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DOES THE SRI STOCK INDEX RETURN CO-MOVEMENTS: EVIDENCE OF THE FTSE STOCK MARKETS

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ABSTRACT

This paper investigates the long-run equilibrium relationship among the FTSE SRI stock index return markets by using the Johansen cointegrtion and VECM model. The empirical results indicated that there is a long-run cointegration relationship among them and the coefficient of the speed of adjustment in FTSE stock index return is negative significant. The show that these stock index return markets are significantly adjusted to disequilibrium from the long-run relationship. According to the variance decomposition analysis, the empirical results stated that the FTSE4 Good index exhibit the significant explanation power to other markets. Next, the empirical results of impulse response analysis display that uni- and bi-directional causality between FTSE stock index return markets. Finally, according to above results, the FTSE stock index return markets can quickly respond to the information from others which show that markets are efficiency. Therefore, investors should respond to the information from others when they are making investment. The efficiency market hypothesis is supported by this analysis.

1. INTRODUCTION

In recent years, the research into the area of Corporate Social Responsibility(CSR) has generated considerable interest among academic and practitioners over the past decades. Based on the portfolio theory, a lot of investors will see to reduce the risk through diversification and to maximize the returns through socially responsible investment. At the same time, the CSR investment gives the individual and institutional investors have the chance to meet their needs and objectives. Therefore, the socially responsible investment. Recently, large institutional investors are placing a greater emphasis on investing in firms that CSR activities(Guenster et al, 2011, Omid Sabbaghi,2013). The commission of the European Comities(2001) defines CSR “is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis.” Another widely definition come from the World Business Concul (1999) for sustainable development, which stated that CSR “is the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the

community and society at large. Another well-cited definition of CSR is Caroll (1999), who argued that companies have economic, legal, ethical and discretionary responsibility. Social Responsible Investing (SRI) has attracted significant interest for several years around the world as many non-governmental organizations, governments, scholars and practitioners are involved in its promotion. SRI is a kind of investment process that integrates social environmental and ethical considerations into the investment decision-making process. Social Investment Forum (2006) well defined the concept of SRI as "an investment process that considers the social and environmental consequences of investments, both positive and negative, within the context of rigorous financial analysis". Generally, SRI is the process which identifies and invest in company that implement CSR standards. In the past two decades, SRI has changed from an activity carried out by a small number of specialist retail investment funds into an investment philosophy adopted by a growing proportion of large investment institutions, i.e., large pension funds and insurance company(Sparkes and cowton,2004, Eduardo et al.,2013). Generally, SRI is the process which identifies and invests in companies that implement CSR standards. In this way, investors can combine the financial objective and social concerns, investing in SRI index(NiKolaos,2010). To address our research, we need a reliable and comprehensive definition of the term SRI. SRI is a kind of investment process that integrates social, environmental and /or ethical considerations into the investment "decision-making" process. The development of the SRI is associated with the growing awareness among investors, companies, and governments in regard to the impact that social and environmental risks may have on long-term issues ranging from sustainable development to long term corporate performance(Eurosif, 2008).

The CSR Europe (2003) mentions the SRI in order to describe investment decisions informed by CSR considerations. SRI combines investors" financial objectives with their concerns about social, environmental and ethical issues. Finally, Sparkers(2002) stated that CSR and socially responsible investing are in essence mirror images of each other, each concept basically asserts that business should generate wealth of society but within certain social and environmental frameworks,CSR looks at this from the viewpoint of companies. This paper try to use the VECM model to find out does the SRI stock index return comovement together in the long run or not. According to the empirical results of VECM, we find that negative and significant effect of the lagged error correction term among stock markets which indicated that FTSE SRI stock index return exhibit long-run equilibrium relationship and comovement together by the short run adjusted the disequilibrium to the long-run equilibrium. The remainder of this paper is organized as follows. Section 2 provides a review of the related literature, while section 3 describe the theory adopted related to this study. In section 4 we present the methodology and data. Section 5 the empirical results are discussion at here. Finally, in section 6 we summarize our conclusions. The objective of this paper try to use the VECM model analyze the FTSE SRI stock index return is there any long-run relationship between them. Besides that, the variance decomposition and impulse response analysis show that the FTSE SRI stock index markets estimate the relative contribution of structural shock to the variation and trace the dynamic response to the effect in one variable upon itself and on other variables.

2. LITERATURE REVIEW

The stock market integration hypothesis stated that there were potential gains from international portfolio diversification if returns from investment in different national stock markets are not perfectly correlated. This implies that low levels of co-movement of stock price offer investors the benefit of diversifying their holdings across the global stock markets. That is, investors who allocated some of their portfolio to share from other countries can increase the portfolio expected return with no increase in risk. The relationship between international stock price returns integrated have been investigated extensively(i.e, Stulz 1981, Jorion & Schmartz 1986, Taylor and Tonks 1989, Jeon and Von-Furstenberg 1990, Arsharapalli and Doukas, 1993, Cheung and Ng 1992, Koop 1994, Lee and Kim 1994, Chowdury 1994, Arshanapalli, Doukas and lay 1995, Hassan and Naka 1996, Chaudhuri 1997, Lenchman 1998, Chen et al. 2002, Diamands 2008, Wong et al. 2005, Hoqut 2007, Li and Majerowskn 2008, Menon er al. 2009, Bastos and Caiado 2010, Park 2010, Subhani et al. 2011, Horvah and Petrovski 2012, Tripathi and Sethi 2012, Thomas Dimpfl 2014, Srimivsan et al 2014).

Some recent papers focus on the relationship of macroeconomic variables between SRI index, for example, Nikolaos et al.(2010) using a GARCH model and monthly data examines the impact of several macroeconomic variables on Dow Jones sustainability and Dow Jones Wilshire 5000 indexes. The results show that changes in returns of crude oil prices affect negatively the U.S. stock market. Nikolas et al (2009) used GJR-GARCH model investigated the relationship between 10 year bond value, Yen/US dollar exchange rate, non-farm payrolls and crude oil to U.S. Dow Jones sustainability index. Results show that an increase of the 10 year bond and non-farm payrolls lead to an increase of the DJSI returns. Hussen (2004) used the Sharpe, Jansen and Treynor ratios analyzed the performance of the FTSE-GII, FTSE4Good Global and FTSE All-world indices and show that the FTSE4Good index outperformed the FTSE All-World index. Hoti et al. (2008) used the Vector ARMA-GARCH model found that the DJSI index and the Ethibel sustainability index gave rise to spillover effect, while the only spillover effect from the Dow Jones Industrial Average to the DJSI returns was found. Hoti et al. (2007) found that five sustainability and ethical index exhibited co-national volatility clustering and asymmetric volatility effects by using GARCH models. Obernadorfer et al. (2013) used the event study and t-GARCH(1.1) model analyzed the effect of the Dow Jones STOXX sustainability index and the Dow Jones sustainability world index(DJSI world) on stock performance. Empirical result suggest that stock markets may penalized the inclusion of a firm sustainability stock index and strongly negative effect on the inclusion in the DJSI world. Hoti et al. (2005) used the univariate GARCH model analyzed the DJSI world, DJSI STOXX and DJSI EURO sustainability index is there any strong evidence of volatility clustering, short and long persistence of shocks to the index returns, and asymmetric leverage between positive and negative shocks to returns. The empirical estimates showed that there was strong evidence of volatility clustering, with both short and long run persistence of shocks to the index returns. A great number of above research used the GARCH related model to test the dynamic relationship between SRI market index return, motivated by the investors who can earn abnormal profits from one market information to trade another market. But just few studies used the VECM model to investigate the lead-lag or long-run equilibrium relationship between

the responsible investment index return and stock market index return. Therefore, we use the VECM model to investigate the long run equilibrium relationship between FTSE index returns, and through the impulse response function and variance decomposition analysis analysis the dynamic relationship and the relative contributions of the stock markets.

3. THEORY AND SRI STOCK INDEX BACKGROUND

3.1 Theory

The fundamental model of stock price which is widely used in the literature, think about that stock price follow a random walk model. The concept of random walk hypothesis to economics and finance that Fama (1970) has captured this idea in his work. Fama (1970) stated that an informational efficient market, prices fully reflect all available information. An investor responds to the new information before the profits from trading on the assets quickly disappear. The rapid growth of information technology and economic globalization this happen instaneously. Therefore, information based trading is always risky; and in an efficient market, price changes are random and unpredictable.

The study of markets efficiency helps us to understand the behavior of that specific markets. However, the increasing levels of trade interaction and the easing of regulatory rules governing the movement of capital have allowed investors to look for international portfolio diversification among the markets. Azad(2009) stated that the study of the behavior of several stock markets has encouraged academics, policy markets and international fund managers to ascertain whether these markets are truly interlinked, interdependent, cointegrated and , therefore contagious to each other. He also clarify the relationship between market efficiency and cointegration. The assumption is related to market integration and statistical cointegration. If asset prices in two different markets are integrated of same order(i.e, I(1)), then these prices are, by and large, cointegrated. The rules applies if the markets considered are geographically close, and , of course, their financial markets are highly integrated. However, to further investigated whether the long-term relationship exists at all among these markets, we have to look at their statistical significance, which we can do using the cointegration test procedure.

The sustainability investment stock index return was assumed as a function of other investment stock index return. Thus the general function form was specified as follows:

$$p_{i,t} = f(p_{i,t-1}) \tag{1}$$

The model can be written as:

$$p_{i,t} = \alpha + \beta_0 p_{i,t-1} + e_{i,t} \tag{2}$$

Where $p_{i,t}$ is the price of stock i at time t, α and β are the parameters to be estimated and $e_{i,t}$ is the error term at time t.

3.2 SRI stock index background

In this paper, there are four-variable SRI index to study the relationship between stock markets. The variables considered for the model are the following:

3.2.1 FTSE4Good-IBEX indexes

The FTSE Group has partnered with Bolsasy Mercados Espanoles(BME) to create the FTSE4Good IBEX index at April 2008. The index comprises companies in the BME's IBEX 35 index and the FTSE Spain All Cap Index that need good standards of practice incorporate social responsibility. These companies are working towards environmental sustainability developing positive relationships with stakeholders and upholding and supporting universal human right.(FTSE 2014). The selection of companies is based on a three-step procedures and covers three key areas(environmental, social and human rights). The FTSE4Good-IBEX is not a static index because it is reviewed twice a year in order to add or remove companies, depending on their economic, social and environmental performance (Ortas et al. 2013).

3.2.2 FTSE Global 100

The FTSE Global 100 is a market-capitalization weighted index representing the performance of the 100 largest and most highly capitalized UK-domiciled blue chip companies, listed on the London Stock Exchange, which pass screening for size and liquidity. The index is the leading share index in Europe and represents approximately 82% of the UK's market capitalization of the whole London Stock Exchange and is suitable as the basis for investment products, such as funds, derivatives and exchange-trade funds. The FTSE 100 index also accounts for 9.15% of the world's equity market capitalization. The FTSE 100 is the most widely used UK stock market indicator. The constituents of the UK FTSE indices all traded on the LSE are ranked by market capitalization-the value of all the shares added together. The FTSE 100 has a fixed number of constituents 100 and it tracks the performance of these highly-capitalized companies.

3.2.3 FTSE4G00d European Index

The FTSE European Index Series is designed to measure the performance of companies resident and incorporated in Europe. It comprises three real-time tradable indices, which are designed for trading of derivatives, index-tracking funds, exchange trade funds and performance benchmarks. All indices times are calculated and published in Euros.

3.2.4 MSCI UK Index

The MSCI United Kingdom Index is designed to measure the performance of the large and midcap segments of the UK market. With 107 constituents, the index covers approximately 85% of the free float-adjusted measure capitalization in the UK.

4. DATA AND METHODOLOGY

4.1 Descriptive Statistics of the Data

Daily data of the FTSE4 Good IBEX(FT4IBEX)) FTSE Global 100(FTSEGL$), FTSE4Good Europe(FT4GBEU) and MSCI UK(MSUTDKL) for the period March 10 2000 through March 8 2013 have been considered for the study. Daily stock price returns fro the selected stock market data are calculated as, $R_{i,t} = 100x\log(P_{i,t} / P_{i,t-1})$ where $R_{i,t}$ and $P_{i,t}$ are the daily stock *i* returns and prices at time *t*, respectively. The descriptive statistics of the data used in our study is as shown in table 1. The statistic value indicated that the value of skewness is greater than zero and the value of kurtosis is greater than 3 and the J-B statistics value is significant at 1% level. The results of summary statistics exhibit that the variables are not normally distributed about its mean and variance.

Table 1. Summary statistics

variables	FT4IBEX	FTSEGL	FT4GBEU	MSUTDKL
Mean	8774.155	937.415	3368.793	1592.369
Median	8706.800	954.560	3419.640	1636.133
Maximum	13331.100	1186.280	4436.280	1920.400
Minimum	5535.300	573.340	2118.100	1037.907
Std. Dev.	1537.029	124.394	404.000	185.127
Skewness	0.405	-0.633	-0.416	-0.942
Kurtosis	3.140	2.815	3.401	3.092
Jarque-Bera	36.138***	87.464***	45.638***	190.273***

Note:***,**and* indicate at least significant at 1%,5% and 10% level, respectively.

4.2 Methodology

The main purpose of this paper is to examine the relationships among sustainability investment price by apply the VECM model. Before applying the VECM models, we must determine the appropriate model specification by identifying the order of integration of each variable series and the existence of cointegration among the variables. If the variables have a unit root, it is best to take first difference in order to make the variables stationary. By the way, if there is a cointegration relationship in the system, we can use the Vector Error Correction model rather than the VAR model in the first difference. We, therefore, conduct the unit root, cointegration test, causality, impulse response analysis and variance decomposition and summarize the results.

4.2.1 Unit Root Testing

We begin through testing for the presence of a unit root in each of the series using the Augmented Dickey and Fuller(ADF)(1979) and Phillips Perron(PP)(1988) unit root tests are then employed to examine the stationary of underlying time-series data. In co-integration tests, the difference economic time series variables are required to be integrated of order one I(1). That is the data should be nonstationary of random walk process but stationary in their first difference. To identify the order of integration for each variable. Dickey and Fuller (1979) used the following regression equation:

$$\Delta Y_t = \alpha + \beta t + \rho Y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (3)$$

Where Δ is the difference operator, ΔY_t is the first difference of the data variable being tested, r and ρ are parameters to be estimated, and ε_t is an residual error term. If the ADF test fails to reject the test levels but rejects the test in first difference, the series contains one unit root and is of integrated order I(1). For the ADF test, we must specify the number of lagged first difference terms to add in the test regression. In this study, the lag was specified according to Schwarz Information Criterion(SIC) for each variables. The test for a unit root in the series is a test of the null hypothesis the $\rho = 0$. If the hypothesis cannot be rejected the series is assumed to be non-stationary.

4.2.2 Co-integration and Granger Causality

The next step of the analysis is to investigate the number of cointegration relation between series. From an economic point of view, cointegration implies that variables can drift apart in the short run, but they will show a long run equilibrium. Therefore, we further examine whether there is a cointegration relationship in the variables. Johansen(1988) and Johansen and Juselius(1990) maximum likelihood co-integration tests are employed to examine if the variables are cointegrated or not. Here, two conventional cointegration tests are performed; one is the Johansen's trace test of no cointegration against four cointegration vectors. We allow for a linear trend in the data and use the lag length which is selected via the Schwarz information criterion for both tests. Johansen's cointegration test has been used to investigate the long-run relationship between the variables. Besides, the causal relationship between selected stock markets was investigated by estimating the following VECM(Johansen, 1988, Johansen and Juselius,1990). The procedure is based on MLE estimation of the model as below:

$$\Delta Y_t = \alpha + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots + \delta_{k-1} \Delta Y_{t-k+1} + \pi Y_{t-1} + u_t \quad (4)$$

Where ΔY_t is *(nX1)* vector of sustainability investment market price index changes in period t, α is *(nx1)* vector of constant error term. ΔY_t is the first difference of stock index return. δ_i and π are *(nxn)* coefficient matrix with($i = 1 \cdots k-1$), of short-run dynamics, π is the *nxn* long-term equilibrium relationship among the variables in ΔY_t, and u_t is (nx1) vector of error term and it is independent of all explanatory variables. Information about the number of cointegrating relationships among the variables is given by the rank of the π matrix. Johansen(1988) used the reduce rank regression procedure to estimate π matrix, and the trace test statistics is used to test the null hypothesis of most r cointegrating vectors against the alternative greater than r, which are computed by using the following formulas:

$$\lambda_{trace} = -T \sum_{j=r+1}^{k} \ln(1-\hat{\lambda}_j), \lambda_{\max} = -T \ln(1-\hat{\lambda}_{r+1}) \quad (5)$$

Where T is the sample size, $\hat{\lambda}_j$ and $\hat{\lambda}_{r+1}$ are the estimated values of the characteristic roots obtained from the matrix. The trace test tests the null hypothesis of r cointegrating vectors, while the maximum eigenvalue test the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r+1$ cointegrating vectors.

4.2.3 Vector Error Correlation Model (VECM)

If the stock variable series are I(1) co-integrated then the VECM model(Engle and Granger, 1987) is represented by

$$\Delta Y_t = u_{11} + \sum_{i=1}^{n} \beta_{1i} \Delta W_{t-i} + \sum_{i=1}^{n} \gamma_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \alpha_{1i} \Delta X_{t-i} + \sum_{i=1}^{n} \theta_{1i} \Delta Z_{t-i} + A_{11} EC_{t-1} + \varepsilon_{1t} \quad (6)$$

$$\Delta X_t = u_{21} + \sum_{i=1}^{n} \beta_{2i} \Delta W_{t-i} + \sum_{i=1}^{n} \gamma_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta X_{t-i} + \sum_{i=1}^{n} \theta_{2i} \Delta Z_{t-i} + A_{21} EC_{t-1} + \varepsilon_{2t} \quad (7)$$

$$\Delta W_t = u_{31} + \sum_{i=1}^{n} \beta_{3i} \Delta W_{t-i} + \sum_{i=1}^{n} \gamma_{3i} \Delta Y_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta X_{t-i} + \sum_{i=1}^{n} \theta_{3i} \Delta Z_{t-i} + A_{31} EC_{t-1} + \varepsilon_{3t} \quad (8)$$

$$\Delta Z_t = u_{41} + \sum_{i=1}^{n} \beta_{4i} \Delta W_{t-i} + \sum_{i=1}^{n} \gamma_{4i} \Delta Y_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta X_{t-i} + \sum_{i=1}^{n} \theta_{4i} \Delta Z_{t-i} + A_{41} EC_{t-1} + \varepsilon_{4t} \quad (9)$$

Where Δ is the difference operator, $\varepsilon_{1t} \ldots \varepsilon_{4t}$ are the white noise error terms, $\Delta Y_{t-i} \cdots \Delta Z_{t-i}$ are stationary variables, EC_{t-1} is the error correction term derived from the long-run co-integration relationship, and *n* is the optimal lag length orders of the variables. In this model, the deviation from equilibrium affects the short-run dynamics of variables in the system. In this methodology, the lag right-hand side variables' coefficients show that short run effect, which is called impact multiplier. The parameters coefficients of error correction variables show the connection of the disequilibrium from the long-run equilibrium and the coefficients are called adjustment effects. If coefficient of error correction term is large, response to the precious period's deviation from long-run equilibrium is high while small value of error correction term's coefficient can be interpreted as left-hand side variable is unresponsive to last period's equilibrium error. With this model; long-run relationship can be captured by adjustment coefficient. If we find out both coefficients of error correction term to be zero. We conclude that there is no long-run relationship and model should be estimated by using VAR model. We also conducted the causality test based on Granger's approach(Granger 1969) in order to see any influences between stock markets have considered. In order to test for Granger causality, we considered stock market index variables. After estimating the Granger-causality we run a F-test for joint insignificance of the coefficients. Assuming the null hypothesis that variables does not Granger cause and vice versa, a rejection of the null hypothesis shows a presence of Granger causality. The Granger causality tests are performed for each pair of stock indices.

5. EMPIRICAL STUDY AND RESULTS

The first step in the empirical analysis to perform a co integration test is that order of integration of variables has the same order. In order to detect the order of integration we employed two unit root test, that is the Augmented Dickey-Fuller(AD) test(Dickey & Fuller,1979) and the Phillips-Perron(PP) test (Phillips & Perron,1988) unit root test results are shown in Table 2. The null hypothesis of a unit root is not reject for all variables in levels. Rather, all variables become stationary after first difference, which means that they are I(1) stationary.

Table 2. Unit Root Test

	ADF		PP	
Variables	level	1st difference	level	1st difference
FT4IBEX	-2.591	-34.545***	-2.491	-34.590***
FTSEGL	-2.267	-42.186***	-1.924	-54.265***
FT4GBEU	-2.144	-60.228***	-2.380	-60.629***
MSUTDKL	-2.141	-37.869***	-2.065	-61.685***

Note:***,**and* indicate at least significant at 1%,5% and 10% level, respectively.

