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A STUDY ON MEASUREMENT OF EFFICIENCY OF INDIAN BANKS IN PRE-MERGER REGIME

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ABSTRACT

This research paper primarily focuses on the selection of input-output variables(IOVs) of36 Indian commercial banks in the frame work of DEA. 20 financial ratios of those selected Indian banks as suggested by CAMEL model over the period 2009 to 2019 are initially used as multiple IOVs for measuring the technical and scale efficiencies of the selected banks. In this paper two types of financial indicators are used for the identification of efficient and inefficient banks-firstly, the CAMEL ratios to select IOVs and measuring technical and scale efficiencies of the Indian banks and secondly, the average logarithmic returns for measuring earning generating efficiency of the scale-efficient banks. Initially this paper focused on selection of IOVs using correlation matrix and multiple regression analysis. Then technical and scale efficiencies of the selected Indian banks is measured by applying non-parametric Data Envelopment Analysis. We have examined the earning efficiency of scale-efficient banks based on their stock prices and returns. In the terminal section, we have identified that stock of 3 Indian Banks namely City Union Bank Ltd., Kotak Mahindra Bank Ltd. and IndusInd Bank Ltd. are relatively scale-efficient as well as earning- efficient in Indian stock markets. Finally, a perceptual map based on the perception of the average investors has been constructed which, in turn, facilitates them to form a "portfolio basket of investment" based on the overall efficiency of the selected Indian banks.

Keywords: *CRS, VRS, IRS, IOVs, DMUs, DEA,CV.*

Introduction

While analysing the past studies related to the testing of technical efficiency through DEA, we have observed that limited attention has been given by the researchers on the selection of input and output variables which has a most significant impact in evaluating technical and scale efficiencies of the selected decision-making units (DMUs). Hence, our paper focuses on the techniques of selection of input and output variables out of multiple variables of the DMUs (Indian commercial banks in our present study). In contrast to the subjective selection of variables by many researchers, we have proposed here a new methodology for the selection of input and output variables using financial ratios of the DMUs. Average logarithmic stock returns are also used to identify the appropriate DMUs which have shown a continuous trend of earning efficiency in the Indian stock market. This paper has finally identified the banks which are technically efficient as well as efficient in generating earnings. Thus, our study has offered a new outlook by enclosing the earning efficiency of Indian banks to the process of measurement of their technical and scale efficiencies through DEA. In the present study, we have examined the earning efficiency and scale-efficient banks on the basis of Coefficient of Variation, Beta value , and Stock Return. Further, it also has proposed a perceptual map and portfolio basket based on the magnitude of coefficient of variation and Beta values of individual scale and earning-efficient Indian banks.

Review of Past Literature

Most of the studies have applied DEA approach to measure the efficiency of banks in various countries and in different scenarios. Some of these past studies include the following:

H Morita et al*.(2009)* revealed that it is difficult to select appropriate input and output from a larger number of possible combinations. They have demonstrated a model that uses diagonal layout experiment for finding out possible input-output combinations. ***A Bhatia et al (2015)****.* studied the determinants of efficiency and the statistical difference in efficiency of Indian Public Sector Banks from 1990-91 to 2011-12

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.They have used Paired t-test and revealed the fact that Public Sector Banks show higher mean of the efficiency parameter in post-reformatory era, i.e., 2001-02 to 2011-12, than in the reformatory era, i.e., 1990-91. ***T Subramanyam (2016)*** observed that a large number of input-output variables reduced the discriminatory power of DEA to evaluate the performance of profit-seeking and non-profit seeking DMUS. He tried to reduce the number of input and output variables before proceeding for DEA. The author proposed a new step-wise method to reduce the data set with the help of non-parametric test. ***Madhvi et a(2016)***. analyzed the productive and operating efficiencies of 41 Indian commercial banks through DEA over a period of 2002 to 2014. They took two input variables, i.e., employee and deposit, and two output variables, i.e., advance and interest income on arbitrary basis. They concluded that the increase in profits and expansion in the spread are not sufficient to improve the efficiency of the banks. ***R I Singh et al(2016).*** evaluated the relative efficiency of Indian public and private sector banks by applying DEA and also identified the slack variables to locate the ineffectiveness of the banks. They found that the efficiency of private sector banks is higher than the efficiency of public sector banks. ***T Koltai et al.(2017)*** calculated the efficiency scores based on financial information of the DMUs with the help of linear programming (LP) method and have also used scoring methods to identify input and output variables for evaluating the performance of those DMUs with DEA technique. ***K Jayarani et al(2018)*** identified the cost, revenue and profit-efficient DMUs over a period of 2015-16. They concluded that cost-efficient banks used less costly input for making themselves efficient. Revenue-efficient banks maximized the output for making themselves revenue-efficient. Profit-efficient banks achieved their efficiency by using optimal combination of inputs and outputs. ***A G Quaranta et al.(2018)*** applied a multi-dimensional approach to analyze the performance of 23 branches of an Italianregional bank. They used three steps namely the efficiency calculated by ratio method, co- linearity analysis to reduce the unnecessary information, and clustering procedure applied to categorize the bank branch in to efficiency classes.. ***I.Henriquesaet al (2018)***applied CCR and BCC models through DEA to analyze the Scale Efficiency of 37 Brazilian banks over a period of 2012 to 2016 and used intermediation approach to select input and output variables. The result found that the inefficiency of banks depends more to the scale of operations than that of the technical and administrative issues. ***R Ghaelia (2019)***applied input-oriented CCR model through DEA to find out the relative efficiency of 5 Canadian banks and 6 US big banks. They concluded that performance of US banks is better than Canadian banks.

Research Objectives

While analysing past studies, we have observed that limited attention has been paid on the selection of input and output variables and evaluation of revenue generating efficiency of Indian banks. Thus this paper is devoted towards the fulfilment of the following objectives:

- To focus on the selection of appropriate IOVs in the framework of DEA by applying statistical techniques.
- To measure the technical and scale efficiencies of the selected Indian banks using DEA;
- To measure earning efficiency of the selected Indian commercial banks using their stock prices; and
- To identify the Indian banks which are scale as well as earning- efficient in order to propose the portfolio basket of investment based on overall efficiency.

