



## STUDYING THE IMPACT OF INTELLECTUAL CAPITAL AND VALUE ADDED ON PREDICTING BANKRUPTCY USING SURVIVAL ANALYSIS

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### Keywords

Bankruptcy prediction, intellectual capital, survival analysis, value added.

### ABSTRACT

Intellectual capital is the assets that are not usually included in balance sheets. Nowadays, intellectual capital is the core of competence of companies and it gains attentions increasingly. This article mainly aims at predicting bankruptcy using survival analysis and examining the relationship between intellectual capital components, value added and risk of bankruptcy. The population under study includes the food and drink industrial companies listed on Tehran Stock Exchange. The present research uses survival analysis (life table and proportional hazard regression) to predict bankruptcy. Bankruptcy prediction using survival analysis was accurate in 81.3% of cases. The results obtained from studying the effect of intellectual capital components on predicting bankruptcy showed that intellectual capital components are not appropriate predictors for bankruptcy. However, the results obtaining from the effect of value added on predicting bankruptcy using Cox regression showed that value added could be used as a predictor.

### JEL Classification

M49, M40

## 1. INTRODUCTION

Predicting financial status of companies is so valuable that it gained attentions of many financiers nowadays. Intensive competition of companies and access to limited earnings are the factors that led to bankruptcy. Therefore, financial decision-making has become more important than before (Bakhshani,2013).

Investors always intend to prevent risk of losing their capital by predicting bankruptcy possibility; therefore, they are looking for methods to predict smash of companies.

Researchers have applied different modeling techniques and estimation methods to develop bankruptcy prediction models of companies. Classic statistical methods are the most common methods to predict bankruptcy(Balcaene & Ooghe,2004).

Quantitative and qualitative methods have been considered as the major tools for formulating analysis and solving organizational and economic issues since the Second World War. Some people – such as Shumway, Chava and Jarrow– showed that the major problem of the traditional models is that they are based on a single aspect of a company. Some researchers, such as LeClere (2000), Shumway (2001), Haling and Hayden (2006) predicted bankruptcy using a hazard model and combination of a company’s financial history and applying survival analysis techniques (Dakovic et al,2007).

In the next sections of this article, first, the related literature will be reviewed and then the method and model used in current study explained. Finally, results are presented and discussed.

## 2. INTELLECTUAL CAPITAL

Intellectual capital is an intangible asset made up of technology, customers' information, and reputation and culture of an organization, which is highly important for competitive power of an organization.

Bontis *et al.* (2002) stated that human capital is knowledge reserve of an organization, which is exhibited by staff. Structural capital includes all the non-human knowledge reserves in an organization. Customer's capital is placed in hidden knowledge in the marketing and customer relations channels. These three components of the intellectual capital are the key incentives of an organization performance and provide its future wealth. Measurement of intellectual capital is important as far as two aspects are concerned. One is intra-organizational aspect, which aims to better allocation of resources in order to improve efficiency and minimize organizational costs. The other is inter-organizational aspect, which aims to provide data of existing and potential investments of an organization to predict future growth and long-term planning (Douglas *et al.*, 1989).

### Value Added Intellectual Coefficient (VAIC) Model

VAIC model was introduced by Pulic (Madhooshi & Asgharnejad, 2010). The model is based on three dependent variables for intellectual capital including 1- Capital Employed Efficiency (CEE), 2- Human Capital Efficiency (HCE), 3- structural capital efficiency (SCE).

Formula of VAIC indices is as the following algebraic expression:

$$\text{Formula 1: } VAIC_i = CEE_i + HCE_i + SCE_i$$

Calculation of value added ( $VA_i$ ) of a company in year  $i$  is as follows:

$$\text{Formula 2: } VA_i = I_i + DP_i + D_i + T_i + M_i + R_i$$

$I_i$ : Total cost of interest of the company for year  $i$

$DP_i$ : Depreciation cost of the company for year  $i$

$D_i$ : Dividend of the company for year  $i$

$T_i$ : Tax of the company for year  $i$

$M_i$ : Equity capital for year  $i$

$R_i$ : Cumulative Dividend of the company for year  $i$

Calculation of  $CEE_i$ , which is defined using the following expressions:

$$\text{Formula 3: } CEE_i = VA_i / CE_i$$

where  $CEE_i$  is capital employed efficiency of  $i$  company

VA<sub>i</sub>: Overall value added of i company

CE<sub>i</sub> is net book value of i company's assets [14].

