Ekonomi, İşletme ve Maliye Araştırmaları Dergisi
Cilt 1, Sayı 3, 2019
s.237-245

EFFICIENCY OF THE MAJOR BORSA ISTANBUL INDEXES: AN EMPIRICAL INVESTIGATION ABOUT THE INTERACTION BETWEEN CORPORATE GOVERNANCE AND EQUITY PRICES THROUGH A MARKET MODEL APPROACH

Fatih Yiğit*
Erol Muzır**

Abstract

This paper is intended to argue the connection between corporate governance quality and stock returns and aimed to present a slightly different approach to capturing relationship between the fundamental stock market indexes and corporate governance in Turkey by relating the major index returns to the corporate governance index returns through a simple market model. Moreover, it is also aimed to compare relative efficiencies of the market portfolios included to one another according to their reactional behaviors against the corporate governance index. For this purpose, three market indexes in Borsa Istanbul, namely BIST 30, BIST 100 and BIST ALL as well as the Corporate Governance Index (CGI) have been considered and analyzed. The returns on each of these three market indexes are regressed on the returns of the corporate governance index through the Ordinary Least Squares (OLS) and Multivariate Adaptive Regression Splines (MARS) techniques. Our findings suggest that the market index returns are positively correlated with the corporate governance index returns and provide some evidence supporting the conclusion that the BIST 100 index can be considered to be relatively efficient as compared to BIST 30 and BIST ALL.

Keywords: *Corporate governance quality, stock returns, efficiency, Borsa Istanbul*

JEL Classification: *M10, G10, C20*

BAŞLICA BORSA İSTANBUL ENDEKSLERININ ETKİNLİĞİ: KURUMSAL YÖNETİŞİM VE HİSSE SENEDİ FİYATLARI ARASINDAKİ ETKİLEŞİME İLİŞKİN PİYASA MODELİ YAKLAŞIMINA DAYALI AMPİRİK BİR ARAŞTIRMA

Özet

Bu çalışmada, kurumsal yönetişim kalitesi ve hisse senedi getirileri arasındaki bağlantı sorgulanmakta olup, Türkiye'deki önde gelen hisse senedi piyasa endeksleri ile kurumsal yönetişim arasındaki muhtemel bir ilişkiyi ortaya çıkarmaya yönelik olarak endeks getirileri ile kurumsal yönetişim endeksi getirilerini basit piyasa modeli kullanılarak ilişkilendirmeye çalışan nispeten farklı bir yaklaşım ortaya konulmuştur. Bununla birlikte, piyasa portföylerinin nispi etkinlik düzeylerinin, kurumsal yönetişim endeksine verdikleri tepkiler doğrultusunda karşılaştırılması amaçlanmıştır. Bu doğrultuda, Kurumsal Yönetişim Endeksi'nin yanı sıra Borsa İstanbul'daki üç piyasa endeksi - BİST 30, BİST 100 ve BİST TÜM - incelenmiş olup, En Küçük Kareler (EKK) ve Çok Değişkenli Uyumlu Regresyon Uzanımları (MARS) teknikleri kullanılarak söz konusu piyasa endeksi getirileri ile Kurumsal Yönetişim Endeksi getirileri arasındaki ilişkiler modellenmiştir. Elde edilen bulgular, piyasa endeks getirileri ile Kurumsal Yönetişim Endeksi getirileri arasında pozitif ve anlamlı bir ilişki olduğunu göstermiş ve BİST 100 portföyünün BİST 30 ve BİST TÜM endeks

* Dr.Öğr.Üyesi., İstanbul Medeniyet Üniversitesi, Siyasal Bilgiler Fakültesi, İşletme Bölümü, fatih.yigit@medeniyet.edu.tr
** Dr.Öğr.Üyesi, İstanbul Medeniyet Üniversitesi, Siyasal Bilgiler Fakültesi, İşletme Bölümü, erol.muzir@medeniyet.edu.tr

portföylerine kıyasla daha etkin bir portföy olarak değerlendirilebileceğine dair bazı kanıtlar ortaya koymuştur.