Research Framework

The present study has considered36 Indian commercial banks as decision making units out of which, 15 are public sectors banks and 21 are private sectors banks. Twenty CAMEL ratios over a pre-merger period (2009 to 2019) have been taken from PROWESS data base for measuring the efficiency of the selected banks [Annexure 1]. Stock prices of the selected DMUs have collected from the website of National Stock Exchange of India https://www.nseindia.com [Annexure 2] Considering the above data set, we have framed the overall structure of the paper in several sections:

Section A: Selection of input-output variables prior to application of DEA and reduction of DMUs (Indian banks) based on logarithmic stock returns.

Section B: Selection of Indian banks which are technically efficient as per BCC model.

Section C**:** Selection of Indian banks which are scale-efficient as per CCR model.

Section D**:** Testing of earning efficiency of the scale-efficient banks using their individual logarithmic stock return and overall market sensitivity index of NIFTY BANK in India.

Section E**:** Derivation of a perceptual map and portfolio basket of efficient banks which are found technically and scale-efficient (based on financial ratios) as well as earning-efficient (based on risk and return).

Research Methodology

In this paper, two types of financial indicators have been used for the identification of efficient and inefficient banks-one the CAMEL ratios and the other is stock prices and stock returns of thirty six selected Indian banks. The averages of twenty CAMEL ratios have calculated and summarised in [Annexture-1] These are initially considered as multiple IOVs. Then we have tested their multi-co linearity and the number of multiple IOVs are then reduced on the basis of correlation matrix. Finally, the input and output variables are selected using multiple regression analysis.

Due to volatility of Indian stock market, the logarithmic method has been applied in order to get their average log return. Considering arithmetic mean of the average log returns of all selected DMUs as a standard yard stick, the numbers of DMUs (Indian banks) are then reduced for the purpose of conducting DEA in the next section of the study. Then DEA developed by Charnes et al (1978) is applied to measure the efficiency of the reduced DMUs. The thumb rule of the number of DMUs proposed by Golany and Roll (1989) and. Bowlin (1998) and Friedman and Sinuany-Stern (1998) has been followed.

As an outset, the data set is normalized by dividing each value of input and output variables by the mean of their specific factors. Still we have found that some data sets are having negative numbers and zero values. Considering the positivity requirement of DEA, we have then added a sufficiently large positive constant to the values of input and output as advised in the study of Bowlin(1998).Thus, we have constructed the existing data free from the problem of "translation variance".

In the second section of the study, output–oriented BCC model is then applied to the normalized data set to identify technically efficient Indian banks. In the third section of our study, output-oriented CCR model is applied to the same data set to identify the scale- efficient Indian banks.

In the fourth section of the study we have examined the earning efficiency of scale efficient banks on the basis of co-efficient of variation, beta value based on their stock prices and returns in National Stock Exchange of India. In the terminal section of the study we have proposed a perceptual map and portfolio basket based on the magnitude of co-efficient of variation and beta values of individual scale and earning efficient Indian Banks.

Empirical Study, Analysis and Findings

For the selection of IOVs, initially we have chosen 16 ratios and 4 output ratios arbitrarily and average of 11 years of each of those input and output ratios of 36 Indian banks have been considered for the study. Considering the determinants of correlation matrix of 16 input variables, we have observed that a high degree of multi-co linearity occurs amongst them as determinant value tends to be zero. Inputs that correlate highly with one another can be eliminated through correlation analysis. We have tried to reduce the number of input variables on the basis of accepted level of correlation of input which lies between -0.7 to 0.7 and thus we get 8input variables which have very low correlation with each other as shown in **Table 1(a).**In case of 4 output variables, we have eliminated none of them as less multi-co linearity occurs amongst them which are shown in **Table 1(b).** We have calculated P values of each of the 4 output variables with respect to 8 input variables separately. It is found that P value of one particular output variable (E1) with respect to all input variables is more than 0.05. Hence, output variable (E1) is excluded in the next stage of analysis. Again, considering the P values of remaining 3 output variables with respect to all input variables, 2 input variables namely C1 and C2 have been eliminated. In this way, number of output and input variables are reduced to 3 & 6 respectively as shown in **Table:1(c).**For final selection of IOVs, we have considered the multiple regression analysis of each of the 3 output variables with respect to 6 input variables separately considering output variables as dependent and input variables as independent variables. Initially,we have conducted linear regression analysis of dependent variable (C3)on independent variables. As P value of the independent variable (M5) is more than 0.05, the next part of regression is conducted after eliminating it.The value of r square comes to 72.9% in respect of which all conditions of regression are satisfied as shown in **Table: 1(d).**In the next stage, we take another dependent variable (E2) and 6 independent variables for conducting regression again but the P values of the 4 independent variables (C4, L1, L2 & M5) are not satisfied. After eliminating these 4 independent variables,we run the regression taking the remaining 2 independent variables (M1 & M4). On the basis of P value, M1 is eliminated again and thereafter it is observed that E2 is explained by 55.7% by the independent variable M4. When we apply regression analysis after removing(M1), this time the regression analysis is satisfied and r square is 54.4%as shown in the Table: 1(e).In final stage of regression, we have considered the third and last output variable (E5) and 6 independent variables but it appeared that P values of3 independent variables (C4, M1 & M5) are not satisfied. Thus, we have decided to remove these 3 variables. All conditions of regression are satisfied for other 3 remaining independent variables(r square comes to 59.1 %.)**.**Out of 6 inputs variables initially taken, input M5 is eliminated as it does not significantly influence any of the output variables as shown in the Table: 1(f).The input variables M1 &C4 are important only for outputC3 while the 3other input variables (L1, L2, & M4) are influencing two output variables at a time. On this ground, the input variables M1 &C4 are rejected. The final selected input variables are M4 (BPP), L1(Cash to Deposit Ratio) and L2(Total Investment to Total Deposit Ratio), and output variables are C3(Return on Assets), E2(Return on Equity)& E5 (Average Stock Market Return).These are shown in the following chart:

Sl	Input Variables	Labelled As	Sl	Output Variables	Labelled As
1	BPP	M4	1	Return on Asset	C3
2	Cash to Deposit Ratio	L1	2	Return on Equity	E2
3	Total Investment to Total Deposit Ratio	L2	3	Average Stock Market Return	E5

The second section of our study we have reduced the number of DMUs from 36 to 18 based on rank of average logarithmic stock return yielded by them in Indian stock market. The results of echnically efficient DMUs as per BCC model of DEA is presented in the following chart:

