

DETERMINANTS OF INTELLECTUAL EFFICIENCY VALUE: EMPIRICAL EVIDENCE OF SELECTED INDIAN BANKS

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Abstract

In today's world the knowledge-based economy has evolved, the method for creating firm value has transferred from traditional physical assets to intangible knowledge. The valuation of intangible assets has become a widespread topic of interest in the future of the economy. This study takes advantage of feature selection, an important data-pre processing step in data mining, to identify important and representative factors affecting intellectual efficiency of Indian banking sector. This study employed Data envelopment analysis technique to calculate the intellectual efficiency score of the bank and it is used as a dependent variable for further analysis. In stepwise regression 20 variables are considered and finally four variables explained the variations: Return on asset (ROA), Human resource intensity, capital intensity and interest income to working funds.

Keywords: *Value added intellectual capital (VAIC), Data envelopment analysis (DEA), Stepwise regression, intangible efficiency.*

Introduction

The market value of a firm's shares reflects the value of all its net assets. In the industrial era, physical assets were the main source for value creation. However, in today's world development of communication technology, electronic commerce, and the Internet enables the knowledge-based era to evolve. Therefore, the important factors for successful companies are the capability and the efficiency in creation, expansion, and application of knowledge. To evaluate the firm's value, we not only consider the tangible assets, but also respect the power of intangible assets. Intangible assets are a firm's dynamic capability created by core competence and knowledge resources, including R&D innovation capability, customer size, recognizable brand, market share, employee expert skills and organizational structure.

Al-Ali (2003) found that 20% of market value is represented by tangible assets and remaining 80% is attributable to intangible assets. Under such a situation where an intangible asset plays

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such a vital role, annual reports should adequately disclose the intangible assets. But, disclosures related to intellectual capital information is not mandatory. Such disclosure initiatives are taken as voluntary exercise by many companies. A comprehensive study using content analysis is undertaken by Chander et al. (2011) on 243 Indian companies and found that reporting of Intangible capital is unorganised and unsystematic. There is lack of appropriate framework for disclosing intangible assets information into annual reports.

The studies on intangibles are segregated in two parts: first part examines the extent of disclosure of intangible capital information in the annual reports. Second one examines the factor affecting intangible value. However, there are limited researches which examined the determinants impacting intangibles asset value. In Indian context no study is performed which examine the relationship of organisational and firm-specific factors on the intangible value. In this paper attempt has been made to examine the factor affecting intangible asset value.

It becomes necessary to understand whether this resource is being efficiently utilized in creating value and which factors impact this intangible resource. Banks happen to be one service sector that uses a huge amount of human capital and customer capital for its survival. This study first evaluates the Intangible efficiency of the Indian banking system using the Value-added Intellectual Coefficient (VAIC) with the help of data envelopment analysis (DEA). Secondly, stepwise regression analysis a feature selection method is used to select important features (or factors) from a given dataset which effects intangible efficiency.

Literature review

Today, effective applications of knowledge and information technology have become the most crucial issue and competitive advantage for nearly every organization. In particular, it is commonly found that the market values of knowledge based firms are much higher than the book values.

An early research of Pulic (2004) on Australian's banks reveals the importance of Intangible capital (IC). The research results highlighted the fact that there is strong interaction between IC and organizational corporate success. He shows in his study that the banks with the higher expenditures on IC components are more profitable and have better financial performance. Another study conducted by Cabrita and Vaz (2006) to examine interrelationship among IC components and banks performance on 53 Portuguese banks. After analyzing the data they concluded that structural and relational capital positively moderates the relationship between HC and organizational performance.

Hitt et al. (2000) proved that intangibles play dominant role in value creation as compared to tangible assets. Teece (2000) stated that intangibles play a strategic role in gaining competitive advantage. Researchers like Gleason and Klock (2006), Gimede (2011), Rehman (2011) and Murale et al. (2011) reported a positive relation between intangibles and respective performance measures. Bontis et al. (1996) believe that IC is the set of intangible assets

which increase not only firm performance but also enhance organizational value.

