Ratio to be monitored towards improved bottom lines.

Bodla & Verma (2006) examined with the help of multiple regression technique, the impact of a few banking variables on profitability in PSBs in India. The study has brought out that the explanatory power of some variables like, Spread, NIM, Provision and Contingencies and Operating expenses are significantly high while others like Business per employee, Credit Deposit ratio, NPAs as percentage of Net advances are found with low explanatory power. The study concludes that variables such as Provision and Contingencies, NIM, Spread and Operating expenses have significant relationship with net profit and therefore are major areas of concern in PSBs in India.

Gopalakrishnan (2006) developed a statistical model for forecasting future value of gross advances, standard advances and NPAs with the help of regression analysis. Time series data for nine years have been taken and regressed with a few strategic variables under two scenarios to enable prediction of the above parameters for 11 years as a matter of reference for the bankers in formulating their strategies.

Singla (2008) examined empirically the financial performance in terms of profitability of sixteen selected banks for a period of five years (2000-01 to 2006-2007). The study reveals that the profitability position was reasonable during the period of study when compared with the previous years. With the help of statistical measures like correlation analysis and multiple regression analysis, the study examines the determinants of profitability of selected banks. During the study period, it was observed that the return on net worth had a negative correlation with the debt equity ratio. Interest income to working funds also had a negative association with Interest coverage ratio and the NPA to net advances was negatively correlated with Interest coverage ratio.

Muraleedharan (2009) discussed in detail the various sources of funds including deposit and its various types.

Nandy (2011) observed that differential profit performance has been attributed to various factors. The objective of the study is to identify these factors and examine whether they have any significant influence on profitability of commercial banks in India. For the purpose of the study a few variables, like Interest Income, Other Income, Interest Expenses, Operating Expenses, Net NPA and Spread are identified.

Rawlin, Sharan & Lakshmipathy (2012) examined the relationship between gross and net NPA% of a bank with its aggregate advances. A strong correlation is observed between gross and net NPA% and the advances made. Based on the above observations attempt is made to predict gross and net NPA% from advances by fitting to Linear and non linear models. A non linear curve estimation model linking both Gross and Net NPA to advances provided the best curve fit and the least deviation from actual values. Thus, by simply looking at advances an overall picture of the banks NPA level can be ascertained.

Veerakumar (2012) to study NPA in Priority Sector Advances (PSA) in a commercial bank examined time series data from 2000-01 to 2009-10 of both GNPA and NNPA (on absolute figure as well as ratio data) and presents trend analysis with the help of curve estimation regression technique. It is observed that a polynomial regression model, particularly a cubic curve is the best fit with very high R^2 value, signifying a dependable forecasting model.

Venkatesan (2012) tried to evaluate empirically the trend and growth in deposits mobilization of banks in Tamil Nadu from 2000 to 2009. For the purpose of the study, deposits have been classified as CD, SB and TD and a time series data collected from RBI Bulletin were analyzed with the help of Descriptive Statistics and Simple Regression Analysis. Compound Growth Rate and Linear Growth Rate have been used to arrive at a definite conclusion that there has been significant growth in mobilization of all types of deposits.

Malyadri & Sirisha (2015) attempted a comparative analysis of trends and progress of Public Sector Banks (PSBs), Private Sector Banks (PrSBs) and Foreign Banks (FBs) in India during 2006 to 2013 by using Compound Annual Growth Rate and found that performance of PrSBs is ahead of 2 other Bank Groups.

Nichols (2017) in his blog titled, 'Lessons in Deposit Mix from last Rate Cycle' reviewed the sensitivity of Interest Rate in Deposit Mix decision and observed that it has varied impact on different types of banks and product.

Soni & Kulkarni (2018) in their Research Paper titled, 'A Study of Deposit Trends in select Public and Private Sector Banks in India' examined the pattern of deposit in selected PSBs and PrSBs during 2011 to 2017 for the purpose of undertaking a comparative trend analysis and observed that there is significant difference in the pattern of deposit in PSBs, PrSBs and deposits of all banks showing rising trend.

Shollapur & Bangati, (2010) examined profitability of funds management of the selected Indian Banks with the help of cost benefit analysis and observed that efficient management of funds involves raising of proper mix of funds and their applications to generate maximum spread. The study revealed that the overall cost of funds comprised of cost of deposit and cost of borrowings have maintained a decreasing trend, which reflects smart handling of the source of funds. However, return on application of funds, also exhibited declining trends resulted in declining spread.