Output Oriented BCC Model (VRS)						
DMU	**Bank Name**	**Efficiency**	**Returns to Scale**	**Efficient Tier / Rank**	**Radial**	**Non-Radial**
Dmu1	City Union Bank Ltd.	1	CRS	1	0	0
Dmu2	DCB Bank Ltd.	0.93817616	IRS	2		
Dmu3	Federal Bank Ltd.	0.99124169	IRS	2		
Dmu4	HDFC Bank Ltd.	1	CRS	1	0	0
Dmu5	IndusInd Bank Ltd.	1	CRS	1	0	0
Dmu6	Karnataka Bank Ltd.	0.93704597	IRS	2		
Dmu7	Kotak Mahindra Bank Ltd.	1	CRS	1	0	0
Dmu8	Lakshmi Vilas Bank Ltd.	1	CRS	1	0	0
Dmu9	South Indian Bank Ltd.	1	CRS	1	0	0
Dmu10	YES BANK Ltd.	1	CRS	1	0	0
Dmu11	Allahabad Bank	0.78198427	IRS	3		
Dmu12	Canara Bank	0.86373322	IRS	3		
Dmu13	Central Bank of India	0.61644395	IRS	3		
Dmu14	IDBI Bank Ltd.	1	CRS	1	0	0
Dmu15	Indian Bank	1	CRS	1	0	0
Dmu16	Punjab & Sind Bank	1	CRS	1	0	0
Dmu17	Union Bank of India	0.96141181	IRS	2		
Dmu18	Vijaya Bank	0.98414116	IRS	2		

In third section, we have applied output–oriented CCR model on the same data set for measuring scale efficiency of the Indian banks and we have derived the following result:

Output-Oriented CCR Model (CRS)						
DMU	**Bank Name**	**Efficiency**	**Return to scale**	**Efficient Tier / Rank**	**Radial**	**Non radial**
Dmu1	City Union Bank Ltd.	1	CRS	1	0	0
Dmu2	DCB Bank Ltd.	0.603966	IRS	2		
Dmu3	Federal Bank Ltd.	0.965987	IRS	2		
Dmu4	HDFC Bank Ltd.	1	CRS	1	0	0
Dmu5	IndusInd Bank Ltd.	1	CRS	1	0	0
Dmu6	Karnataka Bank Ltd.	0.93161	IRS	2		
Dmu7	Kotak Mahindra Bank Ltd.	1	CRS	1	0	0
Dmu8	Lakshmi Vilas Bank Ltd.	0.772375	IRS	2		
Dmu9	South Indian Bank Ltd.	1	CRS	1	0	0
Dmu10	YES BANK Ltd.	1	CRS	1	0	0
Dmu11	Allahabad Bank	0.59588	IRS	3		
Dmu12	Canara Bank	0.855409	IRS	3		
Dmu13	Central Bank of India	0.551212	IRS	3		
Dmu14	IDBI Bank Ltd.	1	CRS	1	0	0
Dmu15	Indian Bank	1	CRS	1	0	0
Dmu16	Punjab & Sind Bank	0.984517	IRS	2		
Dmu17	Union Bank of India	0.857634	IRS	2		
Dmu18	Vijaya Bank	0.956937	IRS	2		

The above result shows that 8 Indian banks are relatively scale-efficient with respect to others. As a researcher, we are keen to know the ranks of the scale-efficient banks on the basis of their performance of stock return with respect to market sensitivity index. Thus, the present section of the study has made an intense effort to measure their stock market efficiency in the light of logarithmic stock returns. As an outset, we have calculated the logarithmic stock return of 8 scale-efficient Indian banks as well as NIFTY-BANK Index of overall banking sector of India. The descriptive statistics (mean, standard deviation& variances) of logarithmic stock returns of each individual banks have also been computed**[Table 2 (a) and (b)]**. Co-efficient of variation (CV) of stock return and Beta of each individual stock is derived by applying the following formula **[Table 2 (c)].**

Co-efficient of variation (CV) of individual stock = $\frac{\text{Standard Deviation}}{\text{Mean of Individual Stock}}$

Beta = $\frac{\text{Co-variance (Market Index, Individual Stock)}}{\text{Variance of Individual Stock}}$

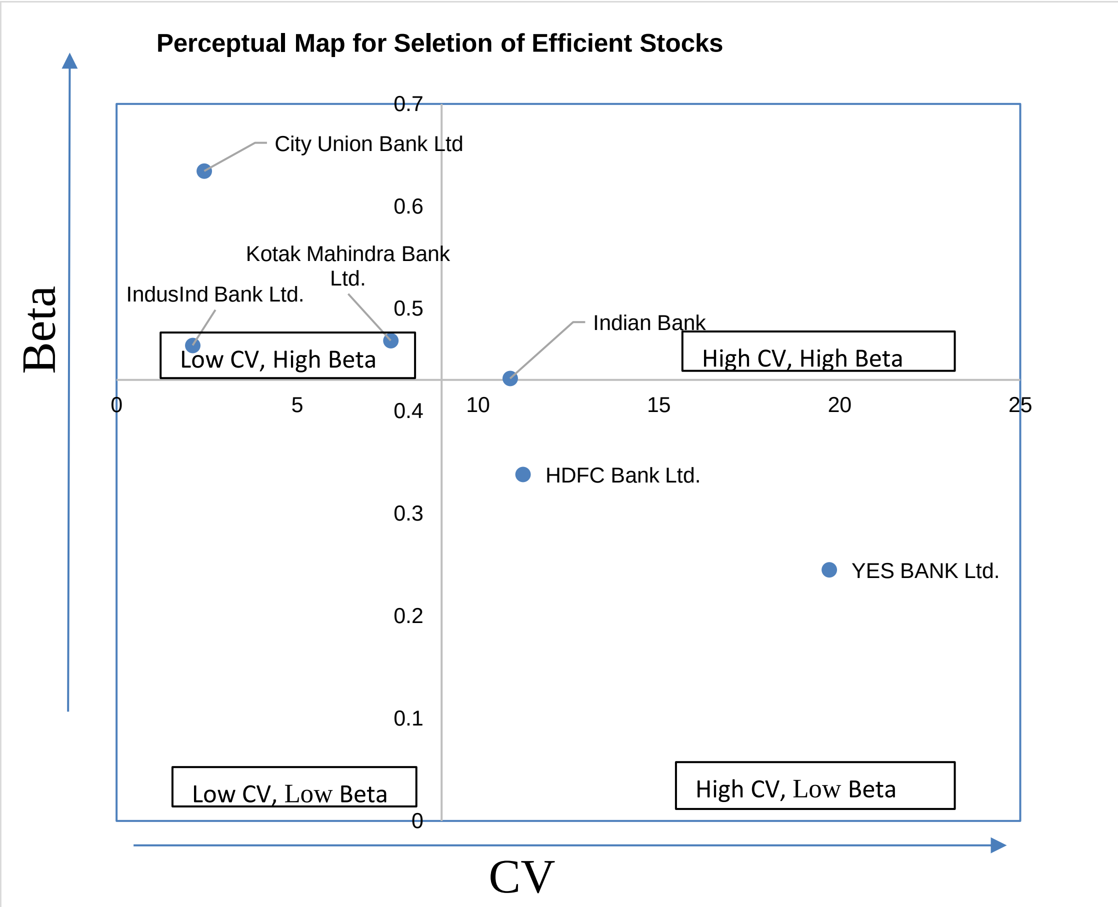
Where, Beta measures the responsiveness of a stock's price to changes in the overall stock market.