Several empirical studies have been conducted in various country specific environments to determine the extent of intangible assets disclosure in annual reports. Guthrie & Ketty (2000) examined the reporting practices of intangibles of 20 Australian firms and found that components of IC are improperly managed, poorly understood and inadequately identified. Oliveras et al. (2008) analyzed 14 Spanish companies and found that levels of IC disclosures are low. April et al. (2003) conducted content analysis of 20 listed South African Mining Companies. They used 24 IC variables and found that South African Mining companies report low amount of IC information in annual reports. Brennan (2001) examined the IC reporting practices of 11 Irish companies. She finds that there is no statutory obligation on IC reporting, companies only report IC in qualitative formats. Williams (2001) investigates 31 FTSE 100 listed companies over 1996-2000. Results found negative correlation between IC disclosure and IC performance. Bozzolan et al. (2003) examined voluntary disclosure of Italian companies. They found that industry type and size are relevant factors in explaining the variations in IC reporting. Singh & Kansal (2011) examined IC variation in 20 Pharmaceutical companies in India. They found IC disclosure is low, narrative and of varied nature among different companies.

Purpose of the study

Therefore, above literature presents that IC is strategic asset in value creation. But, most of the companies are not disclosing it properly in annual reports. Many countries do not have proper guidelines on IC disclosures. In India till date there is no guideline on IC disclosures. Some companies voluntarily disclose intellectual capital in their annual reports. But, such disclosures are not sufficient and are inappropriate for decision making to investors. Even companies in service sector, where IC plays a vital role in growth like software companies, pharmaceutical companies and other service sector companies have low disclosures of IC. In this paper, modest attempt is made to evaluate the business performance of the Indian banking system over a period of four years with value added intellectual capital coefficient. The primary practical implication is that the study might help listed banks address those factors affecting their IC performance and, in turn, maximize their value creation. The originality of the paper stems from the large number of variables utilized and interpreted through empirical regressions, and the descriptive statistics that provide a thorough description of the Indian banking system through the lens of an IC perspective.

Objectives of the study

The first objective of this study is to measure the intellectual efficiency utilisation of Indian banks. And the second objective is to analyze the factors explaining variations in intellectual efficiency of the sample banks.

Sample Selection

The sample for this study is all the banking companies in the BSE 500 index for the period of financial year 2012. The data on all variables are obtained from the prowest (CMIE) database. The sample used throughout this paper contains variables on 37 banks. Banks happens to be one service sector that uses a huge amount of human capital and customer capital for its survival, so this sector is highly knowledge intensive sector which is reason for choosing this sector for study.

Methodology

Measurement of value added intellectual coefficient (VAIC)

Value Added Intellectual Coefficients (VAIC) is very important and consistent approach. VAIC is a component of Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE) and Capital Employed Efficiency (CEE) which is develop by Pulic (2004) in Austrian IC Research Centre. This methodology is being used in many countries like Austria, Australia, China, Japan, Malaysia, U.S.A, U.K, India and Pakistan etc by many researchers. The VAIC is used as a measure to evaluate the efficiency of corporations.

Human Capital: As human capital is not only one of the most important components of intellectual capital, it is also the ability source of intellectual capital. Financial sector in particular, needs a new generation of professional executives who are more customer-centric, technology-savvy, more highly qualified, flexible and agile with skill sets that are now more comprehensive than previously (Guthrie et al., 1999).

Structural Capital: Structural capital encompasses the enabling structures that allow the organization to exploit the intellectual capital. The structures range from tangible items offered by an organization such as patents, trademarks and databases, to complete intangible success such as culture, transparency and trust among employees. Thus, organizations that possess strong structural capital will have a supportive culture that permits their employees to try new things (Guthrie et al, 1999; Pablos, 2003; Wong & Gardner, 2005).

Capital Employed: It refers to physical capital employed for attaining business goals.

Value Added (VA) is calculated as the difference between outputs and inputs. The basic definition is as follows: $VA = OUT - IN$

where:

VA = value added for the company; OUT = total sales; IN= cost of bought – in materials, components, and services

Value added from the bank accounts is calculated as follows:

$$(1) \quad VA = TOI - TOE$$

where:

VA = Total Operating Income (TOI) - Total Operating Expense (TOE)

TOI = Net Interest Income (Interest Income - Interest Expense) + Net fee and Commission Revenue (Fee based income - Fee based Expenses) + Net Trading Revenue (Income from Treasury operations - Treasury operation expenses) + Other Operating Income.

