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CONTENT

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THE EFFECT OF FIRM SIZE ON PROFITABILITY: EVIDENCE FROM TURKISH MANUFACTURING SECTOR

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ABSTRACT

Purpose - This study investigates whether size of 112 publicly listed firms in manufacturing sector affects their profitability in Turkey during the period 2005-2013.
Methodology - Dynamic panel data approach (i.e. two-step system GMM estimator) taking into account potential endogeneity of firm-level variables is employed to estimate the effect of alternative firm size indicators on firm profitability.
Findings- Estimation results suggest that after controlling for financial risk, liquidity level, growth opportunities, unsystematic risk, firm age, and the other factors, the indicators of firm size measured by firm's assets, sales and number of employees tend to have a positive influence on the profitability of firm measured by operating return on assets.
Conclusion- There is enough statistical evidence to support a linear relation between firm size measures and profitability of firms in the period analyzed. However, our empirical results do not support the quadratic or cubic association between size measures and profitability.

Keywords: Size-profitability relationship, dynamic panel data, manufacturing industry, Borsa Istanbul, Turkey
JEL Codes: C33, L25, L60

1. INTRODUCTION

According to scholars in industrial economics, business organization and finance, the size is considered to be one of the most essential characteristics of firms in explaining profitability (Majumdar, 1997; Amato and Amato, 2004; Goddard et al., 2005; Serrasqueiro and Nunes, 2008; Lee, 2009; Isik and Tasgin, 2017; among others). However, the question as to whether higher or lower firm size optimizes the firm's profitability continues to be discussed in the theoretical and empirical literature. The link between size and performance has been dealt with in the theoretical literature through various theories of the firm such as institutional, organizational and technological theories. However, these theories offer different implications for the size-performance relationship given the optimal size of the firm (Kumar et al., 2001; Becker-Blease et al., 2010). Likewise, there is also no consensus among researchers about how size is related to profitability in previous empirical studies. For instance, some studies report the relationship between size and profitability to be either positive (e.g. Majumdar, 1997; Serrasqueiro and Nunes, 2008; Stierwald, 2010; Dogan, 2013; Liu at al., 2014; Çelikyurt and Dönmez, 2017; Isik and Tasgin, 2017) or negative (e.g. Goddard et al., 2005; Becker-Blease et al., 2010; Hatem, 2014; Shehata et al., 2017). Others find a quadratic relationship (e.g. Pattitoni et al., 2014, Lee, 2009; Voulgaris and Lemonakis, 2014) or a cubic relationship (e.g. Amato and Amato, 2004) or no relationship (e.g. Gonenc at al., 2007; Nakano and Nguyen, 2013; Niresh and Velnampy, 2014; Sciascia and Mazzola, 2008). In our study, we ask the question as to what is the association between manufacturing firms' size and their financial performance in Turkey. We attempt to answer to this question as the following. In accordance with the economies of scale hypothesis, large firms are likely to enhance their profitability by minimizing their costs stemming from their production process (Amato and Wilder, 1985; Majumdar, 1997; Goddard et al. 2005; Becker-Blease et al., 2010; Stierwald, 2010; Voulgaris and Lemonakis, 2014; among others). Furthermore, large firms exploiting their size may have access to the public debt markets in an easier and cheaper way in order to fulfil their

financing needs. Because of the fact that large firms are known to have a lower probability of bankruptcy, borrowing more at a lower cost thanks to their size is likely to help them benefit from tax shield (Rajan and Zingales, 1995; Delcoure, 2007; Prasetyantoko and Parmono, 2009; Antoniou et al., 2008). In addition, the fact that large-sized firms are more diversified, have higher market power, and employ better technology could contribute positively to firm profitability (Amato and Wilder, 1985; Rajan and Zingales, 1995; Lee, 2009; Voulgaris and Lemonakis, 2014). However, larger and more diversified firms could face scale inefficiencies and be less profitable because of bureaucratic processes, higher agency costs, and other costs associated with managing larger firms (Jensen and Meckling, 1976; Fama and Jensen, 1983; Goddard et al. 2005; Delcoure, 2007; Jónsson, 2007; Ng et al., 2009; Becker-Blease et al., 2010; Pattitoni et al., 2014; Voulgaris and Lemonakis, 2014; among others).

To contribute to the understanding of above-mentioned discussion, we re-investigate size-profitability relation by using various size measures for a comprehensive sample of Turkish-listed manufacturing firms. As well as we know, this study is the first to explore whether size-profitability linkage is nonlinear in terms of different size indicator in the context of Turkish manufacturing industry. Another contribution is that our profitability model is dealt with in a dynamic framework and estimated through system generalized method of moments (system GMM) estimator, taking into account potential endogeneity of firm-level variables. Based on the findings, our study reveals that there exists a statistically significant positive linear relationship between size measures and profitability of firm, regardless of how size is measured. This relationship is, however, not non-linear.

The remainder of the article is structured as follows. Section 2 summarizes the related studies on the nexus between size indicators and profitability. Our data, variables and methodology applied are described in Section 3. Section 4 explains our empirical findings and Section 5 concludes.

2. LITERATURE REVIEW

Using data of 238 quoted firms in the Indonesia Stock Exchange over 1994–2004 period, Prasetyantoko and Parmono (2009) examine whether firm size affect performance, taking into account the pre- and post-crisis periods. The econometric results suggest that after controlling firm characteristics and macroeconomic indicators, there is a significant and positive linkage between total asset variable and return on assets in both total period and post-crisis period. However, in the same study it is reported that there is no linkage between size variable and market value.

In a study on Croatian manufacturing industry between the years 2002 to 2010, Pervan and Višić (2012) analyze the impact of firm's total assets on return on assets performance using fixed effects regression. The results reveal that size of the firm, natural logarithm of firms' total assets, influences return on assets (ROA) positively and significantly.

Size-performance linkage is investigated by Mule et al. (2015) for 53 listed firms registered in Nairobi Securities Exchange during 2010-2014. Employing random effects GLS estimator, the authors find that firm size (i.e., natural log of sales) is found to be positive and significant only in ROE regression, while it is insignificant in ROA and Tobin's Q regressions.

Majumdar (1997) utilizes a sample of 1020 Indian firms registered in the Bombay Stock Exchange and pooled OLS estimations to analyze the influence of age and size on firm performance for the period 1988-1994. Results demonstrate that firms' size and age are significant determinants of performance of firm. More clearly, when compared with smaller firms, bigger firms are less productive but more profitable, while older firms are more productive but less profitable. In the US retailing industries, Amato and Amato (2004) study the association between firm size and profitability, as measured by return on assets for the period of 1977-1987. The findings obtained from their analysis indicate that there exists a cubic relation between firm size and profit rates for the general merchandize, restaurant, and apparel industries. In other words, while linear and cubic coefficients of firm size variable are found to be significant and positive, the quadratic form of this variable is negatively and significantly related to ROA. Employing static and dynamic panel data estimation techniques, Pattitoni et al. (2014) explore the determinants of firm profitability of 30.764 private firms for the 2004-2011 period in the EU-15 area. Based on their regression results, the authors conclude that there exists a threshold effect of firm size measured by natural logarithm of total assets. In other words, although larger firms tend to have higher profitability than small firms, the fact that firms continue to grow in terms of assets causes them to have lower profitability because of the nonlinearity in size-profitability association.

By employing a sample of 200 listed firms in Borsa Istanbul Stock Exchange (BIST) during 2008-2011, Doğan (2013) investigate the relationship between firms size indicators represented by total assets, total sales and number of employees and firm performance represented by return on assets in Turkey. Estimation results imply that each of size measures really influence returns on assets of firms, i.e., size indicators are positively and significantly associated with return on assets. A sample of 15 listed firms operating in manufacturing industry in Sri Lanka over the period 2008-2012 is studied by Niresh and Velnampy (2014) with the aim of assessing the relation of size-profitability. In their study, while total assets and total

sales are employed as firm size measures, net profit and return on assets are used for firm profitability measures. Based on the regression analysis, they report that there is no relation between size indicators and profitability indicators.

Based on a sample of 1.123 small and medium-sized enterprises (SMEs) in Turkey during the period between 2009 and 2013, Aytürk and Yanık (2015) empirically explore the determinants that influence profitability by using dynamic panel data analysis. As a result of the analysis, the authors report that even though the influence of natural log of total sales on gross sales profit divided by total assets is significant and negative, size measure affects the ratio of profit before tax and interest to total assets positively and significantly. Focusing on 34.798 firms of the SME sector in the UK for the period of 2005-2013, Shehata et al. (2017) try to analyze the influence of board diversity on firm financial performance. Their findings from panel fixed effects vector decomposition (FEVD) estimation method indicate that the size of firm, as measured natural log of total assets, is significantly negatively correlated with return on assets. Employing an unbalanced panel data of approximately 7,000 quoted firms in the United States for the 1987-2006 period, Lee (2009) tries to identify factors that influence firm profitability. The author reveals that there is an inverted U-shaped relation between firm size indicator (i.e. total assets) and profitability through panel fixed effects regressions.

Serrasqueiro and Nunes (2008), aiming to determine the size indicators (i.e. log of assets, log of sales, and log of number of employees) affecting performance of 51 small and medium-sized firms in Portugal, use firm level data during 1999-2003.Their results from dynamic panel regression analysis show that each of firm size measures is positively and significantly related to firm performance, measured as operating income divided by total assets for SMS firms. However, in order to compare the results of SMS firms with those of large firms with regards to size measures, they re-run their regression for large firms and their findings regarding firm size indicators reveal that there is no association between size measures and profitability. The factors that influence the profitability of 12.508 firms operating in service and manufacturing industry from major European countries (i.e., the UK, Spain, Italy, Belgium, and France) for the nine years 1993-2001 period are specifically analyzed by Goddard et al. (2005). Estimation results obtained from dynamic panel data model suggest that the impact of firm size variable (total assets) on firms' ROA is negative and significant, meaning that compared to small firms; large firms are better performers with regards to profitability in each of 5 European countries analyzed.

In United Kingdom for the period 2003-2008, Veprauskaitė and Adams (2013) who employ a dynamic panel data estimation technique for a sample of 468 quoted firms operating in industrial sectors report that size indicators like the log of total sales and assets are not correlated with ROA and ROE but are negatively and significantly associated with market value measured by Tobin's Q.

For a sample consisting of over 2.000 listed firms in China between the period 1999-2011, Liu et al. (2014) document a significantly positive correlation between number of employee and firm financial performance indicators represented by the ratio of net income to total sales (assets) and the ratio of operating income to total sales (assets) by employing different estimation methods.

By using a sample of 153 listed real sector firms in Borsa Istanbul for the period 2005-2012, Işık (2017) has examined the linkage between firm size represented by total assets and firm profitability (ROA). Estimation results suggest that in both full firm sample and sub-samples (i.e. young, old, small and big firm sample), firm size is significant in explaining the variation in ROA.

3. DATA AND METHODOLOGY

3.1 Sample

We use a dataset of 112 firms of manufacturing industry[1] listed in BIST (Borsa Istanbul) in order to examine if firm size indicators have a significant influence on firm profitability. The data set is derived from the Finnet database, which contains financial information regarding Turkish firms listed in BIST. In addition, we use personal number from annual activity report. The sample data used for our analysis covers the nine-year period from 2005 to 2013. Firms with negative equity are dropped from the data set. We also exclude firms with less than 6 years of available data. Consequently, an unbalanced panel of 112 Turkish publicly traded manufacturing firms forms the final sample to be used in this study.

3.2. Model specification

The dynamic panel regression equation to be estimated is as follows:

[1] Firms in the manufacturing industry are classified into 8 sectors based on BIST classification to control fully for potential sector differences. Firms belong to the following sub-sectors: food and beverage; textile and leather; chemical-petroleum and plastic products; non-metal mineral products; basic metal; metal products and machinery; and other manufacturing.

$$\mathrm{oROA}_{i,t} = c + \beta \mathrm{oROA}_{i,t-1} + \psi \mathrm{FSI}_{i,t} + \sum_{j=1}^{5} \mathrm{FC}_{i,t}\delta_j + \mathrm{year}_t + \mathrm{industry}_i + \mu_i + \epsilon_{it} \quad (1)$$

In this econometric model, subscripts i and t denote an individual firm and a time period, respectively. oROA_{it} is the profitability of firm i at time t and $\mathrm{oROA}_{i,t-1}$ is lagged firm profitability. While "FSI" is one of our three size variables-LnSize1, LnSize2, and LnSize3, "FC" comprises FinRisk, liqLev, GrOpp, IsRisk, and LnAge (as defined below). Year and industry represent year and industry dummy variables, respectively. μ_i stands for unobserved firm-specific effects, and $\epsilon_{it}$is the classical error term of our profitability model. The dependent variable, firm size indicators and firm characteristics included in the profitability regression equation (1) are presented in Table 1.

As the lagged firm profitability are correlated with firm-specific fixed effects by way of construction, estimating profitability equation by static panel data techniques (e.g. OLS, fixed effects or random effects) produces biased and inconsistent parameter estimates in a dynamic panel data model on account of endogeneity problems (Nickell, 1981; Baltagi, 2014). In order to cope with this kind of endogeneity (simultaneity problem), the profitability equation is estimated using two-step system GMM (generalized method of moments) estimator proposed by Blundell and Bond (1998). The GMM system estimator also controls for the persistence of the dependent variable, potential endogeneity of firm-level variables and unobserved heterogeneity by including firm-fixed effects (Blundell and Bond, 1998). The reliability of the system GMM estimator used in this study hinges considerably on validity of instrumental variables. We conduct Hansen's test to check whether chosen instruments are exogenous. In addition, we also check for the presence of serial correlation. Consistency of estimation depends on that there is no second-order serial correlation AR(2) in the differenced residuals. By construction, negative first-order serial correlation AR(1) is expected in differences and this does not invalidate the estimation. When sample size is small, two-step estimation of standard errors tends to be downward biased. Therefore, our profitability equation is estimated using Windmeijer's (2005) finite sample correction for the reported standard errors (Roodman, 2009).

Table 1: Variables, Notations and Measures

Variable	Notation	Measure
Panel A: Dependent variable		
Profitability	oROA	Operating return over total assets
Panel B: Independent variables		
Firm size	LnSize1	The natural logarithm of the firm's total assets
	LnSize2	The natural logarithm of the firm's total sales
	LnSize3	The natural logarithm of firm's number of employees
Panel C: Control variables		
Lagged profitability	Lagged oROA	One-year lagged profitability
Financial_risk	FinRisk	Total liabilities over total assets
Liquidity_level	liqLev	Current assets over short term liabilities
Growth_opportunities	GrOpp	Capital expenditure over sales
Idiosyncratic_risk	IsRisk	The standard deviation of stock returns in the past 12 months
Ln_age	LnAge	The natural log of the number of years since the firm's incorporation

Table 2 presents descriptive statistics of dependent and independent variables employed for our study over the period 2005 to 2013. The oROA varies between -27.4% and 35.0% with an average of 5.7% and a standard deviation of 8.7%.The average values of total assets, total sales and number of employees of the sample firms are 748.881, 864.875 and 1581.425, respectively. Results of summary statistics reveal that there are large differences between the maximum values and the minimum values of all the variables. Therefore, we transform the variables regarding firm's assets, sales, number of employees and age into their logarithms for regression analyses. In addition, we reduce observations within the first and beyond the 99th percentiles for all the variables to ensure that our findings are not driven by the extreme outliers.

Table 2: Descriptive Statistics

Variable	Mean	Median	SD	Min.	Max.	Obs.
oROA	0.057	0.055	0.087	-0.274	0.350	1002
Lagged oROA	0.058	0.056	0.088	-0.272	0.350	890
Assets	748.881	212.01	1732.175	7.752	17114.14	1009
Sales	864.875	171.1	2927.803	0	47033.22	1009
Employees	1581.425	520	3215.027	1	22552	1009
FinRisk	0.416	0.402	0.217	0.006	1.350	1009

liqLev	2.086	1.699	1.328	0.127	7.060	954
GrOpp	1.206	1.091	0.597	0.100	3.916	951
IsRisk	0.022	0.0008	0.095	0	1.648	995
Age	36.595	37	11.788	5	77	1009

Notes: In this table, the values concerning total assets and sales are denominated in millions of TL (Turkish Lira), the figures on the employees are expressed in the number of the employees.

Table 3 shows the correlation coefficients among the variables reported in this study. The Pearson correlation results reveal that there are significant correlations between profitability measure and firm size indicators[2]. Similarly, the same holds for control variables. The correlation coefficients among our independent and control variables employed in profitability equation are not bigger than the threshold value of 0.80 as recommended by Gujarati (2004)[3]. Based on results of correlation analysis, we can conclude that there exists no serious multicollinearity problem in our model specifications. As reported in Table 3, the correlation coefficient between oROA and lagged oROA is positive and significant at 1% level, confirming that dynamic panel data estimation method should be employed to estimate profitability model in Eq. (1).

Table 3: Correlation Matrix (Pearson)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(1) oROA	1									
(2) Lagged oROA	0.62[a]	1								
(3) LnSize1	0.28[a]	0.29[a]	1							
(4) LnSize2	0.35[a]	0.35[a]	0.90[a]	1						
(5) LnSize3	0.19[a]	0.20[a]	0.75[a]	0.78[a]	1					
(6) FinRisk	-0.23[a]	-0.23[a]	0.02	0.12[a]	0.14[a]	1				
(7) liqLev	0.32[a]	0.33[a]	-0.03	-0.06	-0.08[b]	-0.69[a]	1			
(8) GrOpp	-0.18[a]	-0.10[a]	0.04	-0.27[a]	-0.07[b]	-0.23[a]	0.14[a]	1		
(9) IsRisk	0.14[a]	0.03	0.02	0.01	0.02	-0.10[a]	0.05	0.007	1	
(10) LnAge	0.16[a]	0.16[a]	0.29[a]	0.21[a]	0.20[a]	-0.15[a]	0.09[a]	0.18[a]	0.06	1

Note: [a] and [b] suggest that the correlation statistics are significant at 0.01 and 0.05 level.

4. FINDINGS AND DISCUSSIONS

Table 4 reports dynamic panel regression results of 112 Turkish listed firms operating in manufacturing industry based on two-step system GMM estimator controlling for both industry and year effects. Hansen's test confirms that chosen instruments are exogenous. Based on the AR(1) and AR(2) test statistics, we can conclude that the residuals in Eq. (1) are serially uncorrelated. These post-estimation results for autocorrelation and validity of chosen instruments support that our dynamic panel model is a plausible specification for investigating size-profitability association. While profitability variable is measured by oROA, three alternative measures of size are used in our regression models, namely LnSize1, LnSize2 and LnSize3 in each set of regressions. In the first, third, and fifth columns of Table 3, using LnSize1, LnSize2, and LnSize3 we examine whether the size-profitability association is linear. In addition, in the second, fourth and sixth columns of Table 4 we include the squared values of firm size indicators (LnSize1SQ, LnSize2SQ, and LnSize3SQ) in the regression equations to investigate if this relationship is non-linear.

As shown in column 1, 3 and 5 of Table 3, the estimated coefficients for LnSize1, LnSize2, and LnSize3 are positive and significant at conventional levels of significance in three regression models, suggesting that firm size indicators measured by the log of firm's assets, sales and number of employees tend to have a positive influence on profitability represented by the ratio of operating income to total assets. These findings also mean that larger firms are highly likely to have higher profitability than smaller firms. Whereas, as reported in columns 2, 4 and 6, all the estimated linear and quadratic coefficients on firm size indicators are negative but statistically insignificant at any conventional levels of significance. These findings confirm that size-profitability relationship is not nonlinear. Following Amato and Amato (2004), we also investigate whether there is a cubic relation between firm size and profitability. Unreported results from two-step system GMM estimator show that none of coefficients on the firm size indicators (linear, quadratic, and cubic) are statistically significant[4].

[2] The correlation coefficients among the indicators of firm size are positive and significant at 1% level. However, these variables will not be used in the same equation. They will be employed for robustness checking.

[3] According to Gujarati (2004), unless correlation coefficients among independent variables are higher than the value of 0.80, multicollinearity is not a major issue in the multiple regression analysis and all independent and control variables can be employed in the same regression model.

[4] These findings are available upon request.

Consequently, these findings imply that there is enough statistical evidence to support a linear relation between firm size measures and profitability of firms operating in Turkish manufacturing industry in the period analyzed.

Table 4: Dynamic Panel Estimation Results

Independent variable	Dependent variable: oROA					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	-0.159	-0.326	-0.097	-0.089	-0.275	-0.349
	(0.555)	(0.188)	(0.458)	(0.403)	(0.152)	(0.325)
Lagged oROA	0.290***	0.315***	0.292***	0.275***	0.298***	0.287***
	(0.076)	(0.093)	(0.083)	(0.083)	(0.076)	(0.073)
LnSize1	0.044***	0.0927				
	(0.015)	(0.067)				
LnSize1SQ		-0.007				
		(0.005)				
LnSize2			0.023**	0.054		
			(0.010)	(0.035)		
LnSize2SQ				-0.003		
				(0.003)		
LnSize3					0.023*	0.057
					(0.013)	(0.086)
LnSize3SQ						-0.003
						(0.006)
FinRisk	0.096	0.095	0.071	0.093	0.085	0.091
	(0.058)	(0.072)	(0.060)	(0.067)	(0.056)	(0.057)
liqLev	0.016**	0.022**	0.015*	0.022**	0.019**	0.025***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
GrOpp	-0.060***	-0.054***	-0.038**	-0.049**	-0.042**	-0.058***
	(0.018)	(0.017)	(0.017)	(0.017)	(0.019)	(0.015)
IsRisk	-0.138	-0.062	-0.059	-0.182	-0.047	-0.204
	(0. 178)	(0.175)	(0.170)	(0. 134)	(0. 187)	(0. 131)
LnAge	-0.022	-0.004	-0.003	0.007	0.009	0.017
	(0.026)	(0.020)	(0.021)	(0.024)	(0.025)	(0.022)
Industry dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies?	Yes	Yes	Yes	Yes	Yes	Yes
F-test	12.72***	17.54***	15.92***	20.32***	19.63***	20.32***
AR(1)	-4.63***	-4.76***	-4.73***	-4.68***	-4.95***	-4.88***
AR(2)	-0.36	-0.02	-0.05	-0.47	-0.02	-0.39
Hansen test	18.42	32.30	20.88	5.93	18.75	19.89
Instruments used	46	51	46	51	46	51
Cross sections included	112	112	112	112	111	111
Observations	767	767	767	767	766	766

Notes: This table presents two-step system GMM estimates of Eq. (1). Robust SEs are in parentheses. Except for sector dummies, year dummies and LnAge, all variables are considered as endogenous in our models. Lagged levels (dated t-2,…, t-5) in the transformed equations, combined with lagged first-differences (dated t-1) in the original equations are employed as instrumental variables based on the GMM procedure. *, ** and *** denotes significant difference at the 0.10, 0.05 and 0.01 levels, respectively.

Our findings suggesting that firm size measures are positively associated with profitability indicator in a linear manner are consistent with the findings of Serrasqueiro and Nunes (2008) for Portugal, Stierwald (2010) for Australia, Mule et al. (2015) for Kenya, Liu et al. (2014) for China, Işık (2017) for Turkey, Majumdar (1997) for India, Prasetyantoko and Parmono (2009) for Indonesia, Pervan and Višić (2012) for Croatia, but contradict the results of Goddard et al. (2005) for European countries, Niresh and Velnampy (2014) for Sri Lanka, Becker-Blease et al. (2010) for the US, and Veprauskaitė and Adams (2013) for the UK. The results regarding the quadratic association are not consistent with those of Pattitoni et al. (2014) and Lee (2009). And finally, our unreported results for cubic association do not support the results of Amato and Amato (2004) as well.

When analysis results are evaluated with regards to the influence of firm specific control variables on profitability, it can be said that lagged (past) profitability has significant impact on current profitability. Besides, while higher liquidity leads to higher profitability, higher growth opportunities cause firms to have lower profitability. The findings seem to suggest that

the other control variables (i.e. financial risk, idiosyncratic risk, and firm age) we have used in our profitability models are, however, found to be statistically insignificant.

5. CONCLUSION

This paper empirically investigates the linkage between firm size indicators and profitability of firms. Our paper contains a total of 112 manufacturing firms quoted on the Istanbul Stock Exchange during the period 2005-2013. In this paper, the size-profitability relationship is dealt with in a dynamic framework and profitability model is estimated employing two-system GMM estimator, taking into account potential endogeneity of firm-level variables. After controlling for financial risk, liquidity level, growth opportunities, idiosyncratic risk (unsystematic risk), firm age and the other factors, we find that there exists a statistically significant positive linear relationship between size and profitability of firm. To further understand whether the size-profitability relation is curvilinear we add the quadratic and cubic form of size variables to the profitability models. The results from these regressions show that this relation is not curvilinear. All these results support the view that as firms get larger, their profitability enhances. To evaluate the robustness of our findings, we estimate the profitability equation for alternative size variables (i.e. total sales, and number of employees (in their logarithmic form)), separately. The results of our empirical analysis indicate that effects of size measures on profitability do not vary, regardless of how firm size is measured. All size indicators continue to be positively related to firm profitability in all models. In other words, our results obtained dynamic panel data models provide econometric evidence that there exists a "size effect" in manufacturing industry in Turkey during the period under consideration.

In brief, the main message of our paper is that scale variable is an important factor affecting the profitability of manufacturing firms listed on the Borsa Istanbul. As emphasized in the introduction section, large-sized firms have significant size advantages compared to small-sized firms. The results achieved in this paper are valid only for the manufacturing sector. They cannot be generalized for the other sectors. In future studies, the influence of the size of the firm on profitability could be empirically analyzed in terms of other sectors as well as financial sector in the Borsa İstanbul.

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INVESTOR SENTIMENT IN THE CRISIS PERIODS: EVIDENCE FROM BORSA ISTANBUL[1]

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ABSTRACT

Purpose- This study aims to analyze the effect of investor sentiment on Borsa Istanbul for the crisis periods between 1997 and 2017. Furthermore, whether the pattern of investor sentiment differs between the crises based on their origin as local or international is investigated.
Methodology – The crisis periods are determined based on the CMAX methodology and the regression analysis is applied to investigate the effect of investor sentiment on the stock market returns.
Findings- From the results of this study it is observed that in the whole period and local crisis period; when closed end fund discount as a proxy for sentiment increases, BIST 100 index returns decrease.
Conclusion- Overall, the findings of this study suggest that Borsa Istanbul is sensitive to investor sentiment especially in the crisis periods that originate locally. The results are substantial for portfolio managers; they have to take into consideration investor sentiment while making decisions.

Keywords: Behavioral finance, investor sentiment, closed-end fund discounts, stock market, financial crises
JEL Codes: G01, G10, G41

1. INTRODUCTION

According to Shefrin (2002:1), behavioral finance is the interaction of psychology with the financial actions and performance of practitioners, namely portfolio managers, financial planners and advisors, investors, brokers, strategists, financial analysts, investment bankers, traders and corporate executives. In contrast to the classical finance theories behavioral finance argues that people have some emotional instincts, and for that reason they often deviate from rationality and as stated by Barberis and Thaler (2003), investors' incentives, emotions and biases could affect the decision-making process. Hence in contrast to the assumptions of the efficient market hypothesis, behavioral finance argues that rational arbitrageurs in the market are limited and therefore insufficient to force prices to match fundamental value, and investor sentiment may significantly distort market outcomes and affect asset prices in equilibrium (Bodie, Kane and Marcus, 2010). Investor sentiment is defined as "a belief about future cash flows and investment risks that is not justified by the facts at hand" (Baker and Wurgler, 2007:1). Based on the Shleifer's (2000) investor sentiment model, when investors receive earnings news about the company if they do not react to this news in revaluing the company, it means they use the conservatism heuristic. Because of this behavior, the prices underreact to earnings announcements and to short horizon trends. Underreaction emerges because investors tend to assume that earnings are mean reverting although they follow a random walk. On the other hand, when the investors receive similar news repeatedly they use the representativeness heuristic, and they overreact to this news believing there is an earnings trend. As a result, the prices increase sharply, and the stocks are overpriced, so the returns go down (Shleifer, 2000).

It is hard to measure investor sentiment directly, and for that reason besides direct measurement methods such as surveys or questionnaires, many studies have attempted to find the most accurate proxy for investor sentiment. Studies that were

[1] This study was presented in the Istanbul Finance Congress on Nov. 3rd, 2017.

conducted in this area use various types of proxies to measure the effect of investor sentiment on the stock market, macroeconomic variables, volatility and recently on the bond market. The commonly used indirect proxies are closed-end fund discount (i.e. Lee, Shleifer and Thaler, 1991; Leonard and Shull, 1996), dividend premium (i.e. Baker and Wurgler, 2004; Fama and French, 2001), mutual fund flows (i.e. Brown, et al., 2002; Frazzini and Lamont, 2008), trading volume (i.e. Baker and Stein, 2004; Kaniel and Titman, 2004), internet search volume (i.e. Son-Turan, 2016), and Baker and Wurgler (2006) sentiment index. On the other hand, the most commonly used direct measurement is the Consumer Confidence Index (CCI) (i.e. Lemmon and Portniaguina, 2006).

The effect of investor sentiment, proxied by different measures, on stock returns was studied widely by many researchers. However, based on the literature, it is observed that there is a gap in the literature about the effect of investor sentiment on stock markets during the crises periods. For that reason, this study mainly aims to analyze the effect of investor sentiment on Borsa Istanbul for the crisis periods between 1997 and 2017. This study differs from previous research in several ways. First, CMAX crisis indicator will be used to detect the crisis periods between January 1997 and April 2017. Second, the detected crises are separated as local and international; in order to analyze if the pattern of investor sentiment differs between the crises based on their origin being local or international. Shefrin and Statman (2011) emphasized the Keynes' view as sentiment may lead to economic crises, so it is expected that the effect of sentiment is high during these periods. Therefore, it is believed that this study will have a significant contribution to the literature as well as investors, portfolio managers and policy makers by providing evidence on the effect of investor sentiment on the stock market and its persistence during financial crises and whether this effect differs based on the origin of the crisis as local or international. The rest of the study is structured as follows: in Section 2 related literature is discussed, Section 3 provides explanations on the data and the methodology including the CMAX method and the regression analyses, in Section 4 empirical findings are presented, and Section 4 concludes with the discussion of the findings.

2. LITERATURE REVIEW

The effect of investor sentiment, proxied by different measures, on stock returns was studied widely by many researchers. Baker and Wurgler (2006) studied the relationship between investor sentiment and cross-section of stock returns by using their constructed index as a proxy. As a result, they found that when sentiment is high, stocks are attractive to optimists and speculators, but unattractive to arbitrageurs, because younger, small, unprofitable, non-dividend-paying, high volatility, extreme growth, and distressed stocks tend to earn relatively low subsequent returns. Furthermore, Schmeling (2009) examined the relationship between consumer confidence (as a proxy for investor sentiment) and expected stock returns internationally in 18 industrialized countries including the U.S., Japan, Australia, New Zealand and 14 European countries. As a result of the long-horizon return regressions, it is found that sentiment is a significant predictor of expected returns across countries. In addition to the consumer confidence index, Bathia and Bredin (2013) also used equity fund flow, closed-end equity fund discount and equity put-call ratio as proxies for investor sentiment to examine the relationship between investor sentiment and G7 countries' stock market returns for the period 1995 and 2007 on a monthly basis. They found that value stocks are affected by investor sentiment particularly. The negative relationship was found between investor sentiment and future stock returns. Effect of investor sentiment, proxied by various measures, on stock returns was also studied extensively in the Turkish stock market. Canbas and Kandir (2007) used closed-end fund discounts, average fund flow of mutual funds and the ratio of net stock purchases of foreign investors to Borsa Istanbul (BIST) market capitalization as proxies for investor sentiment in order to analyze the effect of investor sentiment on returns of BIST sectoral indices for the period July 1997 and June 2006. As a result of the regression analysis, it is found that investor sentiment affects stock returns systematically (Canbas and Kandir, 2007). Canbas and Kandir (2009) also examined the effect of sentiment on Borsa Istanbul (BIST) by implementing a VAR model and Granger causality tests for the period 1997 to 2005. They defined six proxies for investor sentiment as: closed-end fund discounts, mutual fund flows, add lot sales ratios, share of equity issues in aggregate issues, repo shares in mutual fund portfolios, and ISE turnover ratios. As a result of their analyses, they found that previous stock portfolio returns affect all the investor sentiment proxies except share of equity issues in aggregate issues (Canbas and Kandir, 2009).

