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The effect of Board Characteristics on Intellectual Capital-A case study from listed Companies at Tehran Stock Exchange

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Abstract. Nowadays, intellectual capital is as a valuable asset of organizations and and Management has an important role in this aria. The specific board of directors' characteristics is vital in the initiation of mentioned capital. With this subject, the main objective of this study is to evaluate the effect of board characteristics on intellectual capital. A case study from 92 companies listed at Tehran Stock Exchange during 2004-2012. To examine this issue, with using survey method and correlation tests and applying of E-views and SPSS software's, the research hypotheses were tested and analyzed. The results showed: there is no significant relation between board of director's size and independence (as a measure for board characteristics), with intellectual capital on the basis of Pulic and Tobin's Q models.

Keywords: Board of Directors Characteristics, Intellectual Capital, Pulic model

1. INTRODUCTION

Nowadays, the importance of Intellectual Capital has become a valuable tool for the development of the key assets of organization. Research conducted indicated that two-thirds of all American companies are looking for new ways to collect and provide information such as Intellectual Capital. Statistics show that greater reliance on non-financial measures lead to more accurate predictions about future profit will be (Ishak,2013). Due to the initiative of intangible assets such as Intellectual Capital like invention and knowledge is rapidly increasing and has become an important componet of modern business. First, this concept was introducted in 1991. Hence major Swedish company "Scandia" began to implement a series of innovative scientific methods for their special attention to the intangible assets. The term "Intellectual Capital" for the first time was presented by Galbraith (1969).

Formerly, Peter Druckerused "Knowledge workers" (Feiwal, 1975). Due to the dynamic nature and intangible of Intellectual Capital, translating of the word is difficult and often are used it synonymous terms such intellectual assets, intangible assets and knowledge assets (Guthrie et al., 1999). Intellectual capital provides a new resource base through which an organization can compete. Bontis (1999) argues that intellectual capital is the quest for effective use of knowledge (the final product) for the data (raw material). From Roos et al.(1997) perspective, intellectual capital assets includes all processes that are not shown on the balance sheet and also includes all intangible assets such as trademarks, patents, exploitation and trade names that are considered in modern accounting methods. In other words, Intellectual Capital is the collection knowledge of organization's members and application of thier knowledge. Stewart (1999) argues that intellectual capital consists of knowledge, information, intellectual property and experience that can be used for wealth creation. In the last three decades, many researchers have been discussing intellectual capital as a result of organizational intangible resources that is a major source of competitive advantage and in the management field and capital markets has been done much empirical research. The review of the intellectual capital literature, suggests considerable