Hasan *et al.*, (2013) in a study of impact of funds management on banks' Liquidity, Profitability and Productivity in respect of selected Private Commercial Banks in Bangladesh from 2006-2010, observed that loan positively and significantly co-related with Profitability and Productivity and is negatively correlated with Liquidity.

Walsh (2018) observed that rising rate of interest increase uncertainty in deposit mobilization and deposit mix shift towards DD that offer no interest to customers on the one hand but at the same time are highly mobile.

Marsico (2016) observed that spread has helped bank in recent years, but situation can worsen, if interest rate continues to rise. Under the situation, he suggested cheaper source of fund in the form of hot money to fill up the deficit in spread.

Statement of the Problem:

Improper Deposit Mix, i.e. ratio of DD and TD have dampening effect on the banking system since long, though they were not in the public domain till early 90s. TD usually carries much higher rate of interest than DD and if the Deposit mix is heavily tilted towards TD, bank will feel the heat in Profitability. Unfortunately, Deposit Mix of most of the commercial banks in India are having adverse Deposit Mix.

Existence of such an adverse Deposit Mix figure in Commercial Banks in general with PSBs is also a constant worry for the regulators and the ministry, as banking plays a significant role in a developing country like India. Moreover, as slightest casual approach, on any front may put a bank into serious trouble, the task of managing Deposit Mix in banks has become a serious concern for the practicing managers. Therefore, managing liability portfolio in general with Deposit Mix has become the top most priority in PSBs in India, which requires focused and planned effort including examining trend of Deposit Mix data over time, forecasting future value of individual variables of the

Mix and their effective management.

Theoretical Framework:

A time series is a sequence of data points, measured typically at successive points in time spaced at uniform time intervals. Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values.

A model is a representation of an observed dataset of a real-life phenomenon presented as per standard analytical practices and expressed by means of equation. It is well known that the linear model is the most attractive because of its simplicity to fit, easily understandable results and availability of a wide range of techniques for testing the assumptions. However, it should also be noted that, in many cases because of an intrinsic nonlinearity in the data, linear model becomes inappropriate. Moreover, real life data situations are not easy to model because of the uncertainty and variation prevailing in the natural system and due to presence of the interaction of unknown factors interplaying and governing the entire real-life phenomenon. In respect of real-life data, they could speak for themselves in determining mathematical relationship between variables parametric non linear models and related methods though may be too restrictive, have been employed where results exhibited by model selected with very precision and moderately low forecasting error. This makes the Curve Estimation Technique of Regression Analysis (parametric modeling) more feasible and flexible.

Galore of Parametric Model Equations

The set of variables are represented by the n pairs y_t , t being the time variable, and $t = 1, 2, 3, \dots, n$. The expression of the models used in our study is given below:

1. Linear Model: $y = b_0 + (b_1 * t)$
2. Logarithmic Model: $y = b_0 + (b_1 * \ln(t))$
3. Inverse Model: $y = b_0 + (b_1 / t)$
4. Quadratic Model: $y = b_0 + (b_1 * t) + (b_2 * t^2)$
5. Cubic Model: $y = b_0 + (b_1 * t) + (b_2 * t^2) + (b_3 * t^3)$
6. Power Model: $y = b_0 * (t^{b_1})$
7. S Type Model: $y = e^{(b_0 + (\frac{b_1}{t}))}$
8. Exponential Model: $y_t = b_0 * e^{b_1 * t}$

The above models have been fitted to the data sets of three variables of Deposit Mix namely AD, DD and TD.

Objective of the Study:

In view of the relative importance of Deposit Mix in the Profitability of a commercial bank, it is perceived that a comprehensive study in this area should be made. The present study is a humble endeavor to examine various aspects of Deposit Mix in a selected large PSBs, i.e., Punjab National Bank (PNB). The specific objectives embodied under the research are as follows:

- i) to examine the overall trends and to explore the dynamicity of the three variables of Deposit Mix namely AD, DD and TD over time,
- ii) to develop a forecasting model with the help of univariate dataset of the variables AD, DD and TD (dependent variable) and Time (independent variable),
- iii) to forecast the values of AD, DD and TD for next 2 years for PNB.