TOE = Administrative Expenses (Power, fuel & water charges, Rent & lease rent, Selling & distribution expenses, Travel expenses, Packaging and packing expenses, Indirect taxes, Repairs & maintenance, Insurance premium paid, Communications expenses, Printing & stationery expenses, Miscellaneous expenditure + Other Operating Expenses (Financial charges on instruments, Bill discounting charges, Other fund based financial services expenses) + Provisions (excluding provision for taxes).

Value added is a totally objective indicator of business success and shows the ability of a company to create value. Efficiency of human capital (HCE) is calculated as follows:

$$(2) \quad HCE = VA / HC$$

where:

HCE = human capital efficiency coefficient for the company;

VA = value added;

HC = total salaries and wages for company

$$(3) \quad SC = VA - HC$$

where:

SC = structural capital for the company;

VA = value added;

HC = total salary and wage.

$$(4) \quad SCE = SC / VA$$

where:

SCE = structural capital efficiency for company;

SC = structural capital;

VA = value added

IC cannot create value on its own. Therefore, we need information about capital employed

efficiency, which can be calculated in the following manner:

$$(5) \text{ CEE} = \text{VA} / \text{CE}$$

where:

CEE = capital employed efficiency coefficient;

VA = value added

CE = Total Assets-Current Liabilities.

Modelling with Data Envelopment Analysis

DEA is a non parametric mathematical programming model used to evaluate the relative efficiency of a group of entities or Decision making units (DMU's) in their use of multiple inputs to produce multiple outputs. DEA effectively estimates the frontier by finding a set of linear segments that envelopes the observed data points. DEA is developed by Farrell (1957) and Charnes et al. (1978). DEA approach uses linear programming model to construct a hypothetical composite unit based on all units in the reference group.

Let $x^j = (x_1^j, x_2^j, \dots, x_n^j)$ be the bundle of n units of output used and $y^j = (y_1^j, y_2^j, \dots, y_m^j)$ the bundle of m outputs produced by firm j ($j = 1, 2, \dots, N$). Suppose that k is one of the observed firms and we wish to measure the technical efficiency of firm k . The observed input output bundle of firm k is (x^k, y^k) . The relevant DEA LP problem would be

$$\begin{aligned} & \text{Max } \phi \\ \text{s.t. } & \sum_{j=1}^N \lambda_j x_{ij} \leq x_{ik} \quad (i = 1, 2, \dots, n) \\ & \sum_{j=1}^N \lambda_j y_{rj} \geq \phi y_{rk} \quad (r = 1, 2, \dots, m) \\ & \sum_{j=1}^N \lambda_j = 1 : \lambda_j \geq 0 \quad (j = 1, 2, \dots, N); \phi \text{ unrestricted} \end{aligned}$$

The technical efficiency of firm k would be measured by $\pi_k = 1/\phi$ where ϕ is the optimal solution of the DEA LP problem.

Variables used for DEA

Table 1. show the input and output variables used for running DEA

Outputs:

1. Return on Asset (ROA) is the ratio of Net Income (less preference dividend) divided by book value of total assets as reported in the annual report. ROA reflects banks' efficiency in utilizing total assets and as an indicator of profitability and good overall indicator of bank's performance.

2. Return on Equity (ROE) is the ratio of Net Income (less preference dividend) divided by book value of total Equity as reported in the annual report.

Inputs:

Human capital efficiency (HCE), Structural capital efficiency (SCE), Capital employed efficiency (CEE) calculated by Value added intellectual coefficient (VAIC) approach.

Table 1: Input and Output variables for DEA (2011-2012)