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attention to measuring, evaluating and reporting on it. Companies must consider competitve advantage for survival strategies, and since the markets, products, technologies, competitors and regulations are changing rapidly in society, knowledge improvement and continuous innovation, they will be able to maintain a sustainable competitive advantage. Hence, nowadays mangers consider knowledge and ability to create and knoweledge application as the most important source of sustainable competitive advantage. Because knowledge is considered an asset and effort to manage knowledge and usage of intellectual property and has been for organizations leading with considerable success. In the present era of knowledge-based or knowledge-based economy, intangible assets companies and intellectual capital is the key to achieve sustainable competitive advantage. Therefore, to consider the numerous intangible items such as economics, accounting and strategic management has grown quickly. Knowledge is a competitive advantage that has been considered in the business strategy of organizations, so that knowledge creation leads to continuous innovation and continuous innovation to create competitive advantage. Nowadays organizations to improve performance and ensure the success and sustainability of knowledge management it would have to consider knowledge management and this requires strengthening the capacities and potential of human resources to enable organizations to achieve competitive advantage through performance and continuous improvement and show quick response to business environment changes in economic conditions. One of the managers main challenges is potential application of knowledge and intellectual capital firm to create value and in this sense, managers must design tasks that the human resources use his knowledge to create value (Ishak,2013). On the other hand, one of the most important internal corporate governance mechanisms, according to the company board as entity conducting that has the role of surveillance on executive managers in order to maintain the ownership interest of shareholders. It seems that the achievement of the company depends on its optimal guidance. So that it can be claimed that the company's secret for longevity known and reputable lies in the enjoyment of an efficient and effective board. Weakness in the Board requires immediate attention and special care. Having flow of exact information on the Board, it is equally true and correct for companies operation that needs a constant flow of blood to the body (Hassas Yeganeh & Yaghumian, 2004). Board importance as one of the internal mechanisms of corporate governance, until this issue is that many of the corporate governance rules considered and have been introduced guidelines for its effectiveness (such as Sarbenes Oxley,2002; Kadbery Report,1992; Higgs & Smith Reports,2003; Dey committee Report,1994; Kardon Report,1995). The majority of mechanisms focus on the fact that having the special board characteristics limits opportunistic behavior and self-seeking managers. So improve the quality and reliability of reporting and disclosure of information, thereby leads to greater confidence for investors in the capital market (Pergola,2006). Among the characteristics are the board size, separation for board chairman role of managing director, usage non-obligated members for the Board, accounting professionals attendance on board, the services of expert advice using by board, Committees of the board existence and ... (Saghafi & Safar zadeh,2011). In other words, a strong board can cause monitoring improvement (Hassas Yeganeh et al.2012). However, the transparency of the voluntary disclosure is the key component, is considered as an important form of monitoring (Ho & Wong, 2001). With regard to the above, among the board characteristics, study, survey and identification of the effective factors on intellectual capital is very important. On the other hand, the paper intends that determined the effect of board characteristics on intellectual capital in a characterized society and has been studied for the first time in Iran and compares the results with other studies in world and provides main points in this area.

2. METHODOLOGY, COMMUNITY, STATISTICAL SAMPLE AND VARIABLES

According to the research subject, this study was inferential statistics type and has been discussing to the research hypotheses test by regression correlation analysis. The population includes all listed companies at Tehran Stock Exchange, so 92 companies was selected as the final sample of 2004-2012. Based on this study, the models and examined variables include:

$ICDi, t = \beta 0 + \beta 1BSi,t + \beta 2BIi,t + \beta 3Agei,t + \beta 4Sizei,t + \varepsilon i,t$

where:

ICDI,t is the dependent variable(intellectual capital) that is measured by and Pulic models.

BS is the independent variable (board size) that is equal to the number of board members

BI is the independent variable that is equal to the proportion of non-obligated board members to the total board members.

Intellectual capital is calculated based on Tobin's Q and Pulic modeles. Pulic model is based on a 5-stage chorus as follows:

Step One: Determination of the Value Added

VA=OUTPUT-INPUT

OUTPUT= total income from the sale of goods and services

INPUT= the total cost of materials, components and purchaced services

According to this view, every person or group that is affected by the events of business, must have an interest in the entity. This group of stakeholders, including shareholders, employees, funders, government and society. Therefore, for performance measuring, criteria such as stakeholder value added is better than the earnings that only indicate shareholder return. So the value added calculattion can be expressed by the following equation:

VA = S - B - DP = W + I +T + NI

Where NI is profit after tax, R is changes in retained earnings, S is proceeds from the sale, B is cost of goods sold and services provided, DP is depreciation, W is staff salary, I is profit, DD is dividened and T is tax.

Second stage: efficiency determination of employed capital (physical and financial)

VACA = VA ÷ CE

That VACA is the efficiency of employed capital, CE is employed capital (equal to the book value of its total assets minus intangible)

The third stage: determination of the human capital efficiency

According to this model, all employees' charges are considered as human capital.

VAHU = VA ÷ HU

Where VAHU is human capital efficiency, HU is human capital that is equal to the total cost of the company payroll.

Fourth step: determining the structural capital efficiency.

STVA = SC ÷ VA

SC=VA-HU

STVA is capital structure efficiency and SC is capital Structure Company.

