Determinants of Bank Shareholders Value: An Innovative Non Linear Framework

Masuna Venkateshwarlu and Ramesh Thimmaraya

Abstract— **Managing to create a sustainable value is the most important objective of any enterprise. In an enterprise various performance centers contributes to the creation of shareholders value. In fact the synergy of these performance centers will determine the overall performance leading to maximizing the market value and its stability. But, bank is a more complex system with many performance centers interconnected in a non-linear fashion. Therefore, knowing the performance centers that determine the shareholders' value and their relative contribution is essential for managers, investors, analysts and regulators. The model proposed in this paper considers various performance centers contributing to overall performance of banks and thus shareholders value. The central theme of the paper is not only to identify the determinants of shareholders value and also stress the need for use of nonlinear framework for its analysis. The authors prove that there is less usefulness of considering linearity between individual performance centers contributing to the shareholders value, and propose a non-linear framework. The proposed framework is more useful during the times of crisis. The interconnections of these individual performance centers become more complex during the crisis period; the recent failure of banks across the world can be attributed to this fact. The results show that the present model has very high predictability of the bank's performance than the classical econometrics models.**

Index Terms— **bank performance, determinants, shareholders value, nonlinear models**

I. Introduction

Massive expansion of Indian banking after economic and financial sector reforms resulted in increased competition and growth in its size. The banking System in India is characterized by large number of banks with mixed ownership. The commercial banking segment comprises of 26 public sector banks, 21 private sector banks and 43 foreign banks, total bank assets constitute approximately 70% of GDP. Indian Banking industry is competitive, hence challenging for the banks to improve earnings performance and create a sustainable value. During the recent crisis period from 2007 to 2009, many banks failed in the USA, the earliest indicator of bank failure is earnings deterioration (Yadav K Gopalan 2010). Therefore, appropriate performance measures are essential to understand the health of commercial banks to avoid failures. In the recent years, over hundred studies have analyzed the performance of banks and determinants of shareholders value. The extensive review of literature on the bank performance, determinants of shareholders value indicates that, there are three broad approaches; Analysis of Accounting Information, Cost and Profit Efficiency frontier analysis, and hybrid measures like Economic Value Added (EVA), Risk Adjusted Return on Capital (RAROC) etc. There are two major limitations of analyzing bank performance and understanding shareholders value creation in the existing literature; the studies focused on using linear regressions and concentrating only on two or three performance measures like cost efficiency, profitability, size, and capital structure etc. For example, Franco Fioredelisi and Molyneux (2010) found the determinants of shareholder value creation for a large sample of European listed and unlisted banks using a dynamic panel data model. Wherein the bank's shareholder value is a linear function of various bank-specific, industry-specific and macroeconomic variables. The shareholder value and economic profits are negatively related to cost and revenue efficiency and positively linked to bank's leverage. Nemanja Radic (2015) advances the study of Fiordelisi and Molyneux by examining the shareholder value efficiency and its determinants using a specifically tailored measure of the Economic Value Added (EVA) approach in order to account for specific characteristics of the Japanese banking system, and then used in a dynamic panel data model as a linear function of various bank-risk, bank-specific, and macroeconomic variables. Nemja Radic argues that cost efficiency gains, credit risk and bank size are the most important factors in explaining the shareholder value creation in Japanese banking.

In addition to the above, it is also found that the changes in cost efficiency found to significantly influence cost of equity capital. The signaling effect of cost ineffective management for the risk of bank failure. Therefore, finding reliable early warning indicators of problematic management in banks becomes increasingly important issue, given the low signaling performance of the commonly applied financial ratios (Anca Podpiera and Jiri Podpiera 2004).

The above cited reasons for the failure of banks emphasize the need for identifying relevant performance measures, which are the true indicators of value creation in a bank. This paper proposes a model with an objective of overcoming these limitations by developing a comprehensive framework to identify the key performance centers impacting shareholders value, incorporating both nonlinear modeling and multiple performance centers as an approach for better understanding of determinants of shareholders value of banks. The paper is organized in six parts; review of literature, the proposed nonlinear

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framework, description of data, methodology and modeling, results and discussions followed by conclusion.