By using consumer confidence index as a proxy for investor sentiment, Olgac and Temizel (2008) investigated the short-term and long-term effects of investor sentiment on BIST-30 index. They utilized the co-integration test for the long-term relationship, and VAR model for the short-term relationship for the period 2004 - 2007. They used, CCI, BIST-30, consumer price index (CPI), government debt securities index monthly data. As a result of the analyses, they found that while there is a positive relationship between CCI and BIST-30; there is a negative relationship between CCI and government debt securities index. Moreover, Celik (2013) tested the relationship between investor sentiment and sovereign risk in Turkey for the period 2004-2010. For the sovereign risk she used JP Morgan EMBI+ spread, and for investor sentiment she used CCI. As a result of the co-integration analysis she did not find a long-term relationship, but as a result of the Granger causality test she found a short-term relationship between investor sentiment and sovereign risk in Turkey.

Although there are many studies about the effect of investor sentiment on financial markets, there are only a few studies which focus on the economic crises periods. Baur, Quintero and Stevens (1998) analyzed the effect of investor sentiment on the stock market crash of 1987. They used the data for the period between 1986 and 1988. As a sentiment proxy they used closed end funds discount. They found that, movement of stock prices were influenced by sentiment in 1987 stock market crash, but investor sentiment did not significantly influence stock prices in the period surrounding the crash. Zouaoui, Nouyrigat and Beer (2011) examined the impact of investor sentiment in the international context for the crises periods by dividing the countries in terms of their market integrity and herd like overreaction. They used monthly data for the period April 1995 to June 2009, and as a proxy for investor sentiment they used consumer confidence index. In order to detect the crises periods, they used the CMAX crisis indicator that was proposed by Patel and Sarkar (1998). As a result, they found that investor sentiment has a significant effect on financial crisis. They also found that, the impact of sentiment is more significant for countries that are culturally more prone to herd-like behavior, overreaction and low institutional development. Bolaman and Mandaci (2014) examined the relationship between investor sentiment and stock market especially for the crisis period. They used monthly CCI and BIST 100 index data for the period 2003-2012. Between these periods only 2008 crisis was detected. As a result of the ADF and co-integration tests, they found that there are structural breaks at the crisis period, and secondly as a result of the presence of co-integration they found that there is a long-term relationship between the variables. Therefore, from their results it could be concluded that there is an effect of investor sentiment in the crisis periods in Borsa Istanbul.

2. DATA AND METHODOLOGY

In terms of methodology, first the crisis periods were detected using the CMAX approach as proposed by Patel and Sarkar (1998). CMAX initially compares the current value of an index to its maximum value over the previous T periods, usually one to two years. In this study, previous two years were used. The CMAX indicator is calculated as follows:

$$CMAX_{i,t} = \frac{P_{m,t}}{\max(P_{m,t-24\ldots\ldots},P_{m,t})} \quad (1)$$

In equation (1), $P_{m,t}$ indicates the current closing value of the market index at time t.

If $CMAX_{i,t} < \overline{CMAX_i} - \sigma_m$; $C_{i,t} = 1$ and crisis is observed.

Otherwise, $C_{i,t} = 0$

$C_{i,t}$ is the crises indicator for country I at time t. The trigger level could be chosen as 2, 1.5 or 1 standard deviations below the mean of the series. In this study, to capture all known crisis periods, the trigger level is chosen as 1 standard deviation. If CMAX equals 1, it indicates price increases over the period. If prices decrease, CMAX is closer to 0. A crisis is detected when CMAX drops below a threshold level (mean of CMAX minus one standard deviation). Pre-crises and post-crises periods were determined as follows: the start of the crisis (pre-crises period) is the point where the price reaches its historical maximum level (peak point) over a 2-year period. The date of the recovery (post-crises period) is the first month after the crisis when the index reaches the pre-crises maximum value (peak point).

Secondly, closed-end fund discount was used as a proxy for investor sentiment. The closed-end funds are issued only once with fixed capitalization in the initial public offering, and they are traded in the secondary markets like many securities in the market (Anderson and Born, 2002). Therefore, supply and demand of the shares trading on the market determine its price (Dimson and Minio-Kozerski, 1999). As indicated by Pontiff (1997) the value of the fund's portfolio, which is called as net asset value (NAV), is computed based on the market prices of the underlying assets. Since they are traded in the secondary market, the price may differ from its net asset value. Most closed end funds' prices are lower than their net asset values, which is called as "discounts", and these discounts can be substantial and long-lasting (Anderson and Born, 2002; Dimson and Minio-Paluella, 2002). Many researchers tried to explain the rationale behind the closed end fund discount with agency costs or tax liabilities (Lee, Shleifer and Thaler, 1991). Besides these explanations, Zweig (1973) stated that discounts may reflect the expectations of individual investors. As stated by Lee, Shleifer and Thaler (1991) closed end fund discounts are high when investors are pessimistic (negative sentiment) about future returns and low when investors are optimistic (positive sentiment). In other words, the more optimist investors feel, the smaller the discounts of the closed end funds (Halkos, 2005). Following Lee, Shleifer and Thaler (1991) value weighted index of discounts (VWD) in month t are calculated using the following formulas:

$$VWD_t = \sum_{i=1}^{n_t} W_t DISC_{it} \quad (2)$$

where;

$$W_t = \frac{NAV_{it}}{\sum_{i=1}^{n_t} NAV_{it}} \quad (3)$$

$$DISC_{it} = \frac{NAV_{it} - SP_{it}}{NAV_{it}} \times 100 \quad (4)$$

In formula (2), n_t indicates the number of funds with available $DISC_{it}$ and NAV_{it} data at the end of month t. In formula (3) and (4), NAV_{it} shows the per share net asset value at the end of month t. In formula (4), SP_{it} is the stock price at the end of month t. In the second stage, changes in the value-weighted index of discounts (ΔVWD) are calculated with following equation and it is used as a proxy for investor sentiment:

$$\Delta VWD_t = VWD_t - VWD_{t-1} \quad (5)$$

In equation (5), VWD_{t-1} shows the value weighted index of discounts in the previous month[2]. The monthly closed end funds data were obtained from Capital Market Board (CMB) monthly bulletins. Lastly, the following regression equation is applied to detect the effect of investor sentiment on the stock market returns proxied by BIST-100 index.

$$R_{BIST100_t} = \alpha + \beta_1 SENT_t + \varepsilon \quad (6)$$

In Equation (6) $R_{BIST100_t}$ is the return of BIST 100 index at time t, $SENT_t$ is changes in the value-weighted index of closed end fund discounts (ΔVWD) at time t and ε is the error term. Return on the BIST 100 index was calculated as follows:

$$R_t = \ln(P_t / P_{t-1}) \quad (7)$$

In equation (7) R_t is the return of BIST 100 index at time t, P_t is the closing value of BIST 100 index at time t, and P_{t-1} is the closing value of BIST 100 index in the previous month.

Since, there is a possibility that investor sentiment can be affected by particular economic factors; these were included into the analysis as control variables. The change in the industrial production index, consumer price index and change in the exchange rate are determined to be used as control variables following Chen, Roll and Ross (1986), Fama (1981) and Kasman (2003). Monthly returns or changes in economic variables were calculated as follows:

$$r_e = (EV_t - EV_{t-1}) / EV_{t-1} \quad (8)$$

In Equation (8) r_e indicates the return or change ratio, EV_t indicates the value of the economic variable at the end of month t, and EV_{t-1} indicates the value of the economic variable at the end of the previous month. Finally, the following regression model was constructed which includes the control variables along with the sentiment proxy.

$$R_{BIST100_t} = \alpha + \beta_1 SENT_t + \beta_2 IPI + \beta_3 CPI + \beta_4 XR + \varepsilon \quad (9)$$

In Equation (9) $R_{BIST100_t}$ is the return of BIST 100 index on time t, $SENT_t$ is the changes in the value-weighted index of closed-end fund discounts (ΔVWD) at time t, IPI is the change in the industrial production index, CPI is the change in the consumer price index, XR is the change in the change in the exchange rate ($) and ε is the error term. Moreover, the same regression equations were applied for the crisis periods, too. The dates of the crisis periods begin with the pre-crises periods and finish with the end of the post-crises periods. To observe the impact of each crisis period; "no crisis period", "all crisis periods", "local crisis period" and "international crisis periods" were subjected to the same regression analyses with equations (6) and (9) separately. For all the analyses E-Views software was used. The monthly data was collected from monthly bulletins of Capital Market Board of Turkey, Central Bank of Republic of Turkey and Borsa Istanbul website. BIST 100 index closing values were collected for the period 1995-2017 to be able to calculate the crisis periods beginning of the year 1997. Remaining data was collected for the period 1997-2017.

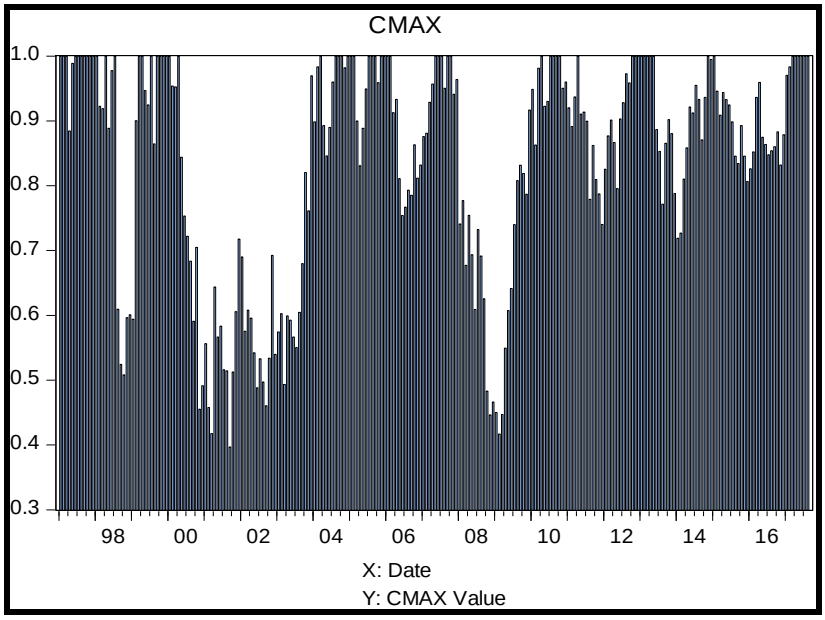
3. EMPIRICAL RESULTS

3.1. CMAX Results

Initially the crisis periods were determined as indicated in Figure 1 based on the CMAX methodology. Over the periods from January 1997 to April 2017 three crises periods are detected.

[2] In the study, since there were missing values for the months December 1997 and March 1999, the average of the series was calculated, and the average value was used for these two months.

Figure 1: Crisis Periods in BIST



First crisis is observed from August 1998 to January 1999 corresponding to the 1998 Asian crisis which is followed by the Russian crisis. For this period, pre-crisis period is observed in July 1998 and the post crisis period is between February 1999 and March 1999. Second crisis is observed from September 2000 to August 2003 corresponding to the 2001 Turkish financial crisis. For this period, pre-crisis period is observed from April 2000 to October 2000. The Index has reached its pre-crisis maximum value in March 2004, therefore post-crisis period is between September 2003 and March 2004. Last crisis is observed from September 2008 to June 2009 which corresponds to the 2008 global financial crisis. For this period, pre-crisis period is observed between October 2007 and August 2008. The Index has reached its pre-crisis maximum value in April 2010, so the period between July 2009 and April 2010 is the post-crisis period. These three crisis periods could be separated as international and local financial crises. For the selected period, only 2001 Turkish financial crisis could be categorized as local. Other two crises, Asian and global financial crises, could be categorized as international crises.

3.2. Regression Results

Before implementing the regression analyses, preliminary analyses have to be carried out in order to meet the assumptions of the regression. First, the descriptive statistics of the variables were examined as exhibited in Table 1. The results show that there are 244 observations. BIST100 index returns range between 0.59 and -0.49 with the standard deviation of 0.122. Sentiment, which is proxied by the changes in the value-weighted index of closed end fund discounts (ΔVWD), ranges between 30.43 and -38.85 with the highest standard deviation of 8.98, and hence it could be stated that variation of the sentiment is the highest among the variables. The change in the consumer price index has a maximum value of 50.50 and a minimum value of 20.50. On the other hand, change in the industrial price index ranges between 0.25 and -0.22; and the change in the exchange rate ($/TL) ranges between 0.31 and -0.08.

Table 1: Descriptive Statistics

Variables	Mean	Maximum	Minimum	Standard Dev.	Observations
R	0.018749	0.586585	-0.494860	0.122714	244
SENT	-0.075376	30.42630	-38.84693	8.979035	244
IPI	0.005492	0.250840	-0.222357	0.083169	244
CPI	0.512492	50.50000	20.50000	5.406791	244
XR	0.015581	0.308708	-0.084083	0.044110	244

Note: This table presents the results of the descriptive statistics. R is the return of BIST100 index, SENT is investor sentiment proxied by the changes in the value-weighted index of closed-end fund discount, IPI is the change in the industrial production index, CPI is the change in the consumer price index, and XR is the change in the exchange rate ($/TL).

Second, the correlation analysis was carried out in order to examine the multicollinearity of the variables. As it can be observed from Table 2, there is a negative correlation between sentiment and the index return. Therefore, it is expected that when sentiment of the investors decreases return of the BIST100 index will increase. Moreover, there is no multicollinearity problem detected among variables, because all the correlations are below 50%.

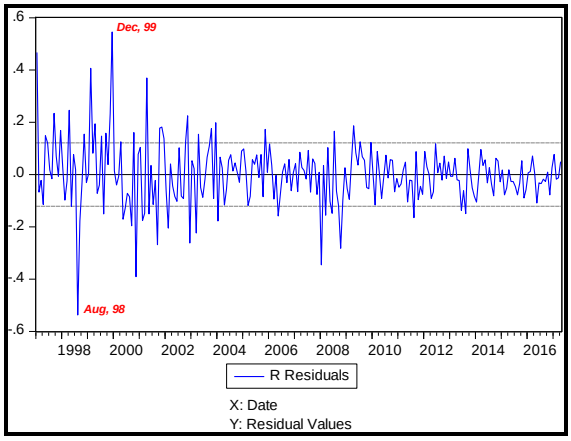
Table 2: Correlation Matrix

	R	SENT	CPI	IPI	XR
R	1.000000	-0.155881	-0.018455	-0.049157	-0.026909
SENT	-0.155881	1.000000	0.086479	0.052848	-0.020807
CPI	-0.018455	0.086479	1.000000	0.003687	-0.025370
IPI	-0.049157	0.052848	0.003687	1.000000	0.011590
XR	-0.026909	-0.020807	-0.025370	0.011590	1.000000

Note: This table presents the correlation matrix between all variables. R is the return of BIST100 index, SENT is investor sentiment proxied by the changes in the value-weighted index of closed-end fund discount, IPI is the change in the industrial production index, CPI is the change in the consumer price index, and XR is the change in the exchange rate ($/TL).

Third, normality of the residuals was checked. According to the Jarque-Bera test statistics with the value of 166.46 (statistically significant at %1) null hypothesis of normality was rejected which means residuals are not normally distributed. Brooks (2014) states that in financial modelling, one or two very extreme residuals that are outliers may cause a rejection of the normality. Therefore, Brooks (2014) suggests removing those outliers by using dummy variables may improve the model. Based on Figure 2, the two extreme residual values were determined in August 1998 and December 1999. After excluding them, the distribution of residuals became close to normality and significance of each model was improved.

Figure 2: Residual Graph



Finally, serial correlation (autocorrelation) and heteroscedasticity of the series were controlled. Serial correlation was analysed with the Breusch-Godfrey Serial Correlation LM Test, and according to the results, Prob. Chi Square Value is 0.8057 which is not statistically significant hence there is no autocorrelation problem. Moreover, heteroscedasticity was analysed with the White test, and according to the results, Prob. Chi Square Value is 0.0000 which is statistically significant at 1%, and indicates a heteroscedasticity problem. That is the series are not homoscedastic which means errors do not have a constant variance, and to minimize this problem White's modified standard error estimates were used while implementing the regression analyses. After the preliminary analyses and corrections, regression equation (6) was run for the "whole period", "no crisis period", "all crisis periods", "local crisis period", and "international crisis period" respectively. The whole sample period includes monthly data from January 1997 to April 2017. After specifying the effect of sentiment on BIST100 index return for the whole period, the crises periods were analysed. The data composed of three crises periods, and each of them starts with the pre-crisis date and finishes with the end of the post-crisis date. "No Crisis Period" represents the period that the crisis dates are not included. "All Crisis Periods" includes only the crises periods data. "Local Crisis Period" includes only the data of the 2001 crisis of Turkey. "International Crisis Period" includes both the 1998 Asian crisis and 2008 Global Financial Crisis data.

Overall, as exhibited in Table 3, according to the F-statistics the model is statistically significant and valid at 1% level for each period. The adjusted R-square values range between 14-25 % which means; that amount of the total variation in index returns is explained by the regression model consisting of closed-end fund discount as a sentiment proxy. When the coefficients are evaluated, sentiment is statistically significant and negative only for the whole period and the local crisis

period. However, the significance level of sentiment in the local crisis period is higher relative to the whole period. In the remaining periods, the coefficient of the sentiment variable is not found to be statistically significant indicating no statistically significant effect of investor sentiment on BIST 100 index returns. These results could be interpreted as in the local crisis period the effect of sentiment on the stock market is higher relative to the other periods.

Table 3: Results of the Regression Analyses

Variables	Whole Period	No Crisis Period	All Crisis Periods	Local Crisis Period	Global Crisis Period
Included Observations	244	156	88	48	40
α	(0.018554)***	(0.023675)***	(0.007058)	(-0.001045)	(0.019723)
SENT	(-0.002139)*	(-0.001111)	(-0.003206)	(-0.005366)**	(0.001902)
Adj. R-Square	(0.174221)	(0.210984)	(0.146067)	(0.145862)	(0.258455)
F-statistic	(18.08923)***	(21.72366)***	(8.440773)***	(9.026259)***	(7.796453)***

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Note: This table presents the results of the regression equation $R_{BIST100_t} = \alpha + \beta_1 SENT_{\ t} + \varepsilon$. The dependent variable is BIST100 index returns, and the independent variable is investor sentiment (SENT) proxied by the changes in the value-weighted index of closed-end fund discounts. The whole sample period includes monthly data from January 1997 to April 2017.

Since, there is a possibility that investor sentiment can be affected by particular economic factors; these were included into the analysis as control variables. Therefore, the regression analyses were re-run using the regression equation (9) which includes control variables along with the sentiment proxy for each period. As exhibited in Table 4, according to the F-statistics the model is statistically significant and valid for each period. The adjusted R-square values range between 9-26 % which means; that amount of the total variation of index return is explained by the regression model consisting of closed-end fund discount, change in the industrial production index, change in the consumer price index and change in the exchange rate. Coefficients show that the sentiment proxy is again statistically significant and negatively related with the index returns when the control variables were added to the model only in the whole period and local crisis period. Hence neither the direction of the relationship nor its statistical significance level has changed following the inclusion of the control variables.

Table 4: Results of the Regression Analyses with Control Variables

Variables	Whole Period	No Crisis Period	All Crises Periods	Local Crisis Period	Global Crisis Period
Included Observations	244	156	88	48	40
α	(0.021018)***	(0.027972)***	(0.008097)	(-0.003806)	(0.029446)
SENT	(-002111)*	(-0.000839)	(-0.003203)	(-0.005384)**	(0.002768)
IPI	(-0.061975)	(-0.118248)	(0.009074)	(-0.107196)	(0.367005)
CPI	(-0.000157)	(-0.000673)	(0.000579)	(0.007697)	(-0.000392)
XR	(-0.132444)	(-0.228404)	(-0.080274)	(0.063686)	(-0.622000)
Adj. R-Square	(0.167970)	(0.213677)	(0.116072)	(0.096870)	(0.265861)
F-statistic	(9.176133)***	(9.424011)***	(3.284863)***	(2.260306)*	(3.824688)***

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Note: This table presents the results of the regression equation: $R_{BIST100_t} = \alpha + \beta_1 SENT_t + \beta_2 IPI + \beta_3 CPI + \beta_4 XR + \varepsilon$. The dependent variable is BIST100 index returns. The independent variables are investor sentiment (SENT) proxied by the changes in the value-weighted index of closed-end fund discounts, change in the industrial production index (IPI), change in the consumer price index (CPI) and change in the exchange rate (XR). The whole sample period includes monthly data from January 1997 to April 2017.

4. CONCLUSION

The study aimed to examine the relationship between investor sentiment and Borsa Istanbul during the financial crisis periods covering the period from January 1997 to April 2017. The relationship is examined for the crisis periods also by differentiating between local crisis and international crisis using regression analysis. The findings of the regression analyses show that investor sentiment proxied by the change in the changes in the value-weighted index of closed-end fund discount in Turkey has a statistically significant and negative relationship with the BIST-100 index returns in the whole period and local crisis period. According to Lee, Shleifer and Thaler (1991) discounts increase when investors are pessimistic, and decrease when investors are optimistic. Therefore, from the results of this study it is observed that in the whole period and local crisis period; when closed end fund discount increases (pessimistic investors), returns of the BIST 100 index returns decreases. Moreover, since no statistically significant relationship between investor sentiment and BIST 100 index returns

during international crisis periods was determined, the findings imply that the statistically significant relationship between sentiment and returns in the local crisis period can be the reason for the statistically significant relationship in the whole period sample. In Borsa Istanbul the share of foreign investors is substantial at approximately 78% level based on the Turkish Capital Markets Association figures. Therefore, during international crises it can be argued that they continue trading at Borsa Istanbul and keep Turkish stocks in their portfolios to diversify internationally. Since the international markets are all affected from the crises, there is no safe haven for the international investors to go. In other words, even though they are pessimistic for the overall economy, they do not take any action that would have a significant effect on market returns. On the other hand, during the local crisis, they have alternative other markets which are not in crisis, so they take action. Hence the investors' actions are more influenced by sentiment and the market is significantly affected.

This study contributes to the literature in several ways. First, the sample period covers three crisis periods in Turkey which are not examined in the literature previously, and the CMAX methodology is used to determine the pre-crisis, crisis and post-crisis periods. Second, the existing literature generally focuses on the developed markets, and there are few studies done in emerging markets. Hence, this study contributes by analysing the Turkish stock market as an emerging market. Finally, this study provides evidence that whether the effect of investor sentiment differs based on the origin of the crisis as local or international by examining the relationship separately for each type. In this study only the closed-end fund discount was used as a proxy for investor sentiment. Since the data of closed-end funds are on a monthly basis the analysis was performed monthly. However, in the crisis periods, lower frequency data such as daily data may capture the effect of sentiment better. Therefore, as a further study different proxies may be used, and the analyses could be done on a daily basis to reach more substantial results. Overall, the findings of this study suggest that Borsa Istanbul is sensitive to investor sentiment especially in the crisis periods that originate locally. Therefore, investors, portfolio managers and policy makers have to take into consideration the presence of investor sentiment while making investment decisions during these risky periods by distinguishing between international and local causes.

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IMPACT OF MACROECONOMIC UNCERTAINTY ON FIRM PROFITABILITY: A CASE OF BIST NON-METALLIC MINERAL PRODUCTS SECTOR[1]

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ABSTRACT

Purpose- The aim of this study is to analyze the impact of macroeconomic uncertainty on Return on Assets (ROA) and Return on Operating Profits (ROAF) by employing panel data analysis within the sample of Borsa Istanbul Non-Metallic Mineral Products sector for the period of 2003:Q1-2016:Q4.

Methodology- Firstly; volatility levels of exchange rate, interest rate, inflation rate and growth rate were determined by Generalized Autoregressive Conditional Heteroscedasticity (GARCH) modelling. Then, the relationship between uncertainty and profitability were examined by panel data analysis.

Findings- Our findings revealed that growth volatility, exchange rate volatility, and interest volatility had a negative effect on both return on assets (ROA) and operating profit (ROAF).

Conclusion- Macroeconomic uncertainty has potential to affect the firm profitability through firm decision-making. The findings of this were consistent with relevant theoretical and empirical literature. In this regard, establishing and sustaining a stable macroeconomic environment is of great importance for firm profitability and in turn achieving a sustainable growth and lower unemployment rates.

Keywords: Macroeconomic uncertainty, firm profitability, non-metallic mineral products sector, Turkey, panel data analysis
JEL Codes: D81, G17, L25

1. INTRODUCTION

Both macro and micro uncertainty levels take form according to current economic conjuncture. The uncertainty level generally increases in the periods of economic recession and decreases under relatively better economic situations. The negative developments in general economic environment increase the volatility of micro or macroeconomic factors and in turn affect the firms' growth rates and profitability ratios negatively (Bloom, 2014: 155). Investments in production sector are generally affected from financing opportunities, exchange rate, growth rate, oil prices and capital cost to a great extent. In this regard, the raising volatility causes the firms to postpone or cancel the investment decisions. Thus; determining the uncertainty sources is of great significance in terms of providing stability in macroeconomic environment by considering all the factors that may affect profitability levels of production sector playing an important role on economic growth and employment.

A stable and foreseeable macroeconomic environment is an important component for the firms' production and investment decisions. Nonvolatile macroeconomic environment and developed financial markets pave the way for production and investment decisions by providing appropriate financing opportunities with the long-term regulatory business plans. On the other hand, the absence of macroeconomic stability causes the decreases in private investments due

[1]This study is derived from the doctoral dissertation titled "The Effect of Macroeconomic Uncertainty on Firm Profitability: A Case of BIST Non-Metallic Mineral Products Sector".

to high inflation rates and fiscal deficits (Mangla and Din, 2015, pp. 242-243). Macroeconomic variables such as foreign direct investments, money supply, interest and exchange rates affecting firms' performance and macroeconomic conditions may be controlled by monetary and fiscal policies. At this point; these macroeconomic policies are of great importance especially for production sector because this sector provides a huge amount of capital and is more affiliated with international markets (Odior, 2013: 363). Not only firm-specific factors such as capital structure, ownership structure and cash flows level but also macroeconomic uncertainty factors including inflation, interest and exchange rate volatility may be effective on the profitability of firms' investments by different channels such as demand and input market conditions, technological developments, competitive environment and financing opportunities. For instance; interest rate volatility has a great impact on firms' capital costs, financing conditions and investment opportunities. Because interest rate is considered as a discount rate in evaluating investment projects, unexpected increases or decreases as to interest rate make firms unwilling in taking investment decisions (Erdal, 2001, p. 27). Additionally; the increase on interest rates has a negative impact on firms' cost of borrowing and firms expose to liquidity risk. This situation causes firms to go bankruptcy because of inadequate cash flows as well (Zeitun et al., 2006: 2). On the other hand; the unexpected changes in the inflation rates are considered as one of the main factors causing macroeconomic uncertainty. High level of price volatility causes the loss of confidence in terms of investors and this perception affects firms' profitability negatively by decreasing the levels of investments. This study investigated the impact of macroeconomic uncertainty on the firms' profitability in operating Non-Metallic Mineral Products Sector quoted on Borsa Istanbul during the period 2003:Q1-2016:Q4 with panel data analysis. The study will contribute to the relevant literature by one of the early studies investigating the interaction between macroeconomic uncertainty and firm profitability in Turkey and also in the relevant literature. Furthermore, the findings of the study will be useful for macroeconomic policymakers. In the following part; theoretical and empirical literature review will be presented, and then the dataset and econometric methodology will be introduced. At the fourth part; the obtained results will be presented and the study will be completed with conclusion part.

2. LITERATURE REVIEW

There has been extensive empirical literature about the raising macroeconomic uncertainty resulting from the financial liberalization in both developed and developing countries as of 1980s. The empirical literature have indicated that the volatility in macroeconomic variables such as exchange rate, inflation rate, interest rate, oil prices and growth rate have affected the firm profitability to a great extent (e.g. see *Shapiro, 1974; Dumas, 1978; Aggarwal, 1981; Jorion, 1990; Baum et al., 2001; Demir, 2009; Sekmen, 2011;Savaş and Can, 2011*; *Anlas, 2012; Mutluay and Turaboğlu, 2013; Kemuma, 2015; Alibabaee and Khanmohammadi, 2016).* However, the relevant literature has generally focused on the relationship between several uncertainty factors and index returns not directly firm profitability (e.g. see Adjasi et al., 2008; Ozbay, 2009; Sariannidis, 2010; Savas and Can, 2011; Mlambo, 2013; Flota, 2014; Li et al., 2016). Only a few studies have researched the effect of macroeconomic uncertainty on firm profitability in both Turkey and all over the world (Demir, 2009; Mutluay and Turaboglu, 2013; Musa, 2014; Kemuma, 2015; Alibabaee and Khanmohammadi, 2016). In one of the studies, Shapiro (1974) and Dumas (1978) investigated the impact of exchange rate volatility on multinational firms' profitability and revealed that exchange rate volatility affected the firms' cash flow, profitability and market value negatively. In another study, Aggarwal (1981) researched the impact of monthly exchange rate changes on the value of the U.S. stock returns over the period of 1974-1978 and found a positive relationship between U.S stock returns and the currency value changes. Jorion (1990) examined the foreign exchange exposure of U.S. multinational firms and revealed that exchange rate volatility affected profit rates negatively and that the comovement between stock returns and the value of the dollar was found to be positively related to the percentage of foreign operations of U.S. multinationals.

Amihud (1994) analyzed the impact of exchange rate changes on the stock returns of 32 large-scale U.S. firms by using the monthly and quarterly data for the period of 1979-1988 and discovered that there was no significant relationship between exchange rate changes and stock returns. Baum et al. (2001) also examined the effects of permanent and transitory components of the exchange rate of multinational firms' profitability under imperfect information and concluded that the volatility of the permanent (transitory) component in the exchange rate leads to greater (lesser) variability in the profit rate levels. Adjasi et al. (2008) analyzed whether the volatility of macroeconomic variables such as exchange rate, monthly money supply, interest rate, and inflation rate and trade deficit affected Ghana Stock Exchange Index returns by using EGARCH method and revealed that there was a negative relationship between exchange rate volatility and stock returns and that the decrease in currency value made an increase (decrease) in long-term (short-term) stock returns. In another study, Demir (2009) investigated the impact of macroeconomic uncertainty and external shocks on the publicly traded manufacturing firms' profitability in the presence of multiple investment options in both real and financial sectors with semi-annual data from 1993 to 2003 by using panel data analysis and discovered that there was a statistically significant negative relationship between macroeconomic uncertainty and profitability. Sariannidis et al. (2010) aimed to determine whether macroeconomic factors had an effect on Dow Jones Sustainability Index and Dow Jones Wilshire REIT Index returns. Volatility of oil prices, ten year bond yields, exchange rate and non-farm employment rate were used as the macroeconomic uncertainty factors by using GARCH model in forecasting volatility. They reached that the volatility of oil

prices and exchange rate affected stock returns negatively and that ten year bond yields had a positive effect on U.S. stock exchange.