Step Five: determination of the Value Added intellectual coefficient

VAIC = VACA + VAHU + STVA

Also as mentioned in the paper, to compare the results has also been used of Tobin's Q that the model is as follows:

$$\text{Toninś Q} = \frac{\text{book value of total assets} + (\text{book value } + \text{market value})\text{Ordinary shares}}{\text{book value of assets}}$$

Changes in Tobin's Q, provides an index to measure of the performance. It is expected that the ratio will tend towards 1 in the longer term.

4. RESEARCH HYPOTHESIS

Based on the proposed theoretical basis, research hypotheses are formulated as follows:

First hypothesis: there is a significant relationship between board size and intellectual capital on Tobin's Q model.

Second hypothesis: there is a significant relationship between board independence and intellectual capital on Tobin's Q model.

Third hypothesis: there is a significant relationship between board independence (percentage of non-obligated board members) and intellectual capital on Pulic model (1998).

Fourth hypothesis: there is a significant relationship between board size and intellectual capital based on Pulic model (1998).

Hypotheses have been tested by using of linear regression analysis in panel data .Regression analysis process research hypothesis is as follows:

1) Manaye tests of variables by using of tests "Lyon, Lin and Choi","Dickey Fuller" and "Philips Peron."

2) Kao cointegration test for long-term variables reliability if necessary.

3) The correlation test between the independent variables using the Spearman correlation table

4) LM test to check POOLED or PANEL of the hypothesis

5) Hausman test to check FIX and RAN of the hypothesis

6) Heteroscedasticity test to select OLS or EGLS method

7) Self-correlation test to verify autocorrelation of the research model

8) EGLS or OLS test for the hypothesis final test

Stability of variables means constant of average and variance of variables over time and the covariance between the different years. Application of econometric methods in estimation model is on the assumption that template variables are valid. If the variables in the model are unsteady or has a unit root, in this cace the usual t and F tests are not valid. In order to evaluate stability of

variables, the unit root tests of Lane, Levens, and Chow, Dickey Fuller and Philips Perron tests were used.

Table 2 results points that two variables, ie firm size and firm age are unmana. For two tests of the three tests indicates that these variables are non-stationary.

Table 1. Stationary test for variables.

variable	Lane, Levens, and Chow tests		Dickey Fuller test generalized		Philips Perron test		result
	F- Statistics	Prob.	F- Statistics	Prob.	F- Statistics	Prob.	
Tobins Q	-37.623	0.0001	276.853	0.0001	524.075	0.0001	stationary
Intellectual Capital-Pulic	-22.423	0.0001	209.981	0.091	351.953	0.0001	non-stayionary
Board size	-6.325	0.0001	22.055	0. 451	38.89	0.014	stationary
Boaed independence	-10.49	0.0001	69.29	0.920	112.06	0.042	stationary
Firm size	-1.053	0.146	188.617	0.392	332.62	0.0001	non-stayionary
Firm age	3.37	0.999	4.212	0.1217	7.377	0.002	non-stayionary

Since the variables ie firm size and age firm were non-stayionary and also considering that these two variables are part of the control variables and in the ultimate test of four hypotheses are used of the two variables, so four hypotheses stationary have to check out by using of Kao cointegration test in the long run. Kao cointegration test results in Table 2 indicates that every four hypotheses are stationary in the long term. So non-stayionary for firm size and age size will not make any problems in the final test of the hypotheses in long term.

Table 2. Stationary check of hypotheses in long term.

hypothesis number	t-Statistic	Prob.
1	-5.299	0.0001
2	-5.223	0.0001
3	-9.341	0.0001
4	-9.336	0.0001

Table 3 points correlation between the independent variables. To check correlation between parametric variables of Pearson's correlation test and for variables non-parametic was used of Spearman correlation test. In parametric statistics, variables have quantitative -scale (continuous) and the observations follow a normal distribution, but most variables have quantitative -scale in non-parametric statistical and since they are not precisely measurable, do not follow any statistical distribution.This type of statistics is called free of distributed (Tourani, 2010). Since all variables follow abnormal distribution in this study; as a result to check relationship between independent variables was used of Spearman correlation. Table 3 points that exit any significant correlation between the independent variables, so also the designed models are suitable to test the hypothesis in this respect.