5.1 Johansen Cointegration Test

In order to further investigate cointegration results among the variables, the multivariate cointegration technique of Johansen(1988) is employed. Here, the two conventional cointegration tests are performed, namely, the trace and maximum eigenvalue test statistic. The trace test examines the null hypothesis that the number of cointegrating vectors in the system, r is less than or equal to r_0 when $r_0 < p$ and p is the number of variable in the system, whereas the alternative hypothesis is that the impact matrix is of a full rank. The maximum eigenvalue test examines the null hypothesis that there are r_0 cointegrating vectors versus the alternative of $r_0 + 1$ cointegrating vectors. We allow for a linear trend in the data and use the lag length supplying the small critical value is determined as the lag length of the model by Akaike Information Criteria(AIC) for both tests. The results are exhibit at Table 3, that the trace statistic indicated significant evidence of long-run relationship, where as the maximum eigenvalue statistics also shows evidence of long-run relationship with at most four cointegrating vector. Therefore, we will proceed to estimate the VECM models.

Table 3. Results of Johansen Cointegration Test

H0	HA	λ max	95%	λ trace	95%
r=0	r=1	131.9910	27.58434	379.8385	47.85613
$r \leq 1$	r=2	97.16897	21.13162	247.8475	29.79707
$r \leq 2$	r=3	80.19446	14.26460	150.6786	15.49471
$r \leq 3$	r=4	70.48410	3.841466	70.48410	3.841466

Note:*r* indicated the number of cointegration vector. Critical value are from Mackinnon （1990）P-Values.Trace test and Max-eigen value test indicates cointegrating equations at the 5% level.

5.2 Vector Error Correction Model and Granger Causality

Granger Causality approach has been the most method to determing the causality validity between SRI stock index returns. It is important to access how stock price affect one another. According to the Bildirki and Bakirtas(2014), and Gupta and Guidi(2012) stated that if variables are cointegrated then the standard Granger causality test results will be invalid. In this situation, the VECM model check the causality relationship among variables. The using of VECM model error correction term to test for causality is that it allows testing for short-run causality through the lagged difference explanatory variables and testing for long-run causality through the lagged ECM_{t-1} term. The presence of cointegration between variables suggest a long term relationship among these variables under consideration. Then, the VECM model can be applied. The long-run dynamic was examined through the effect of the lagged error correction term in the VECM. Empirical results of Table 4 show significant error correction term with a negative sign for all the major SRI stock market returns. The figure indicates that when FT4IBEX is off the long-run equilibrium, FT4IBEX adjust towards its long-run equilibrium with about 10.06% of the adjustment taking place within the year. The FT4IBEX adjusts slowly towards its long-run equilibrium. The coefficient of the speed of adjustment in FTSEGL$, FT4GBEU and MSUTDKL is also negatively significant. The magnitude of the error correction term is found to be 10%,0.8% and 5.1%,respectively. This implies that these major stock markets are significantly adjusted to disequilibrium from the long-run relationship or the response with which the previous period's deviations from the long-run relationships are corrected is found to be significant in these major stock markets.

Table 4. Vector Error Correction Estimates

	FT4IBEX	FTSEGL$	FT4GBEU	MSUTDKL
ECM	-1.006***	-1.010	-0.082	-0.513***
	(-5.487)	(-1.724)	(-1.792)	(-6.370)
FT4IBEX(-1)	-0.925***	-0.008	-0.161**	-0.085***
	(-8.326)	(-0.937)	(-4.633)	(-5.563)
FT4IBEX(-12)	-0.295***	-0.007	-0.063*	-0.028*
	(-4.554)	(-1.457)	(-3.130)	(-3.174)
FTSEGL$(-1)	0.837	-1.073***	-2.375*	-1.255*
	(0.307)	(-5.047)	(-2.791)	(-3.357)
FTSEGL$(-12)	-0.221	-0.051	-0.199	-0.109
	(-0.275)	(-0.808)	(-0.795)	(-0.995)
FT4GBEU(-1)	-0.503	0.001	-0.345	0.322*
	(-0.778)	(0.015)	(-1.708)	(3.637)
FT4GBEU(-12)	0.188	-0.025	-0.004	0.025
	(0.532)	(-0.891)	(-0.042)	(0.523)
MSUTDKL(-1)	1.634	0.196	1.781**	-0.063
	(1.242)	(1.909)	(4.331)	(-0.353)
MSUTDKL(-12)	1.090	0.079	0.383	0.107
	(1.709)	(1.586)	(1.919)	(1.230)
intercept	0.048	0.001	-0.003	0.013
	(0.011)	(0.003)	(-0.002)	(0.024)
R^2	0.498	0.472	0.537	0.549
F-value	24.661	22.269	26.858	30.335
Log-likelihood	-8130.142	-4894.458	-6654.604	-5611.645
AIC	12.892	7.793	10.567	8.923

Note:***,**and* indicate at least significant at 1%, 5% and 10% level, respectively.

According to Table 4, for the FT4GBEU, and FTSEGL$ didn't find that these two major SRI stock return are significantly influenced by each other. However, FT4IBEX, FTSEGL$ and MUSTDKL significantly affected FT4GBEU and FT4IBEX,FTSEGL$ significantly affected MSUTDKL at least 90% significant level. As a result of Table 4, the FT4IBEX(-1) and FTSEGL$(-1) increased by 1%, the stock price return of FT4GBEU will be decrease by 1.6% and 23.75%. Besides that, the FT4IBEX(-1) and FTSEGL$(-1) rise by 10%, the MSUTDKL will decrease by 0.8% and 12.55%. This implies that if the stock price return of FT4IBEX and FTSEGL$ rise, this has a significant negative impact on the FT4GBEU and MSUTDKL at the short-run. Recall that although cointegration between variables does not specify the direction of a causal relation. If any between variables. The results of causality between variables are presented in Table 5. FTSEGL$ Granger cause FT4IBEX granger cause FTSEGL$ at 95% significance level. There is also a bi-directional Granger cause relationship between MSUTDKL and FTSEGL$. Besides, there is a one-way unidirectional causation between FT4GBEU and FT$IBEX and FTSEGL$. According to Table 5, we found significant one-way or two-way granger causality between major SRI stock market return.

Table 5. Variance Decomposition

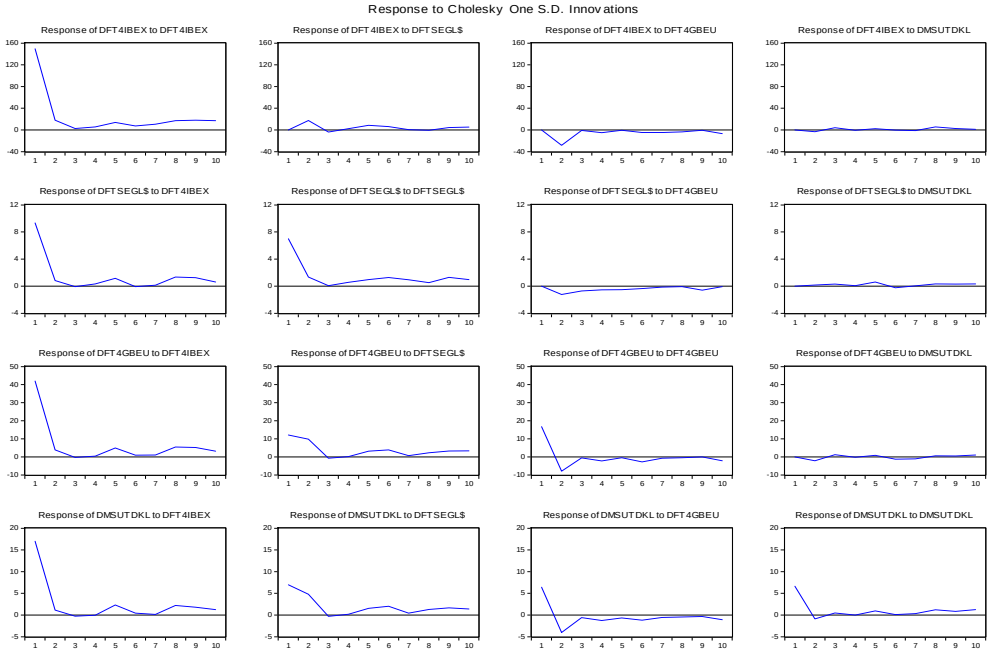
Variable	Period	S.E.	DFT4IBEX	DFTSEGL$	DF4GBEU	DMSUTDKL
	1	149.589	100.000	0.000	0.000	0.000
	8	157.433	94.362	1.762	3.614	0.262
DFT4IBEX	16	170.216	93.079	1.850	4.487	0.585
	24	178.057	92.999	2.014	4.406	0.581
	30	184.440	93.020	2.041	4.374	0.565
	1	11.683	64.020	35.980	0.000	0.000
	8	12.236	61.056	36.734	1.763	0.447
DFTSEGL$	16	13.269	59.356	37.209	2.518	0.917
	24	13.979	57.811	38.590	2.644	0.955
	30	14.507	57.030	39.236	2.771	0.963
	1	46.765	80.519	6.685	12.796	0.000
	8	49.740	74.092	11.096	14.415	0.397
DF4GBEU	16	52.997	73.108	12.178	13.814	0.890
	24	55.079	72.860	13.321	12.950	0.869
	30	56.679	72.850	13.937	12.364	0.849
	1	20.559	68.453	11.435	9.782	10.331
	8	22.135	61.463	16.204	12.721	9.612
DMSUTDKL	16	23.532	60.385	17.515	12.699	9.401
	24	24.479	59.560	18.947	12.242	9.252
	30	25.211	59.193	19.756	11.961	9.090

5.3 Variance Decomposition and Impulse Response Analysis

The impact of SRI stock index return shocks between each other is analyzed using both the forecast variance decomposition and impulse response functions The forecast variance decomposition decomposes the forecast error variance and estimates the relative importance of structural shocks, where as the impulse response analysis helps to access the direction, magnitude, timing and duration of a one-time standard deviation shock between stock markets. The relative contribution of these stock market shock to the variation is captured using the variance decomposition method. The results of variance decomposition analysis based on VECM for the major SRI stock markets over a 30-day horizon are presented in Table 6. The numbers reported indicated the percentage of the forecast error of the four shocks at different time horizons from one day(short-term) to thirty days(long-term). The results of variance decomposition suggest that the importance of DFT4IBEX explains 64.02% of the variations in DFTSEGL$ and it reduce to the 57.03% after 30 days. The empirical result show that the DFT4IBEX explained by its own shock at 94.36% on the 8 trading days, and then it decrease to 93.02% on the 30 trading days. About 74% of variation in the forecast error for DFT4GBEU is explained by innovations of DFT4IBEX after 8 trading days. Results show that DFT4IBEX explains 68.45% of the variations in the DMSUTDKL on the first trading day, and it reduce to 59.19% on the 30^{th} trading days. The shock of other stock markets ranges between 19.76%,11.96% and 9.09% at the 20^{th} trading days. This result indicated that the DFT4IBEX exhibit the importance stock market returns in explaining variations in the other stock markets.

The impulse response functions trace the dynamic response to the effect in one variable upon itself and on all other variables. The findings from the impulse response functions are provided in Figure 1. According to the impulse response functions, in respond to one unit standard deviation shock applied to DFT4IBEX produces a significant positive impact on DFTSEGL$,DFT4GBEU and DMSUTDKL in the short run. Also, in response to a unit shock in DFTSEGL$, DFT4GBEU and DMSUTDKL positive impact at short run then decrease at long run. In response to a one standard deviation shock in DFT4GBEU,DFT4IBEX and DFTSEGL$ negative impact at short-run. However, positive impact at DMSUTDKL at short run. In response to a one standard deviation shock in DMSUTDKL, did not find any significant impact on other variables. The above result suggest that existence of a unidirectional causality running from DFT4GBEU to DMSUTDKL and DFT4IBEX tp DFTSEGL$, DFT4GBEU and DMSUTDKL and DFTSEGL$ to DFT4GBEU and DMSUTDKL in the short-run. Also, the results show no long-run impact effect.

Figure 1. Impulse response of FTSE SRI stock Index Market Returns



6. CONCLUSION

This paper try to use the VECM model to find out does the SRI stock index return comovement together in the long run or not. According to the empirical results of VECM, we find that negative and significant effect of the lagged error correction term among stock markets which indicated that FTSE SRI stock index return exhibit long-run equilibrium relationship and comovement together by the short run adjusted the disequilibrium to the long-run equilibrium. By the way, the granger causality show that bi-directional granger cause relationship between MSUTDKL and FTSEGL$ and one-way unidirectional causality between FT4GBEU and FT4IBEX and FTSEGL$. Next, the analysis empirical result of the variance decomposition reported that the importance of DFT4IBEX explain the variations in DFTSEGL$ and DMSUTDKL. The result stated that the DFT4IBEX exhibit the importance stock market returns in explaining variations in the other stock markets. So, that is why the FTSE4GoodIBEX is the most important investment indicator index for the investor, fund manager, and investing bank. Then, the empirical result from the impulse response function, the DFT4IBEX provides a significant positive impact on the other SRI stock index return market in the short run and also in DFTSEGL$ one unit shock significant positive impact shock to DFT4GBEU and DMSUTDKL. However, in respond to a one unit shock in DFT4GBEU significant negative impact shock to DFT4IBEX and DFTSEGL$. The response of the SRI stock index return is quickly at the short-run, show that market response the information instaneously and efficiently. Lastly, based on the above analysis, the SRI stock index return display the long-run equilibrium relationship between markets. According to this result, we know that if the investor try to investigate the SRI stock should be consider the linkage about other SRI stock markets. Here, we can also see the impact effect of SRI stock return affected by other stock markets. Based on this analysis, the investor should respond to the new information from the other SRI stock markets because of the information efficiency.

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EXPANDING EFFECTS OF MILITARY EXPENDITURES ON EXTERNAL DEBT IN DEVELOPING COUNTRIES

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ABSTRACT

The aim of this study is to investigate the effects of military expenditures on external debt with other variables like GDP growth, fixed capital formation and openness. The empirical analyses are utilized by using annual panel data for 36 developing countries and by following the methodologies of "Pooled OLS Model" and "Dynamic Panel Estimations". The sample period covers the years between 1996 and 2013. The estimation results indicate that a change in military expenditure affects external debt positively in developing countries concerned.

1. INTRODUCTION

The role of military expenditure in external debt is important due to the potential unfavorable effects of external debt on the economic performance. Deterioration in terms of trade, overvaluation of domestic currency and slowdown in economic growth are the examples of these adverse effects of excessive external debt accumulation (Smyth and Narayan, 2009: p. 235). There are three main channels that defence expenditure affect external debt. Firstly, the consumption of arms causes a reduction in the available resources that may be directed to the import of intermediate and investment goods that will stimulate long run growth especially in developing countries with scarce foreign exchange. Secondly, the military expenditure exceeding the government revenues cause budget deficits. And these budget deficits have to be financed by foreign borrowing if the country is in a lack of domestic funding opportunities. Lastly, domestic production of arms may create demand for high-tech imported intermediate inputs and machinery, and hence increase foreign exchange demand to consume these products (Smyth and Narayan, 2009: p. 239; Dunne et al., 2004a: p. 181). However, defence expenditures can create positive externalities by contributing to modernization, leading to technological spillover effects, building physical infrastructure and supporting modernization of healthcare. Through these positive externalities, defence spending can have a contributing effect on the productivity (Ahmed, 2012: p. 491). Impact of military expenditure on macroeconomic indicators has attracted the attention of economics researchers both from developed and

developing countries, since the military expenditure is one of the most important expenditure items in the central government budgets and it can affect future economic performance through its considerable influence on the level of indebtedness (Ahmed, 2012: p. 487). In the review of the empirical literature, it is seen that the majority of the empirical researches have focused on the relationship between military expenditure and growth. Relatively few studies have investigated the effect of military expenditure on external debt. However, understanding of the contribution of defence spending in external debt stock is crucial for policymakers of developing economies. Moreover, the existent literature predominantly consists of empirical studies using time series methods for single countries.

It is detected that there are few studies employing panel data methods for particular regions. Because of these reasons, this study aims to empirically investigate the military expenditure and external debt nexus for a group of developing economies by using panel data methodologies and by this way enrich the empirical literature in this field. Our main objective is to contribute to the related literature by applying panel data methodologies and by exploring the debate for a group of developing countries from different regions of the world rather than selecting the country group from a particular geographical region. For this purpose, the linkage between military expenditure and external debt is investigated for 36 countries by using annual panel data for the period between 1996 and 2013. The empirical investigations are carried out by employing the methodologies of "Pooled OLS Models" and "Dynamic Panel Estimations".

The remainder of paper is organized as follows: The second part includes the recent literature that empirically investigates the relationship between military expenditure and external debt. In the third part, the data and methodology that will be used in empirical applications are presented. The empirical results are submitted in the fourth part; followed by conclusion and suggestions in the last part.

2. LITERATURE REVIEW

This section of the paper reviews the attempts, which aimed to determine the impact of defence expenditure on external debt, in the related literature. The previous studies, evaluating the impact of military expenditure on external debt, are summarized in Table 1 and they can be categorized as those using time series for single countries [(Dunne et al. (2004a), Sezgin (2004), Karagöl (2005), Karagöl (2006), Narayan and Narayan (2008), Karagöl and Turhan (2008), Wolde-Rufael (2009), Zaman et al. (2012), Shahbaz et al. (2013)] and those applying panel data methods [Dunne et al. (2004b), Symth and Narayan (2009), Ahmed (2012)]. The second group is more relevant to our paper based on methodological terms. Dunne et al. (2004a), empirically analyze the effect of defence expenditure on external debt for Brazil, Argentina and Chile by using autoregressive distributed lag (ARDL) model. Estimated model includes independent variables such as defence expenditure, GDP, exports, reserves and interest rate. The data period is between 1970 and 2000 for Argentina and Chile; 1971 and 2000 for Brazil respectively. According to the empirical results, military expenditure has positive effects on external debt in Chile, while there is no empirical evidence about this relationship for Argentina and Brazil.

In another study of Dunne et al. (2004b), defence expenditure-external debt debate is examined in a panel that gathered 11 small industrializing economies (Chile, Brazil, Argentina, Venezuela, South Africa, Malaysia, Philippines, India, Pakistan, South Korea, Turkey), by using panel data methods. The explanatory variables of the external debt model are determined as military burden, GDP growth, international reserves and exports. The sample period is identified from 1960 to 2000 and the study provides estimates with fixed effects and random effects models in addition to generalized method of moments (GMM). It is determined that the military burden has a positive effect on external debt.

Sezgin (2004) investigates defence-debt nexus for Turkey. The period of the empirical analysis is between 1979 and 2000, and the external debt is tried to be explained with the explanatory variables of GDP, defence expenditure and balance of trade. The results of Engle-Granger cointegration test show that the long run relation between defence expenditure and external debt is significantly negative.

One of the popular papers, related to defence expenditure-external debt relationship, for Turkish economy belongs to Karagöl (2005). The external debt is tried to be explained by defence expenditure in a bivariate model. The study employs Johansen cointegration procedure, Granger causality analysis and impulse response function (IRF) between the years of 1955 and 2000. The cointegration analysis shows that there is a long run relationship between defence expenditure and external debt; and the impact of defence expenditure is positive. This positive effect is supported by the IRF results. Furthermore, Granger causality test represents a unidirectional causality from defence expenditure to external debt. In the case of Turkey, Karagöl (2006) investigates the relationship between defence expenditure and external debt by including gross national product (GNP) and investments in the Karagöl (2005)'s model. In the empirical analysis, the methodology of IRF and variance decomposition is applied with the annual data of the years between 1960 and 2002. Empirical results show that defence expenditures increase Turkey's external debt significantly.