II. REVIEW OF LITERATURE

During the last few decades, advances in technologies have allowed the banking sector to take advantage and showing a worldwide improvement in its profitability not only in bank-oriented countries like those in Eastern and Central Europe (Athanasoglou et al., 2006, Sufian and Habibullah, 2009), but also in market-oriented countries like the US (Berger, 1995), (Berger and Bonaccorsi di Patti, 2006), (Zhang et al., 2006). In India using Generalized Method of Moments, observed that, credit risk impact the profitability negatively, whereas capital efficiency, operating efficiency and diversification significantly impact the profitability. (Pankaj and Sakshi,2014). The majority of studies on bank performance, such as Short (1979), Bourke (1989), Molyneux and Thornton (1992), Demirguc-Kunt and Huizinga (2000) and Goddard et al. (2004), use linear models to estimate the impact of various factors that may be important in explaining earnings and market value.

As mentioned above, majority of the studies primarily use internal performance variables such as size, capital, risk management and expenses management etc. Some of the important studies followed this approach includes Haslem (1968), Short (1979), Bourke (1989), Molyneux and Thornton (1992) and Demirguc-Kunt and Huizinga (2000). A more recent study followed this approach is Bikker and Hu (2002), though it is different in scope; emphasis is on the bank profitability and business cycle relationship. There are also studies dealt with the banking system in the US (e.g. Berger *et al.*, 1987 and Neely and Wheelock, 1997) and the emerging market economies (e.g. Barajas *et al.*, 1999) primarily considering the various accounting measure of performance. Some studies also introduced size to account for existing economies or diseconomies of scale in the market. It is also observed that, Akhavein *et al.* (1997) and Smirlock (1985) find a positive and significant relationship between size and bank profitability. Demirguc-Kunt and Maksimovic (1998) suggest that the extent to which various financial, legal and other factors (e.g. corruption) affect bank profitability is closely linked to firm size. In addition, Short (1979) argues, size is closely related to the capital adequacy of a bank since relatively large banks tend to raise less expensive capital and, hence, appear more profitable. Using similar arguments, Haslem (1968), Short (1979), Bourke (1989), Molyneux and Thornton (1992) Bikker and Hu (2002) and Goddard et al. (2004), all link bank size to capital ratios, which they claim to be positively related to size, meaning that as size increases – especially in the case of small to medium-sized banks – profitability rises. In addition to the focus on internal performance management, many research studies also concentrated on cost efficiency and some studies also dealt with comparison at international level. The researchers suggest that, little cost saving can be achieved by increasing the size of a banking firm (Berger et al., 1987), which suggests that eventually very large banks could face scale inefficiencies. However, the extensive review of literature indicates that, none of these studies evaluated the complex value creation process, framework for performance measurement and understanding its impact on market value of a bank. With a view to over- come these limitations an attempt has been made to provide a complex non- linear model and a comprehensive framework considering multiple variables to understand the performance measurement and shareholders value in a bank operating in market economy.

III. PROPOSED FRAMEWORK

The performance measure of any business is not a single factor measure; rather it is much more complex and interconnected. If we consider banking in particular is have many complexities to understand performance. The present paper deals with a novel model to predict and understand the banks shareholders value creation. The ground root of the present framework is by considering the banking system as a complex non-linear interconnected system with many sub-systems. The above statement is very technical, so the intuition behind the above statement is that shareholders value is determined by banks overall business performance which depends upon many sub-performances of the banking business like Cost management, Leverage Management, Capital management, Profits management (RoA) and many more sub-systems which are detailed in the data and methodology section. Each of the sub-systems is connected in a complex way and no simple statistical regression will help us to understand their interconnections. The collective performances of these sub-performances together give us the overall bank performance which determines the shareholders value. The objective of any business is to improve the value of the company and the stability of shareholders value. So the proxy for the overall performance of the banking systems can be taken as the shareholders' value, but the behavior of this value depends on many sub-performances in a non-linear fashion. The present work deals with this issue of non-linearity and prediction of the overall performance (shareholders value) of the bank. A graphical view of the present framework is presented in Figure 1.