RESEARCH METHODOLOGY

The study undertakes an empirical approach to analyze the movement of Deposit Mix Variables (AD, DD and TD) dataset in a selected PSBs India namely PNB. The data is secondary in nature consisting of 23 years i.e. from 1995 to 2018, excluding 1997, sourced from 'Ace Equity'. The statistical analysis had been performed using R in order to draw relevant inference.

The study includes examination of trends of Deposit Mix, developing forecasting model for short term of 2 years with AD, DD and TD as dependent variable. To examine dynamicity of Deposit, mix over time as stated in the first objective, parametric, nonlinear models have been invoked by employing 'Curve Estimation' techniques of regression analysis and to identify the 'best fit' curve for each of the three variables i.e. AD, DD and TD. Of the 23 years data for each of the variable, it is divided into two parts, i.e., 21 years as 'training set' and 2 years as 'testing set'. Three 'Goodness of fit' statistics (R^2 , Adjusted R^2 and Significance of F test) have been used for identifying the competing models. Precision of the models have been confirmed with very high values of R^2 (>0.9), Adjusted R^2 (>0.9) and low value of Significance of F test (<0.05). Among the competing models, the one with highest Adjusted R^2 value was considered first. In the next phase, the residual diagnostics of this competing model have been done.

The forecasted values have been generated based on the said best fitted model as stated in objective number two. Towards this end, 'Box plot' has been employed to identify the presence of outlier(s) in the residuals and 'Shapiro – Wilk' test to identify the normal distribution of the residuals. The 'Box plot' gave visual

representation of the outliers and significance of 'Shapiro – Wilk' test value of greater than 0.05 concludes that the residuals are normally distributed and fit for forecasting. In case, a model fails in any one of the residual diagnostics then the next competing model (in terms of Adjusted R^2 value) was considered and the same procedure was followed to identify the best fit and so on.

In the next phase, we extrapolated the best fitted curves for each of the variables under study, for a period of 2 years and computed the Mean Absolute Percentage Error (MAPE) to examine the aspect of accuracies of forecasting of the respective curves to validate the same.

In the final phase, we had taken 23 years data for each of the variable and identified the best fit for each of them, followed by forecasting of next two years values.

Scope of the Study

Schedule Commercial Banks (SCBs) in India comprise of the Public Sector Banks (PSBs) and the Private Sector Banks (PrSBs), Foreign Banks (FBs) and Small Finance Banks (SFBs) PSBs are banks, where a majority stake (more than 50%) is held by a government. PrSBs refer to those banks where most of the capital is in private hands. In India, there are two types of PrSBs viz. Old Private Sector banks and New Private Sector banks with 12 and 9 number of banks respectively. 70 FBs are incorporated outside India and 6 SFBs are operating branches in India.

The study covers dataset from 1995 to 2018, excluding 1997 consisting of 23 years i.e. (the earliest dataset after two years of introduction and consolidation of implementation of Prudential Norms of Asset Recognition, Asset Classification and Provisioning in 1993) to 2018, (the latest year till the dataset is available).

For the purpose of the study, we have taken one large sized PSB (Punjab National Bank, PNB). Aggregate Deposit of SCBs are shared by PSBs 70.05%, PrSB 25.55%, FBs 4.20% and SFBs 0.20%. PNB accounts for 7.77% share of PSBs and is considered as the 4th Largest bank in India next to SBI, Bank of Baroda and ICICI Bank.

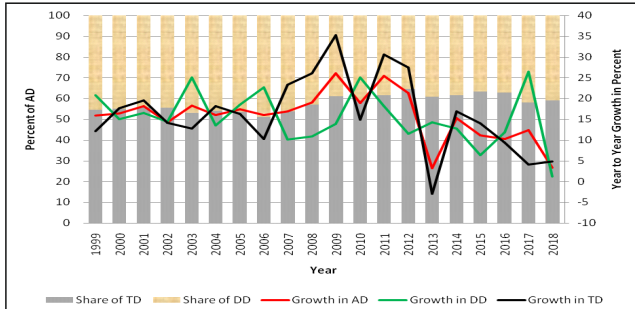
RESULTS

CASA Ratio of above 40% for any bank's deposit portfolio was earlier considered good, where, remaining 60% deposits will be all kinds of term deposits which carry an interest rate of 6–7.5% p.a. But over last few years, with the tremendous rise in NPA and pressure of competition in lending rate, comfortable CASA is estimated at 50%.

