A Logistic Regression Analysis to Examine Factors Affecting Gender Diversity on the Boardroom: ISE Case*

Ilker Sakinc, PhD
AssistantProfessor
Faculty of AdministrativeandEconomicSciences
Turkey

Erginbay Ugurlu, PhD
AssistantProfessor
Faculty of AdministrativeandEconomicSciences
Turkey

Abstract

In the recent years, the importance of financial literature in gender diversity amongst board of directors has been investigated. It is argued whether diversified board of directors has a positive impact on firms. This paper aims to determine the affecting factors of gender diversity in the board of directors in Turkey. For this reason, 40 firms in Istanbul Stock Exchange (ISE) in Corporate Governance Index (XKURY) are examined for 2011 in the paper. Due to having a categorical variable which has a two value as a dependent variable we use logistic regression model which analyzes the effects of independent variables on a binary dependent variable in terms of the probability of being in one of the other. The model results show that size of board of directors and education has a positive and foreign ownership and free float rate have negative impact on gender diversity.

Key Words: Gender Diversity, Logistic Regression, ISE, Corporate Governance, Board of Directors

1. Introduction

On July 25 of 2002 Sarbanes-Oxley Act which is also known as the "Public Company Accounting Reform and Investor Protection Act" and "Corporate and Auditing Accountability and Responsibility Act" was passed from the congress of USA. This act draws attention to the importance of corporate boards, and since its acceptance by Congress, has led to accretion of researchers in gender diversity within corporate boards. Hoel (2008) emphasizes that female representation in corporate decision-making is an important issue for politicians. In Norway and Spain, constitution of women in corporate bonds is predicted to increase toat least 40 percentages by 2015.
In literature, board diversity is defined and measured by various ways. Maznevski (1994), Milliken and Martins (1996); Conyon and Malin (1997), Singh et. al. (2001), Daily and Dalton (2003) defined board diversity as a demographic and cognitive dimensions; gender, age and ethnicity respectively. Majority of literature about gender diversity is descriptive studies. In these studies, women have constitute a very small percentage in top level managerial positions in firms (Singh and Vinnicombe2004, Zelechowski and Bilimoria 2004, Singh et. al. 2001).Furthermore, results show that women do not easily gain access in the board.

This study investigates the affecting factors on gender diversity in corporate boards in Istanbul Stock Exchange (ISE) in firms of Corporate Governance Index (XKURY), whichcomprises of 40 firms. We use logistic regression model which have gender as a dependent, free float rate (FFR), size of board of directors (SIZE), have a foreign ownership or not (FOR), education (GRA) as independent variables.

This paper is organized as follows. Section two investigates literature review; section three describes data and presents empirical application. Finally, section four presents our conclusions.

---

*This article is extended version of the paper which was presented in ICEOS-2012, 13th Internatıonal Conference On Econometrics, Operations Research, And Statistics in 26 May 2012,Famagusta, Turkish. Republic of Northern, Cyprus.
The authors wish to thank HumairaHussain from Nazareth College of Rochester for her helpful comments. All remaining errors, however, are solely ours.

2. Literature Review

Vast majority of the previous academic literature about gender diversity on corporate boards indicate that the proportion of women is low for majority of the countries. Terjesen and Singh (2009) investigate environmental context of female representation on corporate bonds for 43 countries by using logistic regression analysis and find that countries with higher representation of women on boards are more likely to have women in top management. Jurkus et al. (2011) examines the relationship between agency cost and gender diversity. The authors find that firms with a greater percentage of female officers present lower agency costs in less competitive markets for top managers of Fortune 500 firms in USA. Also Grosvoldet. al. (2007) examines the evolving gender diversity for Norwegian and British companies. Although gender diversity has grown in both countries, it has expanded rapidly in Norway as compared to the United Kingdom.

Burgess and Tharenou (2002) describe the characteristics of women on board from an international perspective. They review women representation in corporate boards by using secondary data of previous literature which were obtained from Australia, USA, Canada, United Kingdom, New Zealand and Israel.

Singh and Vinnicombe (2004) and Singh et al. (2001) argued female representation in UK boards in FTSE 100. Singh and Vinnicombe (2004) compare companies with women directors and companies without women directors by using demographic variables through their means and t-tests. The authors conclude that the reasons for low proportion of women in corporate boards are the lack of ambition, experience, and commitment in women. Similarly, Singh et al. (2001) investigate FTSE 100 and compare the results with US Fortune 500. Firms which have more women directors are found to be amongst those with the highest turnover, profit and number of employees in the FTSE 100 and US Fortune 500. They highlight those similar findings with previous researches which are mentioned above.