- Salary (wage) is one of the indices of the company's human capital (HCE<sub>i</sub>). Therefore, HCE<sub>i</sub> is calculated as follows:

$$\text{Formula 4: } HCE_i = VA_i / HC_i$$

where

HCE<sub>i</sub>: Human capital coefficient for i company

VA<sub>i</sub>: Overall value added of i company

HC<sub>i</sub> is total value invested for salary (wage) of i company

- Calculation of SCE<sub>i</sub>, which is SCC of i company; the first step to determine SCE<sub>i</sub> is calculation of the company's structural capital (SC<sub>i</sub>), which is calculated as follows:

$$\text{Formula 5: } SC_i = VA_i - HC_i$$

SC<sub>i</sub>: Structural capital of i company, VA<sub>i</sub>: Overall value added of i company, HC<sub>i</sub>: Total of the sum invested for salary (wage) of i company.

Pulic stated that there is a reversed relationship between SC<sub>i</sub> and HC<sub>i</sub>. Therefore, SCE<sub>i</sub> is calculated as follows:

$$\text{Formula 6: } SCE_i = SC_i / VA_i$$

where

SCE<sub>i</sub>: Structural capital coefficient for i company

SC<sub>i</sub>: Structural capital for i company

VA<sub>i</sub>: Overall value added of i company

Due to the superiority of the model to other models, it was selected as the intellectual capital measurement model in this research(Tan et al,2007)

Bontis studies in Canada revealed that intellectual capital components have a considerable effect on performance of companies. Wang& Chang studied the effect of intellectual capital on performance of Taiwanese companies in 1997-2000. Their research results showed that the intellectual capital components, regardless of human capital, directly affect performance of companies and human capital affect performance of companies indirectly through other components(Rezaei et al,2013 ).

Namazi and Ebrahimi (2012) studied the effect of intellectual capital on current and future financial performance of the companies listed on Tehran Stock Exchange. Research results proved a positive and significant relationship between intellectual capital and current and future financial performance of the companies at level of all companies and level of all industries(Namazi & Ebrahimi,2012).

Li *et al.* predicted bankruptcy using neural networks and combining financial ratios and intellectual capital (Shyug Le, 2004).

In a research in Slovenia, Helena Rudez and Mihalic Tanja (2007) studied the impact of intellectual capital on financial performance in hotel management industry. The results indicated a positive and significant relationship between intellectual capital components and financial performance (Namazi & Ebrahimi, 2012).

Combination of intellectual capital - as an intangible asset, which is often one of the major competitive indices of a company - and financial ratios is probably effective in predicting bankruptcy (Shyug Le, 2004).

### **3. METHODOLOGY**

This research discusses the relationship between intellectual capital, its components and risk of bankruptcy.

It is a descriptive-analytic research of applied studies. Member companies of the statistical population include food industry companies listed on Tehran Stock Exchange, which handed their financial statements to the Stock Exchange Organization in 2004-2009 for more than two terms. The information were extracted from Website of Research, Development and Islamic Studies Management of Stock Exchange Organization and the information presented by library of Stock Exchange Organization. Sample size includes 23 companies and 131 institute-year.

Major steps to execute the research are

- 1- Calculation of the required parameters as the independent variables used at the level under study
- 2- Classification of the companies into two groups of bankrupt and non-bankrupt using the provisions of item 141 of Commercial Law (Bankruptcy Determining Factor)
- 3- Determining the relation of time of bankruptcy of companies using Cox regression

This research calculated intellectual capital variables using Pulic's model. Relational capital, human capital, and structural capital variables - as independent variables - and companies' life - as a dependent variable - were included in the analysis to execute Cox regression.