		Output 1	Output 2	Input 1	Input 2	Input 3
Company Name	Bank no.	ROA	ROE	HCE	SCE	CEE
Allahabad Bank	1	1.0203	3.7334	2.5062	0.6010	0.0157
Andhra Bank	2	1.0758	2.4030	2.2177	0.5491	0.0151
Axis Bank Ltd.	3	1.4851	10.2667	3.0279	0.6697	0.0226
Bank Of Baroda	4	1.1193	12.1788	2.9607	0.6622	0.0144
Bank Of India	5	0.6963	4.6665	1.5288	0.3459	0.0095
Bank Of Maharashtra	6	0.4255	0.6360	5.0817	0.8032	0.0172
Canara Bank	7	0.8766	7.4102	1.7533	0.4297	0.0104
Central Bank Of India	8	0.1758	0.5494	0.9561	-0.0460	0.0068
City Union Bank Ltd.	9	1.5272	6.8655	1.7829	0.4391	0.0115
Corporation Bank	10	0.9203	10.1670	2.5303	0.6048	0.0102
Dena Bank	11	0.9191	2.2943	1.7563	0.4306	0.0109
Development Credit Bank Ltd.	12	0.6340	0.2289	0.5171	-0.9337	0.0077
Federal Bank Ltd.	13	1.2813	4.5414	2.4412	0.5904	0.0200
H D F C Bank Ltd.	14	1.5289	11.0093	2.4818	0.5971	0.0277
I C I C I Bank Ltd.	15	1.3638	5.6088	2.9038	0.6556	0.0205
I D B I Bank Ltd.	16	0.6985	1.5892	3.2148	0.6889	0.0114
I N G Vysya Bank Ltd.	17	0.9677	3.0318	1.0921	0.0844	0.0152
Indian Bank	18	1.2070	3.9718	2.4371	0.5897	0.0172
Indian Overseas Bank	19	0.4781	1.3176	0.9875	-0.0126	0.0072
Indusind Bank Ltd.	20	1.3917	1.7168	2.5735	0.6114	0.0223
Jammu & Kashmir Bank Ltd.	21	1.3328	16.5687	2.7106	0.6311	0.0206
Karnataka Bank Ltd.	22	0.6775	1.3069	1.3469	0.2576	0.0092
Kotak Mahindra Bank Ltd.	23	1.6524	2.9299	2.0043	0.5011	0.0286
Oriental Bank Of Commerce	24	0.6392	3.9127	1.5495	0.3546	0.0096

Source: Computed Data

		Output 1	Output 2	Input 1	Input 2	Input 3
Company Name	Bank no.	ROA	ROE	HCE	SCE	CEE
Punjab & Sind Bank	25	0.5929	1.8457	0.9929	-0.0072	0.0089
Punjab National Bank	26	1.0676	14.4233	2.8964	0.6547	0.0191
South Indian Bank Ltd.	27	0.9947	3.5429	1.8727	0.4660	0.0138
State Bank Of Bikaner & Jaipur	28	0.8975	9.3147	1.8934	0.4718	0.0170
State Bank Of India	29	0.8754	17.4465	1.6863	0.4070	0.0177
State Bank Of Mysore	30	0.6084	7.8558	1.3650	0.2674	0.0114
State Bank Of Travancore	31	0.5930	10.2092	1.1605	0.1383	0.0099
Syndicate Bank	32	0.7198	2.1819	0.7585	-0.3184	0.0076
Uco Bank	33	0.6123	1.6679	1.5321	0.3473	0.0074
Union Bank Of India	34	0.6757	3.2284	1.8303	0.4537	0.0109
United Bank Of India	35	0.5456	1.5416	1.5062	0.3361	0.0100
Vijaya Bank	36	0.4683	0.9051	1.0159	0.0157	0.0059
Yes Bank Ltd.	37	1.3263	2.7678	3.0901	0.6764	0.0215

Source: Computed Data

Stepwise Regression analysis

In a stepwise regression, predictor variables are entered into the regression equation one at a time based upon statistical criteria. At each step in the analysis the predictor variable that contributes the most to the prediction equation in terms of increasing the multiple correlation, R, is entered first. This process is continued only if additional variables add anything statistically to the regression equation. When no additional predictor variables add anything statistically meaningful to the regression equation, the analysis stops. Thus, not all predictor variables may enter the equation in stepwise regression. The variables used for stepwise regression are shown in table 2 as given below.