Sekmen (2011) examined the relationship between exchange rate volatility and U.S. firms' profitability by using Autoregressive Moving Average Model (ARMA) over the period of 1980-2008 and concluded that there was a negative relationship between exchange rate volatility and U.S. stock returns. In another study, Antonakakis et al. (2012) investigated whether political uncertainty index developed by Baker (2012) affects S&P 500 index returns by using monthly data during the period 1997-2012 with Dynamic Conditional Correlation model (DCC), and found that the increase in political uncertainty had a negative impact on stock returns. Furthermore, Flota (2014) assessed the impact of exchange rate changes on the stock returns of 71 non-financial publicly traded Mexican firms by using panel data analysis for the period of 1994-2003 and revealed that there was a statistically significant negative relationship between stock returns and exchange rate changes and that the effects found to be relatively higher in medium-scaled firms. Finally, Kemuma (2015) aimed to determine the relationship between macroeconomic uncertainty and the profitability of 49 insurance firms operating in Kenya by using linear regression model for the year of 2014. While net profit to total assets ratio was used as a profitability indicator; the volatility of exchange rate, inflation rate, growth rate, interest rate and employment rate were used as macroeconomic uncertainty factors. The empirical results showed that the volatility of exchange rate, growth rate and inflation rate had a negative impact on profitability and that there was a positive relationship between interest rate volatility and profitability.

3. DATA AND METHODOLOGY

This study investigated the impact of macroeconomic uncertainty on the firms' profitability in operating non-metallic mineral products sector quoted on Borsa Istanbul during the period 2003:Q1-2016Q4 with panel data analysis.

3.1. Data

Data set is consisted of 23 publicly traded cement firms in Turkey as disclosed Borsa Istanbul database online. The period analyzed is quarter and covers 2003:Q1-2016:Q4. The data as to dependent and control variables are obtained from the quarterly balance sheets, income tables and operating reports of the analyzed firms. In generating the required data set; the firms' going public dates and the period in which observation number is maximum were considered. While Return on assets (ROA) and Return on Operating Profits (ROAF) were used as the profitability indicators; the volatility of exchange rate, interest rate, inflation rate and Gross Domestic Product were considered as macroeconomic uncertainty indicators. The data as to independent variables were provided by the electronic data delivery system of Central Bank of the Republic of Turkey (CBRT) and 'Statistical Indicators' section of Turkish Statistical Institute. The quarterly data as to weighted average deposit interest rates of banks, the average of buying and selling rate and the value of volume index seasonally adjusted quarter on quarter were considered in determining the interest rate, exchange rate and growth rates. Additionally; current ratio and leverage ratio were used as the control variables in the study.

Table 1: Definition of the Variables

Type of Variable	Definition of Variables	Abbr.
Dependent Variable	Return on Assets (Net Profit/ Total Assets)	ROA
Dependent Variable	Return on Operating Profits (Operating Profit/Total Assets)	ROAF
Control Variable	Leverage Ratio (Total Debt/Total Assets)	KALD
Control Variable	Current Ratio [(Liquid Assets-Inventories)/Short-Term Liabilities)]	CO
Independent Variable	Exchange Rate	DKUR
Independent Variable	Interest Rate	FAIZ
Independent Variable	Consumer Price Index	TUFE
Independent Variable	Gross Domestic Product	GSYH

E-views 9.0 and State 14.0 software packages were used in the econometric analysis. The descriptive statistics and correlation matrix of the data set was presented in the Table 2 and Table 3. The mean and median of all the variables appeared to be not normally distributed. Jarque-Bera statistics also showed that all series were non-linear.

Table 2: Descriptive Statistics

Variable	ROA	ROAF	DKUR	FAIZ	TUFE	GSYH	CO	KALD
Mean	0.04092	0.03772	1.76221	17.2164	178.201	1.39642	3.27927	0.17121
Median	0.03954	0.03207	1.53608	15.89	172.846	1.9	2.23915	0.16491
Maximum	0.14126	0.18148	3.28092	45.39	288.893	5.5	10.9952	0.42116
Minimum	-0.04608	-0.05391	1.18801	8.39	96.3733	-5.4	0.99192	0.05517
Std. Error	0.03322	0.04214	0.52861	8.15105	56.448	2.34373	2.38751	0.08004
Skewness	0.21177	1.54323	1.34283	1.62578	0.32511	-0.90902	1.53508	0.84946

Kurtosis	4.80661	6.51916	3.78609	5.62733	1.93987	3.65783	4.38744	3.66652
JB Statistics	8.03417	51.1252	18.2716	40.7762	3.60885	8.72196	26.4855	7.77151
Probability	0.01801	0.00000	0.00108	0.00000	0.16456	0.01276	0.00002	0.02053

3.2. Econometric Model and Method

Volatility forecasting is generally used in hedging risk, managing efficient portfolios and measuring uncertainty levels by considering a number of factors. These models are classified into four main groups: Historical Volatility Models, ARCH Class Conditional Volatility Models, Implied Volatility Models and Stochastic Volatility Model Forecasts (Poon and Granger, 2003: 506). Volatility may be separated into two components such as predicted and unpredicted. The predicted component in financial time series is conditional variance and this function of risk premium is predicted by ARCH class volatility models. In this study; we aimed to determine the exchange rate, interest rate, inflation rate and growth rate volatility by using ARCH class volatility models (Pagan and Schwert, 1990: 267). First, the ARCH effect is tested after making time series stationary in these volatility models and then, volatility model is generated. Volatility levels of exchange rate, interest rate, inflation rate and growth rates were determined by Generalized Autoregressive Conditional Heteroscedasticity (GARCH) modeling. After determining the volatility levels, the following two models were used to analyze the effect of macroeconomic uncertainty factors on firm profitability by using panel data analysis method:

Model I: $ROA_{it} = \beta_{it} + \beta_1 DKUR\_OY_{it} + \beta_2 FAIZ\_OY_{it} + \beta_3 TUFE\_OY_{it} + \beta_4 GSYH\_OY_{it} + \beta_5 FCO_{it} + \beta_6 FKALD_{it} + \varepsilon_{it}$

Model II: $ROAF_{it} = \beta_{it} + \beta_1 DKUR\_OY_{it} + \beta_2 FAIZ\_OY_{it} + \beta_3 TUFE\_OY_{it} + \beta_4 GSYH\_OY_{it} + \beta_5 FCO_{it} + \beta_6 FKALD_{it} + \varepsilon_{it}$

- β_{it}*: Constant term*
- ε_{it} *: Error term*
- *i: Each firm for i*
- *t: time*

Panel data refers to the pooling of observations on cross-sections of households, countries, firms, etc. over several time periods. The use of panel data provides practitioners to control for heterogeneity. Also panels give more informative data, more variability and less collinearity among the variables and are useful in identifying and measuring effects that are simply not observed in a pure cross-section or pure time-series data (Baltagi, 2014: 1-8). In this study, the effect of macroeconomic uncertainty proxied by growth volatility, inflation volatility, exchange rate volatility, and interest volatility was analyzed by panel data analysis. The cross-sectional dependence among the series and homogeneity of the slope coefficients were analyzed by Breusch and Pagan (1980) Lagrange Multiplier (LM) test and Pesaran and Yamagata (2008) adjusted delta tilde test. Then the stationary of the variables was examined with panel unit root test of Hadri and Kurozumi (2012) considering the existence of cross-sectional dependence and homogeneity. Random Effects Model (REM) was selected in the light of pretests of Breusch-Pagan (1980), Chow (1960) and Hausman (1978) tests. Finally, two models were estimated and robustness checks were conducted.

4. FINDINGS AND DISCUSSIONS

Firstly; the volatility levels of exchange rate, interest rate, inflation rate and growth rate were determined by using GARCH model. Then, panel data models were analyzed for investigating the relationship between macroeconomic uncertainty and profitability. The correlation matrix was presented in Table 3. The results showed that there was a positive relationship between interest rate uncertainty, growth rate uncertainty, current ratio and firms' profitability performance variables Return on Assets (ROA) and Return on Operating Profits (ROAF). Additionally; there was a negative relationship between exchange rate uncertainty, leverage ratio and dependent variables. The low levels of correlation coefficients among the variables increases the reliability of the generated models.

Table 3: Correlation Matrix

1.Model	**ROA**	**CO**	**DKUR_OY**	**FAIZ_OY**	**GSYH_OY**	**KALD**	**TUFE_OY**
ROA	1						
CO	0.25391	1					
DKUR_OY	-0.07299	0.01043	1				
FAIZ_OY	0.06132	-0.05605	-0.49283	1			
GSYH_OY	0.056091	-0.01889	0.06857	-0.02252	1		
KALD	-0.29501	-0.57629	0.04783	0.11665	0.02118	1	
TUFE_OY	-0.05841	-0.03797	0.61350	-0.55303	0.09169	-0.2937	1
2. Model	**ROAF**	**CO**	**DKUR_OY**	**FAIZ_OY**	**GSYH_OY**	**KALD**	**TUFE_OY**
ROAF	1						
CO	0.13785	1					

DKUR_OY	-0.03950	0.01043	1				
FAIZ_OY	0.02715	-0.05605	-0.49283	1			
GSYH_OY	0.04652	-0.01889	0.06857	-0.02252	1		
KALD	-0.05966	-0.57629	0.04783	0.11665	0.02118	1	
TUFE_OY	-0.01821	-0.03797	0.61350	-0.55303	0.09169	-0.2937	1

4.1. Homogeneity and Cross-Section Dependency Test Results

First, the homogeneity of the slope coefficients were analyzed by delta tilde and adjusted delta tilde tests of Pesaranand Yamagata (2008), because it will be determinative in choosing the further econometric tests and the test results were presented in Table 4. The null hypotheses were rejected because the probability values of the calculated tests are less than %5 and we concluded that slope coefficients were heterogeneous.

Table 4: Pesaran and Yamagata (2008) Homogeneity Test Results

	Test Statistics	**Probability (p)**
$\tilde{\Delta}$	12.673	0.006*
$\tilde{\Delta}_{adj}$	9.528	0.002*

*significant at 5%

Breusch-Pagan (1980) LM test was used in order to determine whether there is cross-section dependency and the obtained findings were presented in Table 5. The obtained findings showed the presence of cross-section dependency because the probability values are less than 5%.

Table 5- CD_{LM1} Test Results

Variables		**Value**
ROA	t statistics	6.934
	probability	0.000*
ROAF	t statistics	5.832
	probability	0.000*
CO	t statistics	4.099
	probability	0.021*
KALD	t statistics	9.435
	probability	0.002*
KUR_OY	t statistics	7.391
	probability	0.000*
FAİZ_OY	t statistics	5.628
	probability	0.017*
TÜFE_OY	t statistics	9.372
	probability	0.000*
GSYİH_OY	t statistics	4.023
	probability	0.008*

*significant at 5%

4.2. Panel Unit Root Test Results

Hadri and Kurozumi (2012) second generation panel unit root test was used to examine the integration levels of the variables considering the cross-section dependency among the cross-section units. The test results indicated that ROA, ROAF, CO and KALD were I(1) and the rest were I(0).

Table 6: HadriandKurozumi (2012) Panel Unit Root Test Results

Level			
Variables		**Statistics**	**p**
ROA	Z_A^{SPC}	5.953	0.000
	Z_A^{LA}	5.041	0.002
ROAF	Z_A^{SPC}	8.552	0.001
	Z_A^{LA}	8.127	0.000

CO	Z_A^{SPC}	5.329	0.007
	Z_A^{LA}	4.336	0.002
KALD	Z_A^{SPC}	7.112	0.000
	Z_A^{LA}	7.523	0.000
KUR_OY	Z_A^{SPC}	6.835	0.129
	Z_A^{LA}	4.067	0.124
FAIZ_OY	Z_A^{SPC}	0.982	0.097
	Z_A^{LA}	0.884	0.092
TUFE_OY	Z_A^{SPC}	0.672	0.174
	Z_A^{LA}	0.551	0.165
GSYH_OY	Z_A^{SPC}	1.098	0.083
	Z_A^{LA}	1.237	0.094
First Level Differences			
Variables		**Statistics**	**p**
ROA	Z_A^{SPC}	0.763	0.001
	Z_A^{LA}	0.709	0.000
ROAF	Z_A^{SPC}	1.562	0.002
	Z_A^{LA}	1.438	0.008
CO	Z_A^{SPC}	0.997	0.000
	Z_A^{LA}	0.901	0.002
KALD	Z_A^{SPC}	1.178	0.006
	Z_A^{LA}	1.066	0.000

Note: *Optimum lag length is determined with Schwarz information criteria.*

4.3. Panel Data Analysis

There are a variety of different models for panel data such as pooled regression, fixed effects, random effects and random parameters as stated in Baltagi (2005). In this study; some statistical tests were made in order to decide between two possible forecasting models. Chow test is used in order to determine the mutual meaning of firms specific and time specific effects and Hausman test is used whether there is a random effect. The Chow, Breusch-Pagan (BP) and Hausman test results are presented in Table-7 and the random effects model was chosen for the analysis in the light of test results.

Table 7: Panel Data Forecasting Method Selection Test Results

Dependent Variable: ROA			**Dependent Variable: ROAF**		
Test	**p value**	**Decision**	**Test**	**p value**	**Decision**
Chow(F test)	0.012	H_1 accept	Chow(F test)	0.001	H_1 accept
BP(χ^2 test)	0.002	H_1 accept	BP(χ^2 test)	0.019	H_1 accept
Cross-section random		0.128	Cross-section random		0.157
Period random		0.041	Period random		0.121
Cross-section and period random		0.129	Cross-section and period random		0.273

The panel data models were analyzed by considering random effects model and the findings were presented in Table 8.The estimated coefficients showed that all the independent variables except inflation uncertainty had a statistically significant negative effect on firm profitability. While exchange rate volatility had the lowest impact on profitability, growth rate volatility had the highest impact when compared with other macroeconomic uncertainty factors. As for the control variables; the findings showed that leverage ratio affected profitability negatively and current ratio affected profitability positively(Goddard, 2005; Salawu and Awolowo, 2009; Akinlo and Asaolu, 2012; Aygun, 2012;Ozmenvd., 2012; Uluyol et al., 2014; Ahmad et al., 2015; Dogan and Topal, 2016; Demirci, 2017). Inflation uncertainty may be effective on firms' performance especially in terms of the income and tax structures. For instance; the volatility levels of firms' sales increase as well as their costs in an uncertain macroeconomic environment and this situation causes the challenge of income instability (Hatzinikolaou et al., 2002: 46-47). The relevant literature also shows that there is a negative relationship

between inflation uncertainty and profitability (Huizinga, 1993; Beaudry, 2001; Fountas et al., 2006; Caglayan, 2015). On the other hand, economic efficiency decreases in the presence of inflation volatility because relative price movements lose their information transfer edge. Thus this situation causes growth rates to be affected negatively. As for this study; it has been seen that inflation volatility (TUFE_OY) has no impact on firm profitability. The fact that inflation rates in Turkey are relatively low and stabile in the analysis period may be proposed as a reason of this situation.

After the collapse of the Bretton Woods system, the exchange rate volatility has showed increase in comparison with the fixed exchange rate system. Exchange rate volatility may affect profitability negatively by way of reversing financial planning, earning levels, market share and balance sheet structures. The so-called negative relationship is supported by both theoretical and empirical studies (Shapiro, 1974; Dumas, 1978; Jorion, 1990; Amihud, 1994; Bartov and Bodnar, 1994; Baum et al., 2001; Demir, 2009; Kemuma, 2016). Also in this study; the similar results have been obtained and the findings have showed that exchange rate volatility has a negative impact on profitability to some extent. Why this effect level is low may be resulted from the cement sector. Because domestic raw materials are used in production process to a large extent, it is possible to say that there is a protection mechanism within cement sector. Additionally growth rate volatility affects firms' profitability negatively by way of reversing firms' future manufacturing planning. In this study; it has been seen that 1% percent of increase in growth volatility (GSYH_OY) cause ROA to %34 and ROAF to %28 decrease. Interest rate volatility has also a negative impact on firm profitability by reversing firms' financing decisions. Some studies made as to relationship between interest rate volatility and profitability have shown that interest rate affects profitability negatively and in this study, the similar findings have obtained as to interest rate volatility (Amariati, 2013; Hajileeand Nasser, 2017).

Table 8: Panel Data Analysis Results

Dependent Variable: FROA				
Variables	**Coefficient**	**Standard Error**	**t-statistics**	**Probability**
FKALD	-0.04739	0.006835	-6.932382	0.0000*
FCO	0.082625	0.016674	4.955211	0.0000*
DKUR_OY	-0.01848	0.005563	-3.321744	0.0009*
FAIZ_OY	-0.03959	0.006738	-5.875562	0.0000*
TUFE_OY	-0.00034	0.000225	-1.526043	0.1272
GSYH_OY	-0.34075	0.005256	-64.83296	0.0000*
Constant	1.611371	0.15332	10.50988	0.0000*
R-square	0.6625	**Total Error Square**		1.1679
F-statistics	56.982*	**Durbin-Watson statistics**		2.756
Dependent Variable: FROAF				
Variables	**Coefficient**	**Standard Error**	**t-statistics**	**Probability**
FKALD	-0.04821	0.015331	-3.144646	0.0017*
FCO	0.052567	0.007228	7.2726895	0.0000*
DKUR_OY	-0.02574	0.007906	-3.256369	0.0012*
FAIZ_OY	-0.04821	0.009229	-5.224057	0.0000*
TUFE_OY	-0.0002	0.000191	-1.068543	0.2855
GSYIH_OY	-0.28367	0.121126	-2.341966	0.0193*
Constant	4.437068	0.424791	10.44529	0.0000*
R-square	0.6829	**Total Error Square**		2.8534
F-statistics	78.023*	**Durbin-Watson statistics**		2.3213

*significant at 5%

As is the case with all-time series, autocorrelation is also an important problem for panel data analysis. One of the basic assumptions of regression analyses is that there is no relationship between same errors for the different observations. The presence of autocorrelation was tested by Wooldridge test (2002) and the results were presented in Table 9. The null hypotheses were accepted for both two models in the light of test results, and we concluded that there was no autocorrelation problem between the error terms in the models.

Table 9: Wooldridge Autocorrelation Test Results

Dependent Value: FROA		**Dependent Value: FROAF**	
F value	Probability	F value	Probability
564.081	0.172	526.752	0.152

Greene (2003) heteroscedasticity test was used in order to check whether the residuals of regression have changing variance. For both two models; null hypothesis meaning that the residuals of regression don't have a changing variance was accepted. Thus, it is possible to say that the obtained findings from the panel data analysis provide the reliability conditions.

Table 10: Greene Heteroscedasticity Test Results

Dependent Value: FROA		**Dependent Value: FROAF**	
Chi-square	P	Chi-square	p
672.827	0.103	598.552	0.128

5. CONCLUSION

A number of countries, especially developing countries, have passed from the fixed exchange rate system to the floating exchange rate system after the collapse of the Bretton Woods system. However, the globally integration of financial markets has occurred as a result of financial liberalization since 1980s and the frequency and intensity of the financial crises have increased relatively when compared with the past. Furthermore, countries have been more aware towards international economic and social changes. As a result of these developments; providing and sustaining global and domestic macroeconomic stability have become an important factor in firms' decision-making process. In this study; the effect of macroeconomic uncertainty represented by the volatility of different macroeconomic variables on the profitability of the firms listed on Borsa Istanbul Non-Metallic Mineral Products sector was analyzed for the period of 2003:Q1-2016:Q4 with panel data analysis. In the first stage of econometric analysis; the volatility levels of exchange rate, interest rate, inflation rate and growth rate have been forecasted by GARCH model. Then, the relationship between macroeconomic uncertainty and profitability has been examined by using panel data analysis. The estimated coefficients indicated that the volatility of all the macroeconomic variables except inflation rate affect profitability negatively. The findings have also showed that growth volatility/exchange rate volatility had the highest/lowest impact on profitability. In this regard, establishing and sustaining a stable macroeconomic environment is of great importance for firm profitability and in turn achieving a sustainable growth and lower unemployment rates.

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INFORMATION COMMUNICATION TECHNOLOGIES EXPORT and ECONOMIC GROWTH RELATIONSHIP: AN ANALYSIS on SELECTED COUNTRIES

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ABSTRACT

Purpose- The purpose of this study is to analyze the effects on economic growth of export in the leading countries ICT exports. In this context, the relationship between information communication technology exports and economic growth of 7 selected countries using annual data between 2000-2015 was investigated with the help of panel data analysis.
Methodology- The relationship between information communication technology exports and economic growth of 7 selected countries using annual data between 2000-2015 was investigated with the help of panel data analysis.
Findings- The existence of cross section dependency and the slope coefficients are homogeneous. According to the analysis of causality, there is a bi-directional causality relation from export of information technologies to economic growth.
Conclusion- This result reveals the importance of information and communication technologies' export to support economic growth. As a result of policies to be implemented in this direction, the growing sector can make a significant contribution to growth by creating production and export increases.

Keywords: Information communication technology, export, economic growth, panel data analysis, bootstrap panel unit root test
JEL Codes: 040, 047, 033

1. INTRODUCTION

When prehistorical times are defined, the mines that are processed and used have been a key factor. Throughout the historical process, Humanity's knowledge let the different improvements of technological devices. Every social, economic, cultural, and technological change and transformation occurred on the ground of the previous period. In the meantime, different development levels were observed between different communities. While muscle power was the basis of economic activity in primitive societies, in industrial societies it became capital and labor. In today's society called as the knowledge society, the basis of economic activity is transforming to "information" and information based technologies.

After 1970s, developments on information and communication technologies have started to accelerate, and these developments have pushed the countries to change their political, economic and social structure at an unprecedented pace. Information based technologies caused an increase in the number of views about insufficiency of using only physical capital to develop production conditions by easing the access to information. Many developed countries started to strengthen their economic infrastructure by putting the information based technologies in the center of their economic policy. In the countries adapting quickly to this period of change, the changes in the means of production contributed to diminish the costs of goods and services, improvement in the international competition conditions and to increase welfare. Information and technological development related to this has become almost a precondition to increase countries' economic welfare. In sum, information and information technologies, which makes it easier to access information and enables to integrate information into production process, have become the key factor for not only social and cultural areas but also the economic progress. Lots of countries increased investments on the information and communication

technologies in order to increase their welfare level, and correspondingly such exports have gained importance in their economy. It is claimed that information and communication technologies are a driving force behind countries' economies. According to an OECD study in 2006, the information and communication technology sector is providing added value more than 9% in many OECD countries. At the same time, spreading information and communication technology trade is also contributing to growth in the non-OECD countries. In this context, information and communication technologies export's effects on economic growth are examined in seven selected countries in our study.

2. LITERATURE REVIEW

2.1. Information Society and Information Economy

Humanity has transformed from primitive social order to today's information society thanks to social, political, economic and technological progress. In the structure of today's society called as the knowledge society or information society, relations and organizations of production have changed by integrating the information and communication technologies (ICT) into production process (Bensghir, 1999; Tonta, 1999; Atik and Altıparmak, 2011).

As a notion, information economy constitutes the economic field of globalization. Information economy is named also as "network economy", "new economy" and "knowledge based economy", in other words, it can be defined as an economic structure including all knowledge based and information integrated economic activities (Kevük, 2006). Information economy consists data collecting, processing and converting periods associated with distribution period. Within this framework, the most important characteristic of goods and services is information as a main factor of production (Kevük, 2006, Artan et al., 2014).

Improvements in ICTs have changed the industry structure, given an advantage to firms in competition by decreasing production costs, and have crated different employment opportunities in the market (Bensghir, 1999, Gürdal, 2004; Işık and Kılınç, 2013). In 1960s and especially in 1970s, the information technologies were used for processing and organizing the datum by organizations; in 1980s and 1990s, they provided a competitive advantage for these organizations by decreasing costs and creating new employment opportunities (Ekinci, 2006; Hatipoğlu, 2015).

Existing computer usage from 1950s has accelerated especially in 1980s and 1990s, and its effects can be seen on national economies. 1970s' economic crisis occurred in western world eventuated by the neo liberal policies in the beginnings of 1980s, the expectation of positive effect on employment and growth from multiplier effect of industrial policies based on information technology and investments on information sector has become popular in a lot of countries. Information economy, on one hand, linking up with the USA experience in 1990s and information and communication technologies, on the other hand, with the global competition and rapid technological progresses, express that economies with their institutions and rules has gone into a period of change (Söylemez, 2001; Kevük, 2006).

2.2. The Role of Information and Communication Technologies in Economy

Information has become a strategic source, material and foundation of every activity (Castells, 2008). The emergence and convergence of the information and communication technologies constitute the focus of global socio-economic transformations. Proper use of these technologies can reduce the gap between rich and poor, between strong and outsider (Kabanda, 2011). Improvements in information and communication technologies in recent years have caused a series of structural changes such as; restructuring economy, globalization, increasing in capital flow and information usage (Castells, 2008). Information and communication technologies have played an important role in the process of developing the economic sectors especially in the liberalization period (Farhadi and Ismail, 2011). Increase in the number of information and communication technologies' usage areas has caused a decrease in costs, at the same time it has increased the productivity and efficiency. Moreover, increase of the information and communication technologies usage contributes the network effects such as lower transaction costs, improvement in the knowledge workers' productivity, and speed-up in innovations (Moradi and Kebryaee, 2009; Kevuk, 2006). There exists many research about economic growth's indicators in economic policies. Economists generally try to explain GDP per capita variations among countries. One of the key factor that explains these variations is the information and communication technologies. The changes that are created by global economy which relies on information, investment and usage of information and communication technology have become the explanatory element of countries' productivity, growth in international trade and economy. Information and communication technologies which let information be produced, distributed and used are seen as a tool for economic growth, wealth increase and employment (Castells, 2007; Moradi and Kebryaee, 2009; Santibanez and Castillo, 2011).

Information and Communication Technologies' Effects on Economy

- Reduce transaction costs and thereby improve productivity
- Substitute for other, more expensive means of communicating and transacting such as physical
- Increase choice in the marketplace and provide access otherwise unavailable goods and services

- Widen the geographic scope of potential markets
- Channel knowledge and information of all kinds (Kramer et al., 2007).

Increasing usage of information and communication technologies have created an evolution on the management structure of the global economy and the nature of competition. Rapidly rising world's information threshold is changing the course of relations between the individual and the countries. Recent developments have caused an efficiency increase in industries which are unrelated with this technology as a result of the spillover effect, and became the strategic planning center of organizations which are eager to join the occurring digital economy (Santibanez and Castillo, 2011; Wang, 1999).

In the beginning of the 1990s, common usage of computer networks made a contribution to globalization of economic activities. Information and communication technologies converging with telecommunication and being named as information infrastructure are being seen as essential and crucial bases for economic and social progress. Convergence of information, data processing technology and telecommunication technologies are happening for a long time in many countries. Information and communication technologies are accepted as poverty decreasing, skill improving, productivity increasing tools; in short, fundamental tools for progress. It's expected that information technology's contribution to an economy will be predominantly by adopting and using this technology (Wang, 1999). Technological progress has the effecting power on the production by increasing both production info (efficiency increase, change in manufacturing type and R&D) and production subject (new goods and services). Developments and transformations in the information and communication sector, which is directly influenced by technological progress, can increase both production and trade thanks to competition, advertising, more effective and extensive communication opportunities (Karagöz, 2007).

Technological progress has become a determining factor for international competition (Kaymakçı, 2006). In European Commission's 2010 report, information and communication technologies industry occupies only 5% of Europe's GDP but it constitutes 20% of overall productivity growth, so it makes an important contribution to economic growth in Europe. Also in the las 25 years, a significant increase in information and communication technology usage and investment has been observed in developing countries. In studies conducted on countless OECD countries, it's observed that investments on information and communication technologies have an effect upon economic growth between 0.2% and 0.5% (European Commissions, 2010; OECD, 2003). Similarly, many sectoral and national economic analyses show the increasing importance of information and communication technologies in developments such as employment and value creation in all economic sectors. Productivity growth constitutes a basis for improvements of living standards. In an economy, it's seen that the economic growth sustained with productivity growth is supported by investments on the information and communication technologies. This relationship is analyzed for many countries and it's generally observed that information and communication technologies' influence on productivity is favorable and meaningful in an economic sense (European Comissions, 2010; Niebel, 2014). With the transition from industrial society to information society, developments in the information and communication technologies have become an important factor for growth by transforming the economy (Uçkan, 2006). Cost reduction and productivity growth depending on ICT developments show that the investments on this field will be the driving force behind the countries' economic growth (Artan et al., 2014). In modern economy, information and communication technology is considered as an important production factor because of information-driven reasons. Many studies argue that information, innovation and technological changes are an important factor in economic growth. Modern growth theories emphasize that the information is an important tool for economic growth. For this reason, information and communication technologies' impact on economic growth attracts researcher's attention. Even if there is not a certain consensus about the development of information technologies' impact on economic growth, more and more researchers state that the impact is positive (İşcan, 2012; Kim, 2007). Investments on information and communication technologies supports the economic growth by contributing the capital deepening (e.g., Roller and Waverman (2001), Driouchi, et al. (2006), Kim (2007), Moradi and Kebryaee (2009), Farhadi and Ismail (2011), Iscan (2012), Mahyideen, et al. (2012), Göçer (2013), Türedi (2013), Vu (2013), Niebel and Mannheim (2014), Mefteh and Benhassen (2015), Yousefi (2015), Ishida (2015), Edquist and Henrekson (2017).

3. DATA AND METHODOLOGY

In this study, 2000-2015 period annual export of ICT goods, annual import of ICT goods and GDP data are used belonging to leading ICT exporter countries[1]. Dependent variable GDP representing the economic growth shows the annual percentage growth rate of GDP per capita. Data is collected from World Bank data base. For analysis Gauss 10 program and codes written for this program are used. The model to be estimated is as follows:

$$GDP_{it} = \alpha_{it} + \beta_1 ictexp_{it} + \beta_2 ictimp_{it} + e_{it} \quad (1)$$

[1] India, Japan, China, Hong Kong, Germany, United States, United Kingdom

First of all, cross-sectional dependence and homogeneity tests are performed. Not taking into consideration of cross-sectional dependence and homogeneity test while choosing the unit root tests will make the results analysis unbiased and consistent. When there are cross-sectional dependencies between series, making the analysis without taking this into consideration will affect the results considerably (Peseran, 2004).

3.1. Test for Cross-Sectional Dependence

Existence of cross-sectional dependency is tested by Pagan (1980) $CDLM_1$ when time dimension is greater than cross-section dimension, Peseran (2004) $CDLM_2$ when time dimension is equal to cross-section dimension, Peseran (2004) CDLM when time dimension is less than cross-section dimension.

These tests are biased when ensemble average is less than zero.

Initial LM test statistic is as follows:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(\hat{\rho}_{ij}^{2}\right) \sim \frac{\chi^{2}_{N(N-1)}}{2} \tag{2}$$

Pesaran et al. (2008) corrected this bias by adding variance and average to test statistics. For this reason, the name of the test is expressed as bias-adjusted LM test (LM_{adj}). LM_{adj} statistic is as follows:

$$LM_{adj} = \left(\frac{2}{N(N-1)}\right)^{1/2}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2}\left(\frac{(T-K-1)\hat{\rho}_{ij}-\hat{\mu}_{Tij}}{\upsilon_{Tij}}\right) \sim N(0,1) \tag{3}$$

Null and alternative hypotheses for cross-sectional dependence test which tests the existence of cross sectional dependence are given below:

H_0: Cross-sectional dependence doesn't exist.