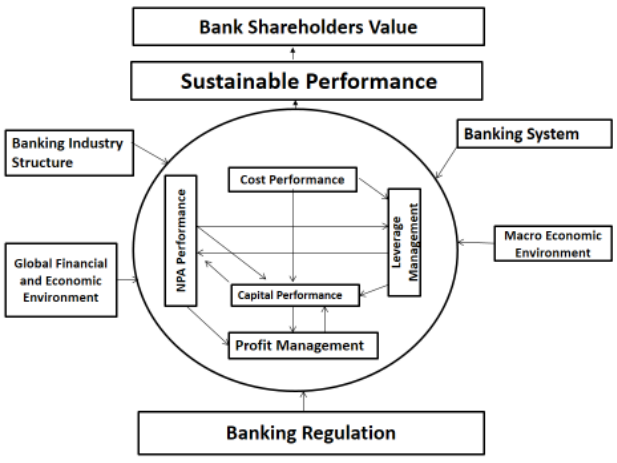

Figure -1 Bank Shareholders Value Creation Framework

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IV. DESCRIPTION OF DATA

The bank wise data of 14 public sector and 3 private sector, commercial banks have been collected from Bloomberg data base and also data from the annual reports of each bank has been considered for analysis. The present work covers almost all the major banks in India, the time period is from 2001 to 2015, which means we have analyzed 255 years of panel data. As explained above in figure -1, the present framework is based on the fundamental understanding that each bank has many performance centers interconnected in a complex way, these centers should work in synergy to improve the overall sustainable shareholders value. The bank performance centers which are considered as determinants of shareholders value for the present study is summarized in Table-1. The total number of performance centers is around eight, the overall banks business performance is assumed as the bank's shareholders value and its stability.

The eight variables considered for this study address all important aspects of a commercial bank such as profit management, leverage management, size, equity buffer to absorb risk, cost management, activity mix reflecting synergy of diversification, NPA management and Deposits. The paper not only identifies the determinants and also ranks their contribution to the shareholders value.

Table 1: Proxy's for Banks Performance Centers

Bank Performance Centers	Significance
Market Value (Share Price Returns)	Talks about shareholder value and Banks stability
RoA	ROA in turn is defined as Profit After Tax divided by Assets, It talks about Profits management.
Capital or Inverse Leverage	Capital is defined as Average Equity divided by Assets, where assets are total assets and equity is shareholders' funds, It talks about the Leverage management.
Size	Size is calculated as logarithm of Assets, which tells us about the efficiency when banks size is increased or decreased
Equity	It tells us about the buffer the bank has with it for risk absorption
Cost Management Or Operational Efficiency	It is defined has the logarithm of the overheads, which will give us information about banks cost effectiveness and which may have a huge impact on the profitability
Activity Mix	This is the ratio between the Net Interest Income to the other Operating Income, which tells about the banks business diversification
NPA	Non-Performing Assets is an important variable for any bank to decide on their credit risk as well as profitability
Deposits	The amount of deposits may have an effect on banks performance

V. METHODOLOGY AND MODELING

The methodology adopted in the present papers is outlines as follows, as it has been mentioned in the framework section that the banks performance centers are connected in a non-linear fashion, before using a non-linear model the assumption of non-linearity between performances centers has is to be supported.

V.I Linear Panel-regression Model

To support the above assumption, the bank's performance centers are modeled in a linear fashion using a well-established and most frequently used Linear Panel-regression analysis. The information content and predictability of the banks business performance obtained from the fixed effects Panel-regression is calculated, so that it can be compared with the Non-linear model recommended in this paper.

V.II Non-linear Support Vector Regression Model

The Non-linear interconnection assumption of the bank's performance centers are tested using a power non-linear regression model called Support Vector Regression. The superiority of this model in capturing non-linear information has been published (Ramesh and Venkateshwarlu, 2012), they applied this model to understand the financial asset prices and its superiority has been compared with many classical regression models.

The methodology is as follows; suppose we are given training data $\{(x_1, y1)\ldots (x_l, yl)\} \subset \chi \times \mathbb{R}$ where χ denotes the space of the input patterns (e.g. $\chi = \mathbb{R}^d$). The series y_i denote the overall banks business performance measured at subsequent weeks and x_i denote the time in weeks. In ε-SV regression, our goal is to find a function f(x) that has at most ε deviation from the actually obtained targets y_i for all the training data, and at the same time is as flat as possible. In other words, we do not care about errors as long as they are less than ε, but will not accept any deviation larger than this. This may be important if you want to be sure not to lose more than ε money when dealing with banks performance, for instance.