Table 3. Results of Spearman correlation test.

correlation prob.	board size	board independence	Firm size	Firm age
Board size	1.000			

Board independence	-0.0986	1.000		
	0.0074	----		
Firm size	0.1759	-0.0345	1.000	
	0.0001	0.3490	----	
Firm age	-0.0446	0.0501	0.1439	0.0001
	0.2265	0.1738	0.0001	---

At this stage, type of data (data panel or integrated) is characterized. For this purpose was used of F Lymer test. If data are from panel, would be determined which panel data models are used (fixed or random effects); also Hausman test is used for this purpose. Indicator 4 show the rsults F Lymer and Hausman test. According to null hypothesis of F- Lymer test, the fixed effects model is used for data panel model if probability statistics obtained is likely to be less than 5%, otherwise, random effects model will be consolidated. As the indicator shows that all of four hypotheses model is panel model; so must be determined panel data model by using Hausman test. According to the null hypothesis of Hausman test, if p <5%, the fixed effects model is considered for panel data models, otherwise, the random-effects model will be selected. According to table 4, fixed effects model is selected for all of four hypotheses.

Table 4. F Lymer test & Hausman test results

hypothesis number	F Lymer test			Hausman test		
	Cross Section F	Prob.	result	Cross Section R	Prob.	result
1	7.482	0.0001	panel	167.93	0.0001	Fixed effects model
2	7.663	0.0001	panel	171.217	0.0001	Fixed effects model
3	11.808	0.0001	panel	96.245	0.0001	Fixed effects model
4	11.910	0.0001	panel	104.033	0.0001	Fixed effects model

In continuos of panel data process, heteroscedasticity and autocorrelation disigned models must be investigated before the final test hypotheses. The results of the two tests (table 5) show that all four hypotheses have heteroscedasticity and autocorrelation problem. The significance level of LR Chi2 statistic is less than 5 percent confidence level so the null hypothesis is rejected in investigation of heteroscedasticity test. Therefore to reduce heteroscedasticity is used generalized least squares method (EGLS). The F-statistic is less than 5 percent confidence level so the null hypothesis of the autocorrelation test was rejected too becouse of the absence of autocorrelation. Since all of four hypotheses have panel data model as fixed effects, AR (1) will be added for all of four hypotheses to reduce of autocorrelation.

Table 5. Results of heteroscedasticity and autocorrelation test of hypotheses

hypothesis number	Heteroscedasticity test		Heteroscedasticity	Autocorrelation test		Autocorrelation test
	LR Chi2(91)	*Prob > chi2*		F-statistics	Prob > F	
1	832.26	0.0001	+	12.516	0.0006	+
2	847.67	0.0001	+	12.526	0.0006	+
3	474.02	0.0001	+	31.708	0.0001	+
4	476.89	0.0001	+	31.806	0.0001	+

4.1. First hypothesis tests

There is a significant relationship between intellectual capital and board size on Tobin's Q model. The following regression model is designed to explore this relationship:

$$Qtobin_{i,t} = a_0 + a_1 directore\ board\ size_{i,t} + firm\ size_{i,t} + Age_{i,t} + \varepsilon_{i,t}$$

Above equation, it has been tested in the fixed effects model and generalized least squares method (Because of the heteroscedasticity problem) that the results are visible in table 6.

The results show that the board size has no significant relationship with Tobin's Q ratio. Since t-statistic for this variable is equal to 0.305 and probability of this statistic is greater than 5% of confidence level, so the null hypothesis cannot be rejected about the lack of effectiveness of the board size on the Tobin's Q ratio. So there is no relationship between board size and Tobin's Q ratio with 95% confidence.

Table 6. Results of the final test for first hypothesis.