H_1: Cross-sectional dependence exists.

When the obtained test result is less than 0.05, H_0 hypothesis is rejected with 5% significance level and it's determined there exists cross-sectional dependence between panel units (Pesaran et al., 2008).

Existence of cross-sectional dependence between variables is indicated on Table 1 below.

Table 1: Cross Section Dependence Test

Constant Model	GDP Statistic	p-value	ictexp Statistic	p-value	ictimp Statistic	p-value
CD_{lm} (BP,1980)	54.143	0.000***	36.195	0.021**	49.368	0.000***
CD_{lm}(Peseran,2004)	5.114	0.000***	2.345	0.010**	4.377	0.000***
CD (Peseran, 2004)	-2.532	0.006***	-1.227	0.110	-0.806	0.210
LM_{adj} (PUY, 2008)	15.004	0.000***	25.357	0.000	23.168	0.000***

Note: *, **, *** represent 10%, 5%, 1% significance levels.

With reference to Table 1, for all variables of Model (1) probability value of cross-sectional dependence test statistic CD_{BP} is less than 0.05 significance level. Then, null hypothesis which determines non-existence of cross-sectional dependence is rejected. Then there exists a cross-sectional dependence between countries in the panel. In the created panel, existence of cross-sectional dependence shows that any crisis occurring in one country can affect the other countries even if it originates from a local shock.

3.2. Homogeneity Test

The homogeneity of variables is analyzed by means of Pesaran and Yamagata's (2008) delta test. Under the null hypothesis of slope homogeneity as long as $\sqrt{N}/T \to \infty$ error terms follow normal distribution, therefore, Peseran and Yamagata's delta_tilde statistic follows standard normal distribution. For small samples, Peseran and Yamagata (2008) suggest adjusted

delta_tilde statistic. This statistic also follows standard normal distribution. Thereby, in case of probability value of test statistics being less than 0.05 significance level, null hypothesis defending that slope coefficients are homogeneous will be rejected. Null and alternative hypotheses for homogeneity test which tests whether the slope coefficients are homogeneity or heterogeneity for each country are given below:

H_0: Slope coefficients have homogeneous.

H_1: Slope coefficients are not homogeneous.

Table 2: Pesaran and Yamagata (2008) Homogeneity Test

	Test Statistic	Probability
delta_tilde	0.429	0.334
adjusted_delta_tilde	0.491	0.312

Null hypothesis which suggests slope coefficients are homogeneous is accepted because delta and adjusted delta test statistics' probability values are greater than 0.05 significance level according to Table 2. In short, slope coefficients are homogeneous. Therefore, when the unit root analysis of the series that are used in the study is tested by considering to cross-sectional dependence and homogeneity.

3.3. Unit Root Tests

Panel unit root tests are accepted as statistically more powerful than time series unit root tests which only consider information about time dimensions, because panel root tests take into account both time and cross-section dimensions (Güloğlu and İspir, 2008).

Pane unit root tests which are common in the literature belong to Levin et al. (2002) and Im, Pesaran and Shin (1997). These tests are defined as first generation unit root tests and do not consider cross-sectional dependence. Thus, despite commonly mentioning the mutual interaction between economic variables, first generation unit root tests assume cross-section members of the panel are independent.

However, for the case of cross-section members being influenced from same kind of shock, suggesting cross-sectional independence will be unrealistic. And this assumption, according to O'Connell (1998), cause excessive denial of null hypothesis.

Differently from the first-generation panel unit root tests, second generation panel unit root tests consider cross-sectional dependence. These tests inform about which member series of the panel are stationary or non-stationary one by one. Unit root hypotheses are given below:

H_0: β_i =0: Series is not stationary.

H_1: β_i <0: Series is stationary.

In the study, since it's detected a cross-sectional dependence among panel countries, one of the second-generation considering cross-sectional dependence unit root tests developed by Smith et al. (2004) is used to analyze the stationarity of the series. This test takes into account cross-sectional dependence when making a unit root test. When there is a cross-sectional dependence between series, making an analysis without considering this condition severely effects the obtained results (Breusch and Pagan, 1980; Pesaran, 2004). Not considering the cross-sectional dependence when choosing the unit root test to perform, it makes tests results unbiased and consistent (Peseran, 2004).

$\bar{t}$ test developed by Smith et al. is a boostrap version of Im et al.'s (2003) panel unit root test, and is calculated as follows: $\bar{t} = N^{-1}.\sum_{i=1}^{N} t_i$. Aforesaid tests are predicated on unit root null hypothesis (Özcan and Arı, 2013).

Whether series contain unit root or not is tested by Smith el al.'s (2004) test and results are given below.

Table 3: Smit et al. "bootstrap" Panel Unit Root Test

Levels Constant		
	Statistic	Bootstrap p-value
GDP	-3.081	0.011**
Ictexp	-2.461	0.014**
Ictimp	-2.424	0.024**

Note: ** represents 5% significance levels.

In Table 3, it is shown in which conditions variables are stationary according to Smit et al. bootstrap unit root test results. When the series are tested to determine stationarity in test statistics, it is observed all of the four variables used in a study for the 1987-2015 period was at stationary level. All of these variables were stationary at the 5% significance level.

3.4. Causality Test

Panel Fisher test developed by Emirmahmutoğlu and Köse (2011) relies on the time series' Toda-Yamamoto (1995) causality test logic. Superior characteristic of this test is I(0) and I(1) series can be analyzed together.

In the first step following model estimation is done:

$$Z_{i,t} = U_i + A_{i1}Z_{i,t-1} + \cdots + A_{ik}Z_{i,t-k_i} + \sum_{l=k_i+1}^{k_i+dmax_i} A_{il}Z_{i,t-1} + u_{i,t} \quad (4)$$

$$i = 1, 2, 3, \ldots\ldots\ldots\ldots N, \qquad t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots T \quad (5)$$

When null hypothesis shows there is not a causality relationship in the panel, alternative hypothesis shows at least one series has a causality relationship between variables.

Table 4: Emirmahmutoğlu and Köse's (2011) Panel Fisher Causality Test

	Statistic	**p-value**
ictexp =>GDP	68.058	0.000***
GDP=> ictexp	202.137	0.001***
ictimp=>GDP	7.220	0.926
GDP=>ictimp	18.753	0.931
ictexp=>ictimp	35.732	0.001***
ictimp=>ictexp	39.680	0.000***

Note: *** represents 1% significance levels.

According to Table 4, since bootstrap p-value values are less than 0.05, null hypothesis is rejected by 5% significance level. In this case, there is bidirectional causality relationship from ictexp to GDP. This result matches with theoretical expectations. Because with the export increase, it will contribute to economic growth. On the other hand, export will increase when the economic growth increases. Similarly, bidirectional causality relationship from ictexp to ictimp is also detected. Any causality relationship from ictimp to GDP cannot be founded.

4. CONCLUSION

In this study, the development of information and communication technologies' effect on economic growth is analyzed for the period between 2000-2015. Panel data analysis is utilized for the analyses. In the study, at first existence of cross-sectional dependence among the member countries of the panel is searched and detected. Then homogeneity of slope coefficients is searched for every country one by one, and detected. Unit root and causality tests are the other tests used in the study. According to study's findings, there is bidirectional causality relationship from the export of information and communication technologies to economic growth. This result reveals the importance of information and communication technologies' export to support economic growth. It can be stated that when the countries in which information and

communication technologies have high effect on economic growth are thought to be developed countries that produce and export such technologies, the sectors that produce goods and services related to these technologies should be supported by various credit and incentive applications. As a result of policies to be implemented in this direction, the growing sector can make a significant contribution to growth by creating production and export increases. Foreign trade practices that hinder the possession of sophisticated technologies should be relaxed or removed altogether.

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ECONOMIC IMPACTS OF CLIMATE CHANGE ON AGRICULTURE: EMPIRICAL EVIDENCE FROM ARDL APPROACH FOR TURKEY

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ABSTRACT

Purpose- The agricultural sector is one of the sectors most sensitive to climate change. This sector is directly affected by temperature and precipitation, which is an input in agricultural production. The main objective of this study is to evaluate the effects of climate change in agricultural production in Turkey.
Methodology- The data cover the period 1961-2013. In this study, economic effects of climate change on agriculture were analyzed for Turkey using a time series approach.
Findings- The increase in precipitation affects agricultural GDP positively, while the increase in temperature has a negative effect on agricultural GDP.
Conclusion- In order to minimize the adverse effects of climate change in Turkey, which is one of the largest countries in the world in terms of agricultural land, it is important to establish policies, strategies, plans and programs to combat climate change.

Keywords: Climate change, agriculture, economic impact, ARDL, Turkey
JEL Codes: Q54,, Q51, C22

1. INTRODUCTION

One of the most defining aspects of this century is climate change. Climate change can lead to the emergence of various socio-economic problems such as poverty, economic growth and unsustainability of development, health and safety (Swart et al., 2003). Climate change will have direct impacts on the size of state budgets (flood, conservation of forest areas, control of pollution), terms of trade (change in agricultural yield and labor productivity), economic growth rates (change in agricultural yield and labor productivity, depletion of natural resources) and social welfare (price increases, flood, pollution and health effects) (Cuervo and Gandhi, 1998). United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UN, 1992). Intergovernmental Panel on Climate IPCC (2007) defines climate change as "a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties that persists for an extended period, typically decades or longer". Thus, climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. The effects of climate change arise as a result of the increase in CO_2 and the rise in temperature due to this increase and precipitation regime changes. While these effects are harmful to one region, they can be positive in another region. For example, increases in temperature can have both positive and negative effects on product yield (Adams et. al., 1998). Meadow and grassy areas may increase in cold regions due to warming and temperature increase can contribute to the development of livestock in these regions (Demir and Cevger, 2007). However, in general, it is suggested that the increase in temperature reduces the yield and quality of many crops. Increases in precipitation (i.e. level, timing and variability) can also benefit soil semi-arid areas and other water resources by increasing soil moisture. But while increases in precipitation may worsen problems in regions with excessive amounts of water, a

reduction in the amount of precipitation may have an adverse effect (Adams et. al, 1998). In other words, extremes in climate elements lead to serious economic losses by increasing the frequency and severity of climate-induced natural disasters such as drought, floods and storms (Başoğlu and Telatar, 2013).

Since temperature and precipitation are a direct input into agricultural production, it is thought that the greatest impact will be on the agricultural sector (Deschenes and Greenstone, 2007; Barnwall and Kotani, 2013). Because the agricultural sector among all sectors is the most sensitive and most vulnerable to climate change (Deressa et al., 2005). The agricultural sector is a sector that creates employment, provides food security, supplies raw materials to the industry sector and provides foreign exchange input to the country in foreign trade. Surveys show that the agriculture sector has a slow growth rate over the years due to climate change. It can be said that this situation is more worrisome when the urbanization phenomenon and population growth rate are considered (Amponsah et al., 2015). Agricultural products and livestock are directly affected by changes in the climate factor, such as temperature, precipitation, the severity and frequency of extraordinary events, the increase CO_2 concentration in the atmosphere, climate variability and the increase in sea level (Adams et. al., 1998). Depending on the physical characteristics of the region and the crops produced, both the positive and negative effects of climate change on agriculture can emerge (Mishra and Sahu, 2014). The changes in agricultural production are due to changes in crop yield and changes in crops (size of land, area of land). Changes in yields of crops are a result of climate change and the intervention of producers in such a way as to increase agricultural productivity. "These mitigating interventions of producers can be in the form of increasing fertilizer or water use or adopting a new crop species (Adams et. al., 1998). The rapid increase in world population will increase demand for food and fuel. For this reason, an increase in agricultural production will be needed. However, climate change puts pressure on agriculture, threatening future food production and supply, makes adaptation measures and resilience very expensive (Maharjan and Joshi, 2012).

In addition, climate change will change the prices of agricultural commodities, the reallocation of resources in the agricultural sector, the structure of many country economies and international trade patterns (Gbetibouo and Hassan, 2005). However, it also changes the comparative advantage of the country. In addition, changes in the amount of agricultural production may also have adverse effects on inflation, unemployment, current account deficit and budget. The decrease in agricultural production will have a negative effect on inflation by increasing agricultural product prices. The decrease in the number of employees in the agricultural sector will have a negative effect on unemployment. The supply deficit in agricultural products covered by imports has a negative effect on the current account deficit. Compensating for some or all of the producer damages due to climate change by governments will affect the budget negatively (Bayraç and Doğan, 2016). However, climate change has more harmful effects on agriculture. Besides, in different regions, the grade of the specified effect is different (Maharjan and Joshi, 2012). The main objective of this study is to evaluate the effects of climate change in agricultural production in Turkey. The rest of the paper is organized as follows. Section Literature Review presents the "empirical background" Section "data and methodology" describes data sources and presents our empirical strategy. Section "findings and discussions" describes the emprical results. Section "conclusion" concludes.

2.LITERATURE REVIEW

Different approaches have been adopted in different studies on economic effects of climate change in agriculture. These are mentioned below.

i. The approach of functioning (also known as crop modeling or agronomic-economic approach)
ii. Ricardian Approach
iii. Advanced Ricardian (Panel Data) Approach
iv. The time series approach

Two of the most commonly used approaches to these approaches are "Production function approach"(known as product modeling and agricultural models) and "Ricardian Approach" (Guiteras, 2005; Sarker et al.,2014; Barnwall and Kotani, 2013).

2.1.Production Function Approach

The production function approach is based on empirical or empirical analysis of the relationship between climate variables (environmental factors) and yield (Deressa et al. 2005).This approach, which is used to predict the impact of climate change, is based on empirical or experimental production functions to estimate environmental damage.This approach, also known as product modeling, deals with a basic production function and estimates the effects of climate change by changing one or more input variables such as temperature, precipitation and carbon dioxide levels (Mendelsohn et.al., 1994). This approach based on controlled experiments simulates (several transient climate change scenarios) climate factors and product yields in a laboratory-type environment. This approach does not take into account farmers' attitudes towards adaptation, although climate change is a useful basis for predicting the impact on farming (Mishra and Sahu, 2014). In other

words, in response to climate change, farmer adaptations such as farmers changing fertilizers, differentiating the composition of crops, or using agricultural land for another activity (such as a housing complex) are totally ignored in the approach of production function (Deschenes and Greenstone, 2007). This leads to an overestimate of the negative effects and an underestimation of the positive effects (Sarker et al., 2014; Mendelsohn et.al., 1994). In other words, there is a tendency to predict too much prejudice and damage in studies based on this approach.This prejudice is sometimes called to as a "dumb farmer scenario" to express that farmers neglect the various adaptations that they give in response to changing economic and environmental conditions (Mendelsohn et.al., 1994). Table 1 presents the literature summary of the production function approach.

Table 1: Studies on The Impact of Climate Change on Agriculture: Production Function Approach

Author	Period/Country	Variables	Results
Aggarwal et. al. (2010)	11 districts of the Upper Ganga Basin, India 1969-1990	Dependent Variable: Growth and yield of rice and wheat crops Independent Variable: Solar radiation, temperatures, rainfall, wind speed and vapour pressure.	In the simulation analysis using infoCropWheat and InfoCrop-Rice models found that rice and wheat crops will be affected by climate change.
Mathauda et al. (2000)	Punjab, India 1970-1990	Dependent Variable: Rice yield Independent Variable: Temperature change (extreme warm, greater warm, moderate warm, slight warm and normal weather)	In the study, the effect of temperature on rice yield was analyzed on 5 different weather scenarios. CERES RICE simulation model was used in the study. The results of the research show that the increase in temperature reduces the rice yield in five scenarios. As the temperature increases, the decrease in rice yield also increases.
Southworth et al. (2000)	Midwestern Great Lakes Region 1987-1990	Dependent Variable: Maize yields Independent Variable: Temperatures, rainfall	CERES maize model was created for the period 2050-2059. It was found that high temperatures during the tasseling of maize lead to significant decreases in productivity.
Olesen et al. (2000)	Denmark 1971-1997	Dependent Variable: Winter wheat Independent Variable: Carbon dioxide emission (CO_2) , temperatures, Rainfall, Evapotranspiration	The CLIMCROP (crop simulation model) simulation model was used in the study, assuming that water does not limit growth. High temperatures reduce crop duration of certain species. For wheat, a temperature increase of 1°C during grain filling is estimated to reduce the length of this phase by 5%.
Alexandrov and Hoogenboom (2000)	Bulgaria 1961–1990	Dependent Variable: Maize yield and winter wheat grain yield Independent Variable: Rainfall, Temperature and solar radiation	At the current CO_2 level, the transitory GCM scenarios predicted a decrease in maize and winter wheat yields, especially in the 2020s, 2050s and 2080s.
Lal, M. et al. (1999)	Madhya Pradesh, India - Raipur (1971±97) - Gwalior (1965±88) - Indore (1985±95) - Jabalpur (1969±97)	Dependent Variable: Soybean Independent Variable: CO_2	Based on simulations carried out the doubled CO_2 level, the effects of future climate change on soybean yields in Central India were examined using the CROPGRO model. Results suggest higher yields (50% increase) for soybean crop for a doubling of CO_2.
Kaiser et. al. (1993)	Southern Minnesota 1980-2070	Dependent Variable: Crop yields, crop mix, and farm revenue Independent Variable: Temperature	A farm-level analysis was conducted to examine the effects of climate change on farm operations and profitability using the Monte Carlo simulation. Climate warming scenarios used. The results indicate that grain farmers in the southern region of Minnesota can effectively adapt to the gradually.

2.2. Ricardian (Hedonic) Approach

It is an empirical approach based on cross-sectional data used to examine the sensitivity of agricultural production to climate change.This approach is referred to as the "Ricardian Approach" in Ricardo (1817), under the conditions of perfect competition, because of the work that promotes the net efficiency of the agricultural land of the land rent.This method is described by Mendelsohn et al. in 1994 (Gbetibouo and Hassan, 2005; Deressa et al., 2005).This approach, also called the hedonic approach, assesses the performance of the farms in climate regions.Land value or rent is considered a function of climate, demographic, economic and physical conditions (Gumel et. al., 2016). In principle, using economic data on the value of the land, it is a technique that can correct the bias in the approach of the production function (Salvo et al.,2013;

Chen et.al., 2013). The Ricardian approach is a remarkable tool for assessing the overall impact of climate change on a specific geographical area.It has been applied to many different geographical areas in both developed and developing countries (Salvo et al.,2013).Instead of examining the yield of certain crops, this approach examines how climate in different regions affects the net rent or value of agricultural land.By directly measuring farm prices or incomes, the direct effects of climate on the yields of different crops are explained.The Ricardian approach allows measuring the economic value of different activities if markets work properly.Hence, the economic effects implied by the production function approach ensures that it can be verified as to whether or not they are reoccurring (Mendelsohn et.al., 1994).Although not explicitly mentioned, both short and long-term adaptations are included in Ricardian models.In other words, farmer adaptations are taken into consideration in order to mitigate the adverse economic effects of climate change (Olesen and Bindi, 2002). This approach is a cross-sectional method that measures the long-term effect of climate on agriculture by regressing over a series of variables such as land value or net income per hectare.This approach has three advantages: "It is relatively easy to guess, gives precise values geographically, catches adaptation" (Salvo et al., 2013). The Ricardian model measures the impact of climate factors through their contribution to the prices of agricultural land. Nevertheless, a Ricardian type model does not take into account time-independent, location-specific factors such as unobserved farming skills and soil quality (Barnwal and Kotani, 2013). In addition, the Ricardian approach does not account for the effect of unchanging variables on the region (such as carbon dioxide concentration, the effects of annual changes in the weather, changes in climate change or extreme events, and future climates) (Salvo et al., 2013). Table 2 presents the literature summary of the Ricardian Approach.

Table 2: Studies on The Impact of Climate Change on Agriculture: Ricardian (Hedonic) Approach

Author	Country/Period	Variables	Results
Mishra and Sahu (2014)	Odisha (for all the nine coastal districts) 1979-2009	Dependent Variable: Farm level net-revenue. Independent Variable: Rainfall, Temperature	The study concluded that the July rainfall was useful for the farm activity in Odisha. The study also concluded that the increase in temperature for all seasons had adverse effects on the agricultural sector of coastal Odisha.
Salvo et al (2013)	Italian Alpin Region 2003–2007	Dependent Variable: Average net revenue Independent Variable: Average temperature, average monthly rainfall	In contrast to the general beneficial effects of climate change in the vast areas of Europe (Germany and the UK), climate change has led to a decline in average annual net income in the Alpine region.
Deressa and Hassan (2009)	Ethiopia 2050 and 2100	Dependent Variable: Net crop revenue Independent Variable: Rainfall and temperature, household, and soil variables	Special Report on Emission Scenarios (SRES) the climate variable such as temperature and precipitation affected slightly net crop income. In addition, it has also been observed that small changes in temperature during the summer and winter period negatively affect net crop revenue.
Kabubo-Mariara and Karanja (2006)	Kenya 1988-2003	Dependent Variable: Net crop revenue Independent Variable: Rainfall and temperature	Global warming has an important influence on net crop revenue in Kenya. However, the result is that temperature is much more important than rainfall.
Deressa et al (2005)	South Africa (11 regions) 1977-1998	Dependent Variable: Sugar cane production Independent Variable: Rainfall, temperature height and latitude	The study concluded that sugar cane production is highly sensitive to climate change.
Gbetibouo and Hassan (2005)	South Africa (300 districts) 1970-2000	Dependent Variable:Net revenue per hectare Independent Variable: Rainfall, temperature, soil types, labour, population, irrigated land and geographical coordinates	The results show that the production of field crops is sensitive to marginal changes in temperature compared to variations in rainfall. The increase in temperature affects the net income positively, while the effect of the decrease in rainfall is negative.
Mendelsohn and Dinar (2003)	USA 1997	Dependent Variable: Farmland value Independent Variable: Rainfall and temperature	The paper shows that the value of irrigated cropland is not sensitive to precipitation and increases in value with temperature.
Chang (2002)	Taiwan 1977-1996	Dependent Variable: 60 crops Independent Variable: Rainfall and temperature	The study was concluded that climate change has a significant effect on crop yield.

2.3. Advanced Ricardian (Panel Data) Approach

In recent studies, a panel data approach is used to estimate the impact of rainfall and temperature change on agricultural production. This approach takes into account the fluctuations that occur randomly year-to-year in the weather conditions (Deschenes and Greenstone, 2007).The panel data approach assesses the impact of climate change on average yield and yield variability. There are two types of panel data approach found in the literature. These are fixed effect method and random effect method (Gumel et. al., 2016; Guiteras, 2007). The panel data approach, which considers fixed effects, has the advantage of controlling factors that are time invariant and unobservable (such as farmer quality or unobservable soil quality) at the regional level. Moreover, contrary to the approach of production function, the data about the real field results are used rather than the results in the laboratory environment. This means that the estimates obtained from the panel data will reflect the farmers' regulations within the year (such as changes in inputs or sowing techniques) (Guiteras, 2007). The random effect model assumes that there is no correlation between unobserved and timely independent variables and independent variables. If this assumption is neglected, the fixed effect model will provide a more unbiased assessment. For this reason, the fixed effect model gives a better estimate (Gumel et. al., 2016). Table 3 presents the literature summary of the Panel Data Approach.

Table 3: Studies on The Impact of Climate Change on Agriculture: Panel Data Approach

Author	Country/Period	Variables	Results
Loum and Fogarassy (2015)	Gambia 1960-2013	Dependent Variable: Cereals production (Maize and Millet) Independent Variable: Rainfall, temperature, CO_2, fertilizer and area planted	A marginal increase or decrease in both rainfall and temperatures may negatively affect cereals productivity. Carbon dioxide has positive effects on crop yield.
Sarker et al (2014)	Bangladesh 1972-2009	Dependent Variable: Various types of rice (Aus, Aman ve Boro) Independent Variable: Rainfall, average maximum and minimum temperature.	Average maximum temperature: Aus and Aman rice are a risk-augmenting factor and Boro rice is a risk-reducing factor. Average minimum temperature: Boro rice is a risk-augmenting factor and Aus and Aman rice are a risk-reducing factor. Rainfall: Aman rice is a risk-augmenting factor and Boro and Aus rice are a risk-reducing factor.
Dasgupta (2013)	66 countries 1971-2002	Dependent Variable: Maize and rice yields Independent Variable: Rainfall, temperature.	Climate change affects the amount of maize and rice production negatively. The increase in the variability of the climate variables has a greater negative effect on the countries with lower productivity for rice.
Barnwal and Kotani (2013)	India 1971-2004	Dependent Variable: Kharif and Rabi rice yields Independent Variable: Rainfall, temperature.	The monsoonic crop (Kharif) is more sensitive to temperature and precipitation, while the winter crop (Rabi) is quite resistant to changes in climate variability.
Dell et al. (2012)	125 Countries 1950-2003	Dependent Variable: GDP Independent Variable: Average temperature and rainfall	The increase in temperature is greatly reducing the economic growth in poor countries and reducing growth rates. The increase in temperature leads to a decrease in agricultural production, industrial production and political stability.
Akram (2012)	8 Asian Countries 1972-2009	Dependent Variable: GDP, Growth rate, added value of agriculture, industry and service sectors. Independent Variable: Rainfall, temperature, population and urbanization	The effect of temperature and rainfall increase on GDP is negative. These effects are higher in the agricultural sector compared to the manufacturing and service sectors.
Lobell et al. (2011)	USA 1980-2008	Dependent Variable: Four crops (maize,wheat,rice, and soybeans) Independent Variable: Rainfall and temperature	Climate change shows that maize and wheat production decreased by 3.8% and 5.5%, respectively.
Brown et al. (2010)	133 Countries 1961-2003	Dependent Variable: GDP growth, added value of agricultural and industrial GDP, poverty headcount ratio Independent Variable: Rainfall and temperature	The increase in the amount of rainfall affects the share of the agricultural sector in GDP positively, while the increase in temperature affects the negative direction.
Guiteras (2007)	India 1961-1999 (200 districts)	Dependent Variable: Agricultural outcome Independent Variable: Rainfall, temperature, urbanization, soil quality.	During the 2010-2039 period, crop yields are reduced by 4.5-9% due to climate change. In the absence of long-term adaptation in the 2070-2099, the yield is predicted to decrease by 25% or more.

2.4. Time Series Approach

To examine the relationship between climate variables and the yield of agricultural products, this approach suggests the use of past time series data on yield and climate variability.The time series approach has been extensively used to assess the impact of climate variables on the yield of various crops at global, country or regional level (Maharjan and Joshi, 2012).

Such an analysis assumes that changes in management are either unrelated to climate or originate from climate. In other words, product yields respond in the same way to rapid and gradual climate changes. These models provide a quantitative assessment of uncertainties. In order to minimize or possibly reverse the adverse effects of climate change, farmers change the cropping system as the climate changes. In addition, adaptation is expected to be a few years behind the climate trends. Because it is difficult to distinguish climate trends from natural variability and the disaggregated nature of farmer decisions (when farmers make decisions about adaptation, they are independent of each other) (Maharjan and Joshi, 2012).

Therefore, the observed data can be used when time series analysis is performed. However, in this regression analysis all possible variables affecting yields such as irrigation coverage, input use, labor utilization should be found. Therefore, in such cases, the estimation using the time series analysis is more suitable (Maharjan and Joshi, 2012). Table 4 presents the literature summary of the Time Series Approach.

Table 4: Studies on The Impact of Climate Change on Agriculture: Time Series Approach

Author	Country/Period	Variables	Results
Rahim and Puay (2017)	Malaysia 1983-2013	Dependent Variable: GDP Independent Variable: Farmland, temperature, rainfall	It has been concluded that there is a long run cointegration relationship between variables in the study. There is a one-way causality relation from rainfall, temperature and agricultural land to GDP.
Bayraç and Doğan (2016)	Turkey 1980-2013	Dependent Variable: Agricultural GDP Independent Variable: CO_2 emissions, agricultural yield, temperature, rainfall	In the study, changes in agricultural yield and rainfall have positive effects on agricultural GDP, and negative effects on CO2 emissions and temperature changes. Moreover, the negative effect of temperature changes on the agricultural sector is more than the positive effect of changes in rainfall amount. For this reason the overall impact of climate change on the agricultural sector is negative.
Zaied and Zouabi (2015)	Tunisia 1980-2012	Dependent Variable: Olive in tons Independent Variable: Rainfall, temperature, labor and capital stock	In long-term semi-arid areas, the olive output decreases with increasing temperature.
Amponsah et.al (2015)	Ghana 1961-2010	Dependent Variable: Cereal yield Independent Variable:CO_2, real GDP	The results indicate that there is significant negative link between CO_2 and cereal yield. There significant positive long run and short run link between cereal yield and income
Alam (2013)	India 1971-2011	Dependent Variable: Cereal yield Independent Variable: CO_2, economic growth	There is a positive and significant relationship between cereal yield and economic growth, while there is a negative and significant relationship between CO_2 emissions and economic growth.
Başoğlu and Telatar (2013)	Turkey 1973-2011	Dependent Variable: Agricultural GDP Independent Variable: Rainfall, Temperature, population, number of diploma from secondary education.	The results indicate that precipitation has a positive impact on agricultural GDP, while temperature has a negative impact.

3.DATA AND METHODOLOGY

Following the recent literature on economic impacts of climate change on agriculture, we take Aagricultural GDP as dependent variable and temperature and rainfall as the main independent variables. Data is transformed in logarithmic form as it provides consistent, better and efficient results. Annual time series data is utilized for the period of 1961-2013. All time series are taken from the World Bank, World Development Indicator database. The empirical model is given below.

Aggricultural GDP= ƒ (rainfall and temperature) (1)

The functional form of the model will be as:

$$AGDP = \beta_0 + \beta_1 Rain_t + \beta_2 Temp_t + \varepsilon_t \quad (2)$$

Where AGDP is the agricultural GDP as measured Agriculture, value added (% of GDP), Rain is rainfall as measured mm and Temp is the temperature as measured °C . t is the time trend and ε_t is white noise error term. The parameters β_1 and β_2 and are the long-run elasticities of Agricultural GDP with respect to rainful and temperature, respectively.

We have employed the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001) to ascertain the long-run relationship between Aggicultural GDP, Rainfall and Temperature. The ARDL approach has several advantages. First, The ARDL approach is that it can be used even in cases when different variables have different orders of integration. Second, when compared to the Johansen and Juselius cointegration test, the ARDL test ensures more consistent estimates in the case of small samples. Third, given that it is free of residual correlation, the ARDL testcan handle the eventual phenomenon of endogeneity among variables (Marques et al., 2016). Fourth, short-run adjustments can be integrated with the long-run equilibrium in ARDL by deriving the error correction mechanism (ECM) via simple linear transformation without trailing the information about long-run (Ali et al., 2017).

The mathematical representation of the ARDL approach is as follows

$$\begin{aligned}\Delta AGDP = {} & \beta_0 + \beta_1 \sum_{i=1}^{n} \Delta AGDP_{t-1} + \beta_2 \sum_{i=0}^{n} \Delta Temp_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta Rain_{t-i} \\ & + \beta_4 AGDP_{t-1} + \beta_5 Temp_{t-1} + \beta_6 Rain_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

Where Δ represents change. n is the optimum delay lengths. The existence of cointegration relationship between variables from Eq. 3 is examined by testing the significance of the lagged levels of variables using the F-statistic or Wald-coefficient test. Pesaran et al. (2001) propose testing $H_0 : \beta_4 = \beta_5 = \beta_6 = 0$ which means that we cannot reject the absence of cointegration, against the alternative $H_1 : \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$, which implies that the hypothesis of the existence of such a relationship cannot be rejected.