The following figure demonstrates the visual

presentation of trends in Deposit Mix in respect of selected variables AD, DD and TD for PNB from 1999 to 2018.

Figure 1: Trend in AD, DD and TD



Observation:

Composite Diagram on Share of TD and Share of DD, with the help Bar Chart and Growth in TD, Growth in DD and Growth in AD with the help Line Chart reveals that

- Share of TD is always higher than share of DD in the deposit mix with the exception in 2006 where TD and DD are almost equal.
- Share TD during 1999 to 2018 ranges between 51.01% (at 2006) to 64.66% (at 2012).
- Share DD during 1999 to 2018 ranges between 35.34% (at 2012) to 48.99% (at 2006).

This indicates deposit mix in respect of few years like 2012 affected adversely the net interest margin and thereby profitability of the PNB.

- The chart reflects tremendous fluctuations in 'Year to Year Growth' in AD, DD and TD. This is primarily on account of dynamic economic environment and policy initiatives by PNB.

Output of Curve Estimation Technique

Variable AD:

1. Best fit identification for 21 years for the variable AD.

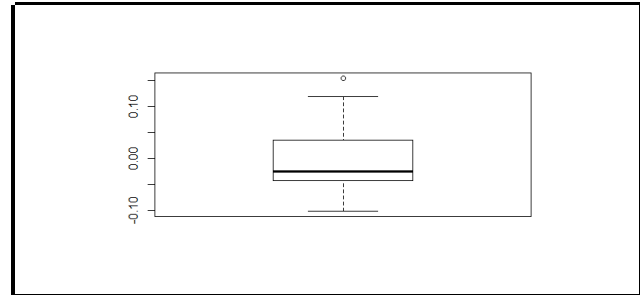
Table 1: Goodness of fit statistics of Variable AD for 21 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.867269	0.860283	124.1466	8.97E -10
Logarithmic	0.55498	0.531558	23.69472	1.07E -04
Inverse	0.21438	0.173032	5.184732	3.45E -02
Quadratic*	0.993459	0.992733	1366.991	2.19E -20
Cubic*	0.994689	0.993752	1061.272	1.58E -19
Power	0.826035	0.816879	90.21739	1.20E -08
S	0.434629	0.404873	14.60627	1.15E -03
Exponential*	0.995854	0.995636	4564.129	4.21E -24

*Competing models

(a)The residual diagnostics of the 'Exponential' model is given below:

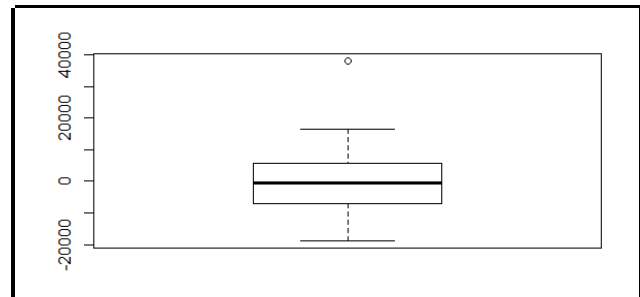
Figure 2: Box plot of the residuals of 'Exponential' model for variable AD



The significance of 'Shapiro – Wilk' test of the residuals of 'Exponential' model (for 21 years) = 0.02509. Therefore, we observe that the residuals of 'Exponential' model have outlier and not normally distributed. Hence, this model cannot be considered as best fit.

(a)The residual diagnostics of the 'Cubic' model is given below:

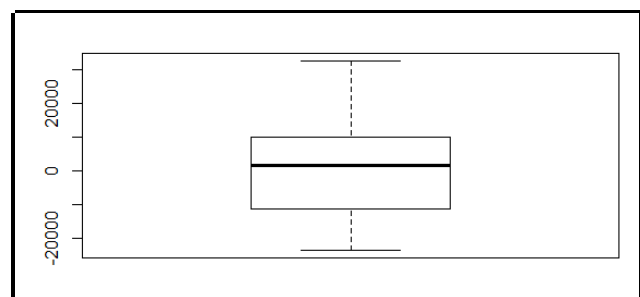
Figure 3: Box plot of the residuals of 'Cubic' model for variable AD



Significance of 'Shapiro – Wilk' test of the residuals of 'Cubic' model (for 21 years) = 0.04779. Therefore, we observe that the residuals of 'Cubic' model have outlier and not normally distributed. Hence, this model also cannot be considered as best fit.