Variable	Coefficient	t-Statistic	Prob.
Board size	0.0027	0.305	0.7602
Firm size	0.3485	24.55	0.0001
Firm age	0.030-	-4.866	0.0001
intercept	1.925-	-11.671	0.0001
AR(1)	0.3560	26.022	0.0001
coefficient of determination	0.9371		
adjusted coefficient of determination	0.9262		
Durbin-watson statistic	2.06877		
F-statistics	85.9584		
Prob(F-statistics)	0.00001		

4.2. Second hypothesis:

There is a significant relationship between board independence and intellectual capital on Tobin's Q model. The following regression model is designed to explore this relationship:

$$Qtobin_{i,t} = a_0 + a_1 directore\ board\ independence_{i,t} + firm\ size_{i,t} + Age_{i,t} + \varepsilon_{i,t}$$

Again this relationship has been tested in the fixed effects model and generalized least squares method (because of heteroscedasticity problem) and also by adding AR (1) (because of autocorrelation) that the results are visible in table 7.

The results show that board independence has no significant relationship with Tobin's Q ratio. Since the t-statistic for this variable is equal to -0.941and the probability of this statistic is greater than the 5% of confidence level, the null hypothesis can not be rejected based on the lack of effectiveness of board independence on Tobin's Q ratio. So there is no significant relationship between board independence and Tobin's Q ratio by 95% confidence.

Table 7. Final results of the third hypothesis.

Variable	Coefficient	t-Statistic	Prob.
Board independence	-0.0395	-0.9415	0.03468
Firm size	0.3504	25.105	0.0001
Firm age	-0.0308	-5.265	0.0001
intercept	-1.8906	-10.039	0.0001
AR(1)	0.3556	26.869	0.0001
coefficient of determination	0.9374		
adjusted coefficient of determination	0.9265		
Durbin-watson statistic	2.0609		
F-statistics	86.402		
Prob(F-statistics)	0.00001		

Modified coefficient of determination indicates that 92% of the dependent variable changes is explained by the independent and control variables. Considering the probability of F- statistics indicates that in general, the designed model to test for the hypothes test was significant too. In addition, the results for Durbin-watson statistic has located in the optimal range between 1.5 to 2.5. This shows that autocorrelation problem is gone by adding AR (1). Also among the control variables, firm size has positive relation and firm age has a negative relation with Tobin's Q ratio.

4.3. The third hypothesis

There is a significant relationship between the board and intellectual capital based on Pulic model. The following regression model is designed to explore this relationship:

$$IC_{i,t} = a_0 + a_1 directore\ board\ size_{i,t} + firm\ size_{i,t} + Age_{i,t} + \varepsilon_{i,t}$$

Also this relationship it has been tested in the fixed effects model and generalized least squares method (because of heteroscedasticity problem) and by adding AR (1) that the results can be seen in table 8.

The results show that there is no significant relationship between the board and intellectual capital based on Pulic model. Since the t-statistic for this variable is equal to -1.422 and the probability of this statistic is greater than the 5% of confidence level, the null hypothesis can not be rejected owing to the absence of significant relation between these two variables.

Table 8. Final results of the third hypothesis.

Variable	Coefficient	t-Statistic	Prob.
Board size	-0.0081	-1.422	0.1556
Firm size	0.0383	7.40	0.0001
Firm age	-0.0103	-9.680	0.0001
intercept	0.0779	1.498	0.1345
AR(1)	0.3346	5.463	0.0001
coefficient of determination	0.8276		
adjusted coefficient of determination	0.7978		
Durbin-watson statistic	1.981		
F-statistics	27.707		
Prob(F-statistics)	0.00001		

Adjusted coefficient of determination shows that 79% of the variability is explained by the independent and control variables. It can be said with regard to the probability of F- statistics that in general the designed model to test the hypothesis was significant. In addition, the results for Durbin-watson statistic located in the optimal range between 1.5 to 2.5. This shows that autocorrelation problem is gone by adding AR (1). Also among the control variables, there is positive relation between firm size and intellectual capital and a negative relation between firm age and intellactual capital based on Pulic model.