ARDL approach is based on two steps. First step, one is to determine the existence of a long run cointegrating relationship among the variables by using the Wald-coefficient test or F-statistics and by comparing them with critical values set out by Pesaran et al. (2001). Pesaran et al. (2001) reported two types of critical values: lower bounds and upper bounds. The critical values for the I(0) variables are referred to as lower-bound critical values while the critical values for the I (1) variables are referred to as upper-bound critical values. If the calculated F-Statistic is higher than the upper bounds, it means the null of hypothesis of no co-integration is rejected, indicating evidence of a long-run cointegratin relationship between the variables, regardless of the order of integration of the variables. If calculated F-statistic is below the lower bound, we cannot reject the null hypothesis of cointegration, indicating the absence of a long-run equilibrium relationship. If calculated F-statistic is between lower and upper bounds, a conclusive inference could not be made without knowing the order of integration of the underlying regressors. The second step is estimation of long-run and short-run coefficient. According to the estimation results of ARDL calculate long term coefficients. In order to investigate the short-run relationship between the variables, the error correction model based on the ARDL approach is established as follows.

$$\Delta AGDP = \gamma_0 + \gamma_1 \sum_{i=1}^{n1} \Delta AGDP_{t-1} + \gamma_2 \sum_{i=0}^{n2} \Delta Temp_{t-i} + \gamma_3 \sum_{i=0}^{n3} \Delta Rain_{t-i} + \gamma_4 ECM_{t-1} + \varepsilon_t \quad (4)$$

Where ECM(-1) term is a lagged value of the residual of model in which the long-term relationship is obtained. ECM(-1) is the speed of adjustment parameter which is expected to be negative.

4. FINDINGS AND DISCUSSION

Before testing whether the Agricultural GDP, rainfall and temperature are cointegrated, we investigated the order of integration of each series. Two different unit root tests were used to assess the integration order of the series: (i) the Augmented Dickey-Fuller (ADF) test; (ii) the Phillips Perron (PP) test.

Table 5: Unit Root Tests Results

	ADF Unit Root Test		Phillips-PerronUnit Root Test		Order of integration
Variables	Level	First Difference	Level	First Difference	
AGDP	-3.185633 (-3.498692)	-6.785477 (-3.500495)	-3.377705 (-3.498692)	-7.491863 (-3.500495)	I(1)
Rain	-6.574099 (-3.498692)	-	-6.539586 (-3.498692)	-	I(0)
Temp	-6.270889 (-3.498692)	-	-6.249822 (-3.498692)	-	I(0)

Note: Intercept and trend model with 5% significance level.

The study applied the unit root test on the natural logarithms of the variables in level and first difference forms as shown in Table 5, Order of integration is a mixture of I (0) and I (1). In other words, the results indicate that rainfall and temperature are stationary at level while aggricultural GDP is stationary at first difference. In Table 6 contains ARDL cointegration test results. Critical values for F-Statistic are presented in Pesaran et al. (2001). Also for small samples size, that are useful for 30 to 80 observations, these critical values were recalculated in Narayan (2005).

Table 6: ARDL (3, 4, 1) Cointegration Test Results

Test statistic	Value	k
F Statistics	7.585593	2
Critical Value Bounds (Peseran et al 2001)		
Significance	I0 Bound	I1 Bound
10 %	3.38	4.02
5%	3.88	4.61
1%	4.99	5.85
Critical Value Bounds (Narayan 2005)		
Significance	I0 Bound	I1 Bound
10 %	3.573	4.288
5%	4.225	5.030
1%	5.805	6.790

Note: k shows the number of explanatory variables. Critical values for the bound test were taken from Case IV in Pesaran et al. (2001) and Narayan(2005) (Pesaran et al. 2001; Narayan, 2005).

As seen in Table 6, the calculated F statistic values are above the critical values. This implies that there is a long-run relationship between the mentioned variables in the period covered. Long term coefficients calculated according to the estimation results of ARDL (3,4,1) model are shown in Table 7. The results of long run estimates are presented in Table 7. The results show that the temperature has a positive and significant impact on the agricultural GDP, in the long run. The coefficient of temperature implies that an increase of 1% in temperature, it will be cause of 1.472% in aggricultural GDP in the long run in Turkey. However, the results show that the rainfall has a negative and significant impact on the agricultural GDP, in the long run. The coefficient of rainfall implies that an increase of 1% in rainfall leads to a decrease of 1.032% on agricultural GDP, in the long run in Turkey.

Table 7: Long-Run ARDL Estimates

Dependent variable is the natural log of Aggricultural GDP		
Regressor	Coefficient	T-statistics (Probability)
lnTemp	1.472744	2.621136 (0.0126)*
lnRain	-1.032954	-2.006958 (0.0521)**
Trend	-0.042544	-24.984897 (0.0000)*
Diagnostic test statistics		
R^2		0.991970
Adj.R^2		0.989583
F-statistic		415.5261 (0.000000)
Durbin-Watson		2.028564
Serial Correlation		0.8971(0.8204)
Normality		1.361629(0.506205)
Heteroscedasticity		0.0659(0.0839)

Note: * and ** indicate significance levels of 5% and 10%, respectively.

The bottom part of Table 7 contains diagnostic test results of the selected ARDL (3, 4, 1) model. The adjusted R^2 value of 99% suggests that rainfall and temperature jointly explain a significant part of the variation in agricultural GDP. The JB test for normality indicates that the residuals are distributed non-normal. Furthermore, from the results of the Breusch-Godfrey serial correlation LM test and the Breusch-Pagan-Godfrey heteroscedasticity test, we fail to reject the null-hypotheses of no serial correlation and no heteroscedasticity of the residuals. In other words, the functional form of the model is normal, there is no serial correlation and heteroscedasticity in our model. The residuals are normally distributed.

Next the results of the short run ARDL estimate and the coefficient of the error correction terms are presented in Table 8.

Table 8: Short-run ARDL Estimate

Dependent variable is the natural log of Aggricultural GDP		
Variable	Coefficient	T-statistics (Probability)
D(LNAGGDP(-1))	0.170216	1.289254 (0.2053)
D(LNAGGDP(-2))	0.336495	2.364978 (0.0234)
D(LNRAIN)	-0.043435	-0.669609 (0.5073)
D(LNRAIN(-1))	0.428389	4.134152 (0.0002)
D(LNRAIN(-2))	0.379731	4.160083 (0.0002)
D(LNRAIN(-3))	0.182407	2.239388 (0.0312)
D(LNTEMP)	0.490778	3.290868 (0.0022)
C	2.467922	5.633993 (0.0000)
ECM(-1)	-0.548492	-5.727352 (0.0000)

The important outcome of the short run dynamics is the calculation of the coefficient of ECM.The lagged error correction coefficients, ECM_{t-1} are correct in sign, and significant in both cases verifying the established co-integrating relationships among the variables (Jalil et al., 2013). The ECM coefficient is negative and statistically significant. The coefficient of ECM_{t-1} shows the speed of the adjustment back to the long-run equilibrium after a short run shock. For example, the coefficient of ECM_{t-1} is 0.5484. This implies, nearly 55% of the disequilibria of the previous year's shock adjusting back to the long run equilibrium in the current year.

5. CONCLUSION

In recent years, the effects of climate change on important variables such as agriculture, industry, human health, energy demand and economic growth are being increasingly investigated. Climate change modifies the distribution of a set of climate variables including temperature, rainfall, humidity, wind speed, sunlight duration, and evaporation. In recent years, a number of studies have been conducted around the world on the impacts of climate change. Climate change affects various sectors such as agriculture, food production, fisheries, livestock, forestry, foreign trade, tourism, health, construction, logistics and finance-insurance. However, among these sectors, agriculture is a very sensitive sector to climate

change. The effects of climate change can arise by influencing production factors and their productivity, prices and international trade patterns. Furthermore, the effects of climate change on the countries may be different. These effects, which differ from country to country, can also change agricultural competitiveness. As a result of climate change, both winners and losers can emerge. In this study, the literature on economic effects of climate change in agriculture is presented in consideration of four different approaches (Production function approach, Ricardian approach, Panel data approach, Time series approach). In these studies, it is observed that especially temperature and rainfall are used as the two most important indicators of climate change for agricultural production. In this study, important climate variables such as temperature and precipitation were used to evaluate the effects of climate change. The effects of climate variables on aggricultural GDP in Turkeywere estimated using the Autoregressive Distributed Lag (ARDL) approach. In this study, the increase in precipitation affects agricultural GDP positively, while the increase in temperature has a negative effect on agricultural GDP. In order to minimize the adverse effects of climate change in Turkey, which is one of the largest countries in the world in terms of agricultural land, it is important to establish policies, strategies, plans and programs to combat climate change. In addition, the production of agricultural products suitable for the increase in temperature in Turkey should be supported and the farmers should be aware of the adaptation to climate change. Further research on agricultural production in Turkey should take into account the impact of other climate indicators (such as solar radiation, light length, humidity, socio-economic and sea level).

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THE IMPORTANCE OF WEB SITE ATMOSPHERICS WITH EMPHASIS ON VISUAL COMPLEXITY IN ONLINE RETAILING BASED ON S-O-R PARADIGM[1]

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ABSTRACT

Purpose - Online retailing web sites have become a valuable platform where consumers are exposed to companies' products and services. Online web sites' visual characteristics include text, pictures, graphics, layout, motion have been identified as some of the main factors contributing to repetitive visits and purchases. As visual design and making the right design decisions are critical to effective online retailing, clarifying these visual elements are crucial. Accordingly, the purpose of this study is to provide the main insights highlighted in the literature related to online shopping web site visual cues as well as to propose the adaptation of visual complexity concept to this relatively new environment via S-O-R paradigm discussion.

Methodology - Through a literature review, the importance of web site atmospherics with emphasis on visual complexity and their influence on consumers' decision making process via their cognitive and emotional states based on S-O-R paradigm is discussed.

Findings – Both the online and offline retailing literature survey suggests that visual complexity of an online retailing web site may have a strong effect on marketing outcomes (revisit/repurchase) and S-O-R paradigm is the foundational theory that helps to support this major argument.

Conclusion - As online shopping becomes more competitive, online retailers continuously look for ways to attract more online customers and hence increase their purchase intentions. One way to induce revisit intention is to provide an online retailing environment that features superior atmospherics that are visually less complex. Rather than getting lost in the design decision of each element individually, taking a more holistic approach attempting to understand the interplay between visual cues that define visual complexity is a necessity to generate effective marketing strategies in online retailing.

Keywords: online retailing, web site atmospherics, visual complexity, online shopping, PAD model
JEL Codes: M30, M31, M39

1. INTRODUCTION

The attention of both practitioners and academics to online shopping is constantly increasing due to several benefits it provides over traditional retailing. Along with the technology improvements (i.e. Internet, smart phones) online retailing offers greater convenience and more information, therefore, more retailers are considering online platform as a means of doing business (Eroglu et al., 2001). The prevalence of shopping on the Internet has changed both retailers' marketing

[1] This paper is produced from the PhD thesis of Nesenur Altinigne with her supervisor. The thesis, which will be submitted to the ITU Institute of Social Sciences, is entitled as "An Examination of Factors Affecting E-Retailer Revisit Intention: An Experimental Study on Individual-Related and Relational Causes".

strategies and consumers' purchasing environments (Varadarajan and Yadav, 2002). Especially, the disappearance of time and space boundaries makes online retailing a desirable commercial medium (Kalakota and Whinston, 1997). Online stores provide cross channel shopping opportunities so that consumers attain time and place convenience, make easier comparisons, and enjoy unconventional experiences (Eroglu et al., 2001). The world statistics indicate that the total e-commerce value was $837389.6 million in 2014, it is forecasted to be $2918 billion in 2020 and online retailing constitutes 50% of this value (Kantarci et al., 2017). In parallel to the global trend, e-commerce has gained great attention in Turkey, too. Online retail value for Turkey was $3096.7 in 2014 and it is expected to be $5479.8 million in 2019 (Afra, 2014).

The statistics indicate that online retailing industry is growing enormously that leads to fierce competition. Therefore, how to create an online retailing environment that assists to attract and retain consumers stays as a major research question in online retailing as to benefit from this growth (Eroglu et al., 2001). Like in traditional retail stores, physical environment features of online stores affect the various psychological and behavioral shopping outcomes (e.g. satisfaction, time spent in online store) of online shopping (Bitner, 1992; Mallapragada et al., 2016). Eventhough several online retailers have adopted advanced technologies (e.g. computer-aided tools), offering functional features may not be enough for the design of a consumer-oriented online retailing environment. Atmospheric properties of online retailing environment are one of the major variables that help to achieve better shopping experience (Shih, 1998). As the literature indicates, the effect of the online retailing elements on online consumer behavior is a potential area that lacks in-depth investigation (Grewal and Levy, 2007). Despite the increasing attention to online retailing, not much research has given emphasis to the clear categorization of different atmospheric features of online stores (Dailey, 2004; Eroglu et al., 2001), hence their impact on online consumer behavior (Grewal and Levy, 2007). Earlier studies about traditional retailing focus on the specific features of the atmospherics that are music (Hui et al., 1997), lighting (Golden and Zimmerman, 1986), color (Belizzi et al., 1983), and scent (Spangenberg et al., 1996). Similarly, these atmospheric qualities tend to have impact on the psychological and behavioral shopping outcomes (e.g. enjoyment, satisfaction, repatronage, amount purchased, and time spent in the virtual store, basket value) in online store environments (Grewal et al., 2009; Mallapragada et al., 2016). In electronic retailing, web sites are the primary interfaces via which consumers are exposed to products and services so that the effective design of online retailing web site may lead to competitive advantage (e.g. higher trust, engagement, loyalty) (Alba et al., 1997). However, shopping web sites partly lack some of the sensory properties of the offline environment that are scent, touch, and taste. Therefore, visual and audial senses should be emphasized in online shopping settings. This paper will focus on the visual cues of e-retailing web sites and highlight how visuals and their design can enhance online shopping experience.

2. THEORETICAL FOUNDATION OF ONLINE STORE ATMOSPHERICS

Atmospherics are defined as ‘‘the conscious designing of space to create certain buyer effects, specifically, the designing of buying environments to produce specific emotional effects in the buyer that enhance purchase probability.” (Kotler, 1973–74, p. 50). Research related to the atmospheric cues’ generally build upon environmental psychology (Mehrabian and Russell, 1974). The Stimulus–Organism–Response (S–O–R) model of this discipline suggests that stimuli influence consumers’ emotional states (organism), whose response result in their retail behaviors (responses) (Mehrabian and Russell, 1974; Russell and Pratt, 1980; Thang and Tan, 2003). When applied in a retail setting, the stimuli are operationalized as the atmospheric cues, organism as emotional and cognitive states of consumers, and response as approach/avoidance behaviors (repatronage, repurchase, longer visit duration) (Donovan and Rossiter, 1982). The S–O–R framework has been extensively tested in the past research of traditional retail environments with promising results (e.g. Baker et al., 1994; Sherman et al., 1997) and can be utilized in studying e-retailing atmospherics, too (Figure 1).

Figure 1: Shopping Web Site Environment and the Adaptation of S-O-R Paradigm

<table>
<tr><td>Stimulus</td><td colspan="3">Organism</td><td>Response</td></tr>
<tr><td rowspan="2">Online Store Atmospheric Cues</td><td colspan="3">Cognitive and Emotional Assessment</td><td rowspan="2">Approach/ Avoidance</td></tr>
<tr><td>Dominance</td><td>Pleasure</td><td>Arousal</td></tr>
<tr><td>Visual Complexity</td><td>Perceived Control</td><td colspan="2">Enjoyment</td><td>Revisit/Repurchase Intentions</td></tr>
</table>

The stimuli in the S–O–R framework are represented by a set of different attributes that affect the perceptions of consumers (Mazursky and Jacoby, 1986). These attributes are cues that enter a consumer's emotional space and arouse or incite him/her consciously or subconsciously into action (Mehrabian and Russell, 1974; Russell and Pratt, 1980). However, slightly different from the argument of Russel's (2003) revised S-O-R paradigm, in this study it is argued that in online store settings, consumers' cognitive mechanism gets activated prior to emotional assessments. At the start of the online shopping experience, some skills' such as computer literacy, navigation skills, familiarity with online jargon and so on need to be utilized by the shopper so that he/she will feel that they have control over the environment. Accordingly, as the Figure 1 illustrates, Russel's (2003) pleasure-arousal-dominance sequence occurs as reversed during online retail environment evaluations of consumers and in addition to emotional one includes cognitive assessment too. The attributes entered into a consumer's mind in a traditional retail environment include social factors such as the people in the store, customers, and employees; design factors such as visual cues of layout, clutter, cleanliness, and color; and ambient factors such as non-visual cues including smells and sounds (Baker et al., 1994). While all these factors except olfactory and touch related ones may be available in online retailing context, the primary attributes that consumers are prevalently exposed to are visual ones which may actually increase the trust, and hence engagement level of consumers (Ganguly, 2010; Sanchez et al., 2010). According to Tan and Guo (2005) the Internet is viewed by customers as a world of chaos and establishing trust in this chaotic online environment is one of the most crucial factors for success (Ganguly et al., 2010). Although some research (e.g. Cyr, 2008; Yoon, 2002) provide empirical evidence on how various design factors build trust in the context of online retailing, the researchers and practitioners have still not reached to a consensus on what constitutes optimal website visual design. In this study, we have carried a review of the literature on website design in order to determine a comprehensive understanding of visual elements in online retailing environment.

3. DEFINITION OF WEB ATMOSPHERICS IN E-RETAILING

Previous studies introduce web atmospherics classification according to their influence on consumers (Dailey, 2004; Eroglu et al., 2003) and they come up with different categorizations that partly overlap. Schenkman and Jonsson (2000) propose a bi-dimensional categorization of visual elements of online retailing web site design that are, aesthetic formality and aesthetic appeal. Aesthetic formality is related to the order, legibility, and simplicity of a website, while aesthetic appeal refers to the overall impressiveness of a web site based on its hedonic quality. Consistent with their categorization Lavie and Tractinsky (2004) put forward two similar dimensions and name them as classical and expressive aesthetics. Classical aesthetics are composed of the organization, clearness, and symmetricity of a web site, and resembles to the aesthetic formality dimension. On the other hand, expressive aesthetics refer to the creativeness, fascination, and originality of a website, and correspond to the aesthetic appeal dimension. Their findings indicate that the former dimension of web aesthetics is related to the utilitarian attributes of visual design, while the latter emphasizes the hedonic qualities.

Eroglu et al. (2001) offer another typology that classifies environmental characteristics of the virtual ''store'' into two groups: high task-relevant and low task-relevant characteristics. According to their grouping high task-relevant cues refer to "all the site descriptors (verbal or pictorial) that appear on the screen which facilitate and enable consumer's shopping goal attainment, while low task-relevant cues represent site information that is relatively inconsequential to completion of the shopping task" (Eroglu et al., 2001, p.180). They claim that verbal and pictorial content directly related to shopping goals such as descriptions of the merchandise, price, terms of sale, delivery and return policies. Pictures of the merchandise, availability of sampling, and navigation aids are considered as high task-relevant cues. The ones that are unrelated to the shopping goals such as colors, borders and background patterns, typestyles and fonts, animation, music and sounds, entertainment, amount of white space, icons, and pictures other than the merchandise are considered as low task-relevant cues. Eroglu et al. (2001) define visual characteristics as low task-relevant cues and assume no direct relationship between them and shopping outcomes. However, Kaltcheva and Weitz (2006) assert that visual characteristics (i.e. the colors, typestyles and fonts, animation) which are arousal-inducing features of an online retailing store environment have a significant effect on consumer affective responses towards the environment and on the subsequent e-shopping behaviors (e.g. revisit, repurchase, browsing duration). Another approach by McKinney (2004) divide online store atmosphere into five dimensions: external variables (links on internet shopping site home-pages), internal variables (links prepared to access a department and/or brand on the web site), layout and design (all appearances; color scheme, graphics, photos, and texts), point-of-purchase signs (options available at the time of purchase), and customer services (links providing information or offering specific services to). According to McKinney's research, the last two dimensions are related to the time of the purchase or post-purchase. The first three dimensions (external, internal, and layout and design) are related to initial exposure which is composed of visual design features.

As the main studies above highlight, the visual cues of an online retailing web site have several categorizations based on different perspectives. While some research offers simpler categorizations (Schenkman and Jonsson, 2000; Lavi and Tranctinsky, 2004; Donderi, 2006; Guo and Hall, 2009; Hoffmann et al., 2011), others suggest more detailed ones (Pieters et al., 2010; Mai et al., 2014). However, they all acknowledge online shopping store's visual cues' impact on consumers' emotional states (arousal, pleasure). Under the model of PAD pleasure-arousal-dominance (Mehrabian and Russel, 1974) visual cues are investigated as stimuli that affect consumers' emotions (arousal, pleasure) which in turn generate approach/avoidance behaviors (repurchase, revisit). Since human emotions are intrigue and complicated concepts (Plutchik, 2003), more detailed approaches are required to understand the role of visual stimuli in online shopping settings is an interesting area of research. However, due to the multidimensionality of web aesthetics rather than focusing on each visual cue (i.e. color, typology, pattern) individually, it is better to evaluate their effect in a more holistic way which is defined as visual complexity being composed of feature complexity, design complexity, coherence, and novelty. By looking at the entire online shopping environment from visual complexity perspective may provide a broader insight into understanding the emotional and cognitive assessment processes and hence its impact on online shopping outcomes.

4. VISUAL COMPLEXITY IN E-RETAILING

Mai et al. (2014) propose the concept of complexity of the visual characteristics of online retailing web sites and define web site complexity as another arousal-inducing element. In general, complexity is defined as "the amount of variety or diversity in a stimulus pattern" (Berlyne, 1960, p. 38). The literature in human-computer interaction argues that different views contribute to web site complexity, including the amount of information, number of links, number of images, and use of animation (Geissler et al., 2001; Germonprez and Zigurs, 2005). Hence, it is possible to offer sub-types of web site complexity. Three components suggested in the literature are content, structural and visual complexity (Donderi, 2006; Guo and Hall, 2009; Hoffmann et al., 2011). Content complexity refers to the amount of information presented in a web site, while the other two define web site complexity in the scope of design characteristics. Structural complexity means the variation of different elements or the arrangement of a web site's objects (the amount of the elements on a given web site or irregular and asymmetric arrangements of these). Visual complexity refers to how visually cluttered the features of a given web site are (variation and details in the elements of a particular web site or the amount of interactive and dynamic elements) (Cox and Cox, 2002). While the researchers in computer and vision science examine the images that contain more detail and variation in their basic visual features (color, luminance, and edges) under the general labels of "visual complexity" (Donderi, 2006) or "visual clutter" (Rosenholz et al., 2007), it is classified in a different way in advertising literature that is more adaptable to online retailing atmosphere. According to one of the leading studies in advertising by Pieters et al. (2010), visual complexity has two dimensions: feature complexity and design complexity. They define the advertisements that contain more detail and variations in terms of three basic visual features that are, color, luminance, and edges, as having more feature complexity. They assert that the more detail and variation that an advertisement contains in terms of the three basic visual features across an image, the more computer memory is needed to store the image, hence it is considered as visually complex. Pieters et al. (2010) assert that design complexity has more depth than feature complexity. It mainly underlines the variation of the structure of the specific shapes, objects, and their arrangements in the advertisement. Overall, they assert that the more the quantity of objects the higher the irregularity in the shape of the objects (symmetry simplifies object and pattern perception), the dissimilarity in shapes, textures, orientations, and/or colors (similarity in the context simplifies the pattern perception), the details of objects in terms of intricate textures or color variations, the asymmetry of object arrangement and the irregular pattern of object arrangement (random distribution of objects across space), the higher the design complexity. Similar to advertisements, the focal point of online retailing web site is to grab consumers attention and attract them to the stimulus (advertisement/web site), influence organisms (consumers' affect and cognition), and in turn generate positive responses (revisit/repurchase). In both contexts, visual cues act as stimuli that help or hurt to facilitate approach behaviors through cognitive and emotional states. Since, the nature of both contexts overlaps, the concept of visual complexity is adaptable to online shopping web sites.

5. DISCUSSION

Visual stimuli are known to have an influence on affective responses towards the target (web site, brand, company) and in turn, strongly influence judgments and decision-making process (Pham et al., 2001). Due to the complicated nature of human emotions (Plutchik, 2003), more detailed approaches should be utilized to understand the underlying mechanism. Kumar et al. (2013) suggest an approach that emphasizes the interplay of visual elements with each other rather than

separately focusing on them. According to their perspective consumers may perceive an environment in terms of five visual aesthetics stimuli, i.e. legibility, mystery, coherence, complexity, and novelty, through which they assess the environment. Adopting complexity and other holistic variables into online retailing web sites may introduce a deeper understanding of the process and the visual cues' impact on online shopping outcomes. S-O-R paradigm suggests that atmospheric cues influence consumers in altering their cognition and affect (Eroglu et. al., 2003) that occur through pleasure-arousal-dominance (PAD) sequence (Russel, 2003). This study acknowledges the underlying value of this paradigm in online retailing but challenges the PAD sequence. In order to understand how this sequence flows in online shopping, web site specific features of this environment should be taken into consideration. The nature of an online retail setting requires individuals to utilize some cognitive skills (e.g. computer literacy, navigation skills, familiarity with online jargon). Therefore, before consumers begin to shop online (as a user of an electronic device), their cognitive mechanism is already activated. For instance, online shopping store with high/less visual complexity (Stimulus) may confuse/comfort consumers (Organism) and decrease/increase their perception of control (Dominance), and then may produce frustration/enjoyment (Pleasure+Arousal) which in turn may cause them to leave the web site without any purchase (Response). Based on these arguments, this study claims that cognitive elaboration takes place before emotional states in online shopping web sites and revises PAD model as DPA (dominance-pleasure-arousal) (Table 2). In other words, visual complexity may impinge on the consumers' perception of their abilities and skills in navigating in the online store environment so that they may lose their sense of being dominant over the environment (perceived control). This feeling then triggers some emotional states which may define revisit/repurchase intentions.

6. CONCLUSION

Statistics indicate that online retailing has undeniably more advantages in Turkey. According to Kantarci et al. (2017), there are 46.2 million Internet users in Turkey and on average Turkish consumers spend 4.9 hours a day using the Internet through their PCs. Furthermore, 1.9 hours a day are spent on the Internet through mobile devices such as tablets and smartphones (Afra, 2014). In order to benefit from the prevailing trends in online retailing in Turkey, online retailers need to invest in dedicated departments to plan and execute internet strategies that follow recent developments in their sector and focus on innovation to remain up-to-date with the latest developments. As online markets become more competitive, online retailers continuously look for a way to attract more online customers and increase their purchase intentions. One way to do so is to provide an online retailing environment that features superior atmospherics and hence induces revisit/repurchase intentions. Each revisit/repurchase has potential to strengthen the bonds with consumers and enhance positive emotions. Visual complexity has potential to help or hurt attention and attitude toward the web site. Stuffing the online shopping web site with detailed patterns, colors, images may prevent consumers from paying attention to the web site due to increased workload. Since when processing resources are limited, attention to the online shopping web site drops when presented in a high complex way. As a result, people do not stay in a web site if they are exposed to high levels of complexity and may leave immediately or may look at it only briefly because complexity distracts them from paying enduring attention. According to the S-O-R paradigm, attention to the stimuli plays a crucial role in generating positive marketing outcomes (revisit, repurchase) (Wedel and Pieters, 2000). Reduced web site attraction can have long-term effects for online retailing web site equity. Drawing on this, reduction of visual complexity is vital in environments with high attention competition, such as in online retailing, print advertising and media contexts. Pracejus et al. (2006) conclude that advertisements with much "white space" lead to more positive brand attitudes. The main reason behind it may the fact that it helps to regulate the perception of visual complexity. Similar design principle can be applied to online shopping web sites to manage visual complexity. The literature indicates that across many environments the ones without visual complexity engender identifiability and familiarity (Pieters et al., 2010). Measurability of visual complexity may give marketers control over their creative tools by offering ways to lower cost to improve their effectiveness. Similar to advertisements, making visual complexity measurable for online stores may set maximum and/or minimum desirable levels of visual complexity and hence indicate areas for improvement for a better online shopping experience.

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THE IMPACT OF SOCIAL CAPITAL ON MARKET EXPLORATION AND EXPLOITATION WITH MEDIATING ROLE OF INTERNAL COMMUNICATION

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ABSTRACT

Purpose – Present study aims to test the mediating role of internal communication on the relationship between social capital and market exploration and exploitation, and to link the impact of market exploration and exploitation to the firm performance.
Methodology - The hypotheses derived from the literature were tested on a sample of 173 information technology firms in Turkey. Survey data was gathered through questionnaires which were applied to the managers of the firms. Relationships among variables were analyzed through structural equation modeling using Amos 25.0 statistical tool.
Findings- Internal communication's full mediating impact on the relationship between social capital and market exploitation and exploration was supported. In return, market exploration was found to have a significant impact on firm performance which was measured by quality, innovation, reputation and customer satisfaction.
Conclusion- Social capital is an antecedent for an effective internal communication and should be well established in the firms. Internal communication has an impact on both market exploration and exploitation activities, thus it should be supported and encouraged within the firms. Market exploration activities should not be neglected since they may contribute to firms' performance especially in the long run.

Keywords: Social capital, internal communication, market exploration, market exploitation, research paper
JEL Codes: L20, D22, D83

1. INTRODUCTION

Since 1970s, rapid development in communication and computer technology changed the rules of global economic growth; and knowledge has become the most important capital especially for high-tech sectors (Chen et al., 2004). The dramatic shift from manufacturing to knowledge-driven services has increased the contribution of intangible assets and market-based capabilities towards firm performance (Ramaswami et al., 2009). Market exploitation and exploration activities are crucial for sustaining the current markets and expanding to the new markets. Recent literature suggests that internal communication can be fostered through the social capital of the firm (Hazleton and Kennan, 2000). In present research, it is proposed that internal communication mediates the relationship between social capital and market learning activities. This study contributes to the current literature through suggesting a new relationship which has been neglected in the literature.

2. LITERATURE REVIEW

In this part, the definitions and the relationships among variables, and theoretical background for the study will be presented.

Market Exploitation and Market Exploration

Market knowledge is considered as an important factor for the survival of the companies and firm performance (Narver and Slater, 2004). Market knowledge's importance has increased during the last decades since the source of competitive

advantage has shifted from tangible assets to market-based assets and capabilities (Ramaswami et al., 2009). According to Lane and Lubatkin (1998), knowledge should be continuously replenished through generation and exploitation of the knowledge. Yli-Renko et al. (2001) argue that market knowledge may speed up product development, enhance technological distinctiveness and increase efficiency. Market exploitation and exploration are two main learning activities that promote acquisition and utilization of market knowledge (Lisboa et al., 2013). The conceptual distinction between exploration and exploitation has been discussed in various management areas including strategic management, organization theory and managerial economics (He and Wong, 2004). Exploitation activity is related to terms ‘‘refinement, choice, production, efficiency, selection, implementation, execution'' whereas exploration is related to ‘‘variation, risk-taking, experimentation, play, flexibility, discovery, innovation'' (March 1991). Since exploitation is associated with the utilization of existing competences, technologies, and paradigms, its returns are usually positive and predictable; on the other hand, exploration is associated with searching for new alternatives, the returns are uncertain (March 1991). Levinthal and March (1993) state that exploration refers to a company's effort to broaden and deepen the companies’ long-term success. Thus, the results of exploration can be realized in the long term and they can turn out to be negative due to uncertainty. Strategy studies relating ambidexterity perspective consider that exploitation and exploration as two distinct but complementary activities (Hsu et al., 2013). Tushman and Anderson (1986) develop punctuated equilibrium model suggesting firms can pursue different strategies in different time periods. In general, overemphasizing exploitation may lead to organizational myopia and competency trap, while overemphasizing exploration may lead to delay in responses to current market demands with existing capabilities (Hsu et al., 2013).