CV determines the volatility of an investment in comparison to expected return rate of investment.

The performance of stock returns has revealed that 2 scale-efficient Indian banks namely, South Indian Bank Ltd. and IDBI Bank Ltd. have negative mean of average logarithmic stock return, and therefore we have rejected them as they are proved inefficient in stock performance. Thus, remaining 6 scale-efficient Indian banks namely, City Union Bank Ltd., HDFC Bank Ltd., IndusInd Bank Ltd., Kotak Mahindra Bank Ltd., Yes Bank Ltd., Indian Bank are found earning-efficient in stock market as shown in **Table 2(d).**

Derivation of a Perceptual Map and Portfolio Basket

In the terminal section of our present study, we have derived a perceptual map on the basis of investors' attitude towards their investment in the highly volatile stock market of Indian Banks. The perceptual map consists of four quadrants depending upon the magnitude of CVs and Beta values as shown below:



The previous section of our study has revealed that the Beta value of the above mentioned 6 scale and earning-efficient Indian banks lies between 0 and 1. Considering the risk-return relationship of financial management, the average investors will prefer high Beta value while they invest their hard-earned money in the stocks of the above 6 Indian banks in order to maximize their return on investment. Thus, they will prefer those stocks which have high Beta value corresponding to low CVs as shown in 2nd quadrant of the perceptual map. Thus, they will prefer the stock of 3 Indian banks namely, City Union Bank Ltd., Kotak Mahindra Bank Ltd., and IndusInd Bank Ltd. which were found scale- efficient as well as earning-efficient in yielding returns in Indian stock market. The perceptual map as formed here, will in turn, facilitates the investors to form and decide on the *"portfolio basket"* of the stocks of 3 Indian banks. It falls in the 2nd quadrant of the perceptual map as shown above.

Conclusion & Future Scope

On the basis of the present study, we may infer that technically and scale-efficient DMUs (Indian banks) have tried to maximise their selected outputs with the given amount of selected inputs. 10 DMUs namely, City Union Bank Ltd., HDFC Bank Ltd., IndusInd Bank Ltd., Kotak Mahindra Bank Ltd., Laxmi Vilas Bank Ltd.., Yes Bank Ltd, IDBI Bank Ltd., Indian Bank, and Punjab & Sind Bank Ltd. are found relatively technically-efficient banks. While measuring their scale efficiency in DEA framework, 2 of them, namely Laxmi Vilas Bank Ltd., and Punjab& Sind Bank Ltd. are appeared as scale-inefficient and rest of 8 Indian banks have shown their efficiency in scale size with respect to others. All scale efficient banks could not be able to attain earning efficiency in highly volatile Indian stock market scenario. Finally, we have invented that three scale-efficient banks namely, City Union Bank, Kotak Mahindra Bank and IndusInd Bank have added a feather to the crown of scale-efficient banks by showing their potentiality to generate stock return. Thus, the present and prospective investors who would be able to identify the appropriate stocks in Indian banking sector based on perceptual investment map. We acknowledge that the study on the application of DEA in banking sector specifically in the areas of Peer bank analysis with peer count, inclusion of Maximum Productive Scale Size (MPSS), etc., are still unaccomplished here. These undone areas may be comprehended in future study.

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List of Abbreviation

Abbreviations of the Ratios		
Sl.	**Abbreviation**	**Financial Ratios**
1	AV_C1	Debt Equity Ratio
2	AV_C2	Total advances to Total assets Ratio
3	AV_C3	Return on Assets
4	AV_C4	Interest Income to Total Assets Ratio (%)
5	AV_C5	Net Interest Income to Total Assets Ratio (%)

6	AV_A1	Gross NPA to Net Advance Ratio
7	AV_A2	Total Investment to Total Assets Ratio
8	AV_M1	Total Expenditure to total Income Ratio
9	AV_M2	Total Advance to Total Deposit Ratio
10	AV_M3	Assets Turnover Ratio
11	AV_M4	BPP
12	AV_M5	PPP
13	AV_ E1	Net Profit Margin (%)
14	AV_E2	Return on Equity
15	AV_E3	Net Interest Margin
16	AV_E4	Interest Income to Total Income Ratio
17	AV_E5	Average stock Market Return
18	AV_L1	Cash to Deposit Ratio (%)
19	AV_L2	Total Investment to Total Deposit Ratio(%)
20	AV_L3	Interest Expanded to Interest Earned Ratio (%)

List of Annexures

Annexure 1

Indian Banks (DMUs) and Their Average Ratios.