We begin by describing the case of linear functions *f*, taking the form

$F(x) = \langle w, x \rangle + b$ with $w \in \chi$, $\mathbf{b} \in \mathbb{R}$ (1)

Where $\langle ., . \rangle$ denotes the dot product in χ. Flatness in the case of eq. (1) means that one seeks a small *w*. one way to ensure this is to minimize the norm, i.e., $\| w \|^2 = \langle w, w \rangle$. We can write this problem as a convex optimization problem:

Minimize $\frac{1}{2}\| w \|^2$

Subject to $\begin{cases} y_i - \langle w, x_i \rangle - b \leq \varepsilon \\ \langle w, x_i \rangle + b - y_i \leq \varepsilon \end{cases}$ (2)

The tacit assumption in eq. (2) was that such a function *f* actually exists that approximates all pairs(x_i , y_i) with ε precision, or in the words, that the convex optimization problem is *feasible.* Sometimes, however this may not be the case, or we also may want allow for some errors analogously to the "soft margin" loss function, one can introduce slack variables ξ_i, ξ^*_i to cope with otherwise

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infeasible constraints of the optimization problem eq. (2). Hence we arrive at the formulation stated.

$$\text{Minimize} \quad \tfrac{1}{2} \| w \|^2 + C \sum_{i=1}^{l} (\xi_i + \xi^*_i)$$

$$\text{Subject to} \quad \begin{cases} y_i - < w, x_i > - b \leq \varepsilon + \xi_i \\ < w, x_i > + b - y_i \leq \varepsilon + \xi_i^* \\ \xi_i, \xi_i^* \geq 0 \end{cases} \quad (3)$$

Again by standard Lagrange multiplier techniques, exactly in the same manner as in the above case one can compute the dual optimization problem. We will omit the indices $_i$ and *, where applicable in order to avoid tedious notation. This yield, maximize;

$$\begin{cases} \frac{1}{2} \sum_{i,j=1}^{l} (\alpha_i - \alpha_i^*)(\alpha_j - \alpha_j^* < x_i, x_j > \\ -\varepsilon \sum_{i=1}^{l} (\alpha_i + \alpha_i^*) + \sum_{i=1}^{l} y_i (\alpha_i - \alpha_i^*) + C(T(\xi_i) + T(\xi_i^*)) \end{cases} \quad (4)$$

$$\text{Where} \quad \begin{cases} w = \sum_{i=1}^{l} (\alpha_i - \alpha_i^*) x_i \\ T(\xi) = \hat{c}(\xi) - \xi \, \partial_\xi \hat{c}(\xi) \end{cases}$$

$$\text{Subject to} \begin{cases} \sum_{i=1}^{l} (\alpha_i - \alpha_i^*) = 0 \\ \alpha \leq C \partial_\xi \tilde{c}(\xi) \\ \xi = \inf \{ \xi | C \partial_\xi \tilde{c} \geq \alpha \end{cases}$$

$$\alpha, \xi \geq 0$$

The data has been solved using the above two methods, the results are compared with each other to better understand the banks business performance behavior.

VI. RESULTS AND DISCUSSIONS

The performance centers discussed in the data section has been used to understand the behavior of banks overall shareholders value during the period of study.

VI.I Linear model results

Initially the performance centers are modeled in a linear fashion and the results of the Panel-regression analysis is given in Table-2.

Table 2: Panel-regression analysis

Proxy	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*95%*
Intercept	0.362	0.151	2.399	0.018	0.064
RoA	0.067	0.101	0.657	0.512	-0.134
Size	0.115	0.192	0.599	0.550	-0.265
Capital	-0.099	0.078	-1.269	0.206	-0.254
Cost	-0.072	0.155	-0.461	0.645	-0.378
NPA	-0.043	0.104	0.410	0.682	-0.163

The above results were obtained after filtering of the non-significant performance centers were the significance level is set as 70%, which is funny to imagine. The adjusted R-Square is only 2.21% which is also not acceptable. The fact is even the performance centers which were filtered as significant has very high type – I error. This is the main reason behind the complexity for equity analysts around the world to value the banks performance; this is why many banks failed during crisis 2008 because the interconnection of the performance centers becomes even more complex during crisis. Due to the above complexity most of the literature on banks performance talks about a small portion of the bank's performance or of an individual performance centers like Cost management or Profits management and does not consider all determinants. No performance of linear panel model demonstrates that the variables have a nonlinear relationship.