Social Capital and Internal Communication

Social capital concept has been frequently used since the 1990s alongside the established concepts of financial, real and human capital (Westlund and Bolton, 2003). The concept of social capital was developed by Jacobs (1965) for the use of community studies, then it spread to other disciplines including organizational studies (i.e. Burt, 1992; Nahapiet and Ghoshal, 1998). Bourdieu and Wacquant (1992) define social capital as "the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition". Coleman (1988) defines social capital by its function as "a variety of different entities having two characteristics in common: they all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure". Putnam (1993) defines social capital as "features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit". Nahapiet and Ghoshal (1998) identify three dimensions for social capital: structural, relational and cognitive. Structural dimension is related with network ties, network configuration, and appropriable organization (the overall pattern of connections among actors); cognitive dimension is related with shared codes, language, and narratives (resources providing shared representations, interpretations, and systems of meaning among parties); and relational dimension is related to trust, norms, and obligations (assets that are rooted in relationships). Adler and Kwon (2002) emphasize two different aspects of social capital: as bonding within the units of the firm and bridging to external networks. Yli-Renko et al. (2001) state that social capital can be crucial for long-term success of the technological firms. Nahapiet and Ghoshal (1998) argue that social capital facilitates the knowledge acquisition and exploitation through the exchange of intellectual resources. Internal communication is key for organizational learning and being responsive (Walter et al., 2006). Mitrega et al. (2012) accept internal relationship quality as a meta-construct which is defined as "interrelations within the company which comprises relations between superior and subordinate and employees from various departments with or without the existence of hierarchical bonds.

Relationship Among the Variables

Hazleton and Kennan (2000) suggest that an important antecedent of social capital is communication, and after social capital is created in the company, social capital starts fostering communication. For an effective internal communication capability, there should be enough social capital to support the process. Since social capital is related to collaboration and mutual trust, employees can find the appropriate atmosphere and motivation to share their knowledge and network within the company. Thus, it is proposed that internal relationship quality is determined by the social capital of the firm and in return predicts the effectiveness of internal communication. Thus, following hypothesis is generated:

H1: Social capital has an impact on internal communication

In order to obtain positive organizational outcomes, Walter et al. (2006) suggest that firms should be able to connect and integrate external relationships internally. Thus, internal communication can be seen as an indispensable part of network capability elements beside coordination, relational skills, and partner knowledge. Mitrega et al. (2012) state that in dynamic capability concept and resource-based theory, internal communication is treated as one of the key elements for competitive advantage. Ritter and Gemünden (2003) found that internal communication has a positive impact on network competence. Similarly, Yli-Renko et al. (2002) argue that internal communication fosters the evaluation of new

technological information and improves the efficiency of technical problem-solving. According to Song et al. (2016), high-quality networking is crucial for gathering useful information, especially under uncertain environments. Mitrega et al. (2012) found that internal relationship quality predicts the customer relationship quality. Similarly, Ritter and Gemünden (2003) argue that internal communication structure is a crucial part of firm's networking ability, since it contributes firms' ability to respond customer needs. Thus, following hypotheses are generated:

H2: Internal communication has an impact on market exploration

H3: Internal communication has an impact on market exploitation

Hazleton and Kennan (2000) argue that social capital increase the organizational advantage via communication, and organizational advantage improves the ability of the organization to adapt to changing environments. Based on the literature, it can be argued that internal communication which is fostered by social capital, may have a positive impact on market exploitation and exploration. Thus, following hypotheses are generated:

H4: Internal communication mediates the relationship between social capital and market exploration

H5: Internal communication mediates the relationship between social capital and market exploitation

He and Wong (2004) find empirical evidence that optimal balance between exploitation and exploration activities has a positive impact on firm performance, whereas the imbalance between them has a negative effect. Yli-Renko et al. (2001) argue that market knowledge may speed up product development, enhance technological distinctiveness and increase efficiency. Garcia et al. (2003) argue that exploiting current markets enables firm to ensure efficiency while exploring new markets enables firm's long run survival. However, the results of the study of Molina-Castillo et al. (2011) on manufacturing companies showed that under high levels of market turbulence (instability or unpredictability of markets), exploitation perform better in launching new products. Based on various findings related to the outcomes of market exploration and exploitation, following hypotheses will be tested:

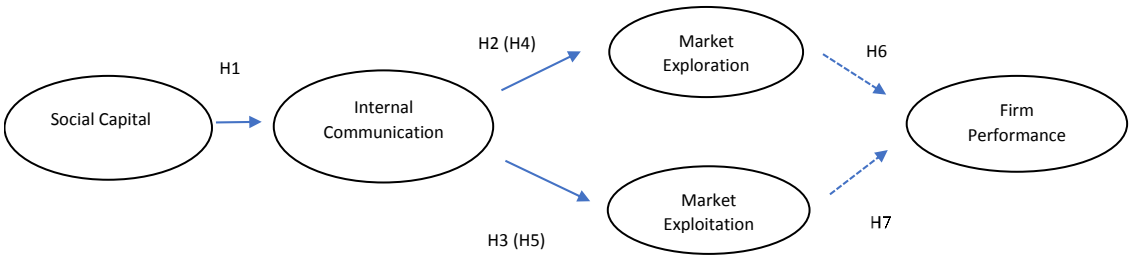
H6: Market exploration has an impact on firm performance

H7: Market exploitation has an impact on firm performance

Theoretical Background

Resource-based view (RBV) suggests that sustained competitive advantage derives from the resources and capabilities a firm control which are valuable, rare, imperfectly imitable, and not substitutable (VRIN) (Barney, 1991). Author argues that such resources and capabilities can be both tangible and intangible assets, such as a firm's management skills, organizational processes and routines, and the information and knowledge it controls. The global competitive battles in high technology industries require a new paradigm other than the resource-based view, since winners in global marketplace show rapid responsiveness to market needs, achieve flexible product innovation and coordinate internal and external capabilities effectively (Teece et al.,1997). The authors define such capabilities as dynamic capabilities. 'Dynamic' refers to the capacity to renew competences; 'capabilities' refer the key role of strategic management in adapting, integrating and reconfiguring internal and external organizational skills, resources and functional competences required in changing the environment (Teece et al., 1997). According to Möller and Svahn (2003, p.219), there is an 'internal' emphasis in dynamic capabilities definition, since the dynamic capability view (DCV) originates from the resource-based view of the firm, which considers strategic capabilities as a pool of the internal resources. Lin and Wu (2014) suggest that strategic management should consider resource-based view and dynamic capabilities view together instead of separating them. The findings of the authors show that dynamic capabilities can mediate the relationship between VRIN resources and firm performance. In present study, market exploration and exploitation can be accepted as integration capability and effective communication can be accepted as a reconfiguration capability from a dynamic view. On the other hand, social capital is considered as an important intangible resource for a firm (Chisholm and Nielsen, 2009). Thus, both resource-based view and dynamic capability view is adopted in this study. The hypothesized model can be seen in Figure 1.

Figure 1: The Hypothesized Model



H1: Social capital has an impact on internal communication

H2: Internal communication has an impact on market exploration

H3: Internal communication has an impact on market exploitation

H4: Internal communication mediates the relationship between social capital and market exploration

H5: Internal communication mediates the relationship between social capital and market exploration

H6: Exploration has an impact on firm performance

H7: Exploitation has an impact on firm performance

3.DATA AND METHODOLOGY

A multi-item questionnaire measured on a 6-point interval scale (1=strongly disagree to 6=strongly agree) was used in this study. 6-point interval scale is preferred to avoid the tendency of respondents choosing the mid-points which is usually observed in 5-point Likert scales. Social capital scale is consisted of 7 items and developed by Nahapiet and Ghoshal (1998). Internal communication scale is consisted of 5 items and adopted from Walter et al. (2006) as a part of the network capability scale. Market exploration (4 items) and market exploitation (4 items) were adopted from the study of Lisboa et al. (2013). Birley and Westhead (1990) suggest that comparisons with competitors brings important information to the studies. Respondents were asked to evaluate their firms compared to their competitors (1=much worse than competitors to 6=much better than the competitors) based on the following indicators: i. product/service quality, ii.new product/service/process innovation, iii. company reputation iv. customer satisfaction (adopted from Wiklund and Shepherd (2003) and Moorman and Rust (1999)). Relationship among factors (path analyses) will be analyzed through structural equation modeling using AMOS statistical program version 25.0. Factor analyses and reliability tests were performed through SPSS 24.0. Sample data was derived from the first 500 information technology firms operated in Turkey. Survey data was collected through face-to-face interviews with the owners, top managers, and middle managers through structured questionnaires. The sampling method of the study is convenience/non-probability sampling. In total, 180 questionnaires could be collected within 2 months. 173 questionnaires were qualified for the research; therefore, response rate is 34.6% (173/500).

4.FINDINGS

4.1.Descriptive Analyses

Respondents were preferred from owners/partners or top-level managers, since they were assumed to have broader knowledge about their firms. When it was not possible to reach the owners or top-level management, questionnaires were directed to the middle-level managers and then to the first-level managers. According to the results, 48 respondents (22%) were top level managers, 58 (33%) respondents were middle level managers, 77(45%) were first- level managers. Ranks of the firm in the first 500 IT firms are as follows: 19% is in the first 100; 11% is in 101-200; 13% is in 201-300; 34 % is in 301-400; 23% in 401-500 interval. Thirty-three firms (19%) were between 2-9 years old; 52 firms (30%) were between 10-14 years old; 47 firms (27%) were between 15-19 years old and 41 firms (24%) were older than 20 years old. Thirty-two firms'

(18%) employee numbers are between 4-10; 34 firms'(20%) employee numbers are between 11-20; 46 firms' (27%) employee numbers are between 21-40; 30 firms' (17%) employee numbers are between 41-150; 31 firms' (18%) employee numbers are more than 150.

4.2.Exploratory Factor Analyses and Reliability Analyses

Exploratory factor analyses and reliability analyses were performed through SPSS v. 24.0 statistical tools. The KMO and Cronbach's alpha values of the dimensions that were used in the analyses can be seen in table 1 (items are available in the appendix.).

Table 1: Factor Analyses and Reliability Analyses Results

Variable Name	N	KMO	Cronbach's alpha
Social Capital	7	0.87	0.876
Internal Communication	4	0.765	0.760
Market Exploitation	4	0.772	0.802
Market Exploration	4	0.794	0.845
Firm Performance	4	0.657	0.733
Total items	**23**		

Path Analyses

Proposed model was tested through path analyses and the results showed that model fit the data quite well (table 2: X^2(187, N=173) =209.436; p=.125; GFI=.91; CFI=.99; NFI=.90; TLI=.98; RMSEA=.026). In the model, impact of social capital on internal communication (std. beta 0.844; p=0.00) and internal communications impact on both exploration (std. beta=0.874; p=0.00) and exploitation (std. beta=0.985; p=0.00) were found significant. Regarding market exploration and exploitation's impact on firm performance, market exploration was found significant (std. beta 0.752; p=0.044) whereas exploitation was insignificant (std. beta -0.323; p=0.355). Thus, H1, H2, H3 and H4 were supported at p<0.001 level, and H4 was supported at p<0.05 level. However, H7 was not supported.

H1: Social capital has an impact on internal communication → supported

H2: Internal communication has an impact on market exploration → supported

H3: Internal communication has an impact on market exploitation → supported

H6: Market exploration has an impact on firm performance → supported

H7: Market exploitation has an impact on firm performance → not supported

Table 2: Path Analyses Test Results for the Model (indirect impact with mediator)

Path	Std. B	t value	p value
social capital --> internal communication	0.844	5.119	***
Internal communication --> market exploration	0.874	6.655	***
Internal communication--> market exploitation	0.985	7.450	***
market exploration --> firm performance	0.752	2.013	0.044*
market exploitation --> firm performance	-0.323	-0.926	0.355

X^2(187, N=173) =209.436; p=.125; GFI=.91; CFI=.99; NFI=.90; TLI=.98; RMSEA=.026

Note: *p<.05; ** p< .01; *** p< .001

GFI=Goodness of Fit Index; AGFI=Adjusted Goodness of Fit Index; CFI= Comparative Fit Index; NFI= Normed Fit Index; TLI=Tucker-Lewis Fit Index; RMSEA= Root Mean Square Error of Approximation

Testing Internal Communication as a mediator

In order to test mediation impact of internal communication between social capital and market exploration/exploitation, first, direct impact of social capital on market exploitation/exploration was tested in the model without the mediation variable (internal communication), and model was found to fit the data (table 3: X^2(187, N=173)=209.436; p=.125; GFI=.91; CFI=.99; NFI=.90; TLI=.98; RMSEA=.026). It was seen that social capital has a direct impact on both market exploration (std. beta 0.877; p=0.00) and exploitation (std. beta 0.989; p=0.00.

Table 3: Direct Effect without Mediator

Path	Std. B	t value	p value
social capital --> market exploration	0.877	6.072	***
social capital --> market exploitation	0.989	6.353	***
market exploration --> firm performance	0.799	1.732	0.083
market exploitation --> firm performance	-0.362	-0.827	0.408
X^2(187, N=173) =209.436; p=.125; GFI=.91; CFI=.99; NFI=.90; TLI=.98; RMSEA=.026			

Note: *p<.05; ** p< .01; *** p< .001

GFI=Goodness of Fit Index; AGFI=Adjusted Goodness of Fit Index; CFI= Comparative Fit Index; NFI= Normed Fit Index; TLI=Tucker-Lewis Fit Index; RMSEA= Root Mean Square Error of Approximation

Then, direct impact of social capital on exploitation/exploration was tested when mediator variable (internal communication) was introduced in the model. As it can be seen in table 4, model fit the data (X^2(185, N=173) =203.616; p=.166; GFI=.91; CFI=.99; NFI=.90; TLI=.99; RMSEA=.024). It was found that social capital's impact on market exploration (std. beta -0.585; p=0.219) and exploitation (std. beta -0.569; p=0.171) became insignificant. Hair (2010) suggest that if the independent variable became insignificant where mediating construct included in the model, it is called full mediation. Thus, in present model internal communication fully mediates the relationship between social capital and market exploration/exploitation.

H4: Internal communication mediated the relationship between social capital and market exploration→ supported

H5: Internal communication mediated the relationship between social capital and market exploitation → supported

Table 4: Direct Impact with Mediator

Path	Std. B	t value	p value
social capital --> internal communication	0.919	5.169	***
Internal communication --> market exploration	0.982	3.222	***
Internal communication--> market exploitation	0.916	3.192	***
social capital --> exploration	**-0.585**	**-1.369**	**0.219 ns**
social capital --> exploitation	**-0.569**	**-1.229**	**0.171 ns**
market exploration --> firm performance	0.778	2.013	0.059
market exploitation --> firm performance	-0.352	-0.926	0.361
X^2(185, N=173) =203.616; p=.166; GFI=.91; CFI=.99; NFI=.90; TLI=.99; RMSEA=.024			

Note: *p<.05; ** p< .01; *** p< .001

GFI=Goodness of Fit Index; AGFI=Adjusted Goodness of Fit Index; CFI= Comparative Fit Index; NFI= Normed Fit Index; TLI=Tucker-Lewis Fit Index; RMSEA= Root Mean Square Error of Approximation

5.CONCLUSION

Present study results showed that social capital is a significant predictor of effective internal communication. Social capital has also direct positive impact on market exploration and exploitation activities, and the total impact on exploration and exploitation increases when it combined with internal communication. These results are in line with the study of Hazleton and Kennan (2000) suggesting social capital leads to exploitative communication which in return brings positive organizational outcomes. When internal communication was included in the model, the direct impact of social capital became insignificant. This result indicates that internal communication acts as a mediator between social capital and internal communication. Internal communication's positive impact on both exploitation and exploration supports the findings of Mitrega et al. (2012) suggesting that internal relationship quality predicts the customer relationship quality. Similarly, Ritter and Gemünden (2003) argue that internal communication structure is a crucial part of firm's networking ability, since it contributes firms' ability to respond customer needs. Results of path analyses in the present study showed that only market exploration has a significant impact on non-financial firm performance (predicted by the indicators of quality, innovation, and customer satisfaction). As a conclusion, present study showed that internal communication fully mediates the relationship between social capital, and market exploration and exploitation. Firms should be aware of the importance of social capital and internal communication to foster their capabilities of market exploration and exploitation. Thus, communication channels should be diversified in the firms so that every employee from different departments can formally and informally exchange their information about the market, customers, new products and competition. The main contribution of the present study is to link between social capital, internal communication and market learning activities and support empirical evidence for the relationship. Second, market exploration's impact on firm performance is supported empirically as a contribution to literature. Even market exploration activities are riskier than exploitation activities, market exploration may create competitive advantage for the firms especially in the long run.

This study is not without limits. Other sectors such as finance, manufacturing, health can be included in the study for comparative purposes. To avoid manager bias, employees could be included as respondents. For future studies, relationship between market exploration and exploitation and firm performance can be analyzed in more detail. Beside internal communication, other variables such as partner relationships' impact on market exploration and exploitation can be examined. As implications for the managers, it can be advised to focus on building and maintaining social capital and internal communication within their firm. The instruments fostering internal communication would increase overall market learning activities of the firm and in return bring positive organizational outcomes. Especially in high technology sectors, firms should engage in market exploration activities, even the results are not shown in short run, exploration of new markets would benefit the firm in long the run. However, it should be in mind that exploration activities hold some risks compared to exploitation activities, thus firms should maintain and keep on focusing on current markets as well, and the resources that are allocated to them should not be endangered.

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APPENDIX: Factor and Reliability Analysis Results

	Factor loadings	Variance Explained	Cronbach's alpha	Number of items
Social Capital		57.51	0.876	7
Our colleagues clearly understand the goal and vision in our company	0.786			
Our colleagues always keep their promises to us	0.782			
Our company is characterized by personal friendship among the colleagues at multiple levels	0.774			
Our colleagues share the same ambitions	0.765			
Employees often exchange information in informal	0.762			
In this relationship both sides avoid making demands that can seriously damage the interests of the other	0.72			
People in our unit are enthusiastic about pursuing the collective goals and missions of the whole organization	0.716			
(KMO=.87; X^2Barlett (21) =519.351; p=0.000)				
Internal Communication		58.513	0.76	4
In our organization, communication is often across projects and subject areas	0.807			
In our organization, managers and employees do give intensive feedback on each other	0.79			
In our organization, employees develop informal contacts among themselves	0.74			
In our organization, we have regular meetings for every project	0.688			
(KMO=.765; X^2Barlett (6) =165.594; p=0.000)				
Market Exploitation		62.883	0.802	4
Enhance understanding of existing customer requirements	0.85			
Reinforce the monitoring of competitive products in current markets	0.805			
Reinforce relationships with current customers	0.769			
Enhance the capture of important market information about existing markets	0.744			
(KMO=.772; X^2Barlett (6) =214.255; p=0.000)				
Market Exploration		68.365	0.845	4
Research new competitors and new customers	0.855			
Build customer relationships in new markets	0.834			
Assess the potential of new markets	0.832			
Acquire information about new markets	0.784			
(KMO=794; X^2Barlett (6) =281.702 p=0.000)				
Firm Performance		55.81	0.733	4
Customer satisfaction	0.811			
Company reputation	0.752			
Product/service quality	0.751			
Product/service/process innovation	0.668			
(KMO=.657; X^2Barlett (6)=174.609; p=0.000)				

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FINANCIAL APPLICATIONS OF STABLE DISTRIBUTIONS: IMPLICATIONS ON TURKISH STOCK MARKET

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ABSTRACT

Purpose- The aim of this study is modelled by examining the trading volumes of the tourism companies located in the high-risk tourism sector and traded in BIST. This modelling will gain point of view for the tourism firms as well as make an important contribution to the decision making of investors who want to invest in this sector.

Methodology- The study is conducted for a sample of 2803 daily trading volumes over the period 01.01.2007-28.09.2017. Then, it is used daily returns rather than daily trading volume data because it provides the ability to measure investment performance independently of the scale used. Daily return data is modelled with stable distributions used with increasing interest in many application areas and that are well-suited to financial asset returns. Parameter estimates is made by using quantiles method which is one of the most known estimation methods.

Findings- By means of the Chi-square test and graphs, it is seen that normal distribution was not suitable for trading volume data. Stable distribution parameters for the log-returns data are estimated according to the quantiles method and obtained the stable parameters α, β, γ and δ. Stable density function is obtained using the MATLAB STBL command according to estimated parameters.

Conclusion- Estimated parameter values indicate that stable distributions can be used as a suitable model for modelling the transaction volume data of analysed index. It has been concluded that it is more appropriate to use the scale parameter of the stable distribution instead of the standard deviation as the risk measure.

Keywords: BIST Tourism, stable distributions, parameter estimation.
JEL Codes: C13, C46, G00

1. INTRODUCTION

The tourism sector is a sector that contributes very much to the national economy. The development of such a sector contributes to meet the foreign currency needs, to create employment and to bring foreign investors to the country. Nature events, internal and external politics, economic relations of the country, socio-cultural differentiations, service quality, environmental factors and many other factors affect the sector (Inskeep,E., 1991; Özdemir, M. A., and Kervankıran, İ., 2013). As a result of these circumstances, the trading volumes of tourism companies which are located in this sector with high risk and traded in the BIST are examined and modelled. This modelling will gain a point of view for tourism firms as well as make an important contribution to decision making of investors who want to invest in this sector. When the trading volume data were analysed, it was observed that normal distribution was not suitable for these data. In this study, daily trading volumes of XTRZM index traded in BIST will be tried to be modelled with Stable Paretian distributions. In the second part of the work, stability and stable distributions are discussed and parametrization of stable rules is mentioned. In the third part, trading volumes belong to the tourism sector are modelled with stable distributions. In the last section, the output of the model is given.

2. STABLE DISTRIBUTIONS

Stable distributions – also called α –stable, Stable Paretian or Levy Stable - are rich class that allow the features like heavy tail and skewness of events and probability distributions that occur as a result of many small effects. This class was

introduced by Paul Levy (1925) in his investigations of behaviour of sums of independent random variables. These distributions were then proposed as an alternative to normal distribution by Mandelbrot (1963) and Fama, & Roll (1968) because of enabled features like heavy tail and skewness of financial time series. Press (1972) also suggested the use of stable distributions in the process of creating a model for probability distributions related to price changes of instruments. Zolotarev (1986) has also contributed greatly to this area. Stable distributions are widely used distributions in many systems with different properties, especially in economics. This distribution has a stability characteristic and a class feature in addition to providing a very good fit to the empirical data. If sums of independent, identically distributed random variables have a limit distribution, the limit distribution will be a member of the stable class (Fama, E.F. and Roll,R., 1968). The Central Limit Theorem explains the growth of interest in stable distributions as data models, especially in the economy. The theorem expresses the sum of the random variables with finite variance approximates a Gaussian random variable (Çekici, E., 2003). If the assumption that the variance is finite is removed, with an appropriate scaling, the one and only distribution for the sum of independent identically distributed random variables is stable distributions. Normal distribution is a special case with finite variance of stable distributions. Infinite variance can be characterized by the tail distribution of probability distributions. If it is $P(|x| > k) > 1/k^2$ for large k values in any given $f(x)$ distribution, variance is infinite. When the total probability in the tails is greater than $1/k^2$, the distribution is called as heavy tail (Önalan, Ö., 2010).

2.1. Definitions

One of the most important properties of Normal or Gaussian random variables is that the sum of two normal random variables is again a normal random variable. X is stable random variable if there exist some positive c and some $d \in R$ for any positive constants a and b with

$$aX_1 + b\,X_2 \overset{d}{=} c\,X + d \tag{1}$$

where X is normal random variable, X_1 and X_2 are independent copies of X. The symbol $\overset{d}{=}$ means equality in distribution, that is, it indicates that both sides of the distribution have the same probability law (Nolan, 2016). A random variable is symmetric stable if it is stable and symmetrically distributed around 0, e.g. $X \overset{d}{=} -X$ (Nolan, 2016).

Two random variables X and Y are said to be of the same type if there exist constants $a > 0$ and $b \in R$ with $X \overset{d}{=} a\,Y + b$ (Nolan, 2016). Non degenerate X is stable if and only if for all $n > 1$, there exist constants $c_n > 0$ and $d_n \in R$ such that

$$X_1 + \cdots + X_n \overset{d}{=} c_n X + d_n \tag{2}$$

Where $X_1, X_2, \ldots, X_n$ are independent , identical copies of X (Zolotarev, 1986).

A random variable X is stable if and only if $X \overset{d}{=} a\,Z + b$, Z is a random variable with characteristic function

$$E\exp(iuZ) = \begin{cases} \exp\left(-|u|^{\alpha}\left[1 - i\,\beta\tan\frac{\pi\alpha}{2}\,(sign\,u)\right]\right), & \alpha \neq 1 \\ \exp\left(-|u|\,\left[1 + i\,\beta\frac{2}{\pi}\,(sign\,u)\log|u|\right]\right), & \alpha = 1 \end{cases} \tag{3}$$

where $0 < \alpha \leq 2$, $-1 \leq \beta \leq 1$, $a \neq 0$, $b \in R$ (Nolan, 2016).

2.2. Parametrizations of Stable Laws

The stable distributions requires four parameters to describe: an index of stability $\alpha \in (0,2]$, a skewness parameter $\beta \in [-1,1]$, a scale parameter $\gamma \geq 0$ and a location parameter $\delta \in R$. The parameter α called the tail index, tail exponent or characteristic exponent. The tail exponent α determines the rate at which the tails of the distribution taper off. When $\alpha = 2$, the distribution is a normal distribution. When $\alpha < 2$, the variance is infinite. As the value of the α parameter decreases, the peak gets higher, the region flanking the peak get lower and the tails get heavier. When $\beta = 0$, the distributon is symmetric around μ. When $\beta = 1$, the distribution is totally skewed to the right. When $\beta > 0$, the distribution is skewed to the right. Similarly when $\beta < 0$, the distribution is skewed to the left by reflection (Fama, E. F., 1965). As α approaches 2, β loses its effect and the distribution approaches the Gaussian distribution regardless of β. The parameter δ determines the width and the parameter δ determines the shift of the mode of the density. Generally $\gamma > 0$, although $\gamma = 0$ will sometimes be used to denote a degenerate distribution concerned at δ when it simplifies the statement of a result. Note that for any β>0, the mode goes to $+\infty$ as $\alpha \uparrow 1$, to $+\infty$ as $\alpha \downarrow 1$, and stays near 0 for $\alpha = 1$ (Nolan, J., 1998).

The family of stable distributions have relatively heavier distribution tails (except the case when $\alpha = 2$, the Gaussian distributions). They belong to the family of heavy-tailed distributions. The tail heaviness of stable distributions can be measured by using their stable index (Fan, Z., 2006). There is a large number parametrizations in the literature for stable

rules and this situation leads to complexity. The variety of the parametrizations result from the historical evolution and the analysis of many problems using the specialized forms of stable distributions.

In most of recent literature, the notation $S_\alpha(\sigma,\beta,\mu)$ is used for the class of stable laws. However we will use a modified notation of the form $S(\alpha,\beta,\gamma,\delta;k)$ due to three reasons. First reason, the usual notation determine α as different and fixed. In statistical applications, all four parameters $(\alpha,\beta,\gamma,\delta)$ are unknown and need to be estimated for these parameters. Second reason, the scale parameter is not the standard deviation (even Gaussian situation) and the location parameter is not generally the mean. Then we use γ for the scale instead of σ and use δ for the location instead of μ. Third reason, there should be a clear distinction between the different parametrizations; the k integer does that (Nolan, 2016). It is possible to change tail thickness and skewness in stable distributions. There are three cases. Closed form expression of probability density functions for stable distributions except for Normal, Cauchy and Levy distribution does not exist. But the most concrete way to describe all possible of stable distributions can be expressed through the characteristic function.

Example 1. Normal or Gaussian distributions**.** , $X\sim N(\mu,\sigma^2)$ if it has a density

$$f(x)=\frac{1}{\sqrt{2\pi\sigma}}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right), \qquad -\infty<x<\infty.$$

Gaussian distribution is stable with parameters $\alpha=2$ and $\beta=0$.

Example 2. Cauchy distributions. $X\sim Caushy(\gamma,\delta)$ if it has density

$$f(x)=\frac{1}{\pi}\,\frac{\gamma}{\gamma^2+(x-\delta)^2}, \qquad -\infty<x<\infty.$$

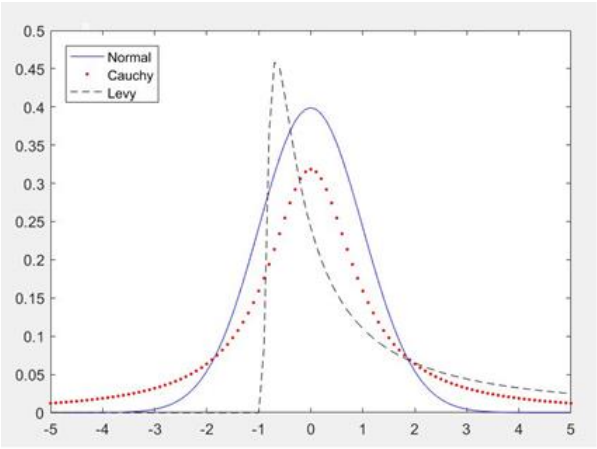
Cauchy distribution is stable with parameters $\alpha=1$ and $\beta=0$.

Example 3. Levy distributions. $X\sim Levy(\gamma,\delta)$ if it has density

$$f(x)=\sqrt{\frac{\gamma}{2\pi}}\,\frac{1}{(x-\delta)^{\frac{3}{2}}}\,\exp\left(-\frac{\gamma}{2(x-\delta)}\right), \qquad \delta<x<\infty.$$

Levy distribution is stable with parameters $\alpha=1/2$ and $\beta=1$.

Figure 1: Graphs of probability density functions of special stable distributions



Normal and Cauchy distributions are symmetric. Main difference between these distributions is that Cauchy distribution has heavier tail than the others. Figure 1 shows a plot of these tree densities. A random variable X is $S(\alpha,\beta,\gamma,\delta;0)$ if

$$X \overset{d}{=} \begin{cases}\gamma\left(Z-\beta\tan\dfrac{\pi\alpha}{2}\right)+\delta & , \quad \alpha\neq 1\\ \gamma\,Z+\delta & , \quad \alpha=1\end{cases} \tag{4}$$

where $Z=Z(\alpha,\beta)$ is given by Eq. (3). X has characteristic function

$$E\exp(iuX) = \begin{cases} \exp\left(-\gamma^{\alpha}|u|^{\alpha}\left[1 + i\,\beta\left(\tan\frac{\pi\alpha}{2}\right)(sign\,u)\,(|\gamma u|^{1-\alpha} - 1)\right] + i\delta u\right) & , \ \alpha \neq 1 \\ \exp\left(-\gamma|u|\,\left[1 + i\,\beta\frac{2}{\pi}\,(sign\,u)\log(\gamma|u|)\right] + i\delta u\right) & , \ \alpha = 1. \end{cases} \quad (5)$$

When the distribution is standardized, that is, scale $\gamma = 1$ and location $\delta = 0$, the symbol $S(\alpha, \beta; 0)$ will be used as an abbreviation for $S(\alpha, \beta, 1, 0; 0)$ (Nolan, 2016).