Sl. No.	Bank's Name	OUTPUT				INPUT															
		AV_ C3	AV_ E1	AV_ E2	AV_ E5	AV_ C1	AV_ C2	AV_ C4	AV_ C5	AV_ A1	AV_ A2	AV_ M1	AV_ M2	AV_ M3	AV_ M4	AV_ M5	AV_ E3	AV_ E4	AV_ L1	AV_ L2	AV_ L3
1	Axis Bank Ltd.	1.3	444.1	14.94	229	1.73	60.5	7.25	2.85	2.343	0.54	39.7	85.1	13.45	114.6	425	3.27	154	1.38	0.012	60.5
2	City Union Bank Ltd.	1.55	121.3	18.83	182	0.18	65.7	9.01	2.99	1.856	0.27	36.9	72.4	11.62	80.78	249	3.37	215	1.11	0	66.6
3	DCB Bank Ltd.	0.56	255.7	5.994	145	0.91	62.6	8.5	2.94	3.785	0.17	63	89.2	12.78	62.68	211	3.44	204	1.12	0	65.3
4	Dhanlaxmi Bank Ltd.	-0.4	1689	-6.86	85.9	0.97	56.6	8.35	2.21	4.125	0.72	80.4	71.1	8.492	-26.5	148	2.43	275	1.33	0	73.2
5	Federal Bank Ltd.	1.06	199.2	11.91	126	0.61	63.1	8.32	2.99	2.763	0.42	42.8	75.1	11.13	47.26	189	3.21	217	0.74	0.199	63.9
6	HDFC Bank Ltd.	1.78	167.8	18.5	396	0.97	61.4	8.15	3.88	1.11	0.14	44.3	80.3	13.69	73.45	215	4.56	150	1.21	0.014	52.2
7	ICICI Bank Ltd.	1.18	270.1	11.19	178	2.21	51.6	6.3	2.4	4.848	0.71	41.7	107	13.46	93.8	350	3.03	138	1.49	0.088	61.6
8	IndusInd Bank Ltd.	1.52	196.1	16.06	330	1.61	60.4	8.55	2.99	1.094	0.19	44.8	87.4	9.588	84.97	311	3.47	180	0.76	0.04	64
9	Jammu & Kashmir Bank Ltd.	0.87	209	11.7	90.6	0.4	57	7.75	2.94	4.904	1	39.5	71.8	8.28	41.46	241	3.51	215	0.41	0.223	60.6
10	Karnataka Bank Ltd.	0.78	252.7	10.99	83.5	0.38	59.7	8.27	2.14	3.556	0.42	48.8	65.9	10.33	46.53	210	2.37	257	0.72	0.01	74.1
11	Karur Vysya Bank Ltd.	1.13	241.2	14.66	139	0.53	65.3	8.86	2.83	2.424	0.83	41.9	74.4	11.23	68.73	286	3.11	226	1.06	0	67.9
12	Kotak Mahindra Bank Ltd.	2.13	182.8	14.47	346	1.63	58.6	8.74	4.37	1.941	0.73	47.4	125	16.13	90.76	300	5.11	134	0.81	1.408	49.9
13	Lakshmi Vilas Bank Ltd.	0.15	300.7	1.667	123	0.62	64.4	8.7	2.19	4.226	1.52	53.9	80.3	7.782	19.35	201	2.54	271	1.23	0	74.7
14	South Indian Bank Ltd.	0.79	272	12.99	97.4	0.51	64.2	8.25	2.4	2.116	0.45	46.1	74.5	10.33	52.17	248	2.72	260	0.56	0	70.8
15	YES BANK Ltd.	1.52	138.2	19.8	254	2.59	57.2	7.89	2.41	0.707	0.3	36.3	85.5	14.31	166.4	510	2.94	203	0.3	0	69.1
16	Allahabad Bank	-0	-41.4	-0.34	57.8	0.98	62.3	7.67	2.38	6.277	1.95	42	73.7	10.04	68.26	202	2.58	227	0.3	0.145	68.9
17	Andhra Bank	0.38	372.6	6.316	65.7	1.18	63.9	8.13	2.62	6.016	1.7	41.2	75.3	8.879	79.99	230	2.89	229	0.54	0.093	67.6
18	Bank of Baroda	0.62	180.8	10.56	97.1	0.95	60.7	6.33	2.2	4.761	1.02	42.4	80.5	10.54	51.41	191	2.45	202	0.55	0.151	65.3
19	Bank of India	0.21	42.21	3.963	71	1.31	61.7	6.71	2.04	6.62	1.79	44	80.6	10.05	42.95	184	2.26	231	0.44	0.264	69.6
20	Bank of Maharashtra	-0.1	399	-0.78	56	1.17	61.5	7.65	2.36	6.91	1.77	49.8	72.8	8.911	62.58	211	2.61	243	0.58	0.108	69.1
21	Canara Bank	0.5	256.6	8.462	69.2	0.87	60.7	7.41	1.94	4.831	0.99	43.3	72.9	9.764	50.76	177	2.16	255	0.37	0.206	73.5
22	Central Bank of India	-0.2	127.7	-3.05	75.1	0.86	57.5	7.68	2.07	8.484	2.15	55.7	70.6	7.672	48.74	374	2.29	277	0.64	0.199	73.1
23	Corporation Bank	0.11	117.4	2.728	69	1.29	59.6	7.6	1.93	5.563	1.56	37.6	76.3	9.239	55.32	166	2.13	268	0.62	0.003	74.3
24	Dena Bank	0.09	96.89	3.243	53.8	0.69	60.6	7.61	2.07	7.578	2.29	50.7	74.7	9.103	-4.09	230	2.26	277	0.52	0.033	72.6
25	IDBI Bank Ltd.	-0.5	114.8	-3.6	63	2.96	58.1	7.31	1.51	9.006	3.11	39.3	91.7	10.2	-23.3	475	1.71	297	0.66	0.015	79.3
26	Indian Bank	0.93	286.2	11.74	69.2	0.39	63.2	7.8	2.69	3.888	0.76	40.1	72.7	10.49	55.94	160	2.97	219	0.27	0.118	65.4
27	Indian Overseas Bank	-0.3	80.51	-5.12	54.9	1.37	61.2	7.87	2.17	10.36	2.33	50.4	73.2	8.984	-35.3	247	2.38	256	0.62	0.059	72.2
28	Oriental Bank of Commerce	0.2	1071	2.018	57.9	0.62	62.2	7.96	2.17	6.411	1.33	44.2	71.4	9.379	12.02	305	2.37	273	0.34	0.107	72.6
29	Punjab & Sind Bank	0.36	291.3	6.659	37.1	0.75	62	8.09	2.07	4.778	1.13	50.1	73.8	9.125	21.42	251	2.27	309	0.28	1E-03	74.1
30	Punjab National Bank	0.41	133.1	5.936	92.3	1.37	61.9	7.34	2.63	7.065	1.81	42.8	76.1	10.64	44.81	159	2.9	201	0.49	0.286	64.3
31	State Bank of India	0.57	-5777	9.49	122	1.56	61	7.19	2.6	5.221	0.78	46.3	81	10.61	10.24	171	2.93	196	0.75	0.107	63.9
32	Syndicate Bank Ltd.	0.29	166.3	6.909	57.3	1.47	66.7	7.4	2.2	4.646	1.37	46.9	88	11.17	28.89	297	2.38	251	0.33	0.44	70.3
33	UCO Bank	-0.2	160.2	-0.52	61.6	1.07	58.5	7.32	1.98	9.227	2.8	46.8	75.7	7.931	-21.3	232	2.32	283	0.28	0.094	73.1
34	Union Bank of India	0.42	264.3	7.522	74.5	1.39	64.2	7.51	2.25	6.054	1.54	44.1	77.3	10.17	50.81	155	2.48	233	0.29	0.053	70
35	United Bank of India	-0.1	243.9	-1.76	52.4	0.62	54.3	7.2	1.84	9.332	1.64	60.2	64.5	7.617	-17	220	2.03	249	0.43	0	74.7
36	Vijaya Bank	0.5	352.3	9.211	64.4	0.9	61.4	7.85	2	3.79	0.59	51.5	67.9	9.274	39.68	241	2.26	301	0.37	0.003	74.1