(a)The residual diagnostics of the 'Quadratic' model is given below:

Figure 4: Box plot of the residuals of 'Quadratic' model for variable AD



Significance of 'Shapiro – Wilk' test of the residuals of 'Quadratic' model (for 21 years) = 0.681. Therefore, we observe that the residuals of 'Quadratic' model do not have outlier and approximately normally distributed ($p>0.05$). Therefore, for variable AD, 'Quadratic' is the best fit.

Aspect of Forecasting Accuracy:

- Mean Absolute Percentage Error (MAPE) for 2 years = 7.07
- Best fit identification for 23 years for the variable AD.

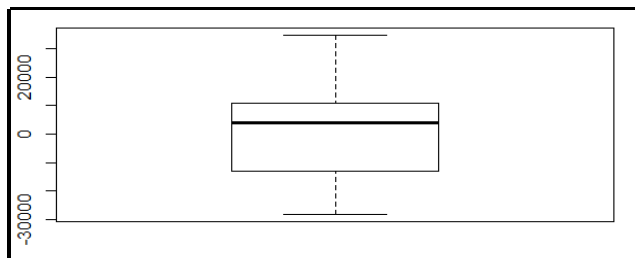
Table 2: Goodness of fit statistics of Variable AD for 23 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.883914	0.878386	159.9008	2.76E-11
Logarithmic	0.568668	0.548128	27.6864	3.24E-05
Inverse	0.210938	0.173364	5.613873	2.75E-02
Quadratic*	0.994676	0.994144	1868.296	1.83E-23
Cubic*	0.994691	0.993853	1186.705	8.79E-22
Power	0.835969	0.828158	107.0244	1.07E-09
S	0.42917	0.401987	15.78852	6.92E-04
Exponential*	0.994027	0.993743	3494.792	7.71E-25

*Competing models

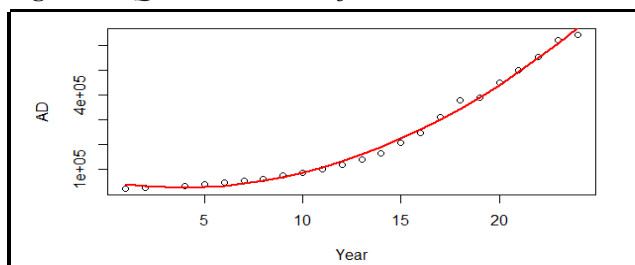
(a) The residual diagnostics of the 'Quadratic' model is given below:

Figure 5: Box plot of the residuals of 'Quadratic' model for variable AD



Significance of 'Shapiro – Wilk' test of the residuals of 'Quadratic' model (for 23 years) = 0.2493. The residuals of 'Quadratic' model do not have outlier and approximately normally distributed ($p>0.05$). Therefore, for variable AD, 'Quadratic' is the best fit. The trend curve for 23 years i.e. 'Quadratic' for variable AD is given below:

Figure 6: 'Quadratic' model for variable AD



Variable: DD

1. Best fit identification for 21 years for the variable DD.

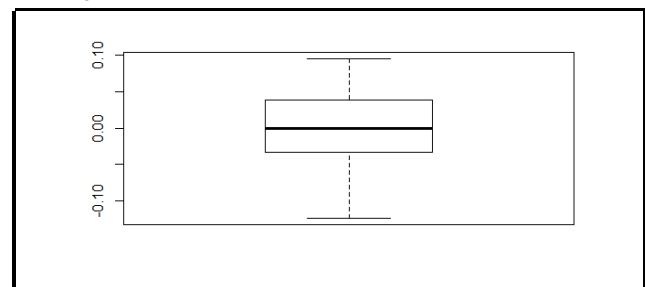
Table 3: Goodness of fit statistics of Variable DD for 21 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.898375	0.893026	167.961	6.99E-11
Logarithmic	0.595453	0.574161	27.96613	4.19E-05
Inverse	0.239491	0.199464	5.983256	2.43E-02
Quadratic*	0.996806	0.996451	2808.397	3.46E-23
Cubic*	0.997541	0.997108	2299.19	2.27E-22
Power	0.852137	0.844354	109.497	2.52E-09
S	0.460165	0.431753	16.19595	7.25E-04
Exponential*	0.996231	0.996033	5022.01	1.71E-24