Anahtar Kelimeler: *Kurumsal yönetişim kalitesi, hisse senedi getirileri, etkinlik, Borsa İstanbul*

JEL Sınıflandırması: *M10, G10, C20*

1. Introduction

Capital markets, the primary function of which is to facilitate fund transfer from lenders to borrowers in an efficient way, play a vital role in stock valuation by providing relevant return and volume data on individual stocks and market portfolios. Most of the existing stock pricing models assume efficient capital markets and merely rely on the concept of efficiency that is a relatively less restrictive as compared to the concept of perfect market. In theory, a market can be considered efficient only if it proves to be efficient in terms of resource allocation and operation. Efficiency in terms of resource allocation means a market mechanism that equates the marginal rates of return for all lenders and borrowers while operational efficiency requires fund transfers to be costless and necessitates all available information to be suddenly and fully reflected in market prices (Copeland & Weston, 2005). The latter is called *informational efficiency* and Fama (1970) defines three hypothetical forms of efficiency as the weak, semi-strong and strong forms with regard to the extent to which current market prices fully reflect all the relevant information available to the market.

Information asymmetry is a serious phenomenon that challenges market efficiency because it is suggested to negatively affect the speed of price adjustment as a result of lack of informational transparency and poor governance and render direct or indirect agency costs to the firm (Lambert, 2001). Therefore, corporate governance has become a prominent issue in maintaining efficiency in capital markets for transparency and quality of governance are the foremost two among its core dynamics. It can be defined as a set of principles that were first designated in 2002 with Sarbanes-Oxley Act in the US and were revised in 2004 by OECD to minimize conflicts between managers and stakeholders through directing the managers towards the stakeholders' interests and benefits firms by increasing their efficiency and performance. The corporate governance principles are intended to enable corporate accountability to stakeholders (Solomon & Solomon, 2004). The past research provides some evidence suggesting a positive correlation between the quality of corporate governance and financial performance. Since corporate governance can be also a functional tool for risk management, it is supposed to improve efficiency in capital markets (Allen and Gale, 2002) and enhance the development of better asset pricing models.

This study about the connection between corporate governance quality and stock returns is structured to present a slightly different approach to capturing any relationship between the fundamental stock market indexes and corporate governance in Turkey by relating the major index returns to the corporate governance index returns through a simple market model. The study consists of three sections: The next section includes a brief overview of the relevant studies carried out to unveil connections between stock market performance and corporate governance quality while the latter section covers our empirical research in which several market models have been constructed using the ordinary least squares (OLS) and multivariate adaptive regression splines (MARS) techniques in order to argue and test the sensitivity of the major stock market indexes to the corporate governance index. In the last section are some comments and inferences on the research findings.

2. Literature Framework

There are a vast of theoretical and empirical studies in the finance literature on the relationship between corporate governance and stock returns. Most of these studies have provided robust

evidence suggesting significant relationships between corporate governance dynamics and stock return performance.

As one of the most recent studies on the related issue, Gu and Hackbarth (2013) examine the interactions among accounting transparency, corporate governance and stock return performance. According to the results, better governance is related with higher abnormal returns, but the effect is large and significant for transparent firms. They found a complementary effect between corporate governance and transparency. Transparent firms benefit more from corporate governance than opaque firms. Like Jensen and Meckling (1976), they also argue that firms with good governance and high transparency create value by reducing agency costs.

Saldanli (2012) investigates the performance of corporate governance index at Borsa Istanbul by using BIST 30, BIST 50 and BIST 100 indexes in addition to corporate governance index (CGI). The aim of the study is to compare the performance of CGI with other exchange market indexes. He concludes that the performance of CGI is less than other market indexes. This result is attributed to poor adaptation of firms in the first three year of using CGI. He also states that financial crisis and corporate bankruptcies enforce managers and shareholders to change their mentality. Financial reports only emphasize quantitative data which may be accepted short term indicator, but non-financial measures as corporate governance are critical for sustainability of short term performance. Good corporate governance leads less cost of capital, more financial opportunities and liquidity, less effective crisis and more efficient markets.

According to the Gompers, Ishii, and Metrick (2003), firms with strong shareholder rights perform better. Moreover, Johnson, Moorman, and Sorescu (2009) re-examine Gompers et al. (2003) findings of significant long-term abnormal returns for portfolios according to their governance characteristics. They suggest that industry clustering is crucial to interpret the studies investigating the relation between governance and firm value or stock returns. They conclude that the impact of governance quality on long-term abnormal stock returns is not reliable.