**Survival Analysis** - In many medical studies, a group of subjects are included in the study during a specific period and followed up so that a specified incident happens for them. Time observations of the studies that accompany censored data are called "survival data". A collection of statistical methods, which is used for analyze them, is called survival analysis" (Kheri *et al.*, 2003) In the follow-up and cohort studies, we usually deal with

survival time, which is the interval between the time to enter the study and occurrence of an incident(Douglas et al, 1989)

There are different parametric and non-parametric methods for analyzing survival data analysis, the most common of which are "life table" and "relative hazards regression" so called *Cox Regression*(Geep & kumar,2008 )

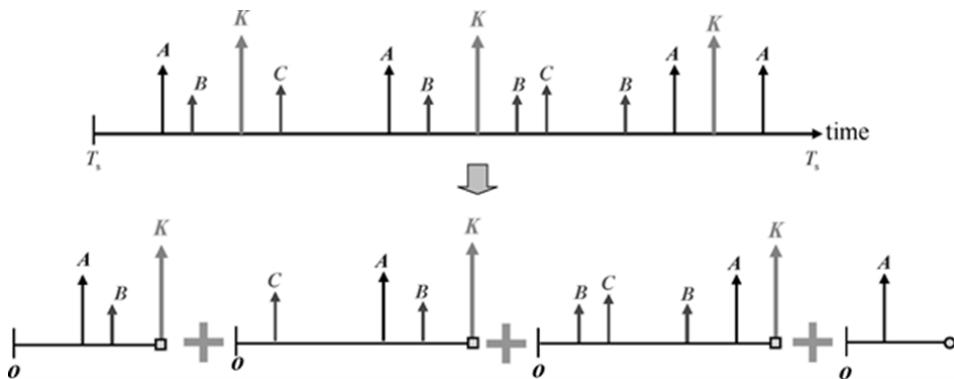
**Life Table Method** - "Survival" is one of the simple methods, which is frequently used in studies. These tables can be used for calculating survival probabilities and life expectancy at different ages(Bakhshani,2013 ).

**Proportional Hazards Regression** - This method is highly appropriate for examining random incident of bankruptcy. It is widely used in medical sciences. For instance, data of death time of the patients are analyzed to examine survivors of kidney patients with kidney transplantation and certain auxiliary variables, such as gender and age of patients, are also examined.

Leading incidents in Cox model, such as auxiliary variables, are time-dependent and a bankruptcy incident can be predicted based on leading incidents(Li et all , 2006 ). A hazard indicates the risk of an incident within a very short period after a certain period for the case that survived until that moment (Douglas et all, 1989).

A sequence of incidents is examined for predicting the main incident. In this sequence, K occurs along a timeline. It is assumed that K incident occurs at time n in the sequence.

Figure 1: An example of a periodic sequence of events



Bankruptcy sequence includes information system that may be used for identifying, controlling and reporting deficiencies in a process. It may also predict future behavior of a process and/or express time of occurrence of an incident. If bankruptcy prediction can be performed based on leading incidents, prohibitory retaining criteria may be formed before collapsing a system and consequently the lost expense will be reduced.

Some base quantities are needed for analyzing bankruptcy time information. If density function of t is created from F(t), t remaining function can be expressed as follows:

$$s(t) = p_r(T > t) = \int_t^\infty f(x)dx$$

Base quantity is other risk factor, which is called the function in proportion to bankruptcy conditions in the authentic literature. Risk function can also be interpreted as an instant probability; a bankruptcy incident occurs at t time and no incident occurs before it (Li et al , 2006).

$$h(t) = \lim \frac{p_r(t < t < t + \Delta t \int T \geq t)}{\Delta t} = \frac{f(t)}{s(t)}$$

#### 4. RESULTS

In this research, intellectual capital variables were calculated using Pulic. The Cox regression variables Relational capital, human capital, structural capital as independent variables , life companies as dependent variable were entered into the process.

**Table 1: Results of Examining the Relationship of Intellectual Capital Components**

Components	B	SE	Wald	df	Sig.
Relational capital	.000	.001	.076	1	.782
Human capital	.002	.003	.655	1	.418
Structure capital	-.302	.308	.962	1	.327
Intellectual capital			.	0 <sup>a</sup>	.

The above table shows the results obtained from comparing the model without the presence of auxiliary variables and the model with variables included. With respect to the level of significance of the results for the above test (P<0.05), it can be concluded that the presence of auxiliary variables studied in the model is not significant.

**Table 2: Studying Relationship of Value Added**

	B	S.E.	Wald	df	Sig.	Exp(B)
Value added	.000	.000	18.725	1	.000	1.000
Constant	-.448	.303	2.187	1	.139	.639

With respect to the level of significance of value added (P<0.05), company’s value added is directly related to companies bankruptcy.