Table 2: The measurement of variables affecting intangible assets

Category	Variable	Measurement
Intangible Capital	HR Intensity	Salaries and bonuses expenses to total assets
	Advertising intensity	Advertising expenses to total assets
	Training Intensity	Training and welfare expenses to compensation to employees.
Profitability	ROI	The ratio of profit after tax to capital employed
	Interest income	Interest income as percentage to working funds

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Category	Variable	Measurement
	Non-Interest Income	Non-Interest Income as percentage to working funds
	ROA	The ratio of profit after tax to total assets
Leverage	D/E Ratio	Debt to equity ratio
	Borrowings/TA	The ratio of borrowings to total assets
SIZE and Growth	No. of subsidiaries	The number of subsidiary companies
	Business per employee	The ratio of Business (deposits plus advances) per employee
	ATMs	The no.of ATMs
	Branches	The no. of branches
	AGE	The years since establishment
	SIZE	Log of sales
Asset Utilisation	Capital Intensity	The ratio of fixed asset to total assets
Mandatory Disclosures	CAR	Capital adequacy ratio
	NPA's	The ratio of net non-performing assets (nnpa) to net advances (in per cent)
	Lending to sensitive sectors	Percentage of Lending to sensitive sectors
Ownership structure	Government	Dummy variables; indicating if the firm has a controlling shareholder who is government. 2 if holding is more than 51%, 1 if less than 50%, 0 if there is no government shareholding.

Source: Compiled by the autor

Results and Findings

Descriptive Statistics

Table 3 describes the nature of variables used in the study for calculating the intellectual efficiency. The average firm has 0.92 as the Return on assets and Return on equity of 5.29. the maximum value of return on asset is 1.65 and minimum value is 0.175, which means there is less variations of ROA values of individual firm to the average mean which is also represented by low standard deviation. the standard deviation of ROE is 4.67 which means there is greater amount of variations of individual ROE value from the average mean value. The average firm has 1.99 as human capital efficiency, minimum value is 0.51 and maximum value is 5.08 which mean most of the firm have lower value of HCE, which is represented by 0.90 as standard deviation. For SCE and CEE mean values are 0.37 and 0.0141 respectively, which are quite

lower than HCE value. It represents that on average banks utilise Human capital more efficiently than SCE and CEE component of value added intellectual coefficient.

Table 3: Descriptive statistics of variables used for DEA

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Standard deviation
ROA	37	0.175	1.65	0.92	0.36
ROE	37	0.228	17.44	5.29	4.67
HCE	37	0.517	5.08	1.99	0.900
SCE	37	-0.933	0.803	0.378	0.337
CEE	37	0.0058	0.028	0.014	0.005

Table 4 describes the nature of variables used for stepwise regression analysis. The average firm has intellectual efficiency score of 0.78; it means most of the banks are effectively utilising their intangible resources. The standard deviation of intellectual efficiency is also low, which means that firms have less variation among intellectual efficiency score. The average age of the banks is 72 years which is also supporting the fact that more experienced firms create more intangible assets and have positive impact on profitability. The average debt equity ratio is 1.39 which is ideal, because more leverage creates a lot of financial burden on the firms shoulder. So, a low leverage is a good indicator for a firm. The average firm has Human resource intensity of 0.73 which means banks pay good amount to maintain its human resource which helps the banks in creating intellectual capital. The average profitability indicators are very good and even the size and growth indicators of an average firm are on positive side.

Table 4: Descriptive statistics of variables used for stepwise regression analysis

Variables	Mean	Std. Deviation	N
Intellectual efficiency	0.78	0.21	37
AGE	72.00	34.72	37
Borrowing/total assets	8.36	6.26	37
ROA(Return on assets)	0.93	0.35	37
HR Intensity	0.73	0.25	37
Advertising intensity	0.02	0.02	37
Branches	2162	2442	37
Capital Intensity	0.71	0.30	37
SIZE	11.66	0.99	37

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Variables	Mean	Std. Deviation	N
Training Intensity	0.08	0.36	37
ROI (Return on Investments)	8.19	4.09	37
D/E ratio (debt equity ratio)	1.39	0.72	37
Interest income	9.22	0.70	37
Non-interest income	1.02	0.41	37
Business per employee	105.81	40.14	37
ATMs	2426	4154	37
CAR	9.30	5.53	37
Lending to sensitive sectors	212489.81	289603.38	37
NPA	1.13	0.73	37
Government	1.14	1.00	37