Aman and Nguyen (2008) construct a governance index for Japanese firms and conclude that poorly governed firms perform better because of the greater risk exposure and low valuation of these firms. After adjusting of size and book-to-market, they find insignificant excess returns between portfolios. Aman and Nguyen (2008) results are consistent with Core, Guay, and Rusticus (2006) who show that Gompers et al. (2003) findings are coincidence on a specific period.

Considering the prevalent argument that informativeness of stock prices is a critical measure of market efficiency and strong corporate governance can reduce the costs and increase the benefits of gathering private information through several channels, Yu (2011) investigates the relation between corporate governance and stock price informativeness using firm level data from 22 developed countries. Stock price informativeness is measured by stock return variation and future earnings response coefficients. He suggests that corporate governance is positively associated with stock price informativeness. His study also concludes that corporate governance has a significant effect on stock return in countries with strong institutional environment. This result shows the role of country-level legal investor protections on the relationship between corporate governance and stock price informativeness.

This paper is expected to contribute a distinctive approach to the existing literature about the interaction between corporate governance and stock prices, thereby arguing and ascertaining the sensitivity of the major stock return indexes at Borsa Istanbul to the corporate governance return index through simple market return models. The following section covers the details and findings of our empirical research carried out for this purpose.

3. Empirical Research

As stated before, this empirical research is mainly interested in exploring any significant relationship between corporate governance quality and stock prices in a way that the market portfolio returns are regressed on the returns a benchmark portfolio which is assumed to be a proxy for an efficient market portfolio. For this purpose, some linear and non-linear models have been developed to explain returns on the market portfolios with returns on the benchmark portfolio undertaking the ordinary least squares method and multivariate adaptive regression splines (MARS) techniques.

The main contribution of this study to the existing literature is that the corporate governance index has been considered to be an efficient portfolio. Also, the use of a non-linear approach to modeling is another matter that makes it distinctive.

To unveil any connection between corporate governance and equity prices in Turkey as a highly developing emerging market, a market portfolio approach is utilized to investigate the sensitivity and reaction of the major stock market return indexes to the corporate governance return index that represents a portfolio index covering the listed firms assigned an overall rating score of governance over 7. The included market indexes are BIST 30 and BIST 100 which include the first 30 and 100 firms respectively in terms of their capitalization as well as BIST ALL composed of all the traded firms regardless of capitalization level.

The findings of our research are expected to supply us with some important inference about which market index can be considered to be relatively more identical to the corporate governance index in terms of systematic risk exposure. This inference is supposed to help us conclude what market index should be regarded to be the relatively efficient one as compared to one another.

3.1. Research Design and Methodology

The sample consists of market portfolios return data for the period between January 2010 and February 2017. The daily return data for BIST 30, BIST 100, BIST ALL and the corporate governance index (CGI) have been collected from the database provided by Borsa Istanbul (BIST) and totally 1779 daily observations have been used. Even though the corporate governance index data have been calculated and reported since September 2007, the data for the period between September 2007 and December 2009 are excluded to eliminate any potential biasing effects of the latest global crisis on prediction performance.

In regressing the return data of each market index (dependent variable) on those of the CGI (independent variable), a simple market model is employed to derive a linear equation represented below in case of undertaking the OLS technique.

$$R_{m,t} = \propto_m + \beta_m R_{CGI,t} + \beta_y D_y \epsilon_{m,t}$$

In the above equation; $R_{m,t}$ stands for return on the market index at time *t* while $R_{CGI,t}$ represents return on the CGI at the same time point. D_y is a dummy variable used to see whether the year of data has any significant effect on the intercept term which takes on the value of 1 for the corresponding year, but the value of 0 otherwise. This OLS model assumes a constant intercept term $\propto_m$ over the whole time period, which is a very strong and restrictive assumption.

On the other hand, in using MARS, we end up with a certain number of basis functions which are eventually gathered on a linear basis in a single model equation using the OLS technique. MARS is a nonparametric model that tries to capture local shifts in relationships between dependent variable and a set of independent variables via regression splines. The locations of assumed shifts are determined as *knots* and a separate basis function is developed for each knot. Determination of maximum number of basis functions and speed of learning are so critical to model performance. The best model form is chosen using the Generalized Crossvalidation technique (Craven & Wahba,