Table 1: Empirical Studies

Researcher	Period	Country	Explanatory Variables of External Debt	Method	Empirical Results
Dunne et al. (2004a)	1970- 2000 (Argentina and Chile); 1971- 2000 (Brazil)	Brazil, Argentina, Chile	Defence Expenditure, GDP, Interest Rate, Exports, Reserves	ARDL Model	Positive Effect
Dunne et al. (2004b)	1960- 2000	11 Small Industrializing Economies	Military Burden, GDP Growth, International Reserves, Exports	Fixed Effect Models, Random Effect Models, GMM	Positive Effect
Sezgin (2004)	1979-2000	Turkey	Defence Expenditure, GDP, Balance of Trade	Engle-Granger Cointegration Test	Negative Effect
Karagöl (2005)	1955-2000	Turkey	Defence Expenditure	Johansen Cointegration Test, Granger Causality Test	Positive Effect Unidirectional causality from military expenditure to external debt
Karagöl (2006)	1960-2002	Turkey	Defence Expenditure, GNP, Investment	Johansen Cointegration Test, IRF, Variance Decomposition	Positive Effect
Narayan & Narayan (2008)	1970-2005	Fiji Islands	Military Expenditure, GDP	Bound Test, ARDL Model, FMOLS, DOLS	Positive Effect
Karagöl & Turhan (2008)	1960-2002	Turkey	Defence Expenditure, Dummy Variables	Johansen Cointegration Test, IRF	Positive Effect
Wolde-Rufael (2009)	1970-2005	Ethiopia	Military Expenditure, GDP	Bound Test, ARDL Model, Granger and Toda Yamamoto Causality Tests	Positive Effect Unidirectional causality from military expenditure to external debt
Symth & Narayan (2009)	1988-2002	Oman, Iran, Yemen, Syria, Jordan, Bharain,	Defence Expenditure, GDP	Panel Cointegration	Positive Effect
Zaman et al. (2012)	1980-2009	Bangladesh	Military Expenditure	Engle-Granger Cointegration Test, ECM, Granger Causality Test	Positive Effect Unidirectional causality from external debt to military expenditure
Ahmed (2012)	1988-2007	25 Sub-Saharan African Countries	Military Expenditure, GDP Exports, Imports, Balance Of Trade,	FMOLS, DOLS, DFE	Positive Effect
Shahbaz et al. (2013)	1973-2009	Pakistan	Military Expenditure, GDP per capita, Investment	IRF, Bound test, ARDL Model, Granger Causality Test	Positive Effect Bidirectional causality between external debt and military expenditure

One other study, focusing on Turkish economy, is conducted by Karagöl and Turhan (2008). Their empirical analysis is for the period of 1960-2002. It is aimed to explain the external debt with three explanatory variables, which are defence expenditure, election dummy variable and political color dummy variable. They adopt Johansen cointegration procedure and IRF methodology, and finally report a positive relationship between the military expenditure and external debt.

Another single country analysis is carried out by Narayan and Narayan (2008) for Fiji Islands. The study investigates the relationship between debt, GDP and military expenditure for the period of 1970-2005. They conduct bound test for cointegration and use ARDL model, fully modified ordinary least squares (FMOLS), dynamic ordinary least squares (DOLS) and ordinary least squares (OLS) to estimate the long run and short run effects. Their empirical results indicate a cointegration relationship between the related variables and a significantly positive long run effect of military expenditure on external debt.

Wolde-Rufael (2009) contributes to the relevant literature by examining the impact of defence expenditure on the external debt of Ethiopia, a least developed country that is also one of the severely indebted low-income countries. Military expenditure and GDP are identified as determinants of external debt. The empirical investigations for the period of 1970-2005 are carried out by using the bounds test approach for cointegration and Granger causality tests. Empirical results reveal a long run and a causal relationship between external debt, defence spending and income. Defence spending is found to have a positive and a significant impact on the stock of external debt. Moreover, Granger causality tests indicate a unidirectional causality from military expenditure to external debt.

Symth and Narayan (2009) analyze the effects of military expenditure on external debt for six Middle Eastern countries as follows; Oman, Syria, Yemen, Bahrain, Iran and Jordan by using annual panel data for the period of 1988-2002. The external debt model is estimated within the independent variables of defence expenditure and GDP. Panel unit root and panel cointegration methodology are implemented in the empirical analyses. They find that defence expenditure has a positive effect on external debt both in the long run and in the short run period.

In a related study, Zaman et al. (2012) investigate the connection between external debt and defence spending in Bangladesh. In investigating the defence–external debt nexus over the period of 1980-2009, they employ Engle-Granger cointegration test, error correction model (ECM) and Granger causality analysis. They find that military burden has a positive effect on external debt. Furthermore, empirical evidence puts forth a unidirectional causality running from military spending to external debt.

Ahmed (2012) contributes to this literature with a multi-country panel data analysis. He investigates the relationship between military expenditure and external debt by including 25 sub-Saharan African countries in his study. In the empirical investigation, three advanced panel techniques FMOLS, DOLS and dynamic fixed effect (DFE) are employed for

the period of 1988-2007. In the analysis, the external debt is explained by independent variables such as military expenditure, GDP, export, import and balance of trade. According to the empirical results, there is a significantly positive effect of military expenditures on the external debt.

More recently, Shahbaz et al. (2013) carried out a time series analysis to investigate the relationship between external debt, military expenditure, investment and GDP. Their empirical analysis includes the period of 1973-2009 of Pakistan economy. ARDL model, Granger causality analysis and IRF are employed to investigate the relationship between these parameters. They find that military expenditure has a positive impact on external debt and there is bidirectional causality between military expenditure and external debt.

3. MODEL, DATA AND ESTIMATION METHOD

3.1. Model and Data

The aim of this paper is to investigate the impacts of military expenditure on external debt by including additional independent variables namely GDP growth, openness and investment into the external debt model. Our proposed modeling framework follows the econometric specification used by the previous external debt-military expenditure literature. The explanatory variables of external debt that have been chosen in the previous studies are summarized in Table 1. Following most of the prior papers on this subject[1], we augment the bivariate model of external debt and military expenditure with GDP growth variable. And following Karagöl (2006) and Shahbaz et al. (2013), we added investment variable (for which we used fixed capital formation data) in our model. Finally, we estimated the following model:

$$EXDGDP_{it} = \alpha_{0i} + \alpha_{1i} MLXGDP_{it} + \alpha_{2i} GDPGR_{it} + \alpha_{3i} FCPFRGDP_{it} + \alpha_{4i} OPNNSS_{it} + \varepsilon_{it} \quad (1)$$

where,

EXDGDP = External debt as a share of GDP

MLXGDP = Military expenditure as a share of GDP

GDPGR = Annual growth of GDP

FCPFRGDP = Gross fixed capital formation as a share of GDP

OPNNSS = Exports plus imports as a share of GDP

Ɛ = is the error term with the conventional statistical properties

As Dunne et al. (2004a) stated as well, in developing the model of military expenditure and external debt, our purpose is not to provide a complete explanation for the development of external debt, but to recognize the specific effects of military expenditure

[1] As can be observed from Table 1, all of the reported papers - except the ones using bivariate models- include GDP/ GDP growth variable into their external debt- military expenditure models.

on external debt, given the capacity of the economy to finance the debt. EXDGDP, MLXGDP, OPNNSS and FCPFRGDP are generated by proportioning the current values of series to the current GDP[2]. GDPGR indicates the percentage change in the constant value of Gross Domestic Product (2005=100). The empirical analyses are carried out by the use of annual datasets from The World Bank and Stockholm International Peace Research Institute (SIPRI) (for military expenditures).

As mentioned before, the specification of the independent variables is based on the prior external debt-military expenditure literature. An increase in military expenditure is expected to affect external debt positively. The general idea in the recent literature is that: If a country imports arm equipment and finances import payments by external resources, then due to the lack of foreign exchange reserves, the country relies on foreign borrowings which in turn increases external debt (Shahbaz et al., 2013: p. 5). Overall evaluations of the recent empirical studies give support to the positive impact of military expenditure on external debt, thus the expectations of this study are consistent with the results of the evaluations made on recent studies in the literature.

The impact of income on external debt may be either positive or negative. It depends on whether the growth in income is a result of consumption expenditure or capital expenditure. If the source of the income growth is capital investment, the increase in income will reduce external debt, since capital investment produces additional revenue for government and it allows the government to pay off the debts. However, if the rise is a result of consumption expenditure, the rise in income will also increase external debt; because, consumption expenditure consists of high import content that result in current account imbalances. Thus, the country needs to borrow to meet the imbalances (Narayan and Narayan, 2008: p. 81). Furthermore, it is seen that Smyth and Narayan (2009) used GDP as a proxy for a country's capacity to engage in international borrowing. In addition, Wolde-Rufael (2009: p. 428) explains his reason for the inclusion of GDP into the model as to test whether GDP growth helps countries to pay off their debts. He also stresses the possibility of a positive effect of GDP growth on external debt due to the reality of more income may increase the propensity of governments to spend more on defence. The effect of investment on external debt is expected to be negative. Since investment allows the country to collect additional resources that can be used to pay off external loans, an increase in investment will decrease external debt (Shahbaz et al., 2013: p. 5). Finally, openness is selected as the last determinant of external debt. This variable demonstrates to what extent a country is open to foreign trade. Open economies are expected to borrow more amounts that results in more external debt accumulation over time. In this study, the relationship between external debt and military expenditure is investigated by using annual panel data for 36 developing countries that are Albania, Armenia, Azerbaijan, Belarus, Bolivia, Brazil, Bulgaria, Cameroon, China, Colombia, Dominican Republic, Egypt, Arab Rep., El Salvador, Georgia, Ghana, Guatemala, India, Jordan, Kenya, Lebanon, Macedonia, FYR, Malaysia, Mexico, Morocco, Pakistan, Paraguay, Peru, Philippines, Romania, Senegal, South Africa, Sri Lanka, Thailand, Tunisia, Turkey and Ukraine. The

[2] Dunne et al. (2004b) has also used the data by proportioning to GDP value.

sample period covers the years of 1996-2013. The referred 36 countries are selected through three criteria. Firstly, we take into account both IMF's "Emerging & Developing Economies" classification and The World Bank's "Lower & Upper Middle Income" classification while determining the countries of interest. Secondly, we used "Political Stability/Absence of Violence" criteria from "The World Bank's Governance Indicators". For this indicator, "<50" shows worse ratings and all countries mentioned above are also chosen for their low percentiles. Lastly, we try not to choose countries from OPEC and too small-sized countries. Country dataset is strongly balanced and sample period covers the years between 1996 and 2013.

3.2. Estimation Method

We will utilize "Pooled OLS Model" and "Dynamic Panel Estimation" methodologies to analyze the effects of military expenditure on external debt. Theoretically, panel data analysis is the estimation of economic relationships by using cross sectional time series data where we have repeated observations, i.e. time series of observations, for each individual rather than havening them on an aggregate level (Greene, 1997).

The pooled OLS model estimates a basic regression model as presented in Equation (2):

$$Y_{it} = \alpha + \beta' X_{it} + \varepsilon_{it} \quad (2)$$

In this model; X_{it} represent the explanatory variables, while t represents the duration and i represents the dimension of the country. This model assumes that all parameters are same for each country (Dunne et al., 2004b: p. 129). This first step of our empirical analysis will give us general clues about the relationship between external debt and our independent variables. There are also other complex solutions available for understanding the relationship between external debt and military expenditures. For a long year data set, it is appropriate using 'static panel' modeling. Or in other words, fixed and random effect models.[3] For this study, due to time and space limitations *-because of small T (not longer than 20 years)-,* it would be wise using dynamic modeling instead of the static one (Eberhardt: 2011: p. 7).

Dynamic panel model estimates a model as presented in Equation (3):

$$Y_{it} = \alpha_i + \beta X_{it} + \lambda Y_{it-1} + \mu_{it} \quad (3)$$

This equation includes a lagged dependent variable as an explanatory variable. As our data has no blank pages and it is strongly balanced, "Dynamic Panel Estimation" method is

[3] The selection among fixed effect or random effect model usually depends on the relation between the effects and explanatory variables. If effects are not related to explanatory variables, then random effects estimator is consistent and efficient, whereas fixed effect estimator is also consistent but not efficient. If the effects are related to explanatory variables, fixed effects estimator is consistent and efficient, and random effects estimator is inconsistent (Baltagi et al., 2003). Hausman test is utilized in order to make a selection between fixed effects and random effects. Random effects are chosen over fixed effects if justified by a Hausman test, or if fixed effect estimates are precluded due to the presence of time-invariant variables.

preferred to observe the variables. Not only for its technical features, it is also a good method for the "small T (time periods)" panel models.

Some econometric problems may arise in panel data estimations. These can be listed as follows (Mileva, 2007):

1. Endogenous variable may be correlated with the error term due to the probability of causality running between x and y.
2. Time-invariant country characteristics (fixed effects), that are contained in the error term, may be correlated with the explanatory variables.
3. The lagged dependent variable, existing in the model as an independent variable, boosts autocorrelation.
4. A short time dimension and a larger country dimension of the panel data set create problems in estimations.

In case of observations performed on samples with small numbers of time series, there is an alternative approach to study with the dynamics. This method allows a dynamic specification in differences, with a lagged dependent variable. Adaptation of an instrumental variable method is essential in this approach, since differencing induces a bias in the coefficient on the lagged dependent variable, due to the correlation between it and the unobserved fixed effects in the residual. In order to get unbiased and consistent estimates of the coefficients, Arellano and Bond (1991) generalized the method of moments (GMM) technique that uses lags of the endogenous variables t-2 and earlier as instruments (Dunne et al., 2004b: p. 129). Two different methods can be chosen to make estimations by using GMM. These are so called "difference" and "system". Because of the shortcomings of "difference GMM", a new estimator called "system GMM" is introduced by Blundell and Bond (1998). The regression in differences and the regression in levels are combined by this estimator. Since Arellano and Bond's (1991) difference GMM estimator has poor finite sample properties and is downward biased when T is relatively small, system GMM is accepted superior in comparison with difference GMM. Hansen Test provides information for making decision whether to apply difference or system GMM. System GMM is chosen over difference GMM if Hansen tests suggest that the instruments are valid, otherwise difference GMM would be implemented.

4. EMPIRICAL RESULTS

Estimation results of Pooled OLS Model are submitted in Table 2. When we look through the military expenditure *-as our concentration focuses mostly onto this variable in this study-,* it can be clearly seen that a change in military expenditure ratio affects external debt positively and statistically significantly in the developing countries of interest. The empirical results indicate that GDP growth creates a significant and negative impact on external debt.[4] The impact of investment on external debt is found to be significantly

[4] As far as we know from the literature of financial liberalization, this interaction was weakened by globalization process because of the changes in the definitions and the facts of economics. It is known that the impact of GDP on external debt is decreasing for most of the developing countries, for the last ten years (as it is similar in our empirical findings). However, also making healthy

negative. Furthermore, the results suggest that openness has a positive effect on the share of external debt in GDP. All these empirical evidence are in line with theoretical expectations.

Table 2: Estimation Results of Pooled OLS Model (Robust)

	EXDGDP ***(Dependent Variable)***
MLXGDP	.0477672*** (5.99)
GDPGR	-.0091827*** (-4.03)
FCPFRGDP	-.0083806*** (-6.57)
OPNNSS	.0027601*** (9.73)
_CONS	.360036*** (10.63)
F Test p value	0.0000
N obs	648
Number of countries	36
Min obs	18
Max obs	18
Average obs	18

Note: ***, **, * indicates statistically significant variables at 1%, 5% and 10% significance level respectively. _CONS represents constant term, N obs represents number of observations, F represents F-test (that tests statistically significance of parameters) and Prob>F values. Figures in the parentheses are t-statistics.

Empirical findings from Arellano-Bond Dynamic Panel Analysis are presented in Table 3. The results demonstrate that effect of military expenditure on external debt is significantly positive. GDP growth is found to decrease external debt significantly. And the impact of openness is significantly positive. All these findings are consistent with the empirical evidence obtained from pooled OLS model estimations. The impact of investment variable is significantly positive and only this result differs from the findings from previous analysis.

Military expenditure variable seems to be one of the main sources of debt spiral or cycle. In our opinion, it gives a clear message to the debt management and to the creditors that if these countries need more arms or other military equipment, they have to handle much

comparisons between internal and external debt levels are getting harder in the last two decades (See Panizza, 2008). When financial integration, capital flows and flights are taken into account, it is not right to consider or call the same traditional differences in mind within this new era. In addition, there are no clear and sharp lines for outer resources; all is determined by marginal utility of their investments. This also means "real investors" may turn into "creditors" in that country from time to time, if it is feasible for them. For example; foreign investors may put the good use of their credits as a stock or bond in the developing countries, instead of using them as a part of FDI. For similar kind of reasons (more than twenty years), identifying and classifying external resources in developing countries are getting more difficult (See Williamson and Mahar, 1998; Laurenceson, 2002; Bekaert et al., 2005; Ranciere et al., 2006; Reinhart and Rogoff, 2008).

more debt. As it can be seen in Table 2 and Table 3, military expenditure causes external debt to increase. This finding is in line with our expectations. However, it is important to note that higher levels of debt, especially in developing countries, are risky in structural means.[5] Similarly, deterioration in fixed capital formation may cause negative effect on the dependent variable, too. On the contrary, trade and financial integration -*which is also reflected in openness-,* are getting higher levels in time that creates a way for the new external resources.

Table 3: Arellano-Bond Dynamic Panel Estimates (Two-Step System GMM)

	EXDGDP (Dependent Variable)
EXDGDP L1.	.9084621*** (120.39)
MLXGDP	.0076807*** (8.58)
GDPGR	-.0070073*** (-22.43)
FCPFRGDP	.0009358*** (6.12)
OPNNSS	.0003206*** (11.17)
_CONS	.0103696** (2.66)
Arellano-Bond AR(1) test p value	0.000
Arellano-Bond AR(2) test p value	0.716
Hansen test χ^2 p value	1.000
F Test p value	0.000
N ins	157
N obs	612
Number of countries	36
Min obs	17
Max obs	17
Average obs	17

Note: ***, **, * indicates statistically significant variables at 1%, 5% and 10% significance level respectively. *_CONS* represents constant term, N obs represents number of observations, N ins represents number of instruments, F represents F-test (that tests statistically significance of parameters) and Prob>F values. Figures in the parentheses are t-statistics.

When we deeply examine the dynamic panel estimates, first of all, we have to control whether AR(1) and AR(2) tests are reasonable or not.[6] Then, Hansen J statistics (an

[5] Not far in history, developing world had faced economic problems like debt overhang, rescheduling and reliefs. Due to the lessons from those experiences, it is a well-known fact that debt may have some 'bad taste' on that countries' realities with its future conflicts (along with other socioeconomic problems). Nowadays, fiscal policy mechanisms may warn us about that countries must not tie themselves only to the external resources.

[6] The first test examines the assumption that the error term is not serially correlated. As this test uses the differenced error term by construction AR(1), it is expected to be presented. Therefore, the Arellano-Bond test for autocorrelation determines whether

extension of the Sargan-test statistics to include a robust error structure) allows us to test whether instruments are valid.[7] Both of these tests indicate that our model is consistent and the results are similar, but there is an inverse relationship in FCPFRGDP with others. According to the coefficients, this variable affects external debt not as powerful as MLXGDP or GDPGR variables do. However, with a strongly (full) balanced panel as ours, it might occur either from the "loss of the one year observation of dynamic modeling" for each country and variable or from the "dynamics of continuous measurement plus the role of external impacts" on this instrument.[8] As far as we know from the estimation results of Pooled OLS model, external debt is mostly influenced by MLXGDP. It is also same as here in the dynamic one, too. Military expenditures affect external debt through the same direction with the statistically significance level of 1%. The consistent accompaniments of GDPGR in a negative relationship and OPNNSS in a positive way are something to attract the attention. The significance levels of all these variables are 1%, both in OLS and GMM models. With the exception of its sign (which is negative in OLS model), FCPFRGDP also has a high significance level (1%) according to its relationship with external debt in the dynamic model. By examining all the estimations separately with their sub-segments, the pooled OLS estimation (with robust error terms) gives us the clue of a strong statistical relationship between our independent variables and external debt. Moreover, it is seen that the significance levels of all variables are so high. As it is mentioned in the theoretical part of this study when time and space balance taken into account, we should also investigate the 'dynamic sightseeing' of these variables. In Table 3, it can be seen from the estimates that reliable and robust scores are obtained (because of the χ^2 and p values). It is possible to interpret from these results that all variables are statistically significant and their signs are all as same as (except fixed capital formation) the pooled OLS model. Both OLS and GMM regressions show that military expenditure and GDP affect external debt relatively more than the other variables.

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the differenced error term has second-order, or higher serial correlation. Under the null hypothesis of no second-order serial correlation, the test has a standard-normal distribution (Curutchet, 2006: 44).

[7] The second assumption is corroborated by a test of over-identifying restrictions, which tests the overall validity of the instruments. Specifically, we use the Hansen J statistics, which is the minimized value of two-step GMM criterion function. Under the null hypothesis of the validity of the instruments, this test has a χ^2 distribution with (J −K) degrees of freedom, where J is the number of instruments and K is the number of regressors. As the two-step estimates of the standard errors are asymptotically more efficient than the one-step variant and AR(1) and AR(2) test p values are reasonable, this statistics is preferred over Sargan, because it is robust to heteroskedasticity and autocorrelation (See Alt and Lassen, 2005: 15; Curutchet, 2006: 44-45; Lopez et al., 2011: 6).

[8] Even with a low probability (because of the data provider source of our study), 'one more note' in mind about "statistical causality" or "non-optimality" should be helpful for every researcher. In their study, Maddala and Wu (2000) pointed out the quality of the data problem of developing countries by saying that: "Once, we go beyond developed nations, the data are of very poor quality (and in many cases non-existent)… Most of the data are constructed by interpolation and extrapolation" (Maddala and Wu, 2000: 641).