Annexure: 2

Stock Prices (NSE)

Sl. No.	Bank	29-03-2019	28-03-2018	31-03-2017	31-03-2016	31-03-2015	31-03 2014	28-03-2013	30-03-2012	31-03-2011	31-03-2010	31-03-2009	31-03-2008
1	City Union Bank Ltd.	204.85	172.45	151.6	94.8	96.9	53.85	52.55	48.5	44.8	28.65	12.2	28.3
2	HDFC Bank Ltd.	2,318.90	1,886.10	1,442.55	1,071.15	1,022.70	748.8	625.35	519.85	2,345.85	1,933.50	973.4	1,331.25
3	IndusInd Bank Ltd.	1,780.00	1,796.75	1,425.15	967.6	886	501.85	404.7	321.65	263.6	170.1	32.1	78.65
4	Kotak Mahindra Bank Ltd.	1,334.50	1,047.80	872.2	680.65	1,313.25	781.05	653	545.35	457.85	748.15	282.2	625.9
5	South Indian Bank Ltd.	16.5	22.8	21.35	17.65	25.2	22.25	24.5	24.7	22.85	178.15	51.2	139.8
6	YES BANK Ltd.	275.1	304.85	1,546.75	865.05	815.75	413.95	428.9	368.8	309.6	256.2	50	168.75
7	IDBI Bank Ltd.	46.65	72.2	75.1	69.4	71	65.3	80.25	104.7	142.45	115	45.4	89.1
8	Indian Bank	280.1	299.8	278.25	103.9	173.45	114.85	176.15	244	232.75	175.4	82.2	163.95
9	NIFTY BANK	30426.8	24263.4	21444.2	16141.7	18206.65	12742.05	11361.9	10212.8	11705.5	9459.6	4133	6655

List of Tables

Correlation Matrix of Input variables. [Table 1(a)]

		AV_ C1	AV_ C2	AV_ C4	AV_ C5	AV_ A1	AV_ A2	AV_ M1	AV_ M2	AV_ M3	AV_ M4	AV_ M5	AV_ E3	AV_ E4	AV_ L1	AV_ L2	AV_ L3
Correlation	AV_C1	1.000	-.378	-.394	-.073	.080	.211	-.226	.611	.401	.208	.611	-.008	-.261	.076	.143	-.071
	AV_C2	-.378	1.000	.426	.144	-.244	-.105	-.205	-.223	-.009	.061	-.308	.054	.139	-.148	-.043	.025
	AV_C4	-.394	.426	1.000	.463	-.485	-.384	.187	-.055	.086	.127	-.032	.423	.058	.242	.057	-.094
	AV_C5	-.073	.144	.463	1.000	-.629	-.571	-.151	.496	.671	.509	-.006	.990	-.774	.392	.522	-.922
	AV_A1	.080	-.244	-.485	-.629	1.000	.897	.188	-.278	-.623	-.698	-.121	-.639	.506	-.385	-.091	.528
	AV_A2	.211	-.105	-.384	-.571	.897	1.000	.007	-.140	-.544	-.584	.030	-.583	.520	-.401	.005	.514
	AV_M1	-.226	-.205	.187	-.151	.188	.007	1.000	-.159	-.323	-.497	-.279	-.161	.315	.245	-.064	.255
	AV_M2	.611	-.223	-.055	.496	-.278	-.140	-.159	1.000	.719	.359	.395	.552	-.605	.341	.657	-.559
	AV_M3	.401	-.009	.086	.671	-.623	-.544	-.323	.719	1.000	.666	.367	.700	-.758	.374	.424	-.702
	AV_M4	.208	.061	.127	.509	-.698	-.584	-.497	.359	.666	1.000	.351	.539	-.646	.182	.149	-.537
	AV_M5	.611	-.308	-.032	-.006	-.121	.030	-.279	.395	.367	.351	1.000	.059	-.121	.123	.026	-.004
	AV_E3	-.008	.054	.423	.990	-.639	-.583	-.161	.552	.700	.539	.059	1.000	-.803	.423	.507	-.931
	AV_E4	-.261	.139	.058	-.774	.506	.520	.315	-.605	-.758	-.646	-.121	-.803	1.000	-.458	-.373	.905
	AV_L1	.076	-.148	.242	.392	-.385	-.401	.245	.341	.374	.182	.123	.423	-.458	1.000	-.097	-.365
	AV_L2	.143	-.043	.057	.522	-.091	.005	-.064	.657	.424	.149	.026	.507	-.373	-.097	1.000	-.514
	AV_L3	-.071	.025	-.094	-.922	.528	.514	.255	-0.56	-.702	-.537	-.004	-.931	.905	-.365	-.514	1.000

a. Determinant = 2.189E-011

Correlation Matrix of output variables. [Table 1 (b)]