1978). As MARS facilitates a non-parametric approach to estimating functional relationships between variables, it has been frequently preferred in many of the empirical studies on economic and financial issues. These studies generally utilize this technique especially to explore and examine determinants of a specific macroeconomic or financial variable under relatively less restrictive model specifications and assumptions. As an example of such empirical research, Yuksel and Zengin (2016) used MARS and LOGIT models to determine the leading indicators of the global mortgage crisis in the USA on a data set covering the period between 1984 and 2014 and included 14 macroeconomic and financial variables as predictors. They conclude that non-performing loans, total derivative assets and bank size are among the major determinants of the crisis. The superiority of MARS over Logit models is reported. In another study carried out by Oktar and Yuksel in 2016, the determinants of use of derivatives in the Turkish banks were investigated through MARS. With the quarterly data covering the period between 2003 and 2011, a negative relationship between the amount of doubtful accounts and use of derivatives was mentioned as well as a positive relationship between use of derivatives and non-performing loans. In 2017, Yuksel and Ozsari tried to ascertain the factors affecting changes in the rating scores of Turkey by using a data set from 1992 to 2015 including 8 macroeconomic variables such as unemployment rate, inflation, GDP growth, budget deficit, current account deficit, and so on. The results of the developed MARS models suggest a statistically significant positive connection between current account balance and country rating. Yuksel and Zengin (2017) utilized the MARS technique in searching for significant factors influencing net interest margin of the banks in Turkey where 14 financial predictors were employed, including non-interest income, non-performing loans, total assets and FX rates. They concluded negative relationships between these variables and net interest margin. In the most recent study carried out on the USA by Uzunkaya, Dincer and Yuksel (2019) via MARS, the effects of the subtitles of GDP on economic growth were focused and analyzed.

In our models utilizing MARS, the maximum number of basis functions is determined to be 15 while the speed of learning is limited at the level 4 as proposed in the previous relevant studies. Furthermore, the maximum number of knots for each independent variable is taken as 3.

The sensitivity of each market index to the CGI is interpreted using the model coefficient of the independent variable. Any upward or downward deviation from the value of 1 implies that the market index lacks efficiency whereas any coefficient value closer to 1 will signal for relative efficiency.

3.2. Research Findings

Since our OLS models assume normality for dependent variable and error terms, the first step of the analysis is to argue the normality assumption for the variable of interest. For this purpose, we undertook a multivariate normal distribution test called the Doornik-Hansen Normality test. The distribution test results and descriptive statistics are presented in the following tables. As can be understood from the findings, we conclude non-normality for all the variables because the tail probabilities for the chi-square test statistics all are below 5%.

Table 1: Descriptive Statistics for the Model Variables (Index Data)

Descriptive Statistics	VARIABLE (INDEX RETURN SERIES)			
	CGI	BIST30	BIST100	BISTALL
Mean	0,0003110	0,0002327	0,0002548	0,0002815
Standard Dev.	0,0138845	0,0155962	0,0146575	0,0142041
Minimum	-0,1046643	-0,1090195	-0,1106379	-0,1105002
Maximum	0,0604479	0,0604479	0,0689517	0,0688058
Observation	1779	1779	1779	1779

Table 2: Multivariate Normality Test Results for the Model Variables (Index Data)

VARIABLES	DOORNIK - HANSEN NORMALITY TEST	
	Test Statistic (Chi-Square)	Tail Probability
CGI - BIST 30	677,212	0,000
CGI - BIST 100	596,603	0,000
CGI - BIST ALL	560,595	0,000

The return series that we use in modeling are time series, so as the first step, whether they are stationary has been tested through the Augmented Dickey-Fuller test at level before going ahead. The test results are given in the Table 3, which suggest stationarity at level for all the index series. Therefore, all the series in level (without differencing) are used in constructing the OLS and MARS models.

Table 3: Unit Root Test Results

	ADF TEST STATISTIC			
	BIST30	**BIST100**	**BISTALL**	**CGI**
In Level (only inctercept)	-42,891*	-42,678*	-42,586*	-41,474*
In Level (intercept with trend)	-42,878*	-42,667*	-42,575*	-41,468*

* Significant at 1 %

A separate OLS model has been developed using robust standard errors to derive the market model equation for each of three market indexes as the dependent variable regressed on the CGI and the year dummy variables. In Table 4, the models results are summarized. Considering these findings based, we see that all the independent variable (CGI) coefficients are found to be significant at 1% in all of the models. The coefficient value is over 1 for BIST 30 while it is below 1 for BIST ALL, but very close to 1 for BIST 100. We conclude that BIST 100 is the market index that most behaves more identically as compared to the CGI. Also, in none of the models, the individual effects of the data year are found significant. The highest R^2 scores have been calculated for BIST 100 and BIST ALL. All the models provide some evidence a positive connection between the corporate governance index and the market indexes in terms of return behavior.