*Competing models

(a) The residual diagnostics of the 'Exponential' model is given below:

Figure 7: Box plot of the residuals of 'Exponential' model for variable AD



Significance of 'Shapiro – Wilk' test of the residuals of 'Exponential' model = 0.8638. The residuals of 'Exponential' model do not have outlier and approximately normally distributed ($p>0.05$). Therefore, for variable DD, 'Exponential' is the best fit.

Aspect of forecasting accuracy

- Mean Absolute Percentage Error (MAPE) for 2 years = 6.46
- Best fit identification for 23 years for the variable DD.

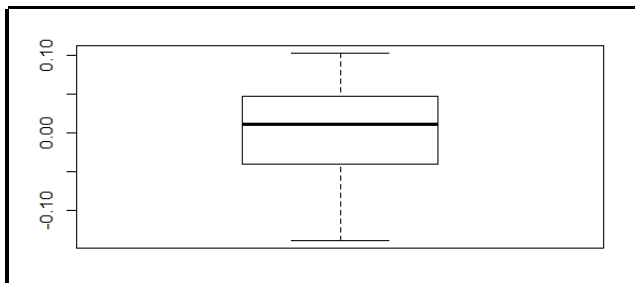
Table 4: Goodness of fit statistics of Variable DD for 23 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.88278	0.877198	158.1496	3.05E-11
Logarithmic	0.574125	0.553845	28.31027	2.82E-05
Inverse	0.217294	0.180023	5.830008	2.50E-02
Quadratic*	0.992819	0.992101	1382.516	3.65E-22
Cubic*	0.995296	0.994553	1340.022	2.79E-22
Power	0.853865	0.846906	122.7022	3.14E-10
S	0.446901	0.420563	16.96789	4.89E-04
Exponential*	0.995959	0.995767	5176.137	1.27E-26

*Competing models

(a) The residual diagnostics of the 'Exponential' model is given below:

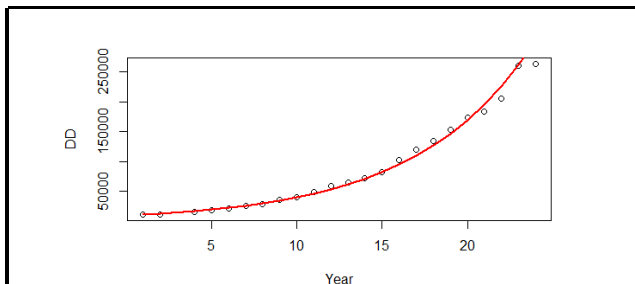
Figure 8: Box plot of the residuals of 'Exponential' model for variable DD



Significance of 'Shapiro – Wilk' test of the residuals of 'Exponential' model = 0.704. The residuals of 'Exponential' model do not have outlier and approximately normally distributed ($p > 0.05$). Therefore, for variable DD, 'Exponential' is the best fit.

The trend curve for 23 years i.e. 'Exponential' for variable DD is given below:

Figure 9: 'Exponential' model for variable DD



Variable: TD

- 1. Best fit identification for 21 years for the variable TD.

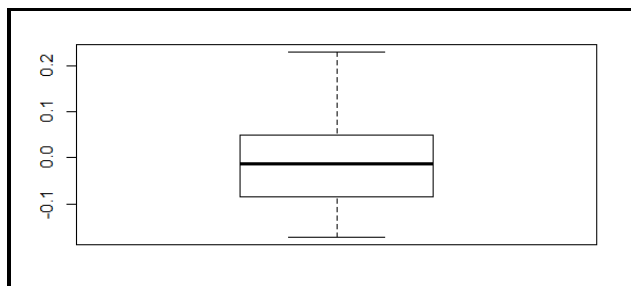
Table 5: Goodness of fit statistics of Variable TD for 21 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.845571	0.837443	104.034	3.82E-09
Logarithmic	0.529909	0.505168	21.41772	1.83E-04
Inverse	0.199696	0.157575	4.740974	4.23E-02
Quadratic*	0.988411	0.987123	767.5849	3.77E-18
Cubic*	0.98997	0.988201	559.3277	3.50E-17
Power	0.805369	0.795125	78.62058	3.52E-08
S	0.416601	0.385895	13.56773	1.58E-03
Exponential*	0.990726	0.990238	2029.8	8.86E-21