Zelechowski and Bilimoria (2004) investigate the qualifications of corporate top directors of Fortune 1000 firms in terms of gender diversity. They find that women directors differ significantly from a random set of men directors on several characteristics: type, gender, corporate board~~'s~~ interlocks, officer title, corporate function, inclusion in the list of top earners and compensation.

Franceouret. al. (2007) test main predictions of agency and stakeholder theory which is regarding the impact on firm's performance of increased women representation in corporate boards. They notice that firms operating in complex environments do generate positive and significant abnormal returns when they have a high proportion of women directors. On the contrary, studies mentioned above, investigated Western countries, Kang et. al (2010) investigate an Asian country, Singapore. They indicate that investors generally respond positively to the appointment of women directors in Singaporean firms.

3. Empirical Application

The data collected from Istanbul Stock Exchange (ISE) in Corporate Governance Index (XKURY) which composed of 40 firms in 2011.The variable which shows gender diversity (GEN) as a dependent variable comprise of two values two values: 1, if boards have a female directors, and 0, if it doesn't. The independent variables used are free float rate (FFR), size of board of directors (SIZE), have a foreign ownership or not (FOR) and education.

The research design of this study involves logistic regression model. Logistic regression is used because the dependent variable, GEN, is a binary variable, which is also called dummy variable. Moreover, Logistic regression model describe and test the hypotheses about relationships between a binary dependent variable, and one or more discrete or continuous independent variables.

In multiple linear regression the expected value of a response variable, y, is modeled as a linear function of the explanatory variables. If dependent variable is binary that takes the values 0 and 1, the expected value is simply the probability, p. Although we could model p as a linear function of the explanatory variables which is called a linear probability model (LPM). But LPM model has two insurmountable problems (Landau and Everit, 2004; Gujarati,2004)

1. The predicted value of p, $\hat{p}$, given by the fitted modelshould satisfy $0 \leq \hat{p} \leq 1$ unfortunately fitted values of dependent variable do not provide this range.

2. The observed values do not follow a normal distribution with mean p, but rather what is known as a Bernoulli distribution.

To consider with these problems we could model p indirectly via what is known as the logistic transformation of p as follows:

$$ln\frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \cdots . + \beta_q X_q$$

Additionally the results of logistic regression can be presented in terms of the odds, rather than the probability, of the outcome which is equal to e, the natural logarithm base, raised to the exponent of the coefficient e^{β_i}.

There are several statistics which can be used for evaluating the performance (goodness of fit) of a logistic model results which are Chi-Square, Pseudo-R2, Hosmer-Lemeshow Statictic and Percent Correct Predictions.

The Chi-Square test is called likelihood ratio (LR), statistic is (Bircan,2004)

$$LR = -2ln\left[\frac{LLofbeginningmodel}{LLofendingmodel}\right]$$

Where LL is Likelihood, the LR statistic is distributed chi-square with i degrees of freedom, where i is the number of independent variables.

The R-square statistic cannot be exactly computed for logistic regression models; therefore a widely used Pseudo R-square is used instead of R-square as follows:

$$\text{Pseudo } R^2 = 1 - \left[\frac{LLofbeginningmodel}{LLofendingmodel}\right]$$

The Hosmer-Lemeshow Statistic is another goodness-of-fit statistic. Hosmer and Lemeshow recommend partitioning the observations into 10 equal sized groups according to their predicted probabilities. The corresponding groups are often referred to as the "deciles of risk" (Hosmer and Lemeshow, 2000).Under the null hypothesis that "The current model fits well" Hosmer and Lemeshow statistic is calculated from 2xg table that shows observed and expected values, as follows :

$$\chi^2_{HL} = \sum_{k=1}^{g} \frac{(O_i - N_i\bar{\pi}_i)^2}{N_i\bar{\pi}_i(1-\bar{\pi}_i)}$$

Where:
g: Number of grous
N_i:Total frequency of subjects in the ith group
O_i: Total frequency of event outcomes in the ith group
$\bar{\pi}_i$: Average estimated probability of anevent outcome for the ith group.