Source: Computed Data

Results of Data envelopment analysis

Table 5 shows the results showing Technical efficiency of sample firms used in the study and the ranking of banks according to their intellectual efficiency utilization. The bank with 1 ranking means that bank is very efficient in intellectual efficiency utilization. In 2012, out of sample of 37 banks, 10 banks (27%) are relatively efficient (technical efficiency=1) and 27 banks (73%) are relatively inefficient (TE <1). The lowest efficiency score is 0.2712 i.e., 27.12% (bank 6). Banks for their operation incurs huge amount of human resource expenses and uses huge amount of customer capital which helps in creating intangible resources so calculating the intangible efficiency utilisation of banks is very important. By considering intangible intensity variables as inputs for DEA it helps to compare the intellectual efficiency of Indian banks. In this paper, the author uses this efficiency score as the dependent variable to evaluate which are the features which play are important role in intangible wealth creation.

Table 5: Intellectual efficiency of banks

Company name	Tech eff.	Ranking	Company name	Tech eff.	Ranking
Allahabad Bank	0.6548	27	Indusind Bank Ltd.	0.8664	16
Andhra Bank	0.6923	26	Jammu & Kashmir Bank Ltd.	1.0000	1
Axis Bank Ltd.	0.9841	11	Karnataka Bank Ltd.	0.6312	30
Bank Of Baroda	0.9778	12	Kotak Mahindra Bank Ltd.	1.0000	1
Bank Of India	0.7226	24	Oriental Bank Of Commerce	0.6205	32

Company name	Tech eff.	Ranking	Company name	Tech eff.	Ranking
Bank Of Maharashtra	0.2712	37	Punjab & Sind Bank	0.6299	31
Canara Bank	0.8556	17	Punjab National Bank	0.8890	14
Central Bank Of India	0.2916	36	South Indian Bank Ltd.	0.6442	29
City Union Bank Ltd.	1.0000	1	State Bank Of Bikaner & Jaipur	0.7301	23
Corporation Bank	1.0000	1	State Bank Of India	1.0000	1
Dena Bank	0.6509	28	State Bank Of Mysore	0.7378	22
Development Credit Bank Ltd.	1.0000	1	State Bank Of Travancore	1.0000	1
Federal Bank Ltd.	0.8115	19	Syndicate Bank	1.0000	1
H D F C Bank Ltd.	1.0000	1	UCO Bank	0.8071	20
I C I C I Bank Ltd.	0.8696	15	Union Bank Of India	0.4898	33
I D B I Bank Ltd.	0.4608	34	United Bank Of India	0.4392	35
I N G Vysya Bank Ltd.	0.9313	13	Vijaya Bank	1.0000	1
Indian Bank	0.7694	21	Yes Bank Ltd.	0.8289	18
Indian Overseas Bank	0.7007	25			

Source: Computed Data

Results of stepwise regression analysis

Table 6 shows the results of stepwise regression analysis. In stepwise regression firstly, the best predictor of dependent variable is entered into the regression model. So, in Model 1 stepwise regression considers only Return on asset (ROA) as independent variable, 29.2% of the variations in Intellectual efficiency (dependent) variable is explained by ROA (independent variable). The model is significant at 0.01 level (99%), and the coefficient ROA is also significant at 0.01 level (99%) and it shows positive relation means if ROA of a bank increases the intellectual efficiency utilisation also increases.

Table 6: Results of stepwise regression

	Model1	Model 2	Model 3	Model 4
R2	0.311	0.416	0.491	0.559
Adjusted R2	0.292	0.381	0.445	0.504
P Value (ANOVA)	0.000***	0.000***	0.000***	0.000***
Constant	0.477	0.317	0.432	1.124
ROA	0.328 (0.000)***	0.283 (0.001)***	0.241 (0.004)***	0.274 (0.001)***

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	Model1	Model 2	Model 3	Model 4
HR Intensity		0.275 (0.019)**	0.371 (0.003)***	0.401 (0.001)***
Capital Intensity			-0.205 (0.034)**	-0.213 (0.021)**
Interest Income				-0.080 (0.034)**

Source: Computed Data

These results also support the previous research of Ante Pulic (2004) on Australian's banks which reveals the importance of IC. The research results highlighted the fact that there is strong interaction between IC and organizational corporate success. He shows in his study that the banks with the higher expenditures on IC components are more profitable and have better financial performance.