The companies under study are classified into two groups of bankrupt and non-bankrupt groups using the criterion of item 141 of Commercial Law. Following results were obtained using survival analysis to predict bankruptcy.

**Table 3: Classified Observations**

Observed	Predicted		
	Bankruptcy		Percentage correct
	Non-bankrupt	Bankrupt	
non-bankrupt companies	92	3	96.8
bankrupt companies	6	26	81.3
Overall Percentage			92.9

The table results show that 96.8% of the non-bankrupt companies and 81.3% of the bankrupt companies were predicted accurately through survival analysis.

**Table 4: Summary of the Processed Items**

Cases available in analysis		N	percent
Cases available in analysis:	Event	82	62.1%
	Censored	0	.0%
	Total	82	62.1%
Cases dropped	Cases with missing values	50	37.9%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	50	37.9%
Total		132	100.0%

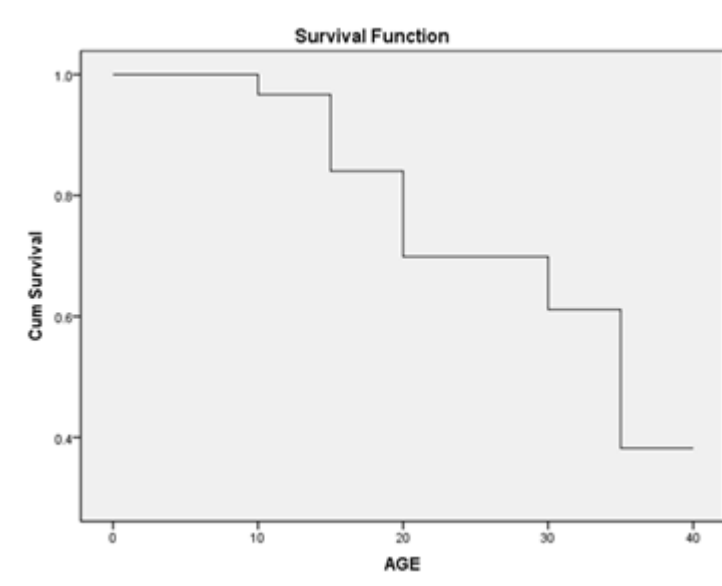
The above table shows descriptive findings including numbers and percentages of the companies, which experienced bankruptcy, numbers and percentages of censorships, total number of percentage of the observations related to bankruptcies and censorships, and number and percentages of observations with lost data and total number of the present individuals. It shows that 62.1% of the companies under study experienced bankruptcy incidents during 2004-2009 and 37.9% of the companies were censored due to lack of experiencing bankruptcy event and/or other reasons.

**Table 5: Life Table of Companies**

Interval Start Time	Number Enter Interval	Number Withdrawing during Interval	Number of Terminal Events	Cumulative Proportion Surviving at End of Interval
0	131	0	0	1
5	131	21	4	0.97
10	106	44	11	0.84
15	51	7	8	0.70
20	36	0	0	0.70
25	36	32	4	0.61
30	24	16	6	0.36
35	2	1	0	0.36

As the life table shows, 3% of the companies bankrupted until the age of 5 and 97% of them could continue their activity without bankruptcy. Seventy percent could survive until the age of twenty and only 38% managed to survive until the age of 35.

**Survival Analysis Diagram**



The above diagram shows survival function of the companies during 40 years.

**5. DISCUSSIONS AND CONCLUSIONS**

The research results showed that survival analysis could be a suitable model for predicting bankruptcy of companies, as it showed an accurate 81.3% predictability power on food and drink industries companies.



Shumway made a comparison between hazard model (survival analysis) and static models for predicting bankruptcy and concluded that the hazard model is more suitable than the static model as far as theory is concerned, as this model creates a continuous evaluation. Using a technical application, he concluded that approximately half of the accounting ratios used in the static models is not statistically significant bankruptcy predictors. Please, do not use references in the conclusion. Either make up a new part, e.g. Elaborations of results, or rephrase the sentences without any reference)

In survival analysis model, bankruptcy of companies is changing over time and their health is a function of their last financial data and life. During the first ten years, 84% of them do not suffer bankruptcy. After 20 years, 70% of them do not suffer bankruptcy. After 30 years, only 38% of them have not suffered bankruptcy.