5. CONCLUSION

In this study, panel estimates for the sample of 36 "specially-chosen" developing countries for the time period of 1996-2013 points out that military expenditure has a statistically significant and positive impact on external debt. This positive relationship between military expenditure and external debt is consistent with both theoretical expectations and the empirical results of previous researches in the relevant literature. Our findings put forth that an increase in military expenditure results in an increase in external debt. With these countries' deep risk perception, military expenditures may not be seen as an extraordinary phenomenon for policymakers. On the other hand, this kind of public expenditures can make the defence system of a country more powerful for a foreseeable time period in the exchange of creating more vulnerable economy. As a conclusion, these expenditures constrain the budgetary actions of governments, which also give a rise to inapplicable/inefficient public policies for today and the future.

Our empirical results show that military expenditure, as one of the most important expenditure items in the central government budgets, affects future economic performance through its positive impact on the level of external debt. The main policy implication is that the decision makers should not ignore the need to reduce military expenditure in resolving the external debt problem. If the governments were able to decrease public expenditure related to military, the resources released would be shifted to more productive areas which are stimulative for countries' economic growth and hence the external debt stock could be reduced.

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Appendix 1. List of Developing Countries Used in Panel Data Analysis

Albania	Kenya
Armenia	Lebanon
Azerbaijan	Macedonia, FYR
Belarus	Malaysia
Bolivia	Mexico
Brazil	Morocco
Bulgaria	Pakistan
Cameroon	Paraguay
China	Peru
Colombia	Philippines
Dominican Republic	Romania
Egypt, Arab Rep.	Senegal
El Salvador	South Africa
Georgia	Sri Lanka
Ghana	Thailand
Guatemala	Tunisia
India	Turkey
Jordan	Ukraine

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FACTORS AFFECTING CURRENT ACCOUNT BALANCE OF TURKEY: A SURVEY WITH THE COINTEGRATING REGRESSION ANALYSIS

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ABSTRACT

In Turkish economy, especially in recent years, ratio of current account deficits to national income is considerably high. Interrelations between current account balance and other macroeconomic indicators make it important to investigate which factors to what extent affect the current account balance in terms of economic policy decisions. In this study, the relationships between current account balance and various macroeconomic variables in Turkish economy are investigated empirically with Johansen cointegration test and with cointegrating regression analyses (FMOLS, CCR and DOLS) for the 1994-2014 period. It is found that foreign trade balance is a strong explanatory of the current account balance; terms of trade and gross domestic product also have statistically significant effects on the current balance. According to the results Harberger-Laursen-Metzler (HLM) hypothesis seems to be valid for Turkey. Besides, results of the study reveal that domestic interest rates and real effective exchange rate affects Turkey's current account balance as expected but these variables are found to be insignificant.

1. INTRODUCTION

Ensuring external economic balance, meaning the balance of foreign exchange in-flows and out-flows, is as important for the stability of macro economy as the internal balance of a country meaning price stability, full employment and in this context growth targets. One of the main indicators concerning the external economic balance is current account balance component of the balance of payments. In this sense, the persistence of current account deficits is seen as one of the most crucial economic problems, especially in developing countries. Large current account deficits imply various risks for an economy and may cause the effects of economic crisis or fluctuations to deepen. Although there is no consensus among economists on whether a certain amount of current account deficit ratio can be accepted as a signal for an economic crisis or not, there is one on that high

level of current deficits make the economy more vulnerable to crisis[1]. The importance of the current account deficits problem holds the subjects of determining the factors affecting current deficits and the sustainability (financing) of current deficits on the agenda of economists. Especially in developing countries, current account deficit is seen among the fundamental causes of instability in the economy. In recent years, compared to the current account deficit ratios of developed and emerging countries and previous figures for Turkey, it is agreed that Turkey's current account deficit is beyond the sustainable level and generates a risk factor for economic stability.

On the other hand, in order to determine the economic policies to be applied for removing the balance of payments disequilibrium and ensuring the sustainability of current account deficits, it is crucial to identify the factors affecting the current account balance. Potential effects of the policies intended for controlling current deficits on economic growth necessitate determining the factors affecting current account balance and effect levels of these factors on current account balance. In this context, the relationships of the current account balance in Turkish economy with foreign trade balance, gross domestic product, terms of trade, real effective exchange rates and domestic interest rates are examined in the study by utilizing 1994:Q1-2014:Q4 quarterly data with KPSS unit root test, Johansen cointegration test and with cointegrating regression (FMOLS, CCR and DOLS) analyses.

2. THEORETICAL DISCUSSIONS ON THE CURRENT ACCOUNT DEFICITS

Current account deficit is regarded as the broadest definition of the foreign trade deficit. Various factors may have direct or indirect effects on current deficits. Income or economic growth rates, budget deficits, foreign trade balance, terms of trade, exchange rates, interest rates, changes in total credit and deposit (saving) volumes, money supply or total money stock, inflation rates, internal-external debts and national/global crisis may be considered as the main factors affecting current deficits. Beside these variables, structural factors such as low level of production technology, import-dependent production and export structure, low level of domestic savings in the country are also seen as the main factors causing current deficits.

[1] It is seen in various studies in the economics literature that direct relationships are established between current deficits and economic crisis, and in some of these studies critical "current account deficit-to-GDP(gross domestic product)" ratios are calculated in terms of current account balance sustainability or its relationship with economic crisis. According to Dornbusch, a *current account deficit-to-GDP* ratio equivalent to 4% would be a crisis alarm for an economy. Similarly, many economists like Fischer state rising current deficits, current deficits expected to rise or unsustainable current deficits are precursors/triggers of economic crisis (***see*** Uygur, 2012; Uygur, 2001). On the contrary, Edwards shows in his study that whether high levels of current deficits would cause exchange rate crisis or not varies with the extent of the description of crisis and the sample of analysis, and also shows that each and every high level of current account deficits does not cause an economic crisis (***see*** Edwards, 2001).

There are numerous approaches for explaining current account balance in economic theory. Classical economics attaches importance to the relationship between changes in money supply and general level of prices (quantity theory of money) for balance of payments adjustment. This approach is basically based on international gold-currency standard system (and therefore foreign exchange rate fluctuations). Another theory for explaining external balance is the elasticity approach. According to the theory, the removal of an external imbalance through exchange rate and price mechanism depends on the Marshall-Lerner condition (the sum of the export and import elasticity should be greater than 1 in absolute terms). According to the Monetarist approach, external imbalances are the result of money supply-demand imbalances. According to Keynesian income and expenditure (absorption) theory, the source of external imbalances is the expenditures exceeding domestic production (income), i.e. budget deficits or expansionary fiscal policies. The Mundell-Fleming model which was built on Keynesian approach and developed in the 1960s, has applies the IS-LM model on a free capital movement-open economy through extending it with the balance of payments (BP). According to the model, both the monetary and fiscal policies can be utilized for affecting external balance target. For explaining external balance, Mundell-Fleming model pays attention on the difference between domestic and foreign interest rates (Seyidoğlu, 2009). According to the Mundell-Fleming model, increased public deficits affects external balance through goods market (real exchange rate and disposable income) and capital account (real interest rate) (Papadogonas and Stournaras, 2006; Corsetti and Müller, 2006).

In parallel with the increased capital mobility and economic fluctuations till the 1980s, discussions on the sustainability of current deficits and the effects of currents deficits on economic crises have become prominent. Within this scope, the current deficit discussions have taken on an inter-temporal and dynamic dimension and started to be explained through a resolution process based on optimization. According to this approach, the determined optimum current deficit is compared with the realized current deficit and in case of a deficit over optimum level, an intervention is deemed necessary. Inter-temporal optimization approach foresees a robust positive relationship between savings and current deficit, but a robust negative relationship between investments and current deficits (Uygur, 2012). On the other hand, coexistence of budget and current account deficits in the 1980s in United States has put forward the twin deficits hypothesis. In addition to this, coexistence of budget and current account deficits with savings gap is called as triple deficit hypothesis in the literature.

Policies applied for accelerating economic growth could cause current deficits to become permanent and to be continuous. In a situation where technology, production and export levels are relatively low in a country, factors such as continuous increase in imports of technology, intermediate goods and investment goods parallel to the growth and industrialization policies, increasing imports of consumption goods in this process through increasing income, and on the contrary non-increasing or even gradually decreasing export-import ratios causes current deficits to become permanent by generating an import-dependent growth. Import-dependent growth and persistence of current deficits compel the economies of developing countries to be vulnerable to economic and financial

instabilities. While the decreases in the value of national currencies due to national or global economic/political developments make it difficult to finance current deficits, the acceleration of capital outflows following increased ricks affects macroeconomic balances such as growth, inflation, interest rates, employment and refinancing of external debts negatively as a whole. Therefore, high level of current account deficits is a crucial indicator to pay attention as it has the risk to create a *domino effect* in economy at crisis periods.

Another point presenting the importance of current account deficit for economies is the expectation of high fragility in an economy against economic, financial or political developments or crises in the case of significantly high *current account deficit-to-GDP* ratio. The capacity of a country to endure existing economic balances against potential external funding cuts refers to the fundamental framework of economic fragility. One of the indicators paid attention in economic/financial fragility indices is the current account deficits or the current account deficit to GDP ratio[2]. Besides, it is stated that the common ground of Turkey, Brazil, India, Indonesia and South Africa, stated as the "fragile five", is their high, increasing and permanent current deficits which further turn these countries dependent to foreign capital flows[3].

3. CURRENT ACCOUNT DEFICIT PROBLEM OF TURKEY

Turkish economy has had continuous foreign trade deficit annually since 1947.[4] With the impact of foreign trade deficits it is observed that current account deficits of Turkey are structurally continuous in time. Although decreases in total consumption and imports especially during the economic crises periods temporarily affect current balance positively, current deficits persist in the subsequent periods.

Higher growth rates of imports than the ones for the exports excepting crises periods, gradually lead to increases in foreign trade deficits. High level of the growth rate of imports is considered to be the result of the import dependence of production and exports in Turkish economy. Thus, if the exports and imports according to the classification of commodity groups' data[5] are analyzed, it is seen that imports consist of raw materials and intermediate goods to a large extent while as the industrial goods take the first place in exports, thus an import based production and export structure prevails in Turkey.

Due to the increases in the external debts of Turkey and in foreign capital inflows, mainly through hot money, Turkish Lira (TL) has overvalued after 2001 and foreign trade deficits

[2] One of the indicators in the fragility index of the American Federal Reserve's (FED) Monetary Policy Report (February, 2014) is the ratio of current deficits to GDP. The result of the index shows that among 15 developing countries examined in the index, Turkey would be affected from decisions of the FED at most (***see*** FED, 2014).

[3] ***See*** Morgan Stanley (2013).

[4] ***See*** Central Bank of the Republic of Turkey (2015a), Balance of Payment Statistics.

[5] ***See*** Turkish Statistical Institute (2015a), Foreign Trade by Classification of Broad Economic Categories.

have increased. As tourism revenues and inflow of workers' remittances reduces the deficits partially, the current account deficits have increased extremely (Ertuna, 2007). The main causes of current account deficit in Turkish economy are seen as overvalued TL and economic growth, but it is understood that the effect of overvalued TL is relatively more severe (Kasman et al., 2005). Hot money inflows induced by high real interest rates makes TL overvalued against foreign currencies through creating an abundance of foreign exchange currency in the money market of Turkey. Foreign exchange abundance caused by speculative capital inflows leads to foreign trade and current account deficits by stimulating imports (Yeldan, 2005). Therefore an appreciation of TL affects the exports (and also the tourism revenues[6]) negatively, whereas by encouraging particularly consumption goods and investment goods imports leads to increasing growth of foreign trade deficits and hence current account deficits[7].

As a result of high interest rate policy followed in Turkey in the 2000s, foreign capital inflows increased, furthermore the environment of confidence ensured by rapid growth and decreased inflation rate supported the growth through increasing consumption and investment expenditures but savings decreased at the meantime. High interest rate and overvalued TL policy was continued for a long time with the influence of the growth in the world economy. While valued exchange rate policy pleased both industrialists due to the production structure based on import of inputs and intermediate goods, and foreign investors due to the high returns on the transfer of profits, it also supported the Central Bank's inflation-targeting due to the economic structure utilizing significant rate of external inputs (Baydur, 2012).

Turkey's current account deficits in 2013 and 2014 were approximately 64.6 and 46.5 billion U.S. Dollars (USD), respectively. If the current account balance of Turkey is analyzed by years, it is seen that current deficits have been continuous since 2002 and had a rising trend excluding the years 2009, 2012 and 2014. On the other hand, Turkey's foreign trade and current account balances made progress with the high depreciations in TL following the economic decisions of the Turkish government in 1994, Russian economic crisis in 1998, and Turkish economic crisis in 2001.

Following the global financial crisis and the European debt crisis, with the effect of the decrease in imports caused by the contraction in domestic production parallel to the contraction in world markets, improvements in foreign trade and current account balances were observed in 2009, 2012 and 2014. On the other hand, the parallel course of foreign trade balance and current account balance reveals that the fundamental factor determining the current deficit in Turkish economy is the foreign trade (merchandise trade) deficit (*see* Fig. 1).

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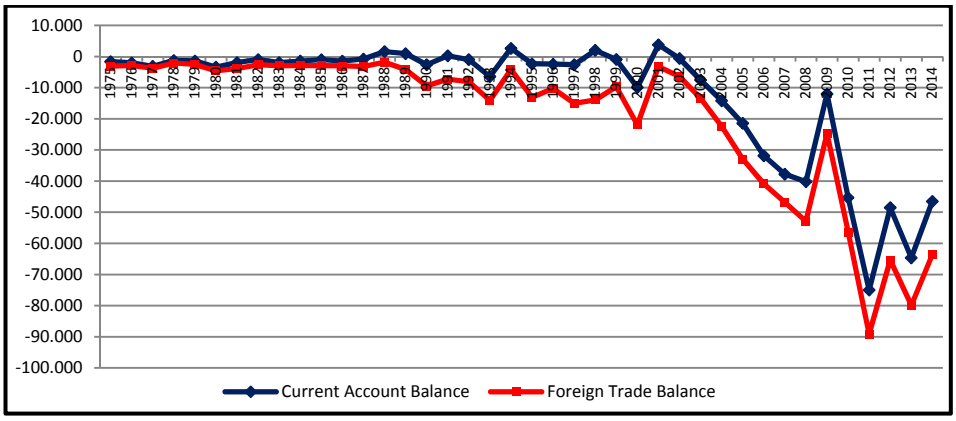
[6] Kara et al. (2012) show that there is a causality relationship from foreign exchange rates to tourism revenues in Turkey.

[7] For a study asserting the causes of the problem of current account deficits in Turkey as the policies of high real interest rate - low foreign exchange rate (overvalued TL) and as the growth models based on short term foreign capital inflows ***see*** Subaşat (2010).

Figure 1: Current Account Balance and Foreign Trade Balance of Turkey (USD, million)



Source: *Composed from the data of* Central Bank of the Republic of Turkey (2015a). (*Data for 2014 is provisional.)

Since 2005 (except for 2009), the *current account deficit-to-GDP* ratio in Turkish economy has remained consistently above 4% critical value which is accepted as a risk level in terms of economic crises by some economists such as Dornbusch. Considering the 1980-2013 period, polynomial trend-line exhibited that the *current account balance-to-GDP* ratio shows a steady downward trend after 1994 until 2012, but after 2013 the trend-line shows an upward trend despite the ratio is still very high. The *current account balance-to-GDP* ratio which has a simple average of -2.42% in 1980-2014 period, reached its highest negative level with the ratio of -9.7% in 2011 during the European debt crisis[8]. One year before 1994 and 2001 economic crisis (i.e. in 1993 and 2000), the *current account deficit-to-GDP* ratio reached high values with the significant impact of hot money (high interest rates-low exchange rate, valued Turkish Lira) policy. In contrast, in the economic crisis years of 1994 and 2001 it is seen that current account surplus was given with the effect of devaluations and the implementations of economic stabilization packages aiming to tighten the markets (***see*** Fig. 2).

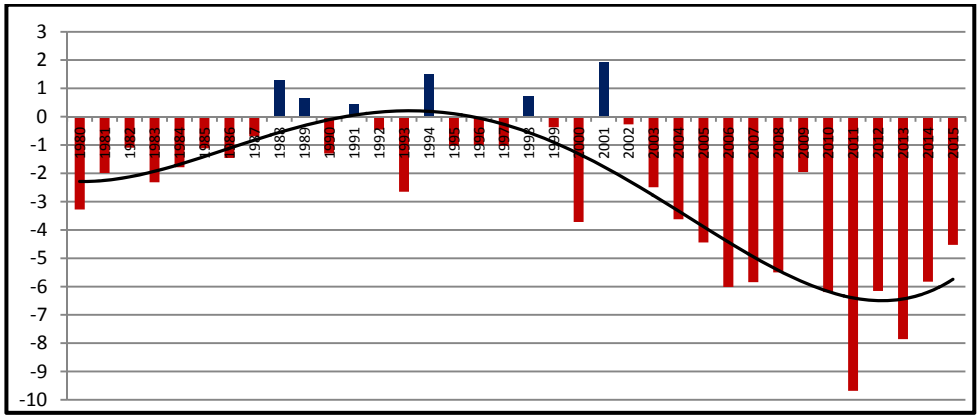
In the 2002-2014 period, simple average of the *current account deficit-to-GDP* ratio was realized as -5.06%. On the other hand, excluding 2009- Turkish economy achieved real growth compared to the previous year continuously during 2002-2014 periods. Considering the annual growth rates of 2002-2014 periods, simple average growth rate of

[8] *Ratios are calculated from the data of* IMF (2015), World Economic Outlook Database-October 2015.

real GDP was 4.9%. When 2002 and 2014 are taken as the beginning and ending period, the annual compound growth rate of real GDP was 4.72%.[9]

It is remarkable that real GDP growth and current deficit to GDP ratio were about 5% level in a similar manner, and this situation gives the idea that there might be a relationship between current deficit problem and economic growth in Turkish economy.

Fig. 2: Ratio of Current Account Balance to GDP in Turkey (Percent)



Source: *Composed from the data of* International Monetary Fund (2015) and World Economic Outlook Database-October 2015. (*Data for 2015 is estimation.)

In the literature, growth rate and exchange rate comes to the forefront as the main factors that determine current account deficit. In the studies on Turkish economy, whether the increase in demand resulting from growth or overvalued Turkish Lira caused by hot money inflows is more effective on current account deficits is a subject of discussion. While some economists regard high economic growth following the 2001 economic crisis as the main cause of current deficits, others defend that exchange rates determine the current account deficits with a delay under the effect of short-term capital movements (Erbaykal, 2007).

Apart from growth, foreign trade deficit and overvalued national currency other remarkable specific factors affecting current deficits of Turkey are dependence on foreign energy sources and increasing energy prices, low rate of domestic savings, high level of external debt stock, income transfers of foreign direct investments, periodic expansionary monetary/fiscal policies (Göçer, 2013). Turkey's import of petroleum products constitutes

[9] *Ratios are calculated from the data of* IMF (2015), World Economic Outlook Database-October 2015 and Turkish Statistical Institute (2015b), Main Statistics (National Accounts, GDP by production approach).

significant share of her total import.[10] In this regard, it is possible to say that one of the main reasons of Turkey's current deficits is dependence of petroleum products imports.

4. LITERATURE REVIEW

In economic literature, there are numerous studies on the determinants of the current account balance. Significant part of these studies is related to developing countries which experience current deficit problems. One of the main variables frequently focused in the studies on determinants of the current account balance is the balance of foreign trade (merchandise trade). As significant part of the current deficits especially in developing countries stems from high level of imports, empirical studies on current account include foreign trade deficit as a variable. In their study on the subject in the axis of Turkey, Canıdemir et al. (2011) obtain that an increase in imports increases current deficit while an increase in exports decreases it. In another study on Turkey, Göçer (2013) concludes that 37% and 26% of current deficit result from energy imports and non-energy foreign trade deficit, respectively. The result of the study by Erdogan and Bozkurt (2009) that investigates the relations among current deficit and a number of economic variables reveals that the highest correlation value belongs to the ratio of exports to imports. According to the study of Javaid and Raza (2013) on Pakistani economy, there is a positive relationship between current deficit and foreign trade deficit in the short-term and also there is a unidirectional causality from current deficit to foreign trade deficit. According to another survey on Pakistan made by Gulzar et al. (2007), a strong and positive long-term relationship exists between current account balance and foreign trade balance. In her study on the factors affecting the current account balance for the Russian economy Ketenci (2010) concludes that the current account balance is significantly affected more from commercial and financial variables in the long-term than the price of natural resources.