VI.II Proposed Framework – Non-linear model results

The non-linear model used in the present work is called Multi-Support Vector Regression model which is a powerful non-linear mapping tool, the same has been summarized in the methodology section. The initial step in the new framework is to find out the importance of the each performance center on the overall banks business performance, the amount of information or impact hidden by the individual performance center is given by the weight attached to it.

Estimation of this weight is trivial in the linear Panel-regression which is the normalization of the coefficients, were as in non-linear regressions particularly semi-parametric models like Support Vector Regressions the estimation is not straight forward. To resolve this issue the present papers has used a Single-SVR model which builds independent non-linear models for each performance center and calculate the amount of information each center has in predicting the overall banks business performance. Based on these predictabilities weights have been assigned which clearly becomes the ranking of each individual performance center which are in Table-3.

Table 3: Ranking of Individual Performance Centers

Performance Centre	Rank	Weights	Cumulative
Size	1	17.05%	17.05%
Profits (RoA)	2	15.00%	32.05%
NPA	3	14.85%	46.90%
Cost Management	4	13.50%	60.40%
Capital Management	5	10.65%	71.05%
Operating Expenses Management.	6	9.50%	80.55%
Equity	7	7.85%	88.40%
Deposits	8	6.50%	94.90%
Activity Mix	9	5.10%	100.00%

The Figures-2 shows the prediction of overall performance using Multiple-SVR Non-linear Model, almost 80% of the information is hidden in the top six centers discussed above but connected in a non-linear way. This study tells us that there is less advantage in using the linear model to measure the banks performance and also studying an individual

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performance center of a bank which is common in the banking literature.

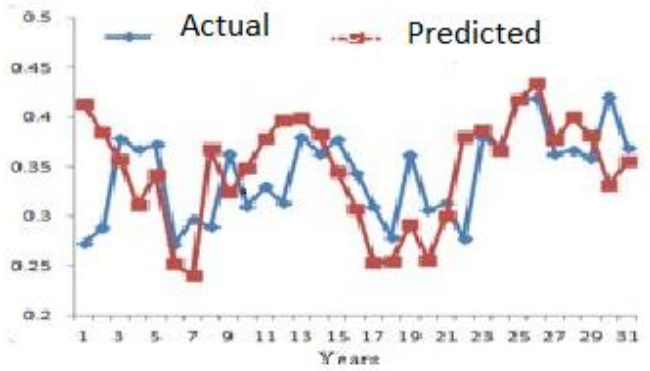

Figure -2 Results of Shareholders Value – Proposed framework

VII. CONCLUSIONS

The objective of the present study is to understand the relationship between performance centers. The first step is to identify the determinants of the bank shareholder value, since identifying the determinants of shareholders value of is very useful information to bank performance. The framework recommended in the present paper considers bank as a complex system with many sub-systems interconnected in a non-linear fashion. These sub-systems are coined as individual performance centers contributing to the shareholders value. The liner relationship among the important value drivers does not really reflect their relative role in creating shareholders value and it does not help us to predict the expected value of a bank. Therefore, the present paper models the banks overall business performance using a powerful non-linear model called Support Vector Regression. The results clearly show that the non-linear models predict the banks shareholder value with good accuracy while the linear models fail to predict them. The shareholder value improvement and stability of the value is most important to any bank, the framework proposed in the paper is very useful in understanding this relationship.

This paper also talks about the ranking of determinants of shareholders value (individual performance centers) in a banking system; this will help the practitioners such as equity analysts, investors, regulators and central banks in each country to adopt appropriate policy frameworks to stabilize the banking system. For example, size play an important role in determining the shareholders' value in the Indian banking system, this results can be used while taking decisions about mergers and acquisitions of banks. The important performance centers (determinants of shareholders value) given in the order of their relative ranking will help banks management to concentrate more on the same and to adopt corporate policies and practices to support the market stability of the bank.

The study did not consider the impact of external factors such as macro-economic factors such as inflation, interest rates, regulation, industry structure etc. Hence future research can be extended considering the external factors to get a better picture about the banks performance. This research also can be extended to cross country analysis to understand the determinants of shareholders value of banks around the globe.

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