The test statistic is distributed as Chi-Square with (g-n) degrees of freedom (Oguzlar, 2005, URL 1)
Percent Correct Predictions shows the proportion of cases we have managed to classify correctly. In the opinion of Hosmerand Lemeshow (2000, 160), "the classification table is most appropriate when classification is a stated goal ofthe analysis; otherwise it should only supplement more rigorous methods of assessment of fit." (Peng, Leeand Ingersoll, 2002).We need to prepare 2x2 table for calculate the proportion. The table assumes that if the estimated/predicted p is greater than or equal to 0.5 then the event is expected to occur and not occur otherwise.

Table 1: LogisticRegression Model Results					
DependentVariable : GEN					
Variable	**Coefficient**	**Std.Err.**	**Exp(Bi)**	**t**	**p**
SIZE	0.721	0.293	2.056	2.46	0.014
FOR	-4.486	1.823	0.615	-2.46	0.014
FFR	-0.064	0.030	0.938	-2.10	0.036
GRA	0.645	0.277	1.905	2.32	0.020
Constant	-4.046	2.480		-1.63	0.103
Number of obs. = 40					
LR chi2(4) = 25.79					
Prob> chi2 = 0.0000					
Loglikelihood = -14.377017					
Pseudo R square = 0.4729					

Table 1.shows the results of logistic regression. Model is statistically significant in 1% level and all independent variables are significant in 5% level. Coefficients show the change in the predicted logged odds of having women director on board for a one-unit change in the independent variables. Pseudo R-square of the model is 0,47.
In Table 1 fourth column show odds ratio of variables which is interpreted as follows; If the value exceeds 1 then the odds of an outcome occurring increase; if the figure is less than 1, any increase in the predictor leads to a drop in the odds of the outcome occurring. (Büyükoğlu, 2000:8). When SIZE is raised by one unit (one person) the odds ratio is 2 times as large, and therefore, directors are 2 more times likely to be women. If it is interpret for other variables; one unit rise in FOR, FFR, GRA, directors are 0.61, 0.95 and 1.90 times more likely to be a women than men respectively.

Table 2: HosmerLemeshow Test Result		
Chi-Square	**DF**	**Prob**
2,64	8	0,9548

Table 2 shows Hosmer-Lemeshow goodness of fit result .The Hosmer and statistic is 2,64 which has a prob. is more than 0,05 thus we cannot reject the null hypothesis that the current model fits well.

Table 3: ClassificationTable					
		Predicted			
		Yes*	**No****	**Total**	**% Correct**
Observed	**Yes***	14	3	17	82,35
	No**	3	20	23	86,96
	Total	17	23	40	85

Notes:*, ** shows boards have a female directors, boards have not a female directors respectively.Sensitivity = 4/ (17) =82, 35 Specificity = 20/ (23) % =86, 96.

Last statistic for goodness of fit is Percent Correct Predictions that summarized in Table 3. It is seen that the model classify 85% in overall correctly. The rate of correct classification is good enough that shows performance of a logistic model is adequate.

4. Results and Discussion

This paper uses logistic regression model to investigate affecting factors of gender diversity in boardroom. We used four variables which have an impact on women diversification; these variables were as follows: free float rate, size of board of directors, have a foreign ownership, faculty of graduated which are named FFR, SIZE, FOR, GRA respectively. The variables which are named SIZE, GRA has a positive and FOR and FFR has a negative effect on probability of women representation in corporate boards. Most effective variables on gender diversity are SIZE and GRA variables in variables which we used in our model.

The coefficient of FOR shows that the increasing proportion of foreign ownership in corporate leads to a smaller representation of women in boards. The percentage of women and men investors is approximately23% and 77% in Turkey (Özçelik, 2008:2; TSPAKB, 2007). This information is parallel with findings of our model on FFR variable. It indicates that when free float rate increases probability of men being equity ownership increases. In general, board of directors exists from investors in Turkey so the high percentage of men investors decrease representation of women in corporate boards. In addition, if number of inside directors of board graduated from economic and administrative science increase, more women take part in board. Comparison of proportion of women who graduated from social science is higher than other sciences. Therefore if the director is graduated from social and administrative sciences, it is more likely that the director will be a woman. In order to increase women representation in corporate boards, the composition of women in investors must be increased. To become an investor the most important asset one must have is knowledge and also to have more knowledge, it is necessary to have higher education. In conclusion, this research model clearly shows that more educated women will lead to a higher representation of women in corporate boards.