*Competing models

The residual diagnostics of the 'Exponential' model is given below:

Figure 10: Box plot of the residuals of 'Exponential' model for variable TD



Significance of 'Shapiro – Wilk' test of the residuals of 'Exponential' model = 0.7724. The residuals of 'Exponential' model do not have outlier and approximately normally distributed ($p > 0.05$). Therefore, for variable TD, 'Exponential' is the best fit.

Aspect of forecasting accuracy

- Mean Absolute Percentage Error (MAPE) for 2 years = 11.15
- Best fit identification for 23 years for the variable TD.

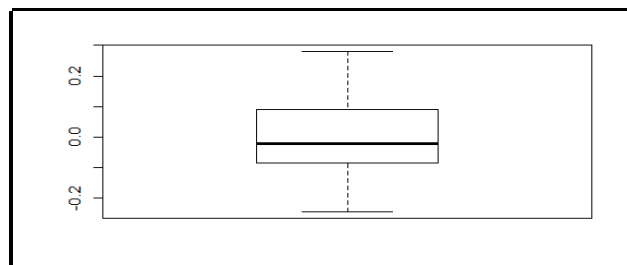
Table 6: Goodness of fit statistics of Variable TD for 23 years

	R ²	Adjusted R ²	F Stat	Sig. of F test
Linear	0.876796	0.870929	149.4492	5.17E-11
Logarithmic	0.560246	0.539306	26.75402	3.99E-05
Inverse	0.205158	0.167308	5.420334	3.00E-02
Quadratic*	0.987029	0.985732	760.9331	1.35E-19
Cubic*	0.987643	0.985692	506.2008	2.68E-18
Power	0.820231	0.81167	95.81649	2.81E-09
S	0.415594	0.387765	14.93389	8.98E-04
Exponential*	0.988454	0.987904	1797.787	7.83E-22

*Competing models

(a) The residual diagnostics of the 'Exponential' model is given below:

Figure 11: Box plot of the residuals of 'Exponential' model for variable TD

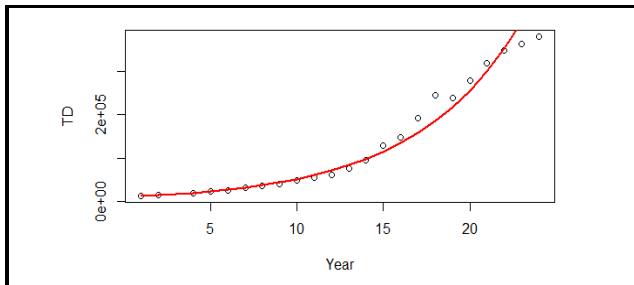


Significance of 'Shapiro – Wilk' test of the residuals of 'Exponential' model = 0.7474. The residuals of 'Exponential' model do not have outlier and

approximately normally distributed ($p > 0.05$). Therefore, for variable TD, 'Exponential' is the best fit.

The trend curve for 23 years i.e. 'Exponential' for variable TD is given below:

Figure 12: 'Exponential' model for variable TD



Important Findings Collated (As Emerged from Analysis)

- The main objective of the research work undertaken is to obtain a quantitative assessment of the movement of Deposit Mix in respect of selected variables AD, DD and TD values over time (Years) with respect to a large sized PSBs, i.e., PNB, and to obtain the pattern of dynamicity with the help of different parametric models. 8 Parametric models have been tried and graph-plots of best (and competitive) models (selected based on standard Best Fit criteria) have been displayed in different Charts, truly, the best identified models possess high precision embedded in those (details are delineated in the relevant portions of this paper).
- Strikingly, the values of AD, DD and TD follow smooth patterns, exhibiting upward trends over time for PNB. Their non linear trend is exhibited through Quadratic Model for AD and Exponential Model for DD and TD.
- Residuals from best models are free from outliers and they follow normality, thus model post-requisites regarding validity have been very well satisfied. The analytical framework and the results obtained indisputably uphold the validity of these models recommending their future uses on AD, DD and TD data-sets for other banks also.
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Forecasting of variables AD, DD and TD for the year 2019 and 2020:

Table 7: Forecasted values of AD, DD and TD

		Year	
		2019	2020
Variable	AD	670302.3	735563.8
	DD	302253.4	349483.3
	TD	483974.7	567826.9

DISCUSSION

The Research Paper makes a sincere effort to examine dynamicity of three critical variables of Deposits Mix over time and develop a forecasting model with the help of univariate 23 years dataset in respect variables AD, DD and TD (dependent variable) and Time (independent variable) with respect to a large sized PSBs, i.e., PNB (Rawlin, Sharan & Lakshmpathy, 2012).

To examine movement of Deposit Mix data over time, nonlinear models have been invoked by employing 'Curve Estimation' techniques of regression analysis and 'best fit' curve for each of the three variables i.e. AD, DD and TD has been obtained and then forecasting for next two years values has been attempted will reasonable precision (Rawlin & Sharan, 2011).

Selected Parametric models have been tried and graph-plots of best (and competitive) models (selected based on standard Best Fit criteria) have been displayed in different Charts, truly, the best identified models possess high precision embedded in those (details are delineated in the relevant portions of this paper) (Veerakumar, 2012).

Limitation of the Study

The study tries to examine empirically movement of three strategic Deposit Mix variables i.e. AD, DD and TD over time for selected PSB, i.e., PNB. However, studies revealed that apart from time variable, bank specific variables and macroeconomic factors like global recession, high rate of inflation have significant influence on composition and behavior of Deposit Mix

of a bank which is beyond the scope of our study.

Time series Deposit Mix variables i.e. AD, DD and TD data are available for twenty-three years for selected PSB, i.e., PNB. Therefore, the dataset can be said to be very small under any standard.

Significance of the Study

Despite the importance of monitoring Deposit Mix variables i.e. AD, DD and TD forecasting on the same have only received moderate attention in literature. This study contributes to the existing literature by modeling above variables in a large sized selected PSBs in India, i.e., PNB, using Curve Fit technique of Regression analysis (Parametric modeling).

By examining trends in significant components of Deposit Mix time series data and forecasting the three variables AD, DD and TD for short term of 2 years in a selected PSB, as attempted in the study, the bank will be in a position to initiate corrective actions as appropriate towards improving level of Deposit Mix in the bank resulting in a great relief for the bottom lines.

CONCLUSION

Deposit Mix inclusive of three strategic banking variables consisting of AD, DD and TD are the most important banking variables, which is having direct influence over the health and prospect of the monetary system in an economy in general with banking sector. It has inevitable impact on NIM and thereby ultimately on the bottom lines in the banking industry. Hence, success of a bank depends upon its ability to manage Deposit Mix judiciously by keeping managing proportionately higher cost of funds at a lower level.

The study attempted to capture trends existed in Deposit Mix variables, namely AD, DD and TD in PNB by employing Parametric Regression (Curve Estimation Technique), and surprisingly the results exhibited non linear feature and upward trend in our dataset in respect of all the three variables. Models of all variables captured, are backed by precision level of high magnitude. Based on our findings, we suggest that highly accurate forecasts may be obtained using univariate time series modeling.

Though significant improvement in Deposit Mix is a very challenging task but it is certainly possible to improve it. Bankers should evolve a two prone strategy and religiously implement the same to put a break on the imbalance in Deposit Mix. The strategies are: (I) CASA improvement measures, including raising the SB Deposit rate of interest with strategic benchmark and (II) Marginally reducing the TD rate of interest. Of

late, several institutional mechanisms have been developed and are being religiously persuaded by PSBs in India, to deal with improper Deposit Mix and there has also been improvement in this direction. However, it is felt effective management of Deposit Mix requires an appropriate internal checks and balance systems in a bank, which primarily depends on the wisdom and mindset of the top management (Board). Forecasted values of variables AD, DD and for two years (2019 and 2020) of PNB clearly demonstrates similar trend, which deserves immediate and serious attention on the part of the management of PNB to relook into the practices of deposit mobilization in the bank.

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