4.4. The final test of the fourth hypothesis

There is significant relationship between board independence and intellectual capital based on Pulic model. The following regression model is designed to explore this relationship:

$$IC_{i,t} = a_0 + a_1 directore\ board\ independence_{i,t} + firm\ size_{i,t} + Age_{i,t} + \varepsilon_{i,t}$$

Also the relationship has been tested in the fixed effects model and generalized least squares method (because of heteroscedasticity problem) and also by adding AR (1) (because of autocorrelation) that the results are visible in table 9.

The results show that there is no a significant relationship between board independence and intellectual capital based on Pulic model. Since the t-statistic for this variable is equal to -0.4050 and the probability of this statistic is greater than 5% of confidence level, the null hypothesis can not be rejected owing to the lack of correlation between these two variables.

Table 9. Final results of the fourth hypothesis.

Variable	Coefficient	t-Statistic	Prob.
Board size	-0.0058	-0.4050	0.6851
Firm size	0.0389	7.251	0.0001
Firm age	-0.0105	-9.234	0.0001
intercept	0.0413	0.9741	0.3304
AR(1)	0.03303	5.437	0.0001
coefficient of determination	0.8272		
adjusted coefficient of determination	0.7972		
Durbin-watson statistic	1.987		
F-statistics	27.621		
Prob(F-statistics)	0.00001		

Adjusted coefficient of determination shows that 79% of the variability is explained by the independent and control variables. With regard to the probability of F-statistics that in general the designed model to test the hypothesis was significant. In addition, the results for Durbin-watson statistic located in the optimal range between 1.5 to 2.5. This shows that autocorrelation problem is gone by adding AR (1). Also among the control variables, there is positive relation between firm size and intellectual capital and a negative relation between firm age and intellactual capital based on Pulic model.

5. CONCLUSIONS AND RECOMMENDATIONS

- There is no significant relationship in board size with Tobin's Q ratio as a measure of intellectual capital measurement. Since the t-statistics have been 30%, thus, although the board has a positive coefficient on Tobin's Q, but it was not statistically significant.

- There is no is a significant relationship between board independence and intellectual capital on Tobin's Q model. According to the t-statistic, the null hypothesis can not be rejected based on the lack of effectiveness board independence on intellectual capital with Tobin's Q model.

- Board size and intellectual Capital was tested based in the third hypothesis on the Pulic model. The results indicated that the board size had no significant correlation with intellectual capital. So the hypothesis is rejected.

- There is no significant relationship between board independence and intellectual capital based on Pulic model. In this hypothesis, the coefficient of determination (79%) indicates that 79% of the independent variable changes by the control variable are age.

Considering the above results, the following results with research activities of others is compared:

- Effect of board size on intellectual capital registered that in both models, there were no significant effects. This finding is consistent with results Bermak (1997), which showed that, there is inverse relationship between board size and performance and it is consistent with William (2000) and Guthrie and Petty (2000). However it is inconsistent with the OBA et al.(2013) and Yao Tseng et al.(2013) and Rakhshani et al. (2013) and Namazi & Ebrahimi(1388) research.

- Effect of board independence on intellectual capital showed that in both models, there was no significant effect. The research findings were consistant with Guthrie and Petty (2000) and William (2000), Oba et al.(2013) (on board independence variables) and it is inconsistent with Rakhshani et al.(2013), esmaeili et al.(2012), Donaldson and Davies (1994), Pill (1995) research.

- With regard to the above, intellectual capital does not affect the properties of the board in Iran. According to the procedures specified executives, directors of listed companies in Iran and its relation to macro-economic and political issues, the board characteristics have not effective on intellectual capital and value creation, unlike many developed countries.

According to the study, the following suggestions are offered:

- According to research conducted in many communities and in many research, board characteristics are effective on intellectual capital. But the results have been inconsistent with the findings. Therefore, it is recommended for the associations, companies, market

analysts, industry associations and owners of public companies (despite the research findings) to have more effort in selection of professional managers.

- Depending on the board size and its negative effects on intellectual capital, is suggested that assemblies in its macro decisions about the number of board members have not a high sensitivity. However it is quite sensitive based on available evidence.

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