A random variable X is $S(\alpha, \beta, \gamma, \delta; 1)$ if

$$X \overset{d}{=} \begin{cases} \gamma\, Z + \delta & , \ \alpha \neq 1 \\ \gamma\, Z + \left(\delta + \beta\frac{2}{\pi}\ \gamma\ \log\gamma\right) & , \ \alpha = 1 \end{cases} \quad (6)$$

Where $Z = Z(\alpha, \beta)$ is given by Eq. (3). X has characteristic function

$$E\exp(iuX) = \begin{cases} \exp\left(-\gamma^{\alpha}|u|^{\alpha}\left[1 - i\,\beta\left(\tan\frac{\pi\alpha}{2}\right)(sign\,u)\right] + i\delta u\right), & \alpha \neq 1 \\ \exp\left(-\gamma|u|\,\left[1 + i\,\beta\frac{2}{\pi}\,(sign\,u)\log|u|\right] + i\delta u\right) & , \ \alpha = 1 \end{cases} \quad (7)$$

When the distribution is standardized, that is, scale $\gamma = 1$ and location $\delta = 0$, the symbol $S(\alpha, \beta; 1)$ will be used as an abbreviation for $S(\alpha, \beta, 1, 0; 1)$ (Nolan, 2016).

2.3. Densities and Distribution Functions

Let $\{X_t : t \geq 0\}$ denote a Levy process. Levy process $\{X_t\}$ is called semistable if there are $a > 1$, $b > 0$ and $c \in R$ such that $\{X_{at}\} \overset{d}{=} \{bX_t + ct\}$ (or $\alpha > 1$ and $b > 0$ such that $\{X_{at}\} \overset{d}{=} \{bX_t\}$). In the case of stable processes, for any nontrivial semi-stable process, the index $\alpha \in (0,2]$ is determined; this is the number such that, for any a and b standing in the relation above, $b = a^{1/a}$. The notion of semi-stable distributions was introduced by Paul Levy in 1937. If $0 < \alpha < 2$, then the class of semi-stable processes is strictly larger than the class of stable processes (Barndorff-Nielsen, O.E., Mikosh,T. and Resnik, S., 2012).

Explicit formulas for general stable densities do not exist. But lots are known about their theoretical properties. The most valid way to describe all possible stable distributions is by way of the characteristic function or Fourier transform. Stable distributions can be characterized by different forms. The complex valued function

$$\phi(u) = E\exp(iuX) \quad (8)$$

is called the characteristic function (c.f.) of a real random variable X. Here, u is some real valued variable.

If the density $f(x)$ exists, Eq.(8) is the Fourier transform of that density and defined by,

$$\phi(u) = E\exp(iuX) = \int_{-\infty}^{\infty} \exp(iux)\ f(x)dx. \quad (9)$$

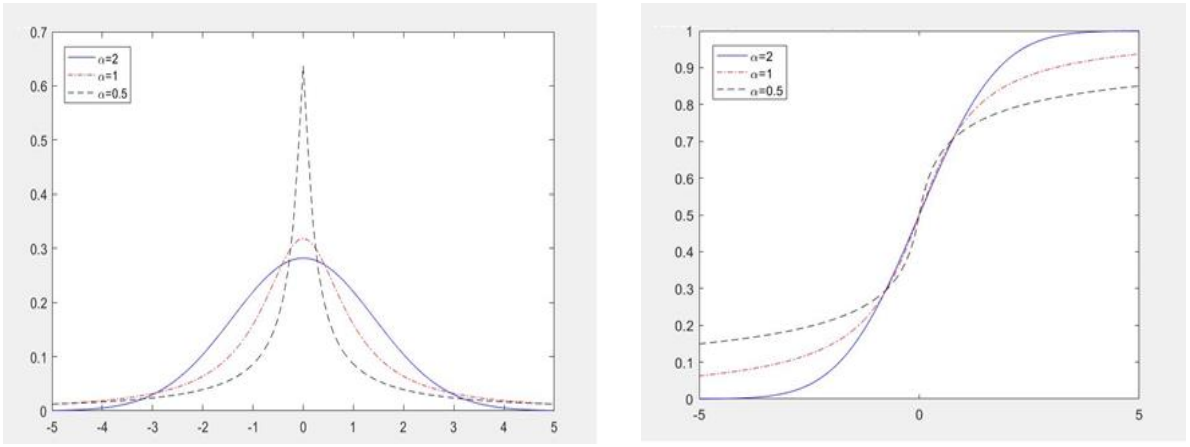
Thus, the inverse Fourier transform

$$f(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \exp(-iux)\ \phi(u)\ du \quad (10)$$

allows us reconstruct the probability density function of a distribution from a known characteristic function (Uchaikin & Zolotarev, 1999).

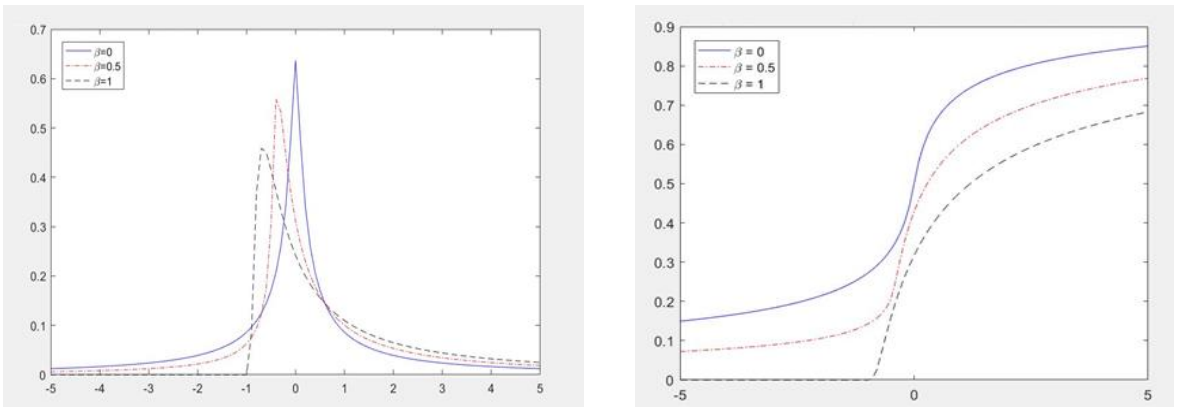
It is necessary to distinguish between probability density function (pdf) and cumulative distribution function (cdf) in different parametrizations. f$(x|\alpha, \beta, \gamma, \delta; k)$ and $F(x|\alpha, \beta, \gamma, \delta; k)$ denote the probability density function and the cumulative distribution function of a $S(\alpha, \beta, \gamma, \delta; k)$ distribution, respectively. Figure 2(a) and 2(b) show plot of densities and cumulative distribution functions for different alpha values. The plots in Figure 3(a) and 3(b) also show the densities and cumulative distribution functions for different beta values.

Figure 2: Stable Densities (a) and Cumulative Distribution Functions (b) for $\alpha = 0.5$, $\alpha = 1$ and $\alpha = 2$.



(a) (b)

Figure 3: Stable Densities (a) and Cumulative Distribution Functions (b) for $\beta = 0$, $\beta = 0.5$ ve $\beta = 1$.



(a) (b)

Density function can be organized as a polynomial function with infinite term. But in this case, the number of terms is infinite causes problems in using the maximum likelihood method. Thus, a standard parametrized integral expression of the density given by (Zolotarev, 1986)

$$f(x|\alpha,\beta,\gamma,\delta) = \frac{1}{\pi\gamma}\int_0^\infty \exp(-u^\alpha)\cos\left(u\left(\frac{x-\delta}{\gamma}\right) - \beta\, u^\alpha \tan\left(\frac{\pi\alpha}{2}\right)\right) du. \quad (11)$$

2.4. Tail Probabilities, Moments and Quantiles

When $\alpha = 2$, the normal distribution has easily understandable asymtotic tail properties. Information about the tails of non-Gaussian $(\alpha < 2)$ stable laws will be given. In the $\alpha < 2$ case, the tails of stable distributions are asymtotically fit to Pareto law. Let $X \sim S(\alpha,\beta,\gamma,\delta;0)$ with $0 < \alpha < 2$ and $-1 < \beta \leq 1$. Then as $x \to \infty$,

$$P(X > x) \sim \gamma^\alpha\, c_\alpha\, (1+\beta)x^{-\alpha} \quad (12)$$

$$P(X < -x) \sim \gamma^\alpha\, c_\alpha\, (1-\beta)x^{-\alpha} \quad (13)$$

where $c_\alpha = \sin\left(\frac{\pi\alpha}{2}\right)\Gamma(\alpha)/\pi$. When $\alpha > 1$, the mean of distribution exists and $E(X) = \mu$. In general, a stable random variable has the pth moment if and only if $0 < p < a$, e.q. $E|X|^p < \infty$.

Stable distributed random variables have finite fractional absolute moments only of order less than the stable index, α say. The traditional statistical methods cannot be used effectively in estimating the parameters of a stable distribution, since

densities of stable random variables do not exist closed form except for a few special case (Fan, Z., 2006). However, various methods have been proposed for parameter estimation of stable distribution in the literature. The most known of these methods include: Hill estimator (Hill, 1975), quantiles method (Fama and Roll, 1971; McCulloch, 1986), the logarithmic moments method (Kuruoğlu,E., 2001), the empirical characteristics method (Yang, 2012), and the Maximum likelihood method (Nolan, 2001). We will investigate their accuracy in the following. The most commonly used of these method is the quantiles method.

The quantiles method

The quantiles method was pioneered by Fama and Roll (1971) but was much more appreciated through McCulloch (1986) after its extension to include asymmetric distributions and for $\alpha \in [0.6, 2]$ cases unlike the former approach that restricts it to $\alpha \geq 1$ (Kateregga, M., Mataramvura, S. and Taylor, D., 2017). Although the method proposed by Fama and Roll is simpler, it leads to bias in the estimation of α and γ.

Suppose we have n independent drawings x_i from the stable distribution $S(x;\alpha,\beta,\gamma,\delta)$, whose parameters are to be estimated. Let x_p be the pth quantile of population so that $S(x_p;\alpha,\beta,\gamma,\delta) = p$ and $\hat{x}_p$ be the corresponding sample quantile, then $\hat{x}_p$ is a consistent estimator of x_p. In this case, the estimatorss α and β are given by $\hat{\alpha} = \psi_1(\hat{v}_\alpha, \hat{v}_\beta)$ ve $\hat{\beta} = \psi_2(\hat{v}_\alpha, \hat{v}_\beta)$ where

$$\hat{v}_\alpha = \frac{\hat{x}_{0.95} - \hat{x}_{0.05}}{\hat{x}_{0.75} - \hat{x}_{0.25}}, \qquad \hat{v}_\beta = \frac{\hat{x}_{0.95} + \hat{x}_{0.05} - 2\,\hat{x}_{0.05}}{\hat{x}_{0.95} - \hat{x}_{0.05}}.$$

These indexes in independent of both γ and δ. The values of functions $\psi_1(\hat{v}_\alpha, \hat{v}_\beta)$ and $\psi_2(\hat{v}_\alpha, \hat{v}_\beta)$ given in Table III and IV in McCulloch (1986) by linear interpolation. The scale parameter is given by

$$\hat{\gamma} = \frac{\hat{x}_{0.75} - \hat{x}_{0.25}}{\psi_3(\hat{\alpha}, \hat{\beta})}$$

where $\psi_3(\hat{\alpha}, \hat{\beta})$ is given by Table V in McCulloch (1986). A consistent estimator of γ is obtained through interpolation. Finally, the location parameter δ is is estimated through a new parameter defined by

$$\zeta = \begin{cases} \delta + \gamma \tan\left(\frac{\pi\,\alpha}{2}\right), & \alpha \neq 1 \\ \delta, & \alpha = 1. \end{cases}$$

Further, the parameter ζ is estimated by $\hat{\zeta} = \hat{x}_{0.5} + \hat{\gamma}\ \psi_5(\hat{\alpha}, \hat{\beta})$ where is obtained from Table VII (McCulloch, 1986) by linear interpolation. The consistent estimator of location parameter is given by

$$\hat{\delta} = \hat{\zeta} - \hat{\beta}\ \hat{\gamma} \tan\left(\frac{\pi\,\alpha}{2}\right).$$

2.5. Simulation of Stable Variables

Difficulties of simulating sequence of stable results from the fact that analytic expressions for the inverse F^{-1} of the cumulative distribution function do not exist. However, the algorithm for constructing a standard stable random variable $X \sim S_\alpha(1, \beta, 0)$ is the following (Weron, 1996):

- Generate a random variable *V* uniformly distributed on $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ and an independent exponential random variable *W* with mean 1.
- For $\alpha \neq 1$ compute,

$$X = S_{\alpha,\beta}\ \frac{\sin\left(\alpha\left(V + B_{\alpha,\beta}\right)\right)}{(\cos(V))^{\frac{1}{\alpha}}}\ \left[\frac{\cos\left(V - \alpha\left(V + B_{\alpha,\beta}\right)\right)}{W}\right]^{(1-\alpha)/\alpha} \tag{14}$$

where

$$B_{\alpha,\beta} = \frac{\arctan\left(\beta \tan\frac{\pi\alpha}{2}\right)}{\alpha},$$

$$S_{\alpha,\beta} = \left(1 + \beta^2 \tan^2\left(\frac{\pi\alpha}{2}\right)\right)^{\frac{1}{2\alpha}}.$$

- For $\alpha = 1$ compute,

$$X = \frac{2}{\pi}\left(\left(\frac{\pi}{2}+\beta V\right)\tan V - \beta \ln\left(\frac{\frac{\pi}{2}W\cos V}{\frac{\pi}{2}+\beta V}\right)\right) \quad (15)$$

Then, given the formulas for simulation of a standard stable random variable, we can easily simulate a stable random variable for all admissible values of the parameters $\alpha, \beta,\ \gamma$ and δ using the following property: if $X \sim S_\alpha(1,\beta,0)$, then

$$Y = \begin{cases} \gamma X + \delta & , \quad \alpha \neq 1 \\ \gamma\, X + \frac{2}{\pi}\,\beta\,\gamma \ln\gamma + \delta\ , & \alpha = 1 \end{cases} \quad (16)$$

is $S(\alpha,\beta,\gamma,\delta;k)$ (Borak, Hardle and Weron, 2005).

3. THE APPLICATION OF STABLE LAWS

In this part of the study, daily trading volumes between 01.01.2007-28.09.2017 (2804 days) of XTRZM index traded in BIST were used. Data set used in this study was obtained from the Bloomberg database. Analysed tourism companies in this study are traded in the BIST with the codes "AVTUR, MAALT, MARTI, METUR, NTTUR, TEKTU, UTPYA".

In this study, we worked with daily returns rather than daily trading volume data because it provides the ability to measure investment performance independently of the scale used. Let Y_t be daily trading volume of index and S_t be the value of a financial asset or portfolio at time t. Then, return values for $[t, t+1]$ is given by (Önalan, Ö., 2010):

$$X_{t+1} = S_{t+1} - S_t = \ln Y_{t+1} - \ln Y_t.$$

Figure 4 show the daily returns above stated period of XTRZM indexes. Table 1 also show descriptive statistics of daily returns related to stock.

Figure 4: Graph of Daily Returns of XTRZM Index for the Period 01.01.2007-28.09.2017

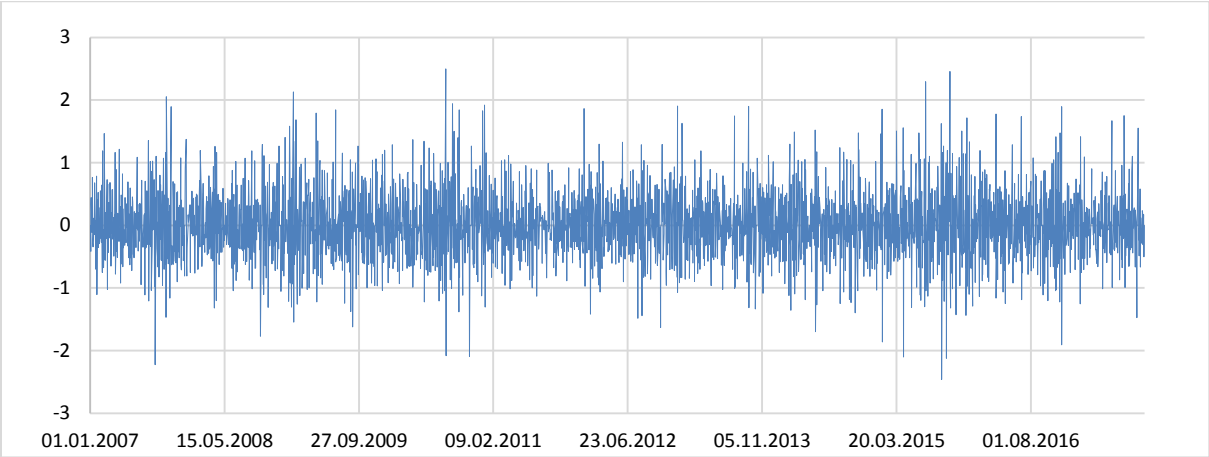


Table 1: Descriptive Statistics Related to XTRZM Index's Daily Returns

	Mean	Std. deviation	Skewness	Kurtosis	Min	Max
XTRZM	0.0003434	0.567	0.233	1.182	-2.462	2.498

Firstly, BIST Tourism index's daily return is considered and the suitability of these returns for normal distribution is examined. Chi-square test (goodness of fit) is used to perform to determine if normal distribution of observed data was appropriate. First of all, the time series of XTRZM index is organised as a frequency series. Then, Chi-square value obtained from observed values and the calculated values is found as $\chi^2_{cal} = 2802{,}92$. Hypotheses about the distribution of daily returns are given

H_0 : The distribution of daily returns is suitable for normal distribution,

H_1: The distribution of daily returns is not suitable for normal distribution.

Degree of freedom is equal to 6, since number of class is equal to 9 and parameter number of estimated is equal to 2. Then, $\chi^2_{0.05,6} = 12{,}592$. In this case, H_0 is rejected. Rejecting the assumption of normal distribution of daily returns supports the hypothesis that a stable distribution is suitable for this data. In addition to these information, Figure 6 show a normal Q-Q plot for the daily returns.

Figure 5: Histogram for Daily Returns of XTRZM Index

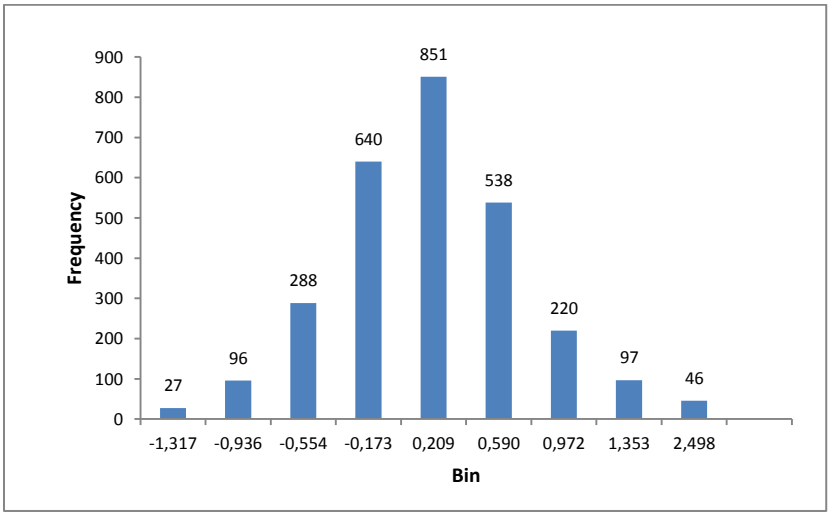
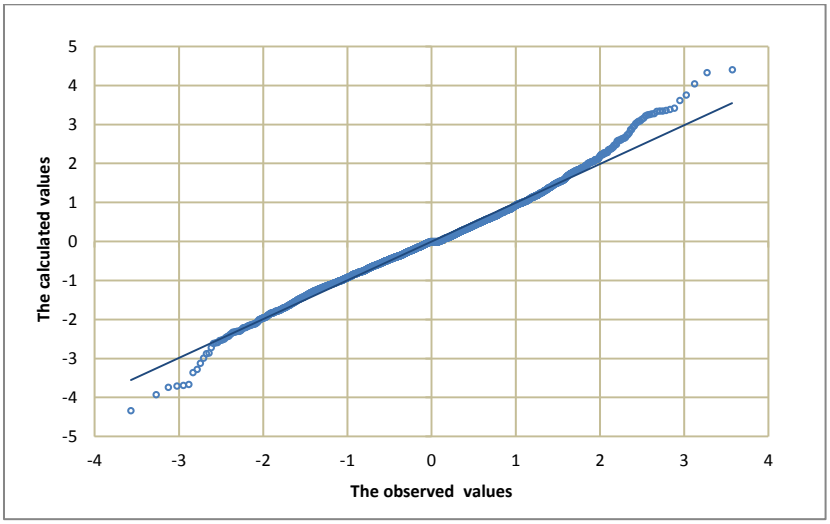


Figure 6: A Normal Q-Q Plot for the Daily Returns



Stable distribution parameters for the log-returns data are estimated according to McCulloch method and obtained the stable parameters in Table 2. $\hat{\alpha} = 1.21$ is a value in the preferred range for stable distribution.

Table 2: Stable Distribution Parameters Estimated from the Log-Returns Data

Index\ Parameter	$\widehat{\alpha}$	$\widehat{\beta}$	$\widehat{\gamma}$	$\widehat{\delta}$
XTRZM	1.21	1	0.0006	0.0038

Figure 7: Comparison of Standardized Actual Returns and Simulated Standard Stable Returns

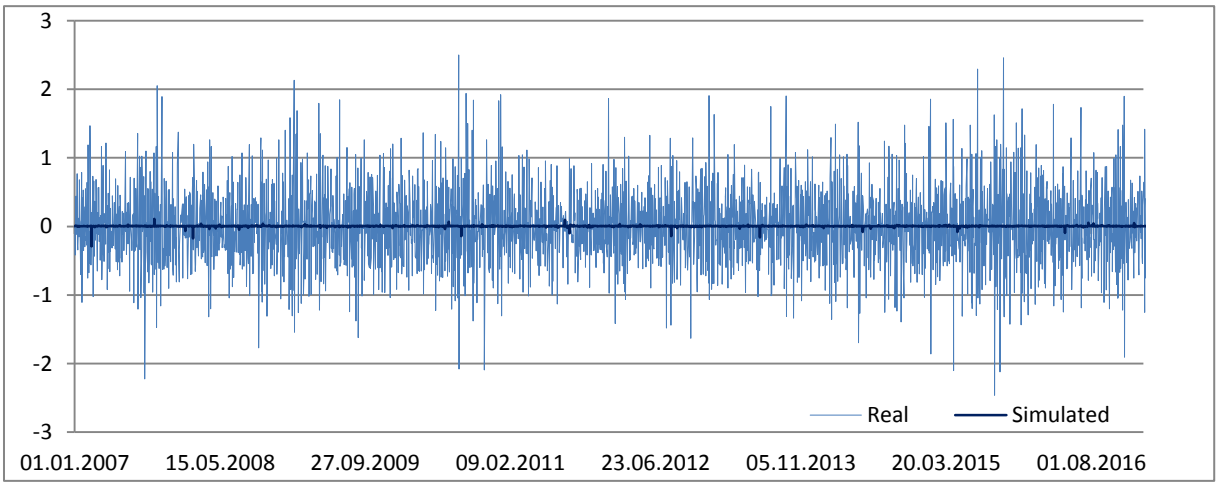


Figure 8 shows the stable density function obtained by using the MATLAB STBL command proposed by Veillette (2014) according to estimated parameters for $\hat{\alpha} = 1.21$, $\hat{\beta} = 1$, $\hat{\gamma} = 0.0006$ and $\hat{\delta} = 0.0038$. Cumulative distribution function is also given Figure 9. Here, ıt should also be noted that Figure 8 shows a large similarity to the graph of the Levy distribution shown in Fig.1.

Figure 8: The Stable Density Function for $\boldsymbol{\alpha = 1.21}$, $\boldsymbol{\beta = 1}$, $\boldsymbol{\gamma = 0.0006}$ and $\boldsymbol{\delta = 0.0038}$.

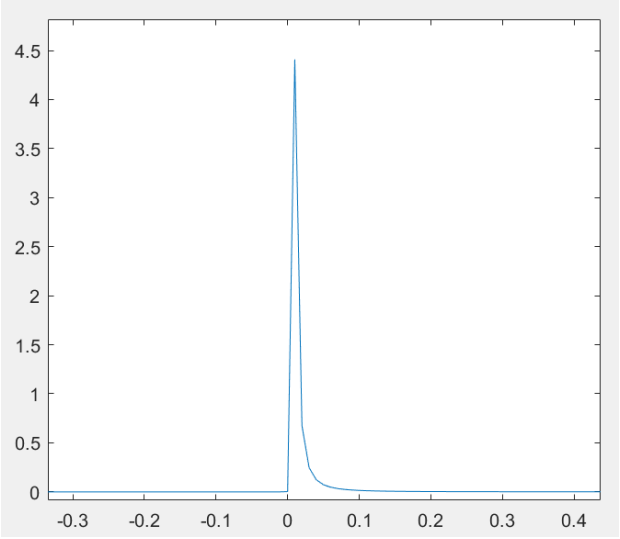
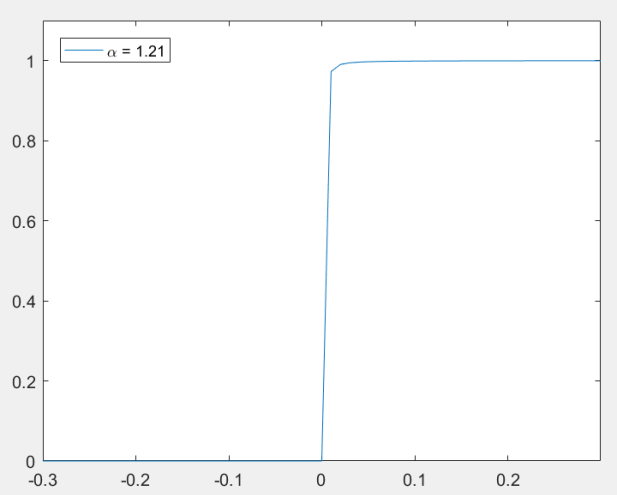


Figure 9: The Stable Cumulative Distribution Function $\alpha = 1.21$, $\beta = 1$, $\gamma = 0.0006$ and $\delta = 0.0038$.



4. CONCLUSION

In this study, it is investigated whether the trading volume data of XTRZM index traded in BIST are suitable for stable distributions. The XTRZM index traded in BIST is examined and the suitability of these volumes for normal distribution is searched. By means of the Chi-square test and graphs, it was seen that normal distribution was not suitable for these volumes. Using the 2804 daily trading volumes data, the parameters of stable distribution are estimated as $\alpha = 1.21$, $\beta = 1$, $\gamma = 0.0006$ and $\delta = 0.0038$. As a result, estimated parameter values show that Stable Paretian distributions can be used as an appropriate model for modelling trading volume data. It has been concluded that it is more appropriate to use the scale parameter of the stable distribution instead of the standard deviation as the risk measure.

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ANALYSIS OF OCCUPATIONAL HEALTH AND SAFETY DATA BETWEEN 2003 -2015 IN TURKEY

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ABSTRACT

Purpose - The aim of this study was to analyse the officially recorded data of Turkey on occupational accidents by covering various kinds of data between the years 2003 - 2015. By this study a view is aimed to be taken over Turkey's behaviour on occupational health and safety.
Methodology – In this study, the statistical yearbook of the Social Security Institution (SSI) of the Republic of Turkey has been used as a data source. These data are arranged yearly and the trend is evaluated.
Findings- The number of occupational accidents had fluctuations as increases and decreases between the years 2003-2012. After the year 2012, the number of occupational and fatal accidents had increased more than twice. The occupational accidents have occurred at the highest rates in the most populated and industrialized two cities in Turkey. Economic activities having the highest percentage of occupational accidents has been determined and interpretated.
Conclusion- Occupational accidents can be reduced by taking effective and preventive measures. There are some tasks that should be fulfilled in order to create a secure work place by employers and employees. Employers should apply occupational health and safety legislation and take preventative measures and train the employers regularly against work related accidents. Furthermore, employees should be conscious and careful about the accidents and fulfill their obligations regarding to work safety while working. Public institutions should work more on creating a secure work place and creating a culture of work safety.

Keywords: Occupational accident, safety, statistics, occupational safety and health, Turkey.
JEL Codes: I18, J28, J89

1. INTRODUCTION

Occupational health and safety (OHS) is a complex phenomenon in working life. Prevention of work accidents is one of the major goals in occupational safety but it is extremely difficult without understanding the causes of accidents (Salguero, 2015). Statistical data on occupational accidents have great importance in evaluation of preventive measures (Palvic, 2011).

The European Statistics on Accidents at Work (ESAW) project was launched in 1990, to harmonize data on accidents at work. In 2001, 'European Statistics on Accidents at Work - Methodology', was published by Eurostat, which is the statistical office of the European Union. Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions. At international level, International Labour Organization (ILO) aims to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue on work-related issues. Although there are slight differences between the ILO and the ESAW classification schemes, they organize statistical results at international level. In Turkey, the statistical data about the occupational health and safety is collected and published by the Social Security Institution of the Republic of Turkey, which is an official agency of the government. After the year 2012, SSI started to publish the data of OHS according to ESAW methodology. The aim of this process is to compare the statistical data of occupational accidents and their causes between the European countries and Turkey more accurately. In Turkey, there has been a growing awareness about occupational health and safety after the Law 6331. The Occupational Health and Safety Law No. 6331 was prepared based on the principles of the EU Directive No. 89/391 and was enacted on 30 June 2012. In the following years, a number of secondary legislation complementary to the

OHS Law has been enacted. Despite some substantial improvements achieved, the rate of accidents is still significantly high. Occupational accidents lead to many fatal and nonfatal injuries in Turkey (Unsar, 2009). The Social Security Institution of the Republic of Turkey reported that 241,547 insured worker suffer from work accidents in 2015, while the number of death cases was 1,252. Before the Law 6331, employers were obliged to report occupational accidents and occupational diseases to both the Social Security Institution and the related regional/provincial directorate of the Turkish Labour Agency. The Law 6331 eliminated the requirement to report to the Turkish Labour Agency. Occupational accidents and diseases have to be reported online to the SSI within 3 days from date when the occupational accident happened and the date that the occupational disease was diagnosed and reported to the employer, respectively. The employer must report the occupational accidents to the SSI in a standard information form electronically via online submission. Since 2013, the work accident notification forms have been received on electronic environment and the work accident insurance data have published in accordance with the European Union. If the resumption of work occurred 3 days after the work accident, the accident was added to the work accident statistics. In case of fatal accident at work, the definition adopted by the ESAW project is that of 'accidents at work leading to the death of the victim within a year (after the day) of the accident'. In practice the majority of the Member States send the cases of fatal accidents at work counted in their national statistics. In fact, the majority of the accidental deaths occur either immediately at the time of the accident, or within a few days or a few weeks after the accident.