Again, the variables with incremental explanatory power are added to the regression model. Independent variables are added as long as their partial correlation coefficients are statistically significant. In Model 2 stepwise regression along with ROA adds up the variable human resource Intensity. The results signify the relation between intellectual efficiency (dependent variable) and ROA and Human resource Intensity as independent variables. The adjusted R² is 0.381. Both ROA and HR intensity explains 38.1% variations in intellectual efficiency calculated by employing Data envelopment analysis technique. The model is significant at 0.01 level (99%). The coefficient ROA and HR intensity are statistically significant at 0.01 level (99%) and 0.05 (95%) respectively. Results show that with increase in return on assets of a bank as well as with increase in HR intensity of a bank technical efficiency also improves. This result is also supported by one previous research conducted by Cabrita and Vaz (2006) to examine interrelationship among IC components and banks performance on 53 Portuguese banks. After analyzing the data they concluded that structural and relational capital positively moderates the relationship between HC and organizational performance.

Model 3 represents the relation between intellectual efficiency and ROA, HR intensity and capital intensity of a bank. The model is significant at 0.01 level. The 44.5% variations in dependent variable are explained by ROA, HR intensity and Capital intensity. The capital intensity coefficient is negatively associated with the intellectual efficiency. It means if the firm is utilising its fixed capital efficiently its intellectual efficiency utilisation decreases and it is significant at 0.05 level, whereas ROA and HR intensity are significant at 0.01 level.

In Model 4, another variable is added to the regression model and this model represents the relation between intellectual efficiency utilisation and ROA, HR intensity, capital intensity and interest income to working funds ratio. The model explains 50.4% variations in dependent variable. ROA and HR intensity are significant at 0.01 level and capital intensity and interest income to working funds ratio are statistical significant at 0.05 level.

Capital intensity and interest income to working fund ratio shows negative relation with the intellectual efficiency whereas ROA and HR intensity shows negative relation with the intellectual efficiency utilisation.

Summary and conclusions

As the method for creating firm value transfers from traditional physical assets to intangible knowledge, it is commonly found that the market values of knowledge-based firms are much higher than the book values. Therefore, valuation of intangible assets becomes a widespread topic of interest in the new economy. In order to effectively evaluate intangible assets, this study employs data mining techniques to identify important factors affecting intangible assets. Particularly, feature selection, the data pre processing step of data mining, is considered to select and extract more useful information in the massive related materials. This paper uses stepwise regression to extract the most important factors affecting intellectual efficiency of banks. In this paper to evaluate the intellectual efficiency I employed data envelopment technique (DEA).

DEA is becoming an increasingly popular modelling tool for measuring the relative performance of DMU's. This paper described the application of DEA methodology to the modelling and evaluation of relative efficiency of 37 banks. The DEA is most useful when a comparison is sought against best practice DMU's. For measuring the intellectual coefficients a very popular technique value added intellectual coefficient (VAIC) is being used in the paper, which originally is developed by Australian researcher Ante Pulic. The VAIC technique is the composite of human capital efficiency (HCE), Structural capital efficiency (SCE) and capital employed efficiency (CEE).

The solution to the DEA models of investigated banks provide a measure of the relative efficiency of the target bank, which is used as dependent variable for stepwise regression. In stepwise regression initially 20 variables are used which seems to impact the intellectual efficiency of banks. The results of stepwise regression show that ROA is the best predictor variable which impacts the intellectual efficiency of the banks. Three more variables human capital intensity, capital intensity and interest income are added in the model. Finally, all these four variables impact the intellectual efficiency of the banks.

The results of this study appear to have provided new insights about the financial performance of banks not available to managers through financial statement and traditional financial ratio analysis. Although DEA provides information to top management about the major determinants of efficiency and inefficiency of intellectual capital utilisation of banks which undoubtedly is not provided by traditional measures such as ratio analysis. The DEA results yield their best payoffs when interpreted and used in conjunction with top managements personalised knowledge and discretionary judgement of the operation of their banks. And additionally this

paper evaluates which are the relevant variable which explain the intellectual efficiency of the banks. This analysis practically is very useful to the managements of banks because it gives clear idea that to improve the intellectual efficiency of banks which are the variable which should be focussed upon. This analysis is important for investors and creditors to understand the critical factors affecting a firm's value before making decisions about investments and loans.

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