References

Anthony F. Jurkusa and Jung Chul Park, Lorraine S. Woodard. (2011). "Women in top management and agency costs", Journal of Business Research, Volume 64, Issue 2, 180-186

Burgess, Zena and Tharenou, Dharenou.(2002). "Women board directors: Characteristics of the few."Journal of Business Ethics, Vol. 37, 39-49.

Bircan Hüdaverdi. (2004)."Lojistik Regresyon Analizi: Tıp Verileri Üzerine Bir Uygulama", Kocaeli Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, Vol: 2 , 185-208

Büyükoğlu, Halit. (2000) Çok Değişkenli Nitel Veri Analiz Teknikleri, Basılmamış Bilim Uzmanlığı Tezi, Hacettepe Üni. Fen Bil. Ens., Ankara.

Daily Catherine M. And Dalton Dan R. (2003) "Are Director Equity Policies Exclusionary?", Business Ethics Quarterly, Vol. 13, No. 4, , 415-432, Oct.

Erdoğan, Muammer and Elmas, Bekir. (2010). "Hisse Senedi Piyasalarında Görülen Anomaliler ve Bireysel Yatırımcı Üzerine Bir Araştırma", Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, Sayı : 14(2), 1-22.

Peng, C. Y. Joanne, Lee Kuk L. and Ingersoll Gary M. (2002), "An Introduction to Logistic Regression Analysis and Reporting", The Journal of Educational Research, Vol. 96, No. 1. , 3-14

Grosvold, Johanneand Brammer, Stephen J. and Rayton, Bruce A. (2007). "Board Diversity in the United Kingdom and Norway: An Exploratory Analysis", Business Ethics: A European Review, Vol. 16, No. 4, 344-357, and October.

Hoel, Marit. (2008). "The quota story: Five years of change in Norway", In: Vinnicombe, S., Singh, V., Burke, R., Bilimoria, D. and Huse, M. (eds.) Women on Corporate Boards of Directors: International Research and Practice, 79–87. Edward Elgar, Cheltenham

Jurkus, Anthony F., Park, JungChulandWoodard, Lorraine S.(2011). "Women in Top Management andAgencyCosts" Journal of Business Research, Volume 64, Issue 2, 180–186, February

Landau,Sabine and EverittBrian S. (2004).A Handbook Of Statistical Analyses Using SPSS, Chapman&Hall/CRC Press LLC,USA

Martin, J. Conyon and ChrisMallin. (1997). "Women in theBoardroom: EvidencefromLarge UK Companies," CorporateGovernance: An International Review, WileyBlackwell, Vol. 5(3), 112-117.

Maznevski, Martha L. (1994). "Understanding Our Differences: Performance in Decision-Making Groups with Diverse Members", Human Relations,Vol.47, 531-552, May.

Milliken, F. J. And Martins, L. L. (1996) "Searching for common threats: Understanding the multiple effects of diversity in organizationalgroups", Academic of Management Review, 21(2), 402-433.

Özçelik, Burcu. (2008)."Küresel Girişimcilik Araştırması 2007 Sonuçları," Hürriyet Gazetesi İK İşve Yönetim,.2.

OguzlarAyse. (2005), "Lojistik Regresyon Analizi Yardımıyla Suçlu Profilinin Belirlenmesi",İktisadi ve İdari Bilimler Dergisi, Volume: 19 , No: 1,21-35

Singh, Val and Vinnicombe, Susan . (2004). "Why So Few Women Directors in Top UK Boardrooms? Evidence and Theoretical Explanations", Corporate Governance: An International Review, 01/2004; 12(4):479-488, October.

Singh, Val and Vinnicombe, Susan and Johnson, Phyl. (2001). "Women Directors on Top UK Boards" Corporate Governance: An International Review, Vol. 9, 206–216, July.

Terjesen, Siri, Sealy, Ruth and Singh, Val. (2009). "Women Directors on Corporate Boards: A Review and Research Agenda", Corporate Governance: An International Review, Vol:17, 320–337.

URL1 :http://www.math.wpi.edu/saspdf/stat/chap39.pdf

Zelechowski, Deborah Dahlen and Bilimoria, Diana. (2004). "Characteristics of Women and Men Corporate Inside Directors in the US.",Corporate Governance: An International Review, Vol. 12, No. 3, 337-342, July.