According to the Article 13 of the Social Security and General Health Insurance Law No. 5510, work accident is the incident which occurs; a) when the insurance holder is at the workplace, b) due to the work carried out by the employer or by the insurance holder if he/she is working on behalf of own name and account, c) for an insurance holder working under an employer, at times when he/she is not carrying out his/her main work due to the reason that he/she is sent on duty to another place out of the workplace, d) for a nursing female insurance holder at times allocated for nursing her child as per labour legislation, e) during insurance holder's going to or coming from the place, where the work is carried out, on a vehicle provided by the employer, and which causes, immediate or delayed, physical or mental handicap in the insurance holder. According to the Article 14 of the Social Security and General Health Insurance Law No. 5510, occupational disease is defined as temporary or permanent disease, physical or mental handicapped status, caused by a reason reiterated due to the quality of the work made or worked by the insurance holder or by the working conditions. It is obligatory to determine that an occupational disease is developed in the insurance holder by the Institution's Health Committee after; examining the health committee report, and the medical documents the report is based on, prepared duly by the providers of healthcare services authorized by the Institution, if found necessary by the Institution, examining the inspection reports, and other necessary documents, which show the working conditions at the workplace and the medical consequences based on this. Permanent absence from work is defined that the insurance holder, whose earning power in the profession, due to the disease or disabilities caused by work accident or occupational disease, is determined to be reduced by 10% by the Institution's Health Committee based on reports issued by the health committees of health - care service providers authorized by the Institution, shall be qualified for permanent incapacity income (5510 numbered laws' 19th article). As a result of permanent absence from work, employee become unable to do his/her work and retires or starts to work in an inactive position. The worker who are permanently absent from work is called permanent disabled employee.

The statistical study of occupational accidents is an important way to describe the general assessment of the occupational accidents. This study aims to examine the official data of fatal and nonfatal occupational accidents covering all economic activities, age ranges, incidence rate and weight rate of work accidents, occupational diseases, permanently disabled employees, type of injuries, injured part of the bodies, and the cities in which the accidents occur.

2. DATA AND METHODOLOGY

In this study, the statistical yearbook of the Social Security Institution of the Republic of Turkey has been used as a data source. SSI is a public institution that gathered and published the work accidents and occupational diseases statistics in all provinces and in many criteria like economic activities, gender, the number of fatal and nonfatal accidents, and distributions of temporary and permanent incapacity data. The incidence rate of work accidents is calculated in two different methods in the SSI yearbook. One of the methods represents the incidence rate of work accident per 1,000,000 work hours. The second method represents incidence rate of work accident per 100 persons. They are calculated as follows:

Incidence rate of work accident per 1,000000 work hours = NEI / (NDPA*8) *1,000,000 (1)

Incidence rate of work accident per 100 persons = NEI / (NDPA*8) * 225,000 (2)

NEI is the number of employment accidents and NDPA is the number of days of premium accrued represents total days worked by all insured persons during calendar year. In the first method, NDPA is multiplied by 8 hours per day and multiplied by 1,000,000 as base for proportion of number of accidents per 1,000,000 working hours. In the second method, NDPA is multiplied by 8 hours per day and multiplied 225,000 base for 100 equivalent full time insured person (working 45 hours per week, 50 weeks per year). The weight rate of accidents is calculated in two different methods. One of the

methods represents the number of lost workdays per 1,000,000 working hours while the other method represents the number of lost hours per 100 working hours because of employment accidents. They are calculated as follows:

Weight rate of work accident (Days) = TLD / (NDPA*8) *1,000,000 (3)

Weight rate of work accident (Hours) = (TLD*8) / (NDPA*8) *100 (4)

TLD = (Duration of temp. Incapacity as day) + (Total degree of permanent Incapacity*75) + (Number of death*7,500) (5)

TLD is the number of total lost working days because of employment accidents. NDPA is number of days of premium accrued represents total days worked by all insured persons during calendar year. In the first method, NDPA is multiplied by 8 hours per day and multiplied by 1,000,000 as base for proportion of number of total lost workdays per 1,000,000 working hours. In the second method, NDPA is multiplied by 8 hours per day and multiplied base for proportion of number of total lost hours per 100 working hours.

3. FINDINGS AND DISCUSSIONS

The number of compulsory insured employee, the number of employment accidents, the number of occupational diseases, the number of the death cases and the number of the permanently disabled employee in Turkey between 2003 and 2015 are shown in Table 1. The number of insured employee increased each year. The average number of compulsory insured employee between 2003 and 2015 was 9,661,332, while the average number of employment accidents was 107,126, the number of occupational diseases was 544, the number of the death cases was 1,196 and the number of the permanently disabled employee was 1,926. It is seen that the number of employment accidents in 2013 is 2.5 times higher than the year 2012. The main reason of this increase is the change of the methodologies in the work accident case number statistics. Since 2013, the work accident notification forms have been received on electronic environment and the work accident insurance data have been published by European Union Standards taken into consideration. The number of fatal cases due to occupational accidents and diseases has shown fluctuations, however it has started to increase last two years. Although the number of occupational accidents and deaths increase, the number of insured employees has been increasing every year. Under this circumstance, it could be more reliable to evaluate the percentages of employment accidents, occupational diseases and fatal cases. Table 1 shows the percentages of employment accidents, occupational diseases, death cases and permanently disabled employee in Turkey. The data of Table 1 is arranged according to article 4-1/aof act 5510. The percentage of employment accidents has been decreasing until the year 2010, and then it remains constant until the year 2013. In 2013, the percentage increase by 2.4 times and continue to increase in 2014 and 2015.

Table 1: The Percentages of Employment Accidents and Cases

Year	Number of compulsory insured employee[a]	Number of employment accidents	Percentage of employment accidents [b]	Number of occupational diseases	Percentage of occupational diseases[c]	Number of death cases[d]	Percentage of death cases[c]	Number of permanently disabled employee[e]	Percentage of permanently disabled employee[c]
2003	5,615,238	76,668	1.37	440	0.57	810	1.06	1,451	1.89
2004	6,181,251	83,830	1.36	384	0.46	841	1.00	1,421	1.70
2005	6,918,605	73,923	1.07	519	0.70	1,072	1.45	1,374	1.86
2006	7,818,642	79,027	1.01	574	0.73	1,592	2.01	1,953	2.47
2007	8,505,390	80,602	0.95	1,208	1.50	1,044	1.30	1,956	2.43
2008	8,802,989	72,963	0.83	539	0.74	866	1.19	1,694	2.32
2009	9,030,202	64,316	0.71	429	0.67	1,171	1.82	1,885	2.93
2010	10,030,810	62,903	0.63	533	0.85	1,454	2.31	2,085	3.31
2011	11,030,939	69,227	0.63	697	1.01	1,710	2.47	2,216	3.20
2012	11,939,620	74,871	0.63	395	0.53	745	1.00	2,209	2.95
2013	12,484,113	191,389	1.53	351	0.18	1,360	0.71	1,694	0.89
2014	13,240,122	221,366	1.67	494	0.22	1,626	0.73	1,509	0.68
2015	13,999,398	241,547	1.73	510	0.21	1,252	0.52	3,596	1.49

Total		**1,392,632**	**7073**	**15,543**	**25,043**
Average	**9,661,332**	**107,126**	**544**	**1,196**	**1,926**

a Number of compulsory insured persons under Article 4-1/a of Act 5510
b Percentage of employment accidents is calculated with respect to number of compulsory insured employee
c Percentages are calculated with respect to the number of employment accidents
d Number of death cases including employment accidents and occupational disease
e Number of permanent incapacity including employment accidents and occupational disease

The percentage of the death cases has shown fluctuations by decreasing and increasing between the years 2003 and 2015. The maximum percentage was 2.47 in 2011, while the minimum percentage was 0.71 in 2013. In 2015, the number and the percentage of death cases was 1,252 and 0.52% respectively. Since the number of compulsory insured employee increased, the percentage of death cases was lower than the other years. According to SSI records, 7,073 occupational disease cases are determined in last 13 years. The average number of occupational diseases is 544 between the years 2003 and 2015. In 2007, 1,208 cases were recorded as occupational disease, which is the highest amount. Although there has been the perception that Turkey has a good performance regarding occupational diseases, the reality is that the occupational diseases have not been reported. Futhermore, 25,043 permanently disabled employees were reported in last 13 years. The average number of permanently disabled employees is 1,926 between the years 2003 and 2015. The distribution of the number of employment accidents cases of insured employee by the age groups and its percentages between 2003 and 2015 are shown in Table 2. The data of Table 2 is arranged according to article 4-1/aof act 5510. Throughout the years, the highest numbers of occupational accidents are observed in the 25-44 age group since this is the age range in which the highest number of insured employees exists. The 19-24 age group has the second highest number of percentages and the age group 18 and below shows the lowest percentage of accidents between the years 2003-2015. Thus it is observed that most of the accidents happen between the ages 25-44. In 2015, the highest percentage of accidents is 64.38 at the 25-44 age group and the second highest percentage is 18.66 at the 19-24 age group.

Table 2: The dDstribution of the Number of Employment Accidents of Insured Employee by the Age Groups and Its Percentages

Year	Age of workers 18 and below		Age of workers 19-24		Age of workers 25-44		Age of workers 45 and above	
	Number of workers	Percentage	Number of workers	Percentage	Number of workers	Percentage	Number of workers	Percentage
2003	223	0.29	9,982	13.02	60,138	78.44	6,325	8.25
2004	1,009	1.20	15,285	18.23	62,248	74.26	5,288	6.31
2005	1,232	1.67	16,343	22.11	52,465	70.97	3,883	5.25
2006	2,789	3.53	19,965	25.26	52,803	66.82	3,470	4.39
2007	3,906	4.85	22,886	28.39	50,917	63.17	2,893	3.59
2008	4,045	5.54	23,062	31.61	43,484	59.60	2,372	3.25
2009	352	0.55	9,724	15.12	48,402	75.26	5,848	9.09
2010	234	0.37	9,353	14.87	47,278	75.16	6,038	9.60
2011	349	0.50	10,810	15.62	50,752	73.31	7,316	10.57
2012	508	0.68	12,043	16.08	53,664	71.68	8,656	11.56
2013	2,844	1.49	40,199	21.00	127,536	66.64	20,810	10.87
2014	3,394	1.53	46,671	21.08	145,171	65.58	26,130	11.80
2015	9,622	3.98	45,081	18.66	155,505	64.38	31,339	12.97

Percentages are calculated with respect to total number employment accidents. Incidence rate and weight rate of work accidents are shown in Table 3 which is arraged accordingly to article 4-1/a of act 5510. The incident rates have been gradually decreasing until 2013. In 2013, the incident rates have been doubled. In terms of weight rate of work accidents, the rates decreased until the year 2005, afterwards there are fluctuations between the years 2006 – 2012. Slight increases are observed at the weight rate and incidence rate of work accidents between 2013 and 2015.

Table 3: The Incidence Rate and Weight Rate of Work Accidents

Year	Incidence rate of work accident[a] (per 1000000 work hours)	Incidence rate of work accident[b] (per 100 person)	Weight rate of work accident[c] (Days)	Weight rate of work accident[d] (Hours)
2003	5.46	1.23	847	0.68
2004	5.52	1.24	791	0.63
2005	4.27	0.96	782	0.63
2006	4.03	0.91	961	0.77
2007	3.61	0.81	634	0.51
2008	3.10	0.70	519	0.42
2009	2.76	0.62	641	0.51
2010	2.46	0.55	706	0.56
2011	2.45	0.55	721	0.58
2012	2.43	0.55	395	0.32
2013	5.88	1.32	507	0.41
2014	6.51	1.47	514	0.41
2015	6.77	1.52	565	0.45

a This method represents the number of accidents per 1.000.000 working hours
b This method represents the number of accidents per 100 full-time workers
c This method represents the number of lost workdays per 1.000.000 working hours
d This method represents the number of lost hours per 100 working hours because of employment accidents

The distribution of the number of insured employee having work accidents by provinces is shown in Table 4 that is prepared according to article 4-1/a act of 5510. Although there are 81 provinces in Turkey, most of the work accidents happen in Istanbul, Izmir, Ankara, Bursa, Kocaeli, Manisa provinces. Between the years 2003 and 2009, the work accident rate had varied between Izmir and Istanbul. After 2009, Istanbul had the highest work accident rate across the country. In 2015, the number of occupational accidents in Istanbul was 56,623. The number of accidents in Istanbul was two times higher than in Izmir, and equivalent to the summation of the accident records in Ankara, Bursa and Kocaeli. During the last 13 years, 829,708 occupational accidents have occurred in İstanbul, Izmir, Ankara, Bursa, Kocaeli, and Manisa. This value was 59.6% of the total occupational accident cases in the 81 provinces in Turkey between 2003 and 2015.

Table 4: The Distribution of the Number of Insured Employee having Work Accidents by Provinces

Year	Istanbul	Izmir	Ankara	Bursa	Kocaeli	Manisa	Other provinces
2003	9,144	10,560	2,933	6,903	6,795	3,428	36,905
2004	9,205	11,199	3,539	8,341	7,792	4,185	39,569
2005	9,697	9,258	3,278	7,440	6,941	5,487	31,822
2006	10,422	9,651	3,404	8,091	7,201	6,623	33,635
2007	10,197	9,832	3,569	8,394	7,532	5,073	36,005
2008	8,489	10,095	3,472	7,150	3,601	6,145	34,011
2009	8,901	7,461	2,234	5,884	2,577	4,600	32,659
2010	7,991	7,942	2,715	7,580	3,203	5,604	27,868
2011	9,303	7,852	2,625	5,450	4,738	5,629	33,630
2012	9,450	7,596	3,081	9,303	3,052	7,227	35,162

2013	37,076	19,429	14,368	12,530	12,476	10,706	84,804
2014	46,559	20,814	16,133	15,595	15,300	11,283	95,682
2015	56,623	22,572	76,668	17,801	17,426	9,285	41,172
Total	**233,057**	**154,261**	**138,019**	**120,462**	**98,634**	**85,275**	**562,924**

The distribution of economic sectors according to the number of accidents of insured employee between the years 2003 and 2015 is given at the Table 5. The data of Table 5 is also arranged according to article 4-1/a of act 5510. The given economic sectors are achieved from SSI and selected due to the most occupational accidents occurrence. There are seven main economic sectors defined on the Table 5 and the rest of the sectors are gathered in the column named as 'others'. These sectors are, manufacture of fabricated metal products, except machinery and equipment, construction of buildings, manufacture of basic metals, manufacture of textiles, manufacture of food products, manufacture of other non-metallic mineral products, mining of coal and lignite and others. Between the years 2003 and 2004 the highest occupational accidents are observed in the sector of manufacture of fabricated metal products, except machinery and equipment. Throughout the years 2003 to 2008 there had been some small fluctuations, but between the years 2009 and 2011 there was a distinctive decrease in the number of occupational accidents. Between the years 2005 and 2008 the number of accidents among the sectors seemed to be increasing while the number of accidents at the manufacture sector of food products decreased. According to the SSI economic sector numbers between 2003 and 2015, the first three sectors with the highest percentage of occupational accidents are 'manufacture of fabricated metal products except machinery and equipment', 'mining of coal and lignite' and 'construction of buildings'.

Table 5: Distribution of the number of insured having work accident by classification of economic activity

Year	Manufacture of fabricated metal products, except machinery and equipment	Construction of buildings	Manufacture of basic metals	Manufacture of textiles	Manufacture of food products	Manufacture of other non-metallic mineral products	Mining of coal and lignite	Other Sectors
2003	9,682	8,198	4,453	7,382	2,892	4,657	5,647	33,757
2004	11,584	8,106	5,636	6,839	3,074	5,626	5,481	37,484
2005	10,283	6,480	4,964	5,869	2,334	4,891	6,011	33,091
2006	11,039	7,143	5,506	5,155	2,452	5,311	6,722	35,699
2007	11,224	7,615	5,923	5,639	2,438	5,087	6,293	41,317
2008	6,971	4,550	4,029	3,641	1,910	3,504	5,728	47,180
2009	7,314	3,497	4,819	3,771	2,484	3,569	8,193	30,669
2010	6,918	3,056	4,621	3,474	2,422	3,861	8,150	30,401
2011	7,268	3,836	3,836	3,239	2,590	4,240	9,217	33,565
2012	7,045	4,511	4,938	5,127	2,972	3,733	8,828	37,717
2013	15,699	14,286	12,061	10,996	9,111	9,213	11,289	148,435
2014	18,529	13,508	12,357	12,128	10,971	10,244	10,026	133,603
2015	19,221	7,498	12,529	12,041	12,003	10,242	7,429	160,584

Table 6 whose data is taken under article 4-1/a of act 5510, shows the type of injuries resulted from occupational accidents between the years 2003 and 2015. For SSI started using ESAW methodology in 2013, there has been a significant change at statistical data. Some of the categories under the heading of the type of injuries have changed. New categories have been added and some of the categories are removed. The new main headings are 'Effects of temperature extremes, light and

radiation', 'Effects of sound, vibration and pressure' and 'Shock'. 'Wounds and superficial injuries' is the most occurred accident, followed by 'dislocations, sprains and strains' and 'bone fractures'. In case of these categories no fluctuations are observed between the years 2003 and 2015. However, on the other categories fluctuations can be seen from year to year. Two categories named as 'Crushed and contusions' and 'Contamination of the body or the eye with a foreign object' for the years 2013 and 2015 have no available data.

Table 6: Distribution of the number of insured having work accident by type of injury

Year	Wounds and superficial injuries	Dislocations, sprains and strains	Bone fractures	Burns, scalds and frostbites	Poisonings and infections	Concussion and internal injuries	Type of injury unknown or unspecified	Other specified injuries not included under other headings	Crushed and contusions	Contamination of the body or the eye with a foreign object	Others
2003	28,586	11,468	8,470	2,932	508	224	1,171	1,380	18,499	2,870	560
2004	32,974	12,513	7,631	2,940	367	131	946	1,200	22,295	2,833	0
2005	28,410	9,944	7,446	2,774	150	91	1,463	900	20,887	1,858	0
2006	30,130	8,707	9,626	2,846	103	102	1,675	2,772	21,532	1,534	0
2007	35,863	7,455	10,188	2,513	270	152	1,850	3,947	17,257	1,094	13
2008	33,281	5,162	9,871	2,065	94	108	1,675	4,239	15,591	877	0
2009	26,743	4,389	9,184	1,524	74	114	2,423	4,452	14,697	715	1
2010	24,833	5,553	8,531	1,762	245	61	2,003	2,404	16,462	1,049	0
2011	26,154	7,279	10,027	1,964	191	56	3,249	1,124	18,051	1,132	0
2012	36,405	6,579	7,433	1,246	273	149	12,874	1,691	7,250	971	0
2013	85,469	27,305	16,172	4,794	1,857	924	9,459	42,876	N/A	N/A	2,533
2014	101,158	31,571	17,202	5,626	4,075	895	10,697	47,389	N/A	N/A	2,753
2015	112,397	35,858	18,131	6,277	2,450	920	11,232	51,432	N/A	N/A	

Table 7 reflects the number of accidents at work by part of the body injured between the years 2003 and 2015. The data of Table 7 is prepared according to article 4-1/aof act 5510. The same change on calculations in others statistics change of the methodology through ESAW has caused an increase at the figures. That is why as it is done in other tables, to evaluate the numbers in their related methodologies would give a more accurate view. There had been a difference in coding after 2013 and this coding became the same as in Eurostat. SSI classified body parts affected from occupational accidents in 8 categories. The categories are listed as 'upper extremities'; 'lower extremities'; 'other parts of body injured', 'not mentioned'; 'head'; 'part of body injured, not specified, back including spine and vertebra in the back'; 'whole body and multiple sites, not further specified'; 'torso and organs, not further specified and neck, inclusive spine and vertebra in the neck'. Before changing the statistics as ESAW methodology between the years 2003 and 2012, the highest values are seen in 2004. However, to have a more accurate view, the numbers after 2013 are more significant. As it can be seen from Table 7 the most injured part of bodies is 'upper extremities' and 'lower extremities'.

Table 7: Distribution of the Number of Insured having Work Accident by Injured Part of the Body

Year	Upper Extremities, not further specified	Lower Extremities, not further specified	Other Parts of body injured, not mentioned above	Head, not further specified	Part of body injured, not specified	Back, including spine and vertebra in the back	Whole body and multiple sites, not further specified	Torso and organs, not further specified	Neck, inclusive spine and vertebra in the neck
2003	39,747	19,340	391	7,454	470	3,934	1,888	2,497	427
2004	44,198	22,058	454	7,673	691	3,981	2,211	2,091	473
2005	39,791	19,272	505	5,865	1,260	3,610	1,287	2,003	330
2006	42,697	20,355	542	5,549	2,533	3,658	1,317	1,767	609
2007	43,290	20,207	3,508	4,239	1,697	2,572	1,258	1,907	340
2008	38,992	16,650	5,397	4,527	1,228	2,586	1,238	2,041	304
2009	32,636	16,604	3,431	4,113	1,770	1,964	1,249	2,152	394
2010	34,151	14,855	1,485	5,028	1,326	2,308	887	2,461	402
2011	36,885	16,984	714	5,843	2,375	2,909	1,272	1,810	435
2012	36,248	14,541	2,851	5,337	8,887	3,218	1,443	1,646	700
2013	73,550	36,969	34,387	23,049	9,821	4,700	3,643	4,111	1,159
2014	85,566	42,223	39,298	26,349	11,013	5,615	5,086	4,823	1,393
2015	94,014	46,710	42,946	29,062	11,285	5,973	4,723	5,344	1,490

The statistical study of occupational accidents is a good way to describe and assess the occupational safety profile of a country .According to the 2012 statistical data of Eurostat 2.5 million non-fatal accidents and 3,515 fatal accidents occurred in 28 member states of the European Union. According to the statistical data of the Social Security Institution of the Republic of Turkey, there has been a significant increase of non-fatal and fatal occupational accidents in Turkey since 2013. The number of nonfatal occupational accidents in 2013 was 2.5 times higher than the year 2012. However, it is difficult to compare the data before and after 2013 (Unsar (2009), Turkan (2016)). Statistically significant differences were established in methodologies of the reported non-fatal and fatal occupational accidents. There is an inconsistency in the data of the statistical yearbooks of the Social Security Institution of the Republic of Turkey. In 2013, The Occupational Health and Safety Law No. 6331 imposed on employers to report all accidents on electronic environment. In addition to that the Social Security Institution of the Republic of Turkey started to record and publishes the work accident insurance data by European Union standards so the occupational accidents resulting in more than three consecutive days of work absence were included. Furthermore, the records of fatal occupation accidents include the cases where death occurred within a year after the accident. As a result of these changes, a significant increase was observed in the number of occupational accidents.

There are several contradictory interpretations of the relationship between age and occupational accidents at work (Burt, 2015). Some researchers have found no significant differences in work accidents among the various age groups (Macedo, 2015). Others have found a higher accident rate for workers in the intermediate groups; those age 28-47 (Root, 1981). In Turkey, the relationship between the age of employees and the number of accidents showed that the employees at the age group 25-44 have more work accidents than the other age groups. Although the number of insured employee is highest at this age group, this is not enough to explain the highest number in occupational accidents. Employees at the age group 25-44 are generally reckless, have dangerous jobs and don't have enough experience. On the other hand, age group older than 45 have lower accidents rates because they are experienced, mature, and are mindful of workplace hazards. Older workers still have accidents because of declining reflexes, hearing, and vision.

In case of occupational diseases, the majority of the occupational diseases, and the death cases due to occupational diseases and the permanent incapacity cases were not sufficiently recorded (Ceylan, 2015) in Turkey. Because of the difficulty in the determination of background conditions causing occupational diseases, recording may not be possible in some of the cases. Another reason is the lack of institutions and doctors with the authority to make medical diagnosis on occupational diseases. In Turkey, there are only three occupational disease hospitals in Ankara, Istanbul and Zonguldak. These three occupational diseases hospitals were not enough and efficient to trace an occupational disease for 81 cities in Turkey. Moreover, they were not reachable for all employees to confirm an occupational disease. In these circumstances a new regulation has been adjusted in the year 2013 to identify new authorized health care providers for tracing and diagnosis of occupational diseases. The authorization was given by the Health Ministry. According to the new regulation the occupational diseases and injury claims can be also made to training and research hospitals, government hospitals and medical faculty hospitals.

Incidence rate of work accidents is an alternative way to analyse the information on accidents at work. It expresses the number of accidents in relation to the number of persons employed. According to the ESAW Methodology, the incidence rate is defined as the number of accidents at work per 100,000 persons in employment. Eurostat publishes standardized incidence rates to take account of differing industrial backgrounds across member states. Across the EU-28 there were, on average, 1702 non-fatal accidents per 100,000 persons employed in 2012. In case of Turkey, incidence rate of work accidents is calculated per 100 workers in the annuals of SSI as explained in methodology part. The occupational accident incidence rate is 1.52 per 100 workers (1,520 per 100,000) for all sectors in Turkey in 2015. The incidence rates in Turkey seem lower than EU-28 countries. However, Turkey's situation is much worse than all European countries. The majority of occupational accidents occurred in Turkey are not reported to the SSI. Thus, the official data is not reliable.

When the distribution of the work accidents throughout Turkey was analysed, it was observed that most of the accidents happened in Istanbul, Izmir, Ankara, Bursa, Kocaeli and Manisa provinces. This observation can probably be explained by the population and economic activities in these cities. Generally, the number of occupational accidents is higher in the industrialized and populated cities. According to the statistics of Turkish Statistical Institute, 18.5% of Turkey's population lives in Istanbul. Approximately 38% of the Turkey's population inhabits in these 6 cities that have the highest number of occupational accident statistics. According to the survey of Socio-Economic Development Ranking Survey of Provinces and Regions the most developed provinces are Istanbul, Ankara, Izmir, Kocaeli, Antalya and Bursa. Furthermore, there are several construction sites in Istanbul. Since the construction sector has one of the highest numbers of accidents, this causes a rise in the accident rates in İstanbul.

According to the 2013 statistical data of Eurostat, the economic sectors are classified also as manufacture, construction, manufacture of basic metals, manufacture of textiles, manufacture of food products, manufacture of other non-metallic mineral products, mining of coal and lignite and others. Because of the changed methodology of statistical data, it's hard to compare the data before 2013. The Eurostat data covers 28 EU countries non-fatal accidents. The most significant data is on mining of coal and lignite, the number of non–fatal accidents on mining sector is 3 times higher than the number in EU28. The following economic sector on non-fatal accidents is textile manufacturing. The numbers of occurred non-fatal accidents are nearly the same with EU28 and Turkey. According to the 2012 statistical data of Eurostat, the type of injuries is classified under the same categories as SSI. The figures are given for EU- 28 by their percentages at the related year. Wounds, dislocations & sprains, concussions& internal injuries and bone fractures are the first four injured part of the body in EU-28, relatively with 29.7%, 25.5%, 15.9% and 11.3%. The statistics of SSI for 2012 shows a different ranking of injured parts such as wounds, other specified injuries not included under other headings, bone fractures and crushed & contusions. According to SSI the percentage is 48.6% and then as second the category named other specified injuries not included under other headings is coming. Afterwards the other headings percentages are at most 9% level. This may show that the officially told numbers are may not classified as under the related headings. To have nearly the half of the injuries just for the wounds may need a re-check while the injuries are claimed.

The highest statistics for the number of accidents at work by part of the body injured were listed as 'upper extremities', 'lower extremities' and 'back including spine and vertebra in the back' for EU15. In another report that has been published

from 'Health and Safety Authority' stated as that the percentage of accidents at work by part of the body injured between the years 2011 – 2012 is as 23% back, 7% hand, 7% leg, 6% shoulder, 6% arm, 9% fingers and 7% ankle (HAS, 2013). As it is observed in Turkey, upper and lower extremities have the highest percentages in body part that is injured by occupational accidents.

4. CONCLUSION

Looking at the overall progress, Turkey has gone through a comprehensive transformation in terms of work health and safety measures especially since 2008 (Ceylan, 2012). In this sense, Turkey has just recently started to seriously debate the necessary precautions to ensure the security of workers. Nevertheless, the new legislation in accordance with the EU standards has not prevented work accidents; and it even failed to generate a stable decrease in such accidents. Since workers perform highly hazardous jobs every day, over time their routine generates a lack of attention towards their own security. Therefore, it is crucial to provide regular and serious training to those workers in order to increase awareness about work safety and fatal accidents. Moreover, it is also important that authorities conduct regular inspections and increase sanctions to ensure that employers and workers are aware of their responsibilities and carry out their duties

Occupational accidents lead to serious problems in Turkey with the results of deaths, injuries or disabilities. Totally 1,392,632 employment accidents, 7,073 occupational diseases, 15,543 death cases and 25,043 permanently disabled employees were reported between the years 2003 and 2015. The results of this study shows that with the growing number of compulsory insured employee, there exists an increase in the number of fatal and nonfatal occupational accidents and the incidence rate of work accidents last two years. In Turkey, the workers are insured under three different categories according to the Article 4-1/a, 4-1/b, 4-1/c of Act 5510. In 2015, the total number of insured persons under Article 4-1/a, 4-1/b, 4-1/c of Act 5510 was 20,773,227. The number of compulsory insured persons under Article 4-1/a of Act 5510 was 13,999,398. Those employed by one or more employer through a service contract are subjected to the Article 4-1/a. Those who are income tax payers in real or ordinary procedure due to commercial earnings or self - employment income are subjected to the Article 4-1/b. Who are active in the public administrations are subjected to 4-1/c. The statistics of occupational accidents and diseases covers only the employees under Article 4-1/a. Thus, in case of the occupational accidents and diseases there is a lack of information in the statistical data of the insured persons under Article 4-1/b, 4-1/c. Losses which are not reflected on the statistical data of SSI must also be taken into consideration. These statistical figures indicate that there are problems in detection and notification of occupational accidents and diseases.

The International Labour Organization estimates that occupational accidents and work-related diseases cause over 2.3 million fatalities annually, of which over 350,000 are caused by occupational accidents and close to 2 million by work-related diseases in the world. As a result of the data in the world, it could be easily concluded that the data recorded in Turkey does not project the real fact.

Enforcement of the Occupational Health and Safety Law No. 6331, and the enacted secondary legislations that are complementary to the OHS Law have immense importance in the prevention of occupational accidents. Most accidents could be prevented through implementation and controlling of existing regulations. However, the sanctions of the Ministry of Labour and Social Security are considered as inadequate. To achieve an overall assessment on occupational accidents in Turkey, it is necessary that all occupational accidents are reported but there are discrepancies and inconsistencies at SSI statistical yearbooks. The methodology and accuracy of occupational accidents' data collection has a major importance. The record managing system of occupational accidents with the Eurostat methodology is indispensable. Since the statistical data of occupational accidents is one of the indicators of the quality of safety and health at work, the occupational health and safety professionals should take it into account in planning and implementing the national policies on safety and health at work. The number of occupational accidents could be decreased by the establishment of a safety culture together with occupational health and safety professionals, employers and employees. Apart from the change of SSI calculation, to prevent or reduce the number of occupational accidents; the root factors causing the accidents should be identified with researches and analysis. Improvements in the system are necessary, corrective measures should be taken and whether the measures are applied effectively or not should be checked regularly. These corrective measures can be evidence based developments as Yranheikki and Savolainen have explained to put the safety culture in order for long term satisfaction and also improved safety working conditions (Yranheikki (2000), O'Toole (2000), Koradeca (2001)). The problem which is usually seen in Turkey is, although the corrective measures are determined importance to the applications are not given. One of the important actions in the occupational safety is to review the corrective measures regularly and check whether the measures are applied effectively or not. The success in the prevention of the accidents depends on this process. Occupational accidents can be reduced by taking effective and preventive measures. There are some tasks should be fulfilled in order to create a secure work place by employers and employees. Employers should apply occupational health and safety legislation and take preventative measures and train the employers regularly against work related accidents. Furthermore, the employers are responsible for applying the identified precautions. Employees should be conscious and

careful about the accidents and fulfill their obligations regarding to work safety while working. Public institutions should work on creating a secure work place and creating a culture of work safety.

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