		AV_C3	AV_E1	AV_E2	AV_E5
Correlation	AV_C3	1.000	-.055	.939	.830
	AV_E1	-.055	1.000	-.130	-.035
	AV_E2	.939	-.130	1.000	.673
	AV_E5	.830	-.035	.673	1.000

a. Determinant = .024

P values of each output variable with respect to input variables [Table: 1(c)]

Correlations

		AV_C1	AV_C2	AV_C4	AV_M1	AV_M4	AV_M5	AV_L1	AV_L2	AV_E1
AV_E1	Pearson Correlation	-.160	-.042	.204	.171	.068	.114	.039	-.025	1
	Sig. (2-tailed)	.350	.806	.234	.318	.693	.507	.821	.884	
	N	36	36	36	36	36	36	36	36	36

Correlations

		AV_C1	AV_C2	AV_C4	AV_M1	AV_M4	AV_M5	AV_L1	AV_L2	AV_E5
AV_E5	Pearson Correlation	.272	-.108	.323	-.177	.596**	.328	.509**	.295	1
	Sig. (2-tailed)	.109	.532	.055	.300	.000	.051	.002	.081	
	N	36	36	36	36	36	36	36	36	36

Correlations

		AV_C3	AV_C1	AV_C2	AV_C4	AV_M1	AV_M4	AV_M5	AV_L1	AV_L2
AV_C3	Pearson Correlation	1	.022	.074	.325	-.423*	.747**	.215	.329	.321
	Sig. (2-tailed)		.898	.668	.053	.010	.000	.209	.050	.056
	N	36	36	36	36	36	36	36	36	36

Correlations

		AV_C1	AV_C2	AV_C4	AV_M1	AV_M4	AV_M5	AV_L1	AV_L2	AV_E2
AV_E2	Pearson Correlation	-.027	.205	.238	-.542**	.746**	.188	.184	.122	1
	Sig. (2-tailed)	.874	.230	.163	.001	.000	.273	.282	.479	
	N	36	36	36	36	36	36	36	36	36

Regression of output variable C3 on selected input variables[Table: 1(d)].

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.857[a]	.735	.680	.3647543

a. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.690	6	1.782	13.392	.000[b]
	Residual	3.858	29	.133		
	Total	14.549	35			

a. Dependent Variable: AV_C3

b. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.834	.843		-.990	.331
	AV_C4	.229	.102	.229	2.243	.033
	AV_M4	.008	.002	.516	4.132	.000
	AV_M5	-.001	.001	-.080	-.769	.448
	AV_M1	-.022	.010	-.286	-2.294	.029
	AV_L1	.516	.198	.283	2.601	.014
	AV_L2	.643	.260	.242	2.476	.019

a. Dependent Variable: AV_C3

Regression of output variable C3 on selected input variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.729	.684	.3622621

a. Predictors: (Constant), AV_M4, AV_C4, AV_L2, AV_L1, AV_M1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.612	5	2.122	16.172	.000[b]
	Residual	3.937	30	.131		
	Total	14.549	35			

a. Dependent Variable: AV_C3

b. Predictors: (Constant), AV_M4, AV_C4, AV_L2, AV_L1, AV_M1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.045	.792		-1.319	.197
	AV_C4	.234	.101	.234	2.312	.028
	AV_M1	-.021	.009	-.272	-2.220	.034
	AV_L1	.496	.195	.272	2.540	.017
	AV_L2	.644	.258	.243	2.497	.018
	AV_M4	.008	.002	.497	4.089	.000

a. Dependent Variable: AV_C3

Regression of output variable C3 on selected input variables[Table: 1(d)].

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.857[a]	.735	.680	.3647543

a. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.690	6	1.782	13.392	.000[b]
	Residual	3.858	29	.133		
	Total	14.549	35			

a. Dependent Variable: AV_C3

b. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.834	.843		-.990	.331
	AV_C4	.229	.102	.229	2.243	.033
	AV_M4	.008	.002	.516	4.132	.000
	AV_M5	-.001	.001	-.080	-.769	.448
	AV_M1	-.022	.010	-.286	-2.294	.029
	AV_L1	.516	.198	.283	2.601	.014
	AV_L2	.643	.260	.242	2.476	.019

a. Dependent Variable: AV_C3

Regression of output variable C3 on selected input variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.729	.684	.3622621

a. Predictors: (Constant), AV_M4, AV_C4, AV_L2, AV_L1, AV_M1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.612	5	2.122	16.172	.000[b]
	Residual	3.937	30	.131		
	Total	14.549	35			

a. Dependent Variable: AV_C3

b. Predictors: (Constant), AV_M4, AV_C4, AV_L2, AV_L1, AV_M1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.045	.792		-1.319	.197
	AV_C4	.234	.101	.234	2.312	.028
	AV_M1	-.021	.009	-.272	-2.220	.034
	AV_L1	.496	.195	.272	2.540	.017
	AV_L2	.644	.258	.243	2.497	.018
	AV_M4	.008	.002	.497	4.089	.000

a. Dependent Variable: AV_C3

Regression of output variable E2 on selected input variables [Table: 1 (e)].

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.816[a]	.666	.597	4.4980219

a. Predictors: (Constant), AV_M5, AV_L2, AV_C4, AV_L1, AV_M1, AV_M4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1169.876	6	194.979	9.637	.000[b]
	Residual	586.734	29	20.232		
	Total	1756.610	35			

a. Dependent Variable: AV_E2

b. Predictors: (Constant), AV_M5, AV_L2, AV_C4, AV_L1, AV_M1, AV_M4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.112	10.397		.107	.916
	AV_C4	2.180	1.258	.198	1.733	.094
	AV_M1	-.317	.118	-.375	-2.683	.012
	AV_L1	2.915	2.445	.146	1.192	.243
	AV_L2	.646	3.201	.022	.202	.842
	AV_M4	.092	.024	.547	3.904	.001
	AV_M5	-.010	.009	-.121	-1.037	.309

a. Dependent Variable: AV_E2

Regression of output variable E2 on selected input variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.772[a]	.596	.572	4.6368284

a. Predictors: (Constant), AV_M4, AV_M1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1047.104	2	523.552	24.351	.000[b]
	Residual	709.506	33	21.500		
	Total	1756.610	35			

a. Dependent Variable: AV_E2

b. Predictors: (Constant), AV_M4, AV_M1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.196	5.615		1.994	.054
	AV_M1	-.192	.108	-.227	-1.784	.084
	AV_M4	.107	.021	.633	4.969	.000

a. Dependent Variable: AV_E2

Regression of output variable E2 on selected input variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.746[a]	.557	.544	4.7832860

a. Predictors: (Constant), AV_M4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	978.696	1	978.696	42.776	.000[b]
	Residual	777.914	34	22.880		
	Total	1756.610	35			

a. Dependent Variable: AV_E2

b. Predictors: (Constant), AV_M4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.392	1.185		1.175	.248
	AV_M4	.126	.019	.746	6.540	.000

a. Dependent Variable: AV_E2

Regression of output variable E5 on selected input variables [Table: 1(f)].