One of the subjects frequently discussed in the studies related to the factors affecting current account balance is the terms of trade. Gacaner Atış and Saygılı (2014) conclude that the most significant determinants of current deficit in Turkey are the terms of trade and the growth rate, and there is also a unidirectional causality from terms of trade to the *current account deficit-to-GDP* ratio variable. In their study on Turkey, Oktar and Dalyancı (2012) found a cointegration relationship in the long-term from terms of trade to current account balance. Hence, deterioration in trade would affect current account deficit in Turkish economy negatively. According to the study made by Erkılıç (2006), direction of the relationship between foreign trade and current account deficit in Turkish economy is uncertain.

[10] Ratio of the import of petroleum products to total import (in US Dollar) for various years are as follows: 12.8% in 1995, 17.4% in 2000, 12.5% in 2005, 7.9% in 2010 and 8.1% in 2014 (*Ratios are calculated from the data of* Turkish Statistical Institute (2015a, 2015c)).

According to the study of Aristovnik (2008) on Eastern European and CIS countries, deterioration in the terms of trade causes current account deficit to enlarge. In the same vein, in their studies on 9 developing countries Bayraktutan and Demirtaş (2011) utilize panel data analysis and identify that an improvement of the terms of trade reduces current deficit. Tagliabue (2005) concludes in his study on Italy that current deficit and terms of trade are associated in both short and long terms but the argument that the terms of trade causes the current account deficit is not supported for the period of 1992-2001. The results of the study of Chinn and Prasad (2003) which comprises 18 industrialized and 71 developing countries reveals that the volatility of the terms of trade is significantly and positively related with current account balance in terms of developing countries except for Africa, but negatively for industrialized countries. Bouakez and Kano (2008) analyze the effect of the terms of trade on current account balance in terms of the Harberger-Laursen-Metzler (HLM) effect for three different countries. The results of the study reveal that the changes in the terms of trade do not affect current account balance significantly, and the terms of trade shocks are not significant in explaining the changes in the current account balance for two out of three countries examined. Otto (2003) examines the presence of traditional HLM effect for 55 small open economies. According to the findings of the study, in the majority of the countries examined the primary effect of a positive shock in the terms of trade is an improvement in the trade balance. Therefore, according to the study the improvements in the terms of trade would affect current account balance positively.

The exchange rate effect is another subject frequently emphasized in empirical studies on the determinants of the current account balance. If the studies on Turkish economy are examined, it is seen that in general significant relationships are detected between exchange rates and current deficit. According to Erkılıç (2006), the most important determinants of the current account deficit in Turkish economy are previous current deficit, GDP growth rate and real exchange rate. According to empirical results of the research of Peker and Hotunoğlu (2009); real exchange rate, real interest rate and ISE-100 index are the most important factors affecting the current account deficit.

The findings of the study of Uz (2010) presents that exchange rate variable has the strongest effect on the current account balance but the improvement of the current account balance is associated with an appreciation of national currency in the short term whereas associated with depreciation in the long term. According to aforementioned study of Gacaner Atış and Saygılı (2014), in Turkish economy there is a unidirectional causality relationship from real exchange rate to the *current account balance-to-GDP* ratio. The findings of the mentioned study of Canıdemir et al. (2011) assert that the increase in the real exchange rate increases the current deficit in Turkey. Similarly, in his study Kayıkçı (2012) concludes that appreciation of the real exchange rate would lead to the deterioration of current account balance in Turkey. In the study of Erbaykal (2007), exchange rate and economic growth are determined as the causes of the current deficit, while no causality from exchange rate and the current account deficit towards economic growth is found.

According to the panel VAR analysis of Kesikoğlu et al. (2013) for 28 OECD countries, exchange rate does not have any effect on current account deficit. On the other hand, according to the study of Das (2012) on developed, emerging and developing 106 countries; while current account balance has a positive relationship with exchange rate stability and has a negative relationship with real effective exchange rate in terms of developed countries, for emerging economies it has a negative relationship with exchange rate stability. According to aforementioned study of Aristovnik (2008), appreciation of the real exchange rate causes deterioration in current account balance. In their study on Pakistani economy Javaid and Raza (2013) determine a positive relationship between exchange rate and the current account deficit in the long term and also bidirectional causality between exchange rate and the current account deficit.

In terms of the importance of their effects on the current account balance, another variable which is frequently utilized in empirical studies is the domestic or world interest rate. According to the mentioned study of Gacaner Atış and Saygılı (2014), in Turkish economy, there is a unidirectional causality from real interest rate to the share of the current account balance in GDP. Canıdemir et al. (2011) find that an increase in interest rate reduces current deficit in Turkey. In their study Esen et al. (2012) investigate the effects of a probable increase in the policy interest rate on current account deficit for Turkish economy. The findings of the study reveal that the credit channel is more dominant than the exchange rate channel in the period examined, therefore an increase in policy interest rate would reduce the current account deficit via the credit channel. According to the results of the panel data analysis made by Kesikoğlu et al. (2013) for 28 OECD countries, interest rates have a medium-term and low-level impact on the current account deficit. In their study Obstfeld and Rogoff (2001) empirically explore that countries with current account deficit tend to have a higher real interest rate. In their analysis on the OECD countries, they find that there is a highly significant negative relationship between current account surplus and domestic real interest rate.

5. METHODOLOGY AND DATASET

In Turkish economy there is a general opinion that the most important cause of current deficits is the foreign trade deficits. Thus it is observed that in Turkish economy current account balance and foreign trade balance statistics move considerably alike (***see*** Fig. 1 and also Appendix 2). The production structure of Turkish manufacturing industry that is dependent on import of intermediate goods raises foreign trade deficits and hence current deficits through an increase in growth. From this viewpoint gross domestic product and foreign trade balance of Turkey is integrated to the empirical model in the study. On the other hand, there are two distinct approaches on the effects of domestic interest rates on current balance in the literature. Accordingly, an increase in domestic interest rates affects foreign trade and current account balance negatively by appreciation of domestic currency (i.e. decreasing nominal exchange rate -in *direct quotation* definition) through an increase in foreign capital inflows. On the other hand interest rates positively affect foreign trade and current account balance through reducing import demand by contracting consumption and hence credit demand. The final effect of an

increase in interest rates on external balance would alter according to the extent of these two effects.

By frequently emphasizing the Harberger-Laursen-Metzler (HLM) effect, the relationship between international terms of trade and current balance is also underlined. By utilizing a Keynesian model, Harberger (1950) and Laursen and Metzler (1950) showed an exogenous increase in the terms of trade caused an improvement in trade balance of an open small economy. Accordingly an improvement in the terms of trade of a country would increase its current income, hence (under the assumption that marginal propensity to consume is less than unity) current consumption would increase less than current income. This in turn would increase personal savings and affect current balance positively (Bouakez and Kano, 2008). HLM hypothesis, in simplest terms, argues that positive (or negative) alterations in the terms of trade of any country, *ceteris paribus,* would cause positive (or negative) alterations in the balance of trade of the country (Yamak and Korkmaz, 2006).

Real exchange rates are also accepted as a crucial variable in explaining current balance. Besides the effects of real exchange rates on foreign trade and current account balance is still a more controversial topic. Depending on the appreciation of national currency or a higher increase in domestic inflation rate compared to trade partners, it is anticipated that an increase in real effective exchange rate would -*ceteris paribus*- decrease foreign trade competitiveness and hence affect foreign trade and current account balance negatively.

In the empirical part of the study, the relationships of the current account balance (CAB) with foreign trade balance (FTB), gross domestic product (GDP), terms of trade (TOT), domestic interest rate (INT) and real effective exchange rate (RER) in Turkish economy are analyzed for the 1994:Q1-2014:Q4 period. Explanations for the dataset are given in Appendix 1.[11] CAB, FTB, GDP and TOT series are included to the analyses after they are corrected with the X-12 (additive) method for seasonal effects. CAB, FTB and GDP series are taken as millions of USD. KPSS unit root test, Johansen Cointegration test, Fully-modified Ordinary Least Squares (FMOLS), Dynamic OLS (DOLS) and Canonical Cointegrating Regression (CCR) methods are used in order to examine the relationships between current account balance and other variables. Eviews 8 is used for the analyses.

6. EMPIRICAL RESULTS AND DISCUSSION

6.1. Unit Root Test

In a time series model it is necessary to test whether stochastic process varies depending on time or not, in other words whether it is stationary or not. If stochastic processes is constant (stationary) throughout the time, a model with a constant coefficient can be obtained by using past values of the series (Kutlar, 2005). In stationary series possible shocks would be temporary, the effect of the shock would decrease gradually and the series would turn back to its long-term average. On the contrary, there would not be a long-term average to be turned back after shocks for non-stationary series (Öztürk et al.,

[11] Time graphs of the variables are also given in Appendix 2, Appendix 3 and Appendix 4.

2012). "A stochastic process is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two periods and not on the actual time at which the covariance is computed" (Gujarati, 2004). If the series used in the analysis are not stationary, the reliability of the results becomes questionable due to the emergence of spurious regression problem in models and the lack of constant variance in time series (Hatırlı et al., 2008).

In order to determine a time series is stationary or not, the main method is the unit root tests. Therefore in the empirical analysis part of the study, at first the stationarity of the time series is tested with the KPSS unit root test (Kwiatkowski et al., 1992). Some studies show that the Dickey-Fuller tests have low power in distinguishing between the null and the alternative hypothesis. These studies suggest performing tests of the null hypothesis of mean stationarity against an alternative of a unit root in order to decide whether the time series data are stationary or integrated (Sukar and Hassan, 2001). Thus, KPSS unit root test uses Lagrange Multiplier (LM) statistic for testing the null hypothesis of the time series is *stationary* around a deterministic trend against the alternative hypothesis of *non-stationary*. In this regard we apply the KPSS unit root test to time series data. The results of the KPSS test are shown in Table 1.

Table 1: KPSS Unit Root Test Results

Variable	Level		First Difference	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
CAB	1.094889*** [6]	0.142610* [5]	0.046180 [2]	0.023812 [2]
FTB	1.088811*** [6]	0.170566** [6]	0.050171 [1]	0.027652 [1]
GDP	1.096156*** [7]	0.172277** [6]	0.069544 [2]	0.063139 [2]
TOT	1.178365*** [6]	0.213883** [6]	0.252868 [2]	0.041167 [3]
INT	1.212764*** [6]	0.147471** [3]	0.281751 [9]	0.096274 [10]
RER	1.186715*** [6]	0.162479** [5]	0.107484 [10]	0.106138 [10]

(***), (**) and (*) denotes rejection of the null hypothesis of "no unit root" (KPSS test) at the 1%, 5% and 10% statistical significance level, respectively. The values in brackets indicate the optimal bandwidth chosen automatically by Newey-West using Bartlett kernel. Asymptotic critical values (Kwiatkowski et al., 1992, Table 1) for the models including intercept are 0.739 (1%), 0.463 (5%), 0.347 (10%) and for the models including trend and intercept are 0.216 (1%), 0.146 (5%), 0.119 (10%).

Table 1 shows the null hypothesis of "no unit root" for the variables is rejected in levels but cannot rejected in first differences for both models including intercept and models including trend and intercept by the KPSS test. According to the KPSS unit root test results, it is seen that all variables are not stationary in level but they are stationary in first differences.

6.2. Johansen Cointegration Test

If time series variables are non-stationary in their levels but stationary in first differences, they are integrated of order one. These variables may also be co-integrated if one or more linear combinations exist among them which are stationary. If these variables are co-integrated, then there is a stable long-run or equilibrium linear relationship among them

(Lim and McAleer, 2001). In case of the series are co-integrated, it is concluded that they move together in the long term and level values of the variables can be used for the long run analysis. If the variables are more than two, it is possible to be more than one co-integrating vectors. In this context Johansen (1988, 1991) and Johansen and Juselius (1990) showed that there could be more than one co-integration relationship among variables with the cointegration test based on vector autoregressive (VAR) model. As all the variables are first-difference stationary (i.e. *I*(1)) in our empirical model, all variables will be included in the Johansen cointegration analysis. The optimal lag level for the unrestricted VAR model is determined as six where the variables in the model are in level values.[12] The number of cointegrating relations according to the different cointegration models is given in Table 2 below.

Table 2: Selected (0.05 level)* Number of Cointegrating Relations by Cointegration Models

	Model-1	Model-2	Model-3	Model-4	Model-5
Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept and Trend	Intercept and Trend
Trace Test	2	1	1	1	1
Max-Eigen Test	1	1	1	1	1

*Critical values (0.05 level) based on MacKinnon, Haug and Michelis (1999).

All models except Model-1 show that there is one cointegrating relation among variables. In this case it is important to choose the appropriate model. For this purpose, in order to simultaneously determine the cointegration rank and the deterministic components of the cointegration model, Pantula principle (Pantula, 1989) is applied for the models except Model-1 which shows different results for trace and max-eigen test. Results of the Pantula principle are given in Table 3.

Table 3: Model Determination According to the Pantula Principle by Cointegration Rank Test (Trace)

Hypothesized No. of cointegrating equation(s)	Model-2	Model-3	Model-4	Model-5
None	127.3289	103.6366	123.6951	109.5012
	(0.0006)*	(0.0128)*	(0.0197)*	(0.0358)*
At most 1	74.55643	57.62134	77.67920	64.22736
	(0.0753)	(0.3156)	(0.2418)	(0.3937)

[12] According to the VAR analysis with six lag, the inverse roots of the VAR model are found to take place within the unit circle (***see*** Appendix 5). Autocorrelation problem is examined up to ten lag length with LM test and no autocorrelation is observed in the model. According to the White test results there is no heteroscedasticity problem in the model (***see*** Appendix 6). CUSUM and CUSUM-Q structural change tests for the model also showed there is no structural change in the model, so there is no need to a dummy variable (***see*** Appendix 7). These results show that VAR(6) model satisfies the stability conditions.

*Denotes rejection of the hypothesis at the 0.05 level. Coefficients are the trace statistics. The values in brackets indicate the *p*-values (MacKinnon, Haug and Michelis, 1999).

Table 3 shows that for all models the null hypothesis of "no cointegration" is rejected whereas the null hypothesis of "at most 1 cointegration" cannot be rejected. On the other hand according to the Pantula principle, the null of existence of a cointegration cannot be rejected in first place by the Model-2. This result shows that the appropriate model for the Johansen cointegration analyses is Model-2 which assumes no deterministic trend in data and includes intercept (but no trend) in cointegration equation. Johansen cointegration test results for the Model-2 are presented in Table 4 below. According to the Johansen test results, Trace and Max-Eigenvalue cointegration rank tests indicate one cointegrating equation at the 0.05 level.

Table 4: Johansen Cointegration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.491642	127.3289	103.8473	0.0006
At most 1	0.323352	74.55643	76.97277	0.0753
At most 2	0.181910	44.08937	54.07904	0.2843
At most 3	0.138578	28.42826	35.19275	0.2227
At most 4	0.125155	16.79298	20.26184	0.1404
At most 5	0.078346	6.363696	9.164546	0.1644
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.491642	52.77245	40.95680	0.0016
At most 1	0.323352	30.46706	34.80587	0.1506
At most 2	0.181910	15.66111	28.58808	0.7686
At most 3	0.138578	11.63528	22.29962	0.6903
At most 4	0.125155	10.42929	15.89210	0.2968
At most 5	0.078346	6.363696	9.164546	0.1644

*Denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) *p*-values.

6.3. Long-Term Coefficients

Depending on there is a cointegration relationship among variables it is possible to apply ordinary least squares (OLS) methods with the level values of the variables for long term coefficient estimations. In this context Fully Modified Ordinary Least Squares (FMOLS), Canonical Cointegrating Regression (CCR) and Dynamic Ordinary Least Squares (DOLS) methods are used in order to examine the relationships of current account balance (CAB) with foreign trade balance (FTB), gross domestic product (GDP), terms of trade (TOT), domestic interest rates (INT) and real effective exchange rate (RER) for Turkey. If all such alternative methods show similar results, confidence in their estimates increases. The estimated model is as follows:

$$CAB_t = c_t + \alpha_1 FTB_t + \alpha_2 GDP_t + \alpha_3 TOT_t + \alpha_4 INT + \alpha_5 RER + \varepsilon_t$$

FMOLS, CCR and DOLS are single equation methods. These methods are designed to provide efficient estimates of cointegrating regressions. The FMOLS was originally introduced by Phillips and Hansen (1990). FMOLS estimation procedure assumes the existence of a single cointegrating vector (Phillips and Hansen, 1990). In order to eliminate the estimation problems caused by the long-run correlation between the cointegrating equation and the stochastic regressors innovations, this method employs a semi-parametric correction. FMOLS method employs kernel estimators of the nuisance parameters that affect the asymptotic distribution of the OLS estimator. For asymptotic efficiency this method modifies least squares to account for serial correlation effects and test for the endogeneity in the regressors that result from the existence of a cointegrating relationship (Aljebrin, 2012; Risso et al., 2013). The resulting estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic Chi-square statistical inference (Belke and Czudaj, 2010).

CCR and DOLS estimators deal with the problem of second-order asymptotic bias arising from serial correlation and endogeneity, and together with FMOLS they are asymptotically equivalent and efficient (Risso et al., 2013). Park's (1992) Canonical Cointegrating Regression (CCR) is closely related to FMOLS, but instead employs stationary transformations of the data to obtain least squares estimates to remove the long run correlation between the cointegrating equation and stochastic regressors innovations (Belke and Czudaj, 2010). Like FMOLS, CCR estimates follow a mixture normal distribution which is free of non-scalar nuisance parameters and permits asymptotic Chi-square testing. Another simple approach to constructing an asymptotically efficient estimator that eliminates the feedback in the cointegrating system has been presented by Phillips and Loretan (1991), Saikkonen (1991, 1992) and Stock and Watson (1993) which is termed as Dynamic OLS (DOLS). This method involves augmenting the cointegrating regression with lags and leads of the first differences of the regressors to correct for the endogeneity bias, so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic regressor innovations (Belke and Czudaj, 2010; Eviews 8 User's Guide II, 2013; Vogelsang and Wagner, 2014). In DOLS procedure, one of the *I*(1) variables regresses on the other *I*(1) variables, the *I*(0) variables, and lags and leads of the first-differences of the *I*(1) variables. The procedure includes the first-differenced variables to avoid small-sample bias resulting from correlation between the error term and the *I*(1) variables. Standart hypothesis testing can then be done by using robust standart errors (Caporale and Chui, 1999). All these methods require tuning parameter choices. For FMOLS and CCR, a kernel function and a bandwidth have to be chosen for long run variance estimation. For DOLS the number of leads and lags has to be chosen and if the DOLS estimates are to be used for inference, a long run variance estimator -with an ensuing choice of kernel and bandwidth- is also required (Vogelsang and Wagner, 2014).

The results for the FMOLS, CCR and DOLS methods are given in Table 5 below.

Table 5: Estimation of Long-Term Coefficients

	FMOLS	CCR	DOLS
FTB	0.950***	0.950***	0.943***
	(24.441)	(24.085)	(18.456)
GDP	0.017**	0.016**	0.015*
	(2.054)	(2.392)	(1.727)
TOT	62.968***	59.052***	61.837**
	(3.380)	(3.173)	(2.580)
INT	3.607	1.745	5.938
	(0.826)	(0.433)	(0.931)
RER	-12.703	-16.106	-5.190
	(-0.825)	(-1.045)	(-0.239)
Constant	-5237.2*	-4405.8*	-5825.6**
	(-1.148)	(-1.726)	(-1.682)

(***), (**) and (*) denotes 1%, 5% and 10% statistical significance level, respectively. Values in brackets indicate t-statistics. Cointegrating equation deterministic is selected as constant (level) parallel to the Model-2 determined by the Pantula principle for the Johansen cointegration test. Long run covariance estimate method is selected as Bartlett kernel using Newey-West automatic bandwidth (NW. automatic lag length=3) in FMOLS and CCR. Lead and Lag is determined by Schwarz Info Criterion automatically (Lead=0, Lag=0; max.=4) in DOLS.

Table 5 shows that both FMOLS, CCR and DOLS methods gives very close results for the estimated model. According to the results FTB, GDP, TOT and constant coefficients are statistically significant while INT and RER are not both in three methods. As expected FTB, TOT and INT affects CAB positively and RER affects CAB negatively[13]. Relationship between CAB and GDP could be either positive or negative, and in our results GDP affects CAB positively.

Findings of the analysis reveal that one unit rise in FTB affects CAB positively almost as the increment in itself. This shows that CAB in Turkish economy is highly dependent to the FTB and they move together very closely. Rise in GDP also affects CAB positively but the effect level is quite low both in three methods. If the domestic investments which substitute imports increase when GDP increases, the effect of GDP on CAB could be positive. According to DOLS results, one unit rise in domestic interest rates (INT) affects CAB positively about 6 million USD. Findings show that rise in domestic interest rates has a positive effect on CAB but it is statistically insignificant and the effect level is low. According to CCR results, one unit rise in RER will affect CAB negatively about 16 million USD and this shows that RER does not have very high effect on CAB because RER generally does not change in high ratios in time. On the other hand coefficient of RER is also insignificant.

[13] If the national currency appreciates (i.e. decrease of nominal exchange rates in *direct quotation* definition) or domestic inflation is higher than trade partners inflation then the RER increases and in this case RER is expected to affect CAB and FTB negatively. In contrast, if the national currency depreciates (i.e. increase of nominal exchange rates in *direct quotation* definition) or domestic inflation is smaller than trade partners inflation then the RER decreases and in this case RER is expected to affect CAB and FTB positively.

Another important result is about the TOT variable. All three methods show that TOT has a strong effect on CAB. According to the results one unit rise in TOT affects CAB positively about 60 million USD. This shows that depending on the production and export of high-tech products Turkey's CAB could get better by time. In this respect the HLM hypothesis seems to be valid for Turkish economy which means increase of TOT affects FTB and therefore CAB positively. At the same time this result is consistent with the positive effect of GDP on CAB. An improvement in the TOT of a country would increase its current income, therefore (under the assumption that marginal propensity to consume is less than unity) current consumption increases less than current income and in this situation personal savings increase and hence GDP effects CAB positively.

7. CONCLUSION

Since 2002, Turkish economy has achieved approximately an average annual real growth of 4.9%. Despite real economic growth, one of the main problems in Turkish economy as in many emerging economies is increasing current account deficit. In Turkish economy, simple average value of the *current account deficit-to-GDP* ratio is -5.06% in 2002-2014 period and this shows that economic growth is financed without reducing the risk of the current account deficit, in other words it is financed by enduring the increase in the current account deficit. In this respect, it is important to examine the factors that affect the current account balance in Turkish economy.

In the study, the relationships of current account balance with foreign trade balance, gross domestic product, terms of trade, domestic interest rates and real effective exchange rates in Turkish economy are analyzed by using 1994:Q1-2014:Q4 quarterly data. KPSS unit root test has shown that all variables are stationary in their first differences. According to the all variables are stationary at first order, Johansen cointegration test was applied and one cointegration relationship is determined among variables in the model. As one cointegration is found among variables FMOLS, CCR and DOLS analysis were applied to determine long run relationships between current account balance and other variables.

Results of the analysis reveal that there is a strong relationship between current account balance and foreign trade balance in Turkish economy as expected. Gross domestic product and terms of trade are found as other statistically significant factors affecting current balance. On the other hand, effects of domestic interest rates and real effective exchange rates on current account balance are found statistically insignificant.

Effect of the gross domestic product on current balance is found quite low both in three methods. On the other hand all three methods show that terms of trade has a strong effect on current balance in Turkish economy. In this respect the Harberger-Laursen-Metzler (HLM) hypothesis seems to be valid for Turkish economy. In this case increase of terms of trade is expected to affect foreign trade balance and therefore current balance positively and strongly in Turkish economy. This is also consistent with the positive effect of gross domestic product on current balance. This result indicates that depending on the production and export of high-tech products, Turkey's current account balance could get better by time.

The positive effect of gross domestic product on current balance also reveals that if domestic investments increase with the increase of real income and substitute imports especially in high-tech products, this would generate a strong effect for Turkey for reducing foreign trade and hence current account deficits. Also by this way average price of Turkish exports might increase and average price of Turkish imports might decrease and thereby terms of trade would improve.

According to the results it is also assessed that increase in the domestic interest rates might improve current account balance via credit channel -by the decrease of consumption and import demand. In this regard, a reduction in interest rates through the Central Bank channel would increase directly both the imports and domestic prices by increasing the consumption demand; as a result this would bring about a negative effect on the current account balance. Therefore, even though a decline in domestic interest rates would decrease investment and financing costs, reduction in interest rates without taking remedial steps for the current account balance would increase the financial fragility and economic risks by increasing the current account deficit to unexpected levels. On the other hand, when the current account deficit and foreign trade deficit problems are considered together, the importance of the policies which aims to enhance the national competitiveness and to reduce dependence on intermediate goods in production would be understood once again.

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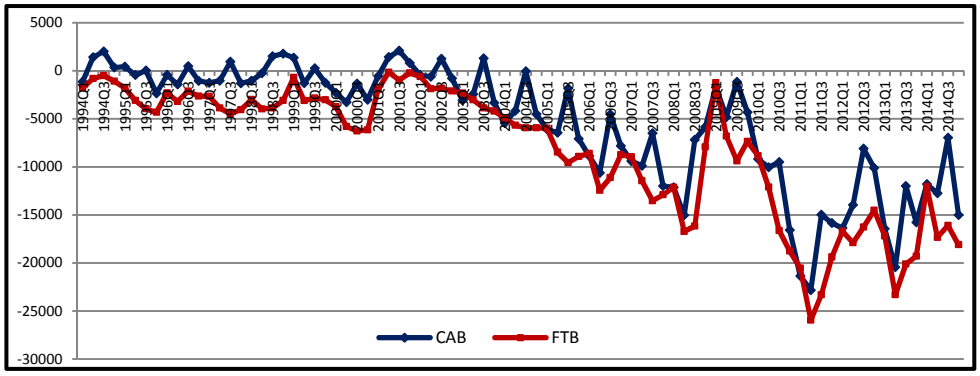
Appendix 1: Explanations for the Dataset

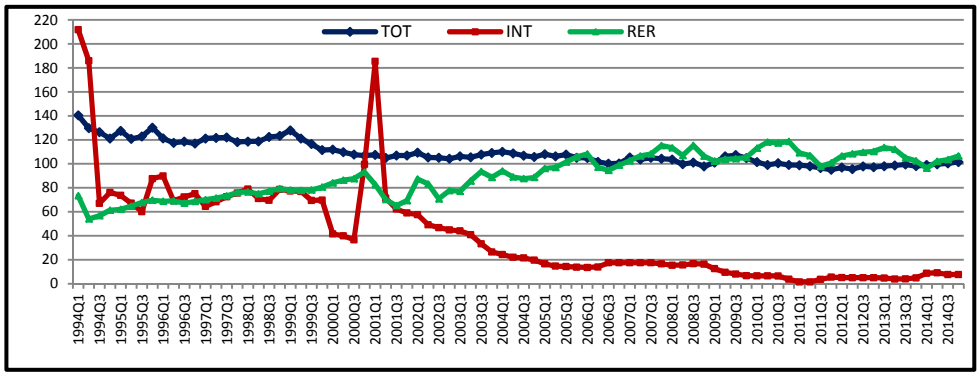
The data for Current Account Balance (CAB), Foreign Trade Balance (FTB) and domestic interest rates (INT) are gathered from the Electronic Data Delivery System (EDDS) of the Central Bank of the Republic of Turkey (CBRT). As a proxy of domestic interest rates, the weighted average of the overnight simple interest rate on the interbank market is used. The Terms of Trade (TOT) data (based on 2010=100, as USD) is obtained from the Foreign Trade Indices Database of Turkish Statistical Institute. Real Effective Exchange Rate (RER) data for Turkey (based on 2005=100 and deflated with the consumer price indices of 37 trading partner countries) are taken from the Eurostat (European Commission Statistics) database. Nominal GDP data for Turkey is taken from Eurostat in millions of Turkish Lira (TL) and converted to USD with the TL/USD exchange rate which is taken from the EDDS of CBRT. The data for all the variables belong to the 1994:Q1-2014:Q4 period.

Appendix 2: Current Account Balance (CAB) and Foreign Trade Balance (FTB) of Turkey (USD, million)



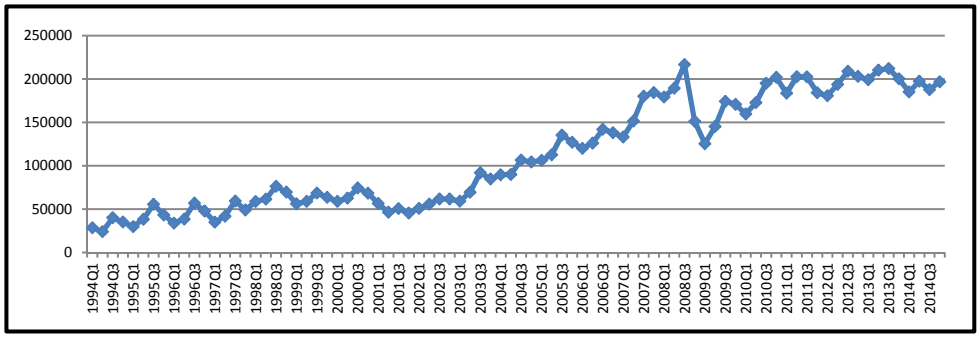
Source: *Composed from the data of* Central Bank of the Republic of Turkey (2015b). ***See*** Appendix, Explanations for the dataset.

Appendix 3: Terms of Trade (TOT), Domestic Interbank Overnight Interest Rate (INT) and Real Effective Exchange Rate (RER) of Turkey



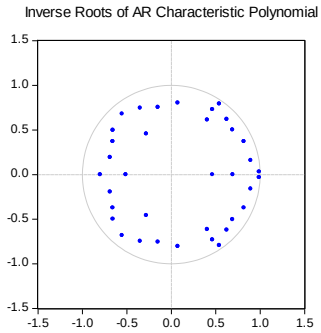
Source: *Composed from the data of* Central Bank of the Republic of Turkey (2015b), Eurostat (2015) and Turkish Statistical Institute (2015d). ***See*** Appendix, Explanations for the dataset.

Appendix 4: Gross Domestic Product (GDP) of Turkey (USD, million)



Source: *Composed from the data of* Eurostat (2015) and Central Bank of the Republic of Turkey (2015b). ***See*** Appendix, Explanations for the dataset.

Appendix 5: Unit Circle Test Results

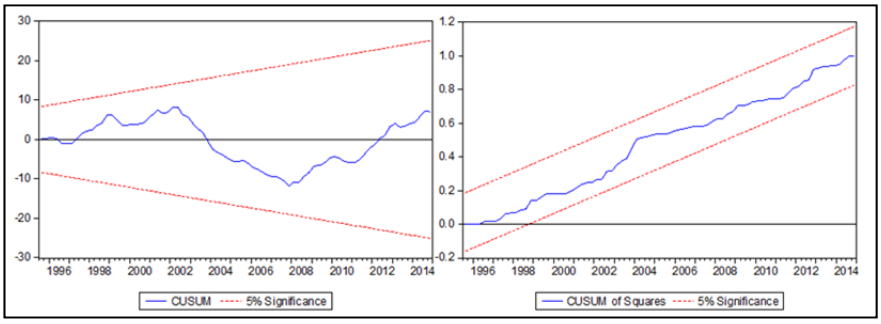


Appendix 6: Autocorrelation-LM and White's Heteroscedasticity Test Results

Autocorrelation-LM Test Results		
Lags	LM-Stat	Prob.
1	40.43526	0.2808
2	44.69465	0.1517
3	39.96362	0.2984
4	34.05960	0.5612
5	37.20517	0.4134
6	36.78804	0.4322
7	33.60843	0.5829
8	41.05279	0.2587
9	41.40549	0.2465
10	36.36400	0.4517
White's Heteroscedasticity Test Results		
Chi-sq	Df	Prob.
1555.787	1512	0.2116

Note: VAR lag order is 6.

Appendix 7: CUSUM & CUSUM-Q Structural Change Test Results



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INTER-RELATIONSHIP BETWEEN PROFITABILITY, GROWTH AND SIZE: CASE OF TURKEY

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Bootstrap causality

JEL Classification
C22,C58,L25,O47

ABSTRACT

This study aims to analyze inter-relationship between firm profitability, growth and size by using quarterly data of Turkish manufacturing industry consisting of Borsa Istanbul (BIST) listed manufacturing firms covering 1991.Q2-2014.Q4. In the study, to test the stationarity of series and the co-integration relationship between them, unit root test of Carrioni-i-Silvestre *et. al.* (2009) and co-integration test of Maki (2012) are used, respectively. Co-integration coefficients are estimated by means of Stock and Watson (1993)'s dynamic ordinary least squares (DOLS) method. Finally, causal relationships between the series are tested by Hacker and Hatemi-J (2012) bootstrap causality test. Structural break dates estimated point out dramatic turning points in Turkish economy. Maki (2012) test results show that the series are co-integrated in the long-run. Long-run parameters estimated by DOLS method posit a significantly negative relationship between profitability and size. Causality test results indicate the existence of one-way causality from size to profitability.

1. INTRODUCTION

The inter-relationship between firm profitability, growth and size has attracted massive research interest among academic researchers and industry practitioners for several decades (Goddard *et. al.*, 2006; Brännback *et. al.*, 2009). However, related empirical findings show inconsistency (*See* Coad, 2007, 2009; Davidsson *et. al.*, 2009; Steffens *et. al.*, 2009). The explanation of this inconsistency can be that though it is generally presumed that profitability and growth (and consequently, size) influence each other, they may not be necessarily connected. Therefore the impact and direction of the inter-relationship between them remain ambiguous. Greiner (1972) tries to explain this ambiguity with several arguments. According to him, excessive and/or rapid growth may contribute to a breakdown of informal relationships established over time in firms causing increases in formality in relationships, profitability may be negatively affected. However, excessive and/or rapid growth may also result in greater profitability as an outcome of increased motivation among employees expecting additional gains in future due to this growth. Beyond these managerial explanations, the ambiguity may also be related with

econometric issues. Due to endogeneity, it is difficult to capture a clear causality and direction between profitability, growth and size. Moreover, incorporation of profitability and growth time lags into the econometric models complicates the endogenous relationship between them due to unknown influences of different time lags.

This study aims to shed light on the inter-relationship between firm profitability, growth and size intentionally focusing on econometric issues, rather than managerial implications. Throughout this aim, advanced econometric methods are performed to estimate the mentioned inter-relationship on a sample of Turkish manufacturing industry (consisting of Borsa Istanbul (BIST) listed manufacturing firms) for the period of 1991.Q2-2014Q4. In the following section of the study, literature review is presented. Then methodology and empirical results are given. Finally, in the *Conclusion*, findings are discussed, limitations of the study and suggestions for further studies are presented.

2. LITERATURE REVIEW

There exist a very comprehensive literature on the inter-relationship between profitability, growth and size. However, while the majority of studies focus on dual relationships between these variables such as profitability-growth, profitability-size or growth-size in a limited framework; a few of them attempt to undertake the entire relationship in depth. Empirically considering both profitability-growth and profitability-size inter-relationships with their causalities, this study is one of the latter. As it is widely assumed that profitability and growth are inter-related, the literature should be discussed from two different perspectives such as (1) the effect of growth on profitability, and (2) the effect of profitability on growth. Concerning the first perspective, there exists several theories claiming that growth positively affects profitability such as Kaldor-Verdoorn Law suggested by Verdoorn (1949) and Kaldor (1966). According to this law, (firm) growth increases the productivity of a firm and this increase triggers sales' growth and consequently profitability. However, this notion conflicts with the theory of diseconomies of scale, an economic concept in which economies of scale -sustaining that larger firms with relatively high growth rates may benefit from cost advantages due to their economies of scale and in turn enhanced profitability- no longer function. Beyond these theories, related empirical studies also indicate similar inconsistent findings. While findings from studies of Capon *et. al.* (1990), Chandler and Jansen (1992), Mendelson (2000), Cowling (2004), Serrasquerio *et. al.* (2007), Asimakopoulous *et. al.* (2009), Serrasquerio (2009) and Jan and Park (2011) indicate positive effect of growth on profitability; Reid (1995)'s, Roper (1999)'s, Gschwandtner (2005)'s and Nakano and Kim (2011)'s findings are opposite to them.

From the second perspective, some prior studies like Alchian (1950)'s theoretical article, financing constraints-based hypotheses, and pecking order theory firstly suggested by Donaldson (1961), then modified and popularized by Myers (1984) and Myers and Majluf (1984) have placed emphasis on the positive effect of profitability on growth. In contrast, some theories have been put forth opposing this effect such as the managerial growth maximization hypothesis under market competition (Mueller, 1972). This theory asserts that firm's primary managerial objective is growth maximization -rather than profit maximization-, and this objective may sometimes cause decreases in profit rates as a

result of competitive relationship between profitability and growth. In the scope of empirical studies, inconsistent research findings are also seen. Robson and Bennett (2000), Cox *et. al.* (2002), Liu and Hsu (2006), Coad (2007) and Bottazzi *et. al.* (2008) express that profitability affects firm growth positively. However, an opposite effect has been observed in studies of Capon *et. al.* (1990), Markman and Gartner (2002) and Coad (2010).

Firm size as a proxy of firm's resources is one of the other main determinants of profitability due to theory of economies of scale positing that for bigger firms, manufacturing costs are relatively low compared to the smaller ones. According to this theory, the relationship between profitability and size is expected to be positive. However, opposite of economies of scale, i.e. diseconomies of scale theory predicts that efficiency lessens in firms expanding beyond their optimum scales as a result of several diseconomies including poor communication, co-ordination, x-inefficiency, low motivation and agency problems. In such circumstances, the expected direction of the relationship may turn out to negative. Theoretical and empirical evidence concerning the relationship between profitability and size has also attracted massive interest. While in the pioneering studies of McConnell (1946), Alexander (1949), Haines (1970) and Shepherd (1972), a weak or negative relationship or none at all have been obtained; Hall and Weiss (1967), and Gale (1972) have found positive relationship between profitability and size. Following them, mixed empirical results have been obtained from mainly cross-sectional and time series studies. Briefly concluding that larger firms have tendency to have higher rates of profitability, and therefore supporting the theory of economies of scale; Fiegenbaum and Karnani (1991), Gschwandtner (2005), Özgülbaş *et. al*. (2006), Wu (2006), Jonsson (2007), Akbaş and Karaduman (2012), Mule *et. al.* (2015) find that size has significantly positive effect on profitability. On the contrary, findings of Amato and Burson (2007), Becker-Blease *et. al.* (2010) and Khatap *et. al.* (2011) indicate statistically negative relationship between profitability and size.

3. DATA, VARIABLES and THE MODEL

The data of the study covers 1991.Q2-2014.Q4 for the manufacturing industry (consisting of Borsa Istanbul (BIST) listed manufacturing firms) in Turkey. As mentioned before, the primary aim of the study is to analyze possible relationship between *profitability* and *growth*. Additionally, *size* -as an alternative possible determinant of profitability- is also undertaken in order to check the robustness of the profitability-growth relationship and to enhance the empirical analysis. Therefore, three key variables are included in two different models: profitability as dependent variable in both models, and growth and size as independent variables in each model. These three variables can be measured in different ways due to the aim and context of the studies involved. For instance, while many researchers such as Amato and Wilder (1985), Roquebert *et. al.* (1996), McGahan and Porter (1997), Glancey (1998), Mauri and Michael (1998), Claver *et. al.* (2002), Fitzsimmons *et. al.* (2005), Asimakopoulous *et. al.* (2009), Davidsson *et. al.* (2009), Narware (2010), Vijayakumar and Devi (2011), Delmar *et. al.* (2013), and Li and Wang (2014) have used *return on assets* (*ROA*); some such as Hall and Weiss (1967), Ebaid (2009), Ferati and Ejupi (2012), Velnampy and Niresh (2012), and Bokhari and Khan (2013)

have used *return on equity* (*ROE*) as profitability variable. Here, it can be emphasized that *ROE* has mostly been used in studies related with (especially in financial) service industries. Additionally, less often than *ROA* and *ROE*, some other profitability variables such as *return on sales* (*ROS*) (see, for instance, Fitzsimmons *et. al.,* 2005; Jang and Park, 2011; Vijayakumar and Devi, 2011), and *earnings before interest and taxes* (*EBIT*) (see, for instance, Kwoka and Ravenscraft, 1986; Brännback *et. al.*, 2009; Fareed *et. al.*, 2014) have also been used in related studies. In this study, the most generally employed profitability variable; i.e., return on assets is used as the dependent variable, as it gives a quick indication of the capital intensity and assets utilization depending on the industry, and overcomes variations based on size in terms of total profits. Besides, use of *ROA* rather than *ROE* and any other profitability variables shows consistency with the data.

As in most of related studies (Delmar, 1997; Weinzimmer *et. al.*, 1998; Coad, 2007; Short *et. al.*, 2009; Serrasquerio, 2009; Bottazzi *et. al.*, 2010; Jang and Park, 2011), the growth variable focused on this study is sales' growth. It is relatively easy to obtain sales' growth data from financial statements. As an important indicator reflecting both short-term and long-term changes in sales capacity of the industry, sales' growth is also favored by entrepreneurs themselves (Barkham *et. al.*, 1996). The study by Shepherd and Wiklund (2009) delving into the relationships between various growth variables such as growth in (1) sales, (2) employees, (3) profit, (4) assets, and (5) equity indicates that in many situations sales' growth is the most appropriate variable for growth.

Size is the other independent variable of the model. There are several size variables used by researchers in their studies such as *total assets* (see, for instance, Friend and Lang, 1988; Anderson and Makhija, 1999; Frank and Goyal, 2003; Dalbor *et. al.*, 2004; Deesomsak, 2004; Padron *et. al.*, 2005; Zeitun and Tian, 2007; Saliha and Abdessatar, 2011; Doğan, 2013), *total sales* (see, for instance, Titman and Wessels, 1988; Rajan and Zingales, 1995; Wiwattanakantang, 1999; Booth *et. al.*, 2001; Huang and Song, 2006; Serrasquerio and Nunes, 2008), and *number of employees* (see, for instance, Bonaccorsi, 1992; Archarungroj and Hoshino, 1998; Jonsson, 2007). In this study, size variable is represented by total assets due to the fact that it is the most appropriate variable to epitomize the size of activities. It is measured as the natural logarithm of total assets with the aim of controlling a possible non-linearity in the data, and the consequent problem of heteroscedasticity (Sogorb and Lopez, 2003). Definitions and calculations about the variables of the study are summarized in Table 1.

Table 1.: Definitions of Variables

Variable	**Calculation**	**Symbol**
Profitability (Return On Assets)	Net Income / Total Assets	*ROA*
Growth (Sales' Growth)	$[Sales_t - Sales_{t-1}] / Sales_{t-1}$	*GROWTH*
Size (Natural Logarithm of Total Assets)	ln(Total Assets)	*lnSIZE*

The regression equations in order test possible relationships between profitability and growth, and between profitability and size are as given as given below:

$$ROA_t = \beta_0 + \beta_1 GROWTH_t + \varepsilon_t \qquad (Model\ 1)$$

$$ROA_t = \beta_0 + \beta_1 lnSIZE_t + \varepsilon_t \qquad (Model\ 2)$$

In the model, profitability, growth and size variables are denoted by *ROA*, *GROWTH* and *lnSIZE*, respectively.

4. METHODOLOGY and EMPIRICAL FINDINGS

This study tries to find out the inter-relationship between profitability, growth and size via various empirical analyses including (1) multiple structural breaks unit root test of Carrioni-i-Silvestre *et. al.* (2009), (2) multiple structural breaks co-integration test of Maki (2012), (3) dynamic ordinary least squares (DOLS) method developed by Stock and Watson (1993) and (4) bootstrap causality test developed by Hacker and Hatemi-J (2012), respectively.

4.1. Multiple Structural Breaks Unit Root Test of Carrion-i-Silvestre *et. al.* (2009)

The results derived from traditional unit root tests may sometimes be misleading when major events like economic crises, wars, catastrophes, etc. have influence on the data analyzed, as these events have tendency to create structural breaks in the series. In these cases, unit root tests allowing for the presence of multiple structural breaks should be referred. The multiple structural breaks unit root test developed by Carrioni-i-Silvestre *et. al.* (2009: 1786) is one of them allowing for the presence of multiple breaks affecting the individual effects and time trend under the endogenous structural break assumptions; and also offers improvements over commonly methods in even small samples (as the one in this study). In this study, this unit root test is employed because of its superiority to other similar tests, especially about the total number of presence of multiple breaks (maximum up to five).

Carrioni-i-Silvestre *et. al.* (2009: 1786) see their study as an extension of Kim and Perron (2009)'s work by (1) allowing for an arbitrary number of changes in both the level and slope of the trend function; (2) adopting the so-called quasi-generalized least squares (quasi-GLS) detrending method advocated by Elliot *et. al.* (1996); and (3) considering the class of *M*-tests introduced in Stock (1999) and analyzed in Ng and Perron (2001).

In their model, y_t is the stochastic process generated according to:

$$y_t = d_t + u_t \qquad (1)$$

$$u_t = \alpha u_{t-1} + \nu_t, \qquad t = 0, \dots, T \qquad (2)$$

where $\{u_t\}$ is an unobserved mean-zero process. It is assumed that $u_0 = 0$. The disturbance term ν_t is defined by $\nu_t = \sum_{i=0}^{\infty} \gamma_i \eta_{t-i}$ with $\sum_{i=0}^{\infty} i|\gamma_i| < \infty$ and $\{\eta_t\}$ a martingale difference sequence adopted to the filtration $F_t = \sigma$ *-field*$\{\eta_{t-1}; i \geq 0\}$. The short-run and long-run variance are defined as $\sigma^2 = \sigma_\eta^2 \gamma(1)^2$ and $\sigma_\eta^2 = lim_{T\to\infty} T^{-1} \sum_t^T E(\eta_t^2)$, respectively.

Carrioni-i-Silvestre *et. al.* (2009) have developed five test statistics. The first one is based on the analyses of Elliot *et. al.* (1996) and Perron and Rodriguez (2003). Here the feasible point optimal statistic is given by:

$$P_T^{GLS}(\lambda^0) = \{S(\overline{\alpha}, \lambda^0) - \overline{\alpha}S(1, \lambda^0)\}/s^2(\lambda^0) \quad (3)$$

where $s^2(\lambda^2)$ is an estimate of the spectral density at frequency zero of v_t. Following Perron and Ng (1998) and Ng and Perron (2001), Carrioni-i-Silvestre *et. al.* (2009) use an autoregressive estimate defined by:

$$s(\lambda^0)^2 = s_{ek}^2 / (1 - \sum_{j=1}^{k} \hat{b}_j)^2 \quad (4)$$

where $s_{ek}^2 = (T-k)^{-1} \sum_{t=k+1}^{T} \hat{e}_{t,k}^2$ and $\{\hat{b}_j, \hat{e}_{t,k}\}$ obtained from the ordinary least squares (OLS) regression:

$$\Delta\tilde{y}_t = b_0 \tilde{y}_{t-1} + \sum_{j=1}^{k} b_j \Delta\tilde{y}_{t-j} + e_{t,k} \quad (5)$$

with $\tilde{y}_t = y_t - \widehat{\Psi}' z_t(\lambda^0)$ where $\widehat{\Psi}$ minimizes the objective function[1].

The order of autoregression k is selected using the modified information criteria suggested by Ng and Perron (2001) and with the modification proposed by Perron and Qu (2007).

The three *M*-class of tests allowing for multiple structural breaks used by Carrioni-i-Silvestre *et. al.* (2009) are defined by Equations 6-8 as given below. These tests have been analyzed previously in Ng and Perron (2001).

$$MZ_\alpha^{GLS}(\lambda^0) = \left(T^{-1} - s(\lambda^0)^2\right)\left(2T^{-2}\sum_{t=1}^{T} \tilde{y}_{t-1}^2\right)^{-1} \quad (6)$$

$$MSB^{GLS}(\lambda^0) = \left(s(\lambda^0)^{-2} T^{-2} \sum_{t=1}^{T} \tilde{y}_{t-1}^2\right)^{\frac{1}{2}} \quad (7)$$

$$MZ_t^{GLS}(\lambda^0) = \left(T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2\right)\left(4s(\lambda^0)^2 T^{-2} \sum_{t=1}^{T} \tilde{y}_{t-1}^2\right)^{-\frac{1}{2}} \quad (8)$$

with $\tilde{y}_t = y_t - \widehat{\Psi}' z_t(\lambda^0)$, where $\widehat{\Psi}$ minimizes the objective function given in the footnote 1 and $s(\lambda^0)^2$ is defined in Equation (4).

Following Ng and Perron (2001), the fifth statistic in Carrioni-i-Silvestre *et. al.* (2009) is a modified feasible point optimal test defined by:

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[1] The so-called GLS detrended unit root test statistics are based on the use of the quasi-differenced variables $y_t^{\bar{\alpha}}$ and $z_t^{\bar{\alpha}}(\lambda^0)$ defined by $y_1^{\bar{\alpha}} = y_1$, $z_1^{\bar{\alpha}}(\lambda^0) = z_1(\lambda^0)$, and $y_t^{\bar{\alpha}} = (1 - \overline{\alpha}L)y_t$, $z_t^{\bar{\alpha}}(\lambda^0) = (1 - \overline{\alpha}L)z_t(\lambda^0)$ for $t = 2, \ldots, T$ with $\overline{\alpha} = 1 + \bar{c}/T$ where $\bar{c}$ is a noncentrality parameter. Once the data have been transformed, the parameters Ψ, associated with the deterministic components, can be estimated by minimizing the following objective function: $S^*(\Psi, \overline{\alpha}, \lambda^0) = \sum_{t=1}^{T}(y_t^{\bar{\alpha}} - \Psi' z_t^{\bar{\alpha}}(\lambda^0))^2$. The minimum of this function is denoted by $S(\overline{\alpha}, \lambda^0)$ (Carrioni-i-Silvestre *et. al.*, 2009: 1758-1759).

$$MP_T^{GLS}(\lambda^0) = \frac{[c^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2 + (1-\bar{c})T^{-1}\tilde{y}_T^2]}{s(\lambda^0)^2} \quad (9)$$

In Carrioni-i-Silvestre *et. al.* (2009), asymptotic critical values are obtained by using the bootstrap. The null hypothesis of a unit root is rejected in case of calculated test statistics being smaller than critical values. In this situation, it can be said that series is stationary under the presence of structural break. Results of unit root test of Carrioni-i-Silvestre *et. al.* (2009) are given in Table 2.

Table 2.: Results of Unit Root Test of Carrion-i-Silvestre *et. al.* (2009)

Variable	*Critical Values*					*Break Dates*
	P_T^{GLS}	MZ_α^{GLS}	MSB^{GLS}	MZ_t^{GLS}	MP_T^{GLS}	
ROA	13.236 (8.869)	-33.102 (-46.219)	0.122 (0.103)	-4.066 (-4.786)	12.534 (8.869)	1993.Q4; 1996.Q2; 1999.Q2; 2001.Q4; 2008.Q2
lnSIZE	24.236 (9.250)	-21.739 (-47.749)	0.151 (0.101)	-3.285 (-4.877)	20.792 (9.250)	1993.Q3; 1998.Q1; 2003.Q3; 2006.Q1; 2010.Q4
GROWTH	13.039 (9.169)	-36.538 (-46.490)	0.116 (0.103)	-4.274 (-4.806)	11.817 (9.169)	1993.Q2; 1999.Q1; 2001.Q4; 2009.Q1; 2011.Q4
ΔROA	*2.358*** (5.543)	*-38.138*** (-17.325)	*0.114*** (0.168)	*-4.363*** (-2.896)	*2.409*** (5.543)	
ΔlnSIZE	*2.141*** (5.543)	*-44.517*** (-17.325)	*0.105*** (0.168)	*-4.710*** (-2.896)	*2.087*** (5.543)	
ΔGROWTH	*2.804*** (5.543)	*-40.055*** (-17.325)	*0.111*** (0.168)	*-4.468*** (-2.896)	*2.311*** (5.543)	

Note: Figures in parenthesis are critical values obtained by using the bootstrap at significance level of 5%. ** and *Δ* denote stationarity at significance level of 5%; and the first difference, respectively.

According to the empirical results, the null hypotheses of a unit root test is accepted as calculated test statistics at level are bigger than critical values. Test results also indicate that series are stationary at their first differences and integrated of order one, I(1).

As seen in Table 2, structural break dates estimated by the unit root test of Carrion-i-Silvestre *et. al.* (2009) point out dramatic turning points in Turkish economy. These break dates are to be discussed in the *Conclusion* part of the study.

4.2. Multiple Structural Breaks Co-integration Test of Maki (2012)

Among co-integration tests considering structural breaks, tests suggested by Zivot and Andrews (1992); Gregory and Hansen (1996), and Westerlund and Edgerton (2007) allow only one structural break. However, Gregory and Hansen (1996) criticizes that in case of referring such tests, breaks may cause spurious unit root behavior in the co-integrating relationship. So, multiple (at least more than one) structural breaks should be processed in co-integration tests. In this context, tests developed by Carrion-i-Silvestre and Sanso (2006) and Hatemi-J (2008) allow two structural breaks. Additionally, Maki (2012) proposes a test performing better than its ancestors when the co-integration relationship has more than three (maximum up to five) breaks or persistent Markov switching shifts. Therefore in this study, Maki (2012) co-integration test is used. Maki (2012) tries to identify the long-run relationships between series with four different regression models in as given below:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \mu_t \quad (10)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + \mu_t \quad (11)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + \mu_t \quad (12)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta_i' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (13)$$

where $t = 1,2,\dots,T$. y_t and $x_t = (x_t \dots x_{mt})'$ denote observable 1(1) variables, and u_t is the equilibrium error. y_t is a scalar and $x_t = (x_{1t}, \dots, x_{mt})'$ is an $(m \times 1)$ vector. It is assumed that an $(n \times 1)$ vector $z_t$is generated by$z_t = (y_t, x_t')' = z_{t-1} + \varepsilon_t$, where $\varepsilon_t$are independent identically distributed with mean zero, definite variance-covariance matrix Σ, and $E|\varepsilon_t|^s < \infty$ for some $s > 4$. $\mu, \mu_i, \gamma, \gamma_i, \beta' = (\beta_{i1}, \dots, \beta_{im})$ are true parameters. $D_{i,t}$ takes as value of 1 if $t > T_{Bi} (i = 1, \dots, k)$ and of 0 otherwise, where k is the maximum number of breaks and T_{Bi} denotes the time period of the break.

The first model with level shifts and without trend in which there is a break in the constant term, and the second model (also called as the regime-shifts model) without trend in which there are breaks in both constant term and slope are given in Equations (10) and (11), respectively. The third model given in Equation (12) is the second model with a trend. The fourth and the last model is the comprehensive one with breaks in constant term, slope and trend (Equation 13).

The asymptotic critical values of the tests for the maximum number of breaks (from 1 to 5) approximated by Monte Carlo simulations coded by GAUSS are given in Maki (2012). The null hypothesis of non-existence of co-integration between series is rejected in case of calculated test statistics being smaller than these critical values. In the study, null hypothesis is accepted for the 1st model, while it is rejected for the 2nd one. Therefore, there exists a co-integration relationship between firm profitability and size. The results of multiple structural breaks co-integration test of Maki (2012) are given in Table 3.

As seen in Table 3, calculated test statistics being smaller than critical values point out that alternative hypothesis of existence of co-integration between the series under multiple structural breaks is accepted. Maki (2012) test results show that the series are co-integrated in the long-run. In the next step of the analysis, estimation of long-run parameters are made by using the dynamic ordinary least squares (DOLS) method developed by Stock and Watson (1993). Break dates obtained from co-integration test are also included in the model developed for parameter estimation.

Table 3.: Results of Maki (2012) Co-integration Tests

		Models	*Test Statistics*	*Critical Values*			*Break Dates*	*Existence of Co-integration*
				1%	*5%*	*10%*		
ROA → GROWTH	Null hypothesis is accepted	Model 0	-3.934	-5.959	-5.426	-5.131	1992.Q4; 1998.Q4; 2001.Q1; 2001.Q4; 2008.Q4	-
		Model 1	-4.561	-6.193	-5.699	-5.449	1992.Q3; 1998.Q4; 2000.Q3; 2001.Q4; 2005.Q3	-
		Model 2	-5.222	-6.915	-6.357	-6.057	1993.Q4; 1999.Q4; 2000.Q3; 2000.Q4; 2011.Q1	-
		Model 3	-5.777	-8.004	-7.414	-7.110	1992.Q3; 1994.Q2; 1995.Q4; 1998.Q4; 2001.Q4	-
ROA → lnSIZE	Null hypothesis is rejected	Model 0	-4.628	-5.959	-5.426	-5.131	1992.Q4; 1995.Q1; 1998.Q4; 2001.Q4; 2011.Q2	-
		Model 1	*-5.788***	-6.195	-5.699	-5.449	1992.Q4; 1995.Q1; 1998.Q4; 2001.Q4; 2011.Q2	+
		Model 2	-5.752	-6.915	-6.357	-6.057	1993.Q4; 1996.Q4; 1998.Q4; 2001.Q4; 2005.Q1	-
		Model 3	-6.984	-8.004	-7.414	-7.110	1995.Q4; 1999.Q4; 2001.Q4; 2008.Q3; 2012.Q2	-

Note: Critical values are obtained from the Table 1 in Maki (2012)'s study. **, denotes significance level of 5%.

4.3. Estimation of Long-run Parameters

DOLS method of Stock and Watson (1993) is improved on ordinary least squares (OLS) having certain advantages over both it and the maximum likelihood procedures such as coping with small sample and dynamic sources of bias. As a robust single equation approach, DOLS corrects for regressor endogeneity by the inclusion of leads and lags of the first differences of the regressors, and for serially correlated errors by a generalized least squares (GLS) procedure (Esteve and Requena, 2006: 118). Moreover, it has the same asymptotic optimality properties as the Johansen (1991) distribution (Al-Azzam and Hawdon, 1999). Using DOLS estimators requires existence of co-integration between dependent and explanatory series.

The DOLS estimator is obtained from the Equation (14):

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 x_t + \sum_{i=-q}^{q} \delta_i \Delta x_{t-i} + \varepsilon_t \qquad (14)$$

where q represent optimum leads and lags, and ε_t error term, respectively.

The long-run parameters estimated by DOLS method given in Table 4 indicate that the only statistically significant relationship is between profitability and size. Accordingly, size has statistically negative effect on profitability. This empirical result may be discussed in terms of diseconomies of scale.

4.4. Bootstrap Causality Test of Hacker and Hatemi-J (2012)

As co-integration analyses do not provide information on the direction of causality, causality analysis should be undertaken in determining causal relationships between the series. For this purpose, the bootstrap causality test of Hacker and Hatemi-J (2012) is used in this study. In their previous study, Hacker and Hatemi-J (2006) have used the Granger

causality Wald test with a modification for integrated variables suggested in Toda and Yamamoto (1995), concluding that such test is not appropriate to be used with relatively small sample sizes. Therefore, in 2012, they have improved their test by assuming the lag length to be unknown and the one chosen is data-driven; presenting the power and simulation results; and focusing on smaller sample sizes (20-40 observations).

Table 4.: DOLS Estimation Results (Model 2)

Variables	*Coefficients*	*t-statistics*	*Prob.*
Ln SIZE	-0.004***	-1.785	0.078
D1	-0.047	-0.696	0.488
D2	0.147	2.397	0.019
D3	0.015	0.263	0.793
D4	-0.166	-2.846	0.005
D5	0.071	0.058	0.226
C	0.139	2.629	0.010
R^2: 0.58		*D-W test statistics*: 1.013	

Note: ***, denotes significance level of 10%.

In the context of Granger causality, Hacker and Hatemi-J (2012) consider the vector autoregressive model of order k, $VAR(k)$;

$$\gamma_t = \beta_0 + \beta_1 \gamma_{t-1} + \cdots + \beta_k \gamma_{t-k} + \mu_t \qquad (15)$$

where γ_t, β_0 and μ_t are vectors with dimensions $n \times 1$ and β_i, $i \geq 1$ is a parameter matrix with $n \times n$ dimensions. The error vector, μ_t, has a zero-expected value, assumed to be independent and identically distributed with a non-singular covariance matrix Ω. The lag length, k, is determined by estimating the $VAR(k)$ model in Equation (15) for $k = 0, \dots, K$, where K is the maximum lag length considered, and finding that k which minimizes the information criterion suggested by Hatemi-J (2003; 2008) as an alternative to Schwarz Bayesian Information Criterion (*SBC*) and Akaike Information Criterion (*AIC*). Hatemi-J Information Criterion (*HJC*) is as below:

$$HJC = ln\left(\det\widehat{\Omega}_k\right) + k\left(\frac{n^2 lnT + 2n^2 \ln(lnT)}{2T}\right) \qquad k = 0, \dots, K \qquad (16)$$

where ln is the natural logarithm; $\det\widehat{\Omega}_k$ is the determinant of the estimated variance-covariance matrix of the residuals in the $VAR(k)$ model for lag order k; n and T are the number of variables and the sample size (number of observations), respectively.

In case of variables being integrated, standard asymptotical distributions cannot be used to test for restrictions in the VAR model. To overcome this problem, Toda and Yamamoto (1995) uses an augmented $VAR(k+d)$ model, where d denotes integration order of variables. This model can be written compactly as below (Hatemi-J *et. al.*, 2006: 69):

$$Y = DZ + \delta \quad (17)^2$$

To test the null hypothesis of non-Granger causality, the modified Wald (*MWALD*) test statistic is used. This test is as:

$$MWALD = \left(Q\hat{\beta}\right)^{'}[Q((\mathrm{Z}^{'}\mathrm{Z})^{-1}\Theta\Omega_U)Q^{'}]^{-1}\left(Q\hat{\beta}\right) \sim \chi_k^2 \quad (18)$$

where Q is an $k \times n\left(1 + n(k+d)\right)$ indicator matrix used to identify restrictions implied by the null hypothesis; and Θ is the element by all element matrix multiplication operator (the Kronecker product. Ω_U is the estimated variance-covariance matrix of residuals in Equation (17) when the restrictions implied by the null hypothesis of non-Granger causality is not imposed and is determined by the formula $\Omega_U = (\delta_U \delta\delta_U^{'}) \div \left(T - (1+nk)\right)$, where $(1+nk)$ is the number of parameters.

Under the normal distribution assumption, the Wald test statistics follows a χ^2 distribution with k degrees of freedom asymptotically. However, in cases where sample size is relatively small; the error terms are not normally distributed; and autoregressive conditional heteroscedasticity effects exist, asymptotic critical values of the Wald test are not precise. For the solution of this problem, Hacker and Hatemi-J (2012) suggest a test based on leveraged bootstrap simulations emphasizing that when the lag length choice is endogenized, the suggested test will perform better with more precise results. The null hypothesis non-Granger causality is rejected in case of calculated Wald statistic being higher than the bootstrap critical value. The causality relationships among variables are given in Table 5.

Table 5.: Bootstrap Causality Test of Hacker and Hatemi-J (2012)

The Null Hypothesis	*MWALD Statistics*	*1% Critical Value*	*5% Critical Value*	*10% Critical Value*
No Causality from ROA to GROWTH	1.544	6.939	3.768	2.716
No Causality from GROWTH to ROA	0.211	6.737	3.947	2.748
No Causality from ROA to lnSIZE	4.982***	11.164	6.102	4.676
No Causality from lnSIZE to ROA	0.364	10.431	6.346	4.923

Note: ***, denotes significance level of 10%. The bootstrapping is repeated 10,000 times.

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[2] Toda and Yamamoto (1995)'s augmented $VAR(k+d)$ model is as: $\gamma_t = \beta_0 + \beta_1\gamma_{t-1} + \cdots + \beta_k\gamma_{t-k} \ldots + \beta_{k+d}\gamma_{t-k-d} + \mu_t$. Assuming that the initial values are given, the denotations in Hatemi-J *et. al.* (2006) in order to represent the modified Wald statistics are as:

$Y: -\left(\gamma_1, \ldots, \gamma_T\right) \quad (n \times T)$ matrix,

$D \coloneqq \left(\beta_0, \beta_1, \ldots, \beta_k, \ldots, \beta_{k+d}\right) \quad \left(n \times 1\left(1 + n(k+d)\right)\right)$ matrix,

$$Z_t \coloneqq \begin{bmatrix} 1 \\ \gamma_t \\ \gamma_{t-1} \\ \vdots \\ \gamma_{t-k-d+1} \end{bmatrix} \quad \left(\left(1 + n(k+d)\right) \times 1\right) \text{ matrix, for } t = 1, \ldots, T$$

$Z \coloneqq (Z_0, \ldots, Z_{t-1}) \quad \left(\left(1 + n(k+d)\right) \times T\right)$ matrix, and

$\delta \coloneqq (e_1, \ldots, e_T) \quad (n \times T)$ matrix.

Bootstrap causality test results indicate the existence of one-way causality from size to profitability variable at significance level of 10% for the manufacturing industry (firms) in Turkey. The result imply that (firm) size statistically affects (firm) growth.

5. CONCLUSION

This study investigates the inter-relationship between firm profitability, growth and size in Turkish manufacturing industry consisting of Borsa Istanbul listed manufacturing firms covering 1991.Q2-2014.Q4. In the study, the stationarity of series are tested by unit root test of Carrioni-i-Silvestre *et. al.* (2009. The structural break dates estimated by this test point out dramatic turning points in Turkish economy. Last quarter of the year 1993 is seen as the beginning period of Turkey's currency crisis in 1994. As known, huge public sector borrowing requirements and major policy fallacies in financing the deficit have led to a currency crash in Turkey in 1994. After five years, on August 17th and November 12th, 1999, earthquakes struck the Marmara and Bolu areas of Turkey causing high casualties and significant material damage on property, with severe effects on economy. Following, a new crisis occurred on February 19th, 2001 in the form of a virtual raid on foreign currencies. Finally, along with the world economy, Turkish economy faced with the financial crisis of 2007-08 (also known as Global Credit Crunch or 2008 Financial Crisis) considered by many economists to have been the worst financial crisis since the Great Depression.

Besides, co-integration relationship and co-integration coefficients between profitability, growth and size are tested by means of co-integration test of Maki (2012) and Stock and Watson (1993)'s dynamic ordinary least squares (DOLS) method, respectively. The results of Maki (2012) test indicate a co-integration relationship between firm profitability and size. The long parameters estimated by DOLS method show that the only statistically significant relationship is between firm profitability and size. Accordingly, size has statistically negative effect on profitability indicating that firm profitability decreases due to increase in size. This finding supports to the theory of diseconomies of scale. In diseconomies of scale, long-term average cost of production increases due to increase in the scale of operations beyond a certain level.

Finally, causal relationships between the variables are also tested by Hacker and Hatemi-J (2012) bootstrap causality test. Results of this test indicate only the existence of one-way causality from size to profitability.

This study is subject to some limitations. The findings of the study cannot be generalized to other industries, as the sample consists of only the manufacturing industry. Besides, the profitability, growth and size variables used in the study may be changed with the ones discussed in the 3rd part of the study. So, further studies may investigate the mentioned inter-relationships using other various variables with more enlarged samples consisting of different industries.

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FIRM'S DEGREE OF UNCERTAINTY and EARNINGS FORECASTS

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ABSTRACT

This study examines the relationship between earnings forecasts and task uncertainty. Company uncertainty is applied as a proxy for task difficulty and is investigated in terms of its effect on analysts' forecasts in three aspects: forecast accuracy, the optimism degree of the forecast, and the timely response to public information. The current study concludes that company uncertainty is positively related to forecast inaccuracy, positively related to the analysts' forecast optimism level, and is negatively related to revision timeliness. This finding suggests that if a company has a high uncertainty, then predicting the company's future earnings is difficult for financial analysts. Furthermore, when new public information is released (such as an earnings announcement), much time is needed to interpret this new information and to revise prior forecasts. We contribute to extant literature in the following ways: First, this study clarifies the effect of firm uncertainty on analyst performance. Second, we remind investors to be careful when taking an analyst's research reports as a reference for investment decisions.

1. INTRODUCTION

Factors that can induce bias in earnings forecasts have been the subject of research and regulatory interest since the 1980s; prior studies have reported on many elements that affect analysts' earnings forecasts. Clement (1999) indicates that an analyst's forecasting accuracy can be affected by his/her ability, portfolio complexity, and data resources. Libby et al. (2008) suggest that analysts are motivated to report optimistic forecasts to maintain a good relationship with company management. O'Brien et al. (2005) determine that an analyst responds more slowly to bad news than to good news. Holden and Stuerke (2008) reveal that forecast revision frequency is positively associated with earnings variability and trading volume; however, this frequency is negatively associated with the skewedness of trading volume.

Furthermore, a financial analyst's personal characteristics influence his/her earnings forecasts to a certain extent. In addition to such characteristics, task uncertainty also affects the forecasting accuracy of companies. When a company is highly uncertain,

reporting earnings forecasts is difficult for financial analysts; thus, the task uncertainty level is high. Duru and Reeb (2002) determine that firms' diversification degrees are associated with analyst forecasts that are not very accurate and are optimistic. Wallner (1999) and Anderson and Tushman (2001) define the complexity degree of a firm according to the level of diversification and information uncertainty. Prior studies have motivated our research by investigating the effect of a company's uncertainty degree on analysts' forecast behaviors in three aspects: forecast accuracy, the optimism degree of a forecast, and response timeliness to public news. In general, the future earnings of a highly uncertain firm are difficult to predict, and forecast accuracy may also drop. The second aspect of analyst behaviors examined in the present study is the degree of optimism/passivism in an analyst in relation to a firm's uncertainty degree. This issue is crucial to market participants because previous literature has documented that optimistic and passive analysts provide different opinions to the same firm. An analyst must spend much time and effort in processing and analysing the information of a highly uncertain firm; thus, his/her willingness to add coverage of such a company may indicate a belief that the firm has good prospects. As a result, this analyst presents an optimistic forecast. Nonetheless, an analyst may also have incentive to issue optimistic forecasts to gain access to private information according to Lim (2001) and Libby et al. (2008). This analyst may have increased motivation to favor management if he/she includes the coverage of a highly uncertain company; hence, he/she is likely to issue optimistic forecasts for this firm. The third topic investigated in the present work is the association between the adjustment speed of earnings forecasts to new information and the degree of firm uncertainty. Analysts normally adjust their forecasts upon receiving new public information; if an analyst adjust his/her forecasts frequently and in a timely manner, then the resultant forecasts are usually accurate. Therefore, we postulate that highly uncertain firms may be linked to slower earnings forecast adjustment because the message for such a company may take much time to interpret.

The current study concludes that company uncertainty is positively related to forecast inaccuracy, positively related to the analysts' forecast optimism level, and is negatively related to revision timeliness. This finding suggests that if a company is highly uncertain, then predicting the company's future earnings is difficult for financial analysts. Furthermore, when new public information is released (such as an earnings announcement), much time is needed to interpret this new information and to revise prior forecasts. We contribute to extant literature in the following ways: First, this study clarifies the effect of firm uncertainty on analyst performance. Second, we remind investors to be careful when taking an analyst's research reports as a reference for investment decisions. The remainder of this paper is organized as follows: Section 2 discusses related theoretical literature and the hypotheses of the current study. Section 3 describes the research design and all the variables in the regression. Section 4 presents the data resources and the sampling procedures, and discusses the empirical results. Finally, section 5 provides the conclusion.

2. LITERATURE REVIEW AND HYPOTHESES

Prior research regarding financial analyst forecasts focuses on forecasting performance, bias, and analysts' recommended revision. Clement (1999) and Clement et al. (2007) investigate forecast accuracy. McNichols and O'Brien (1997) as well as Libby et al. (2008) note that analysts tend to report optimistic forecasts. O'Brien et al. (2005) discuss the adjustment speed of analyst forecasts to public information. The current paper presents a new firm-level factor (company uncertainty) that affects the degree of analyst forecast optimism; moreover, this study offers insights on the type of company that may easily receive optimistic forecasts. On this basis, investors can interpret forecast information accurately.

Prior studies provide evidence on whether or not analysts differ in terms of individual forecasting performance. Mikhail et al. (1997) report that analysts' forecast accuracy is enhanced once they gain additional firm-specific experience. Jacob et al. (1999) reveal that an analyst's aptitude and brokerage house characteristics are related to forecast accuracy; however, learning-by-doing is not linked to this accuracy when the analyst's company-specific forecasting aptitude is controlled. Mikhail et al. (1997) and Jacob et al. (1999) also identify a positive relationship between forecast accuracy and experience.

Clement (1999) discusses the reason for the positive relationship between forecast accuracy and experience and suggests that the former increases with an analyst's personal ability and the size of the company employing him/her. By contrast, this accuracy decreases with the number of firms and industries followed. Furthermore, Bolliger (2004) applies European data and obtains results similar to those reported by Mikhail et al. (1997), Jacob et al. (1999), and Clement (1999) when U.S. data are used; however, Bollinger does not detect a significant relationship between forecast accuracy and analysts' job experience as well as the size of the brokerage house that employs them.

Many studies also discuss diversification and uncertainty. Gort (1962) indicates that no significant cross-sectional correlation was observed between profitability and diversification. Palepu (1985) and Rumelt (1982) utilize complete data to investigate the same issue and reach a conclusion similar to that presented by Gort. In terms of literature on product diversification of a firm and earnings forecast accuracy, Kini et al. (2009) indicate that the relation between sector diversification and forecast accuracy is context-specific. In an international context such as European Zone, forecast accuracy may increase with sector diversification, whereas in the U.S., analyst may generate higher accuracy when focus on a specific industry. With regard to regional diversification, Duru and Reeb (2002) suggest that increased international diversification in corporate is associated with analyst forecasts that are less accuracy accurate and are optimistic. This finding holds true even after controlling for a few determinants of forecast accuracy and bias, such as earnings variability, forecast horizon, firm size, and industrial diversification. Uncertainty is another proxy of complexity. Zhang (2006) investigates the inefficiency of analyst forecasts from an information perspective and determines that forecast accuracy and the frequency of forecast revisions are negatively linked to increased information uncertainty. In other

words, analysts' revisions are almost complete when this uncertainty is low; when such uncertainty increases, revisions are far from complete. Barron et al. (2002) report that analysts' forecast errors are positively associated with a firm's level of intangible assets. An additional analysis indicates that low levels of analyst consensus are associated with high-technology manufacturing companies, which suggests that certain factors in high-technology companies affect the predictions of financial analysts.

Based on these prior studies, the degree of a firm's uncertainty affects forecast accuracy; therefore, the first hypothesis of the current study is as follows:

H1: *The degree of uncertainty of a company negatively influences financial analysts' forecast accuracy.*

Financial analysts may report optimistic forecasts for certain reasons. McNichols and O'Brien (1997) suggest that analysts tend to avoid or delay the delivery of unfavorable news; moreover, their earnings forecasts are generally overoptimistic. Lim (2001) notes that issuing an optimistic forecast is a strategy to favor firm management. Libby et al. (2008) indicate that the optimistic or pessimistic forecasts may be linked to relationship incentives and access to information from management. Ke and Yu (2006) determine that analysts usually issue optimistic earnings forecasts initially, followed by pessimistic earnings forecasts before the day earnings are announced. On this basis, these analysts can acquire additional private information from firm management and enhance the accuracy of these forecasts; in the process, they are less likely to be fired by their employers.

Prior works on optimistic or pessimistic analyst forecasts usually focus on private information from firm management. In a highly uncertain company, an analyst may have increased incentive to favor management to acquire additional private information; hence, he/she must present optimistic forecasts to the firm. Moreover, an analyst must spend much time and effort in processing and analyzing a highly uncertain firm; thus, his/her willing to add coverage of a highly uncertain company may indicate a belief that the firm has good prospects. Therefore, the analyst issues an optimistic forecast. In line with these findings, the second hypothesis of the present study is as follows:

H2: *The degree of uncertainty of a company positively influences the optimism degree of financial analysts' forecasts.*

Ivković and Jegadeesh (2004) determine a sharp increase in recommendation revisions and forecast revisions after earnings announcements are made. O'Brien et al. (2005) also suggests that an analyst responds more slowly to bad information than to good information; this situation is particularly significant in large brokerage houses. This finding indicates that such houses increase analysts' reluctance to reveal negative news, particularly to clients in the investment bank business. Gleason and Lee (2003) reach the same conclusion as Ivković and Jegadeesh (2004) and O'Brien et al. (2005); Gleason and

Lee also report that an earnings revision signal can deter the efficiency of market price discovery, particularly in firms with low analyst coverage.

Prior studies on adjustment timeliness usually discuss positive and negative information. Certain firm-level factors affect the timeliness of forecast adjustments; in a highly uncertain company, analysts may require additional time and effort to analyze new information they obtain regarding a company; subsequently, they can revise prior forecasts. The corresponding hypothesis of the current study is as follows:

H3: *The degree of uncertainty of a company negatively influences the adjustment speed of financial analysts' forecasts.*

3. RESEARCH DESIGN

3.1 ACCURACY MODEL

This study investigates the effect of company uncertainty on analyst performance in three aspects: the accuracy of earnings forecasts, the optimism of earnings forecasts, and the timeliness of analysts' responses to new information. Our first model tests hypothesis 1 and is estimated as follows:

Model 1:

$$\begin{aligned} Accuracy_{i,j,t} = {} & \beta_0 + \beta_1 RD_{j,t} + \beta_2 ADE_{j,t} + \beta_3 AT_{j,t} + \beta_4 ForHorizon_{i,j,t} \\ & + \beta_5 DaysElap_{i,j,t} + \beta_6 IndSpec_{i,j,t} + \beta_7 NCom_{i,j,t} \\ & + \beta_8 Bro\,\mathrm{ker}\,Size_{i,j,t} + \beta_9 GExp_{i,j,t} + \beta_{10} FExp_{i,j,t} \\ & + \beta_{11} AnalystFollowing_{j,t} + \beta_{12} Dispersion_{i,j,t} \\ & + \beta_{13} H_{j,t} + \beta_{14} lagAccuracy_{i,j,t} + \varepsilon_{i,j,t}, \end{aligned} \quad (1)$$

where $forecast_{i,j,t}$ is the earnings forecast of analyst *i* for firm *j* in year *t*, $actual_{i,j,t}$ represents the actual earnings of firm *j* in year *t*. We apply absolute forecast error as the proxy for earnings forecast accuracy ($Accuracy_{i,j,t}$); a small forecast error indicates that the earnings forecast is accurate. Accuracy is scaled according to the prior year's stock price. We also follow Barron et al. (2002) in terms of taking R&D expenses (RD) and advertising expenses (ADE) as a proxy of company uncertainty; $RD_{j,t}$ and $ADE_{j,t}$ denote company *j*'s R&D and advertising expenses as deflated by total operating expenses in year *t*, respectively.

In this regression, $RD_{j,t}$, and $ADE_{j,t}$ are the main variables discussed in this paper; all other variables are controls. In accordance with Mikhail et al. (1997), Jacob et al. (1999), and Clement (1999), we include the characteristics of analysts and brokerage houses as control variables, including the following: $AT_{j,t}$ is the logarithm of the total assets of company *j* in year *t*; $ForHorizon_{i,j,t}$ is the number of calendar days between the forecast issue date and

the fiscal end date; $DaysElap_{i,j,t}$ denotes the days between the date on which the present earnings forecast was issued by analyst *i* and the date on which the most recent forecast was issued by other analysts for the same firm in the same year; $IndSpec_{i,j,t}$ measures industrial specialization, which is defined as the number of companies in the industry to which the firm *j* belongs covered by analyst *i* divided by the number of companies covered by analyst *i* in year *t*; $Ncom_{i,j,t}$ is defined as the number of companies covered by analyst *i* in year *t*; $BrokerSize_{i,j,t}$ is the total number of analysts employed by the brokerage house to which analyst *i* when the forecast was issued in the year *t*; $GExp_{i,j,t}$ is general experience and is defined as the number of years analyst *i* exists in I/B/E/S before year *t*; $FExp_{i,j,t}$ is firm-specific experience, which is represented by the number of years analyst *i* issues a forecast to firm *j* before year *t*; $AnalystFollowing_{j,t}$ is the number of analysts following company *j* in year *t*; $Dispersion_{i,j,t}$ is the variance of all forecasts issued by different analysts for company *j* in year *t* within 90 days before the fiscal year end date; $H_{j,t}$ is an assets-weighted measure of Herfindahl-based indices that is applied to determine firm diversification which is classified according to the business segment; $lagAccuracy_{i,j,t}$ is the accuracy of the forecast issued by analyst *i* for company *j* in the previous year *t*−1.

3.2 OPTIMISM MODEL

To clarify whether or not company uncertainty influences the optimism degree of financial analysts' forecasts, the following equation is applied:

Model 2:

$$\begin{aligned} Optimism_{\mathrm{i,j,t}} = {} & \beta_0 + \beta_1 RD_{j,t} + \beta_2 ADE_{j,t} + \beta_3 AT_{j,t} + \beta_4 ForHorizon_{i,j,t} \\ & + \beta_5 DaysElap_{i,j,t} + \beta_6 IndSpec_{i,j,t} + \beta_7 NCom_{i,j,t} \\ & + \beta_8 Bro\,\mathrm{ker}\,Size_{i,j,t} + \beta_9 GExp_{i,j,t} + \beta_{10} FExp_{i,j,t} \\ & + \beta_{11} AnalystFollowing_{j,t} + \beta_{12} Dispersion_{i,j,t} \\ & + \beta_{13} H_{j,t} + \beta_{14} lagOptimism_{i,j,t} + \varepsilon_{i,j,t}, \end{aligned} \quad (2)$$

where $Optimism_{i,j,t}$ is the difference between the earnings forecast and the actual earnings relative to the prior year's stock price. $lagOptimism_{i,j,t}$ is the $Optimism_{i,j,t}$ for analyst *i* in relation to firm *j* in year *t*−1. $RD_{j,t}$, and $ADE_{j,t}$ are the variables of interest in this study; all other variables are controls. The definitions of the remaining variables conform to those in Model 1.

3.3 TIMELY RESPONSE MODEL

To clarify whether or not company's degree of uncertainty negatively influences the timeliness of forecast adjustment by financial analysts, the following model is applied.

Model 3:

$$\begin{aligned} nextREVdays_{i,j,t} = {} & \beta_0 + \beta_1 RD_{j,t} + \beta_2 ADE_{j,t} + \beta_3 AT_{j,t} \\ & + \beta_4 DaysElap_{i,j,t} + \beta_5 IndSpec_{i,j,t} + \beta_6 NCom_{i,j,t} \\ & + \beta_7 Bro\ker Size_{i,j,t} + \beta_8 GExp_{i,j,t} + \beta_9 FExp_{i,j,t} \\ & + \beta_{10} AnalystFollowing_{j,t} + \beta_{11} Dispersion_{i,j,