Table 4: The OLS Models and Accuracy Results

	Dependent Variable		
Predictors	**BIST30**	**BIST100**	**BISTALL**
Constant	-0,000454	-0,000283	-0,000178
CGI	1,051927*	1,004638*	0,975062*
YD2011	0,000058	-0,000051	-0,000151
YD2012	0,000801	0,000548	0,000414
YD2013	0,000213	0,000132	0,000059
YD2014	0,000795	0,000582	0,000491
YD2015	0,000331	0,000194	0,000157
YD2016	0,000355	0,000195	0,000095
YD2017	-0,000253	-0,000096	0,000581
Model F-stat	1184,58*	1587,78*	1553,89*
Significance F	< 0,000	< 0,000	< 0,000
Adj.R-Square	0,8781	0,9066	0,9097
Root MSE	0,0055	0,0045	0,0043

* Significant at < 0,01 ** Significant at < 0,05 *** Significant at < 0,10

Despite the satisfactorily high R^2 values, the finding that the error terms of all the models do not seem to approximate a normal distribution (see the Shapiro-Wilk W test statistics in Table 5) suggests that the coefficient estimates may be biased, so we decide to repeat modeling employing MARS as a nonparametric technique that can be utilized in case of non-linearity.

Table 5: Normality Test Results for Error Terms

MODEL	SHAPIRO-WILK W TESTS		
	Test Statistic (W)	**Z - STATISTIC**	**Tail Probability**
BIST 30 on CGI	0.959	9.535	0.000
BIST 100 on CGI	0.963	9.306	0.000
BIST ALL on CGI	0.966	9.124	0.000

The following table summarizes the results of three MARS models constructed for BIST 30, BIST 100 and BIST ALL. According to the BIST 30 model results, the interaction between the CGI and BIST 30 is modeled by three basis functions: The first basis function where the CGI return exceeds -1.4% is associated with a positive coefficient while both the second function where the CGI return is below -1.4% and the third function where the CGI return is over -0.65% take on negative coefficient values. The changes in the coefficient values are remarkable and considerable. These results suggest that the regression relationships between the CGI and BIST 30 can be formulated with three different equations within those three separate regions. All the coefficients are statistically significant at 5%. The adjusted R^2 value is very high.

With respect to the results of our MARS model for BIST 100. It is obvious that there is no difference between this model and the OLS model we developed for BIST 100 before. No breaks in the relationship between the indexes were detected by the model. The CGI index variable is associated with a positive value that is very close to 1. Only one basis function is defined and all the coefficients are assumed to be significant at 1%. The functional relationship is effective when the CGI return is over -10.5%. No significant functional interaction between the two indexes can be defined below this rate of return.

The last MARS model developed for BIST ALL is depicted in the table. As can be interpreted from the findings, the fitted MARS model does not significantly differ from the OLS model developed for the index. One basis function has been defined which is effective when the rate of return on the CGI is over -10.4% and is associated with a positive coefficient value slightly below 1. No functional relationship has been detected for the rates of return on the CGI below this percentage.

Table 6: The MARS Models and Accuracy Results

	Dependent Variable		
Predictors	**BIST30**	**BIST100**	**BISTALL**
Constant	-0,01615*	-0,10525*	-0,10213*
BF1	1,21486*	1,00505*	0,97559*
BF2	-0,92012*	---	---
BF3	-0,14638**	---	---
Model F-stat	4313,21*	17205,32*	17845,27*
Significance F	< 0,000	< 0,000	< 0,000
Standard Error of Regression	0,00542	0,00449	0,00428
Residual Sum of Squares	0,05217	0,03576	0,03249
Regression Sum of Squares	0,38031	0,34623	0,32424
R-Square	0,8794	0,9064	0,9094

Adj.R-Square	0,8792	0,9063	0,9094
Uncentered R-Square	0,8794	0,9064	0,9095
Explanations for Basis Functions	**BF1: max(0, CGI + 0,0140017)** **BF2: max(0, - 0,0140017 - CGI)** **BF3: max(0, CGI + 0,0064657)**	**BF1: max(0, CGI + 0,1046664)**	**BF1: max(0, CGI + 0,104364)**