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.793[a]	.630	.553	59.5378128

a. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	174762.744	6	29127.124	8.217	.000[b]
	Residual	102797.783	29	3544.751		
	Total	277560.527	35			

a. Dependent Variable: AV_E5

b. Predictors: (Constant), AV_L2, AV_M5, AV_C4, AV_L1, AV_M1, AV_M4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-182.816	137.616		-1.328	.194
	AV_M4	.797	.313	.376	2.547	.016
	AV_C4	24.152	16.654	.175	1.450	.158
	AV_M1	-.827	1.561	-.078	-.530	.600
	AV_M5	.123	.126	.120	.979	.336
	AV_L1	107.892	32.361	.429	3.334	.002
	AV_L2	96.032	42.366	.262	2.267	.031

a. Dependent Variable: AV_E5

Regression of output variable E5 on selected input variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.769[a]	.591	.552	59.5739985

a. Predictors: (Constant), AV_L2, AV_L1, AV_M4

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	163990.566	3	54663.522	15.402	.000[b]
	Residual	113569.961	32	3549.061		
	Total	277560.527	35			
a. Dependent Variable: AV_E5						
b. Predictors: (Constant), AV_L2, AV_L1, AV_M4						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-15.697	23.403		-.671	.507
	AV_M4	1.006	.247	.475	4.068	.000
	AV_L1	113.064	29.197	.449	3.873	.001
	AV_L2	98.017	42.227	.268	2.321	.027
a. Dependent Variable: AV_E5						

Logarithmic stock return of 8 Indian banks as well as NIFTY-BANK index [Table 2 (a)]

	City Union Bank Ltd.	HDFC Bank Ltd.	IndusInd Bank Ltd.	Kotak Mahindra Bank Ltd.	South Indian Bank Ltd.	YES BANK Ltd.	IDBI Bank Ltd.	Indian Bank	Nifty Bank
P1	0.1721707	0.206582	-0.009366	0.241863962	-0.32340016	-0.10269	-0.43677	-0.068	0.226
P2	0.1288619	0.268099	0.2317024	0.183429252	0.065708796	-1.62409	-0.03938	0.0746	0.124
P3	0.4694761	0.29768	0.3872136	0.247970531	0.190315956	0.581124	0.078934	0.9851	0.284
P4	-0.02191	0.046287	0.0881018	-0.657212036	-0.35610821	0.058679	-0.02279	-0.512	-0.12
P5	0.5874771	0.31173	0.5684157	0.519621092	0.124501986	0.678363	0.083688	0.4123	0.357
P6	0.0244373	0.18016	0.2151552	0.179062039	-0.09633111	-0.03548	-0.20615	-0.428	0.115
P7	0.0802013	0.184771	0.2296821	0.180149339	-0.00813013	0.150969	-0.26595	-0.326	0.107
P8	0.0793557	-1.50686	0.1990312	0.174886171	0.077852126	0.174973	-0.30789	0.0472	-0.14
P9	0.4470547	0.193316	0.4380463	-0.491061873	-2.05367477	0.189323	0.214059	0.2829	0.213
P10	0.8537175	0.686292	1.6675305	0.974987453	1.24688636	1.633935	0.92942	0.7579	0.828
P11	-0.841426	-0.31307	-0.896152	-0.796574575	-1.0044733	-1.2164	-0.67425	-0.69	-0.48

Mean, Standard deviation, Variances of Logarithmic Stock Returns of each individual banks.[Table 2(b)]

	City Union Bank Ltd.	HDFC Bank Ltd.	IndusInd Bank Ltd.	Kotak Mahindra Bank Ltd.	South Indian Bank Ltd.	YES BANK Ltd.	IDBI Bank Ltd.	Indian Bank	Nifty Bank
Average	0.179946	0.05045	0.283578	0.0688292	-0.194259	0.044428	-0.05883	0.0487	0.138
Variance	0.190609	0.32181	0.356427	0.2724831	0.666901	0.76677	0.17402	0.281	0.108
Beta	0.634536	0.33839	0.464345	0.4690010	0.193890	0.245358	0.60962	0.4319	0.909

Co-efficient of variation of stock return and Beta of each individual stock [Table 2(c)]

Bank	Mean	Standard Deviation	Coefficient of Variation	Beta
City Union Bank Ltd.	0.179946927	0.436588034	2.426204443	0.634536583
HDFC Bank Ltd.	0.050452235	0.567283327	11.24396822	0.338393039
IndusInd Bank Ltd.	0.283578274	0.597015287	2.105292761	0.46434569
Kotak Mahindra Bank Ltd.	0.068829214	0.521999142	7.583976498	0.469001052
South Indian Bank Ltd.	-0.194259314	0.816640361	-4.203867225	0.19389076
YES BANK Ltd.	0.044428758	0.875654039	19.70917213	0.24535824
IDBI Bank Ltd.	-0.058826037	0.417167176	-7.091539676	0.609628347
Indian Bank	0.048689562	0.530051062	10.88633874	0.431934653

Earning Efficient in Stock Market [Table 2(d)]

Bank	Mean	SD	Coefficient of Variation	Beta
City Union Bank Ltd.	0.179947	0.436588	2.426204	0.634537
HDFC Bank Ltd.	0.050452	0.567283	11.24397	0.338393
IndusInd Bank Ltd.	0.283578	0.597015	2.105293	0.464346
Kotak Mahindra Bank Ltd.	0.068829	0.521999	7.583976	0.469001
YES BANK Ltd.	0.044429	0.875654	19.70917	0.245358
Indian Bank	0.04869	0.530051	10.88634	0.431935
Average	0.112654	0.588098	8.992492	0.430595