The research results are in line with the research conducted by Bakshani on bankruptcy prediction using survival analysis model (proportional hazards) on home appliance companies. According to the research, proportional hazards model managed to predict 96% of bankruptcy time accurately. Altogether, survival analysis results with further data lead to a better understanding of bankruptcy process.

However, the results of Dakovice, Czado and Berg studies that compare static and hazard models to predict bankruptcy in Norway show that application of survival analysis model (proportional hazards) instead of static model does not correct performance of different simple, linear and multi linear improved models.

The research results showed that intellectual capital components are not appropriate predictors for bankruptcy in food companies; however, value added may be applied as an appropriate predictor for predicting bankruptcy.

Future researchers are proposed to use balanced scorecard methods to evaluate intellectual capital dynamicity and to use the effect of intellectual capital on financial performance using other criteria.

## **REFERENCES**

Bakshani, Safiey (2013). Bankruptcy Prediction of Companies Listed in Tehran Stock Exchange Using Proportional Hazard Regression (Cox), *Interdisciplinary Journal of Contemporary research in business*, Vol 5, No2. PP:327-340

Balcaene, S & Ooghe, H (2004). 35 years of studies on business Failure: an overview of the classic statistical methodologies and their related problems, *Vlerick leuven gent*, No 16. PP:3-70

Dakovic, R & Czado, C & Berg, D (2007), Bankruptcy Prediction in Norway a Comparison Study. *Statistical Research Report*, NO 4-. Douglas, A et al (1989); *statistics with confidence*, translated by: Roudbari M; Saneii, S (2005); Andishmand publishing; vol 1. PP:3-16. PP:

Geep, A & Kumar, K. (2008). The Role of survival Analysis in Financial Distress prediction, *International Research journal of finance and Economics*. PP:13-34.

Hajizadeh, E & Asghari, M (2011). *Statistical Methods and Analyses In Health and Biosciences*; Iranian Student Book Agency.

Kheri.S ; Faghihzade.S ; Meshkani.M.R;Mahmudi.M;Babaei.G.H (2003).A comparison of cox and frailty models in presence of unknown risk factors;Journal of Research in medical sciences.8(2).PP:23-28.

Li , Z et all (2006).Failure event Predication using the Cox Proportional hazard model driven by Frequent Failure Signatures<sup>4</sup>IIE Transition , Vol 39 , No3.PP:303-315.

Madhooshi.M<sup>4</sup>Asgharnejad.M(2010). Measuring Intellectual Capital and Investigate the Association Between the Intellectual Capital and Financial Returns of Companies; Journal of The Accounting And Auditing Review,Vol 16,No 4.PP:10-116.

Namazi.M<sup>4</sup>Ebrahimi.sh (2012).Investigating the impact of the components of intellectual capital on the firm's financial performance<sup>4</sup>Journal of Accounting Advances (JAA) Vol 3 , No 2.PP:163-197.

Rezaei.F<sup>4</sup>Piri.A<sup>4</sup>Nili.V(2013).Influence of intellectual capital on firm's market value in defferent life-cycle stages<sup>4</sup>Journal of development & evolution management,Vol5,No13.PP:19-28.

Shum Way , T (2001) . Forecasting Bankrupt more Accurately : A simple Hazard model,The journal of business<sup>4</sup>Vol 74<sup>4</sup>No 1.PP:101-123.

Shyug Lee,Tian(2004). Incorporating Financial Ratios and Intellectual Capital in Bankruptcy Predictions, Available Online [http://www.researchgate.net/.../237806102\\_Incorporating\\_Financial](http://www.researchgate.net/.../237806102_Incorporating_Financial).PP:1-25.

Sveiby.k (2001). Methods for Measuring Intangible Assets. Available Online <http://www.sveiby.com.au/BookContents.html>.

Tan, Hong Pew, David Plowman and Phil Hancock(2007). Intellectual Capital and Financial Returns of Companies, The Graduate School of Management, University of Western Australia, Crawley, Australia , The Current Issue and Full Text Archive of this Journal is, Journal of Intellectual Capital 8(1).PP:76-95.