* Significant at < 0,01 ** Significant at < 0,05 *** Significant at < 0,10

4. Conclusion

This paper is mainly concerned with the interaction between corporate governance and stock returns and aimed at assessing efficiency for the major Borsa Istanbul stock indexes (BIST 30, BIST 100 and BIST ALL) through some linear and non-linear market models regressing returns to these indexes on the corporate governance index (CGI) returns using the OLS and MARS techniques. First of all, the findings show that the OLS models do not meet the normality assumption for the error terms and therefore, the MARS models have better performance in explaining the index return changes confirming the suggestion by Yuksel and Zengin (2016).

Some important breaks in the interaction between BIST 30 and CGI are observed, which motivates us to conclude that the assumed relationship is non-linear, but no breaks are defined for the relationship between CGI and BIST 100 or BIST ALL.

In addition, the coefficient values assigned to the CGI return variable are very volatile and significantly differ from 1 in explaining returns on BIST 30, which may mean that BIST 30 can be considered to be not identical to the CGI. On the other hand, as the coefficient value closest to 1 is attributed to BIST 100, we think that BIST 100 can be viewed as the index or portfolio that is relatively identical to CGI and the more efficient one as compared to the other two.

REFERENCES

Allen, F., & Gale, D. (2002). *A comparative theory of corporate governance*. Wharton Financial Institutions Center.

Aman, H., & Nguyen, P. (2008). Do stock prices reflect the corporate governance quality of Japanese firms? *Journal of the Japanese and International Economies, 22*(4), 647-662.

Copeland, T. E., & Weston, J. F. (2005). *Financial Theory and Corporate Policy*: Addison-Wesley.

Core, J. E., Guay, W. R., & Rusticus, T. O. (2006). Does weak governance cause weak stock returns? An examination of firm operating performance and investors' expectations. *The Journal of Finance, 61*(2), 655-687.

Craven, P., & Wahba, G. (1978). Smoothing noisy data with spline functions. *Numerische Mathematik, 31*(4), 377-403.

Fama, E. F. (1970). Multiperiod consumption-investment decisions. *The American Economic Review*, 163-174.

Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate governance and equity prices. *The Quarterly Journal of Economics, 118*(1), 107-156.

Gu, L., & Hackbarth, D. (2013). Governance and equity prices: Does transparency matter? *Review of Finance, 17*(6), 1989-2033.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*(4), 305-360.

Johnson, S. A., Moorman, T. C., & Sorescu, S. (2009). A reexamination of corporate governance and equity prices. *The Review of Financial Studies, 22*(11), 4753-4786.

Lambert, R. A. (2001). Contracting theory and accounting. *Journal of Accounting and Economics, 32*(1), 3-87.

Oktar, S., & Yüksel, S. (2016). Bankalarin Türev Ürün Kullanimini Etkileyen Faktörler: Mars Yöntemi ile Bir Inceleme/Determinants of the Use Derivatives in Banking: An Analysis with MARS Model. Finans Politik & Ekonomik Yorumlar, 53(620), 31.

Saldanli, A. (2012). Analyse of corporate governance index performance. *The International Journal of Economic and Social Research, 8*(8), 137-154.

Solomon, J., & Solomon, A. (2004). *Corporate Governance and Accountability*: John Wiley & Sons.

Uzunkaya, S. Ş., Dinçer, H., & Yüksel, S. A Historical Analysis of The Economic Development of The USA (1947-2017). MANAS Sosyal Araştırmalar Dergisi, 8(1), 209-222.

Yu, J. (2011). Stock price informativeness and corporate governance: An international study. *International Review of Finance, 11*(4), 477-514.

Yüksel, S., & Zengin, S. (2016). leading indicators of 2008 global crisis: an analysis with logit and mars methods. Finansal Araştırmalar ve Çalışmalar Dergisi, 8(15), 495-518.

Yüksel, S., & Özsarı, M. (2017). Türkiye'nin Kredi Notunu Etkileyen Faktörlerin MARS Yöntemi İle Belirlenmesi. Politik Ekonomik Kuram, 1(2), 16-31.

Yüksel, S., & Zengin, S. (2017). Influencing factors of net interest margin in Turkish banking sector. International Journal of Economics and Financial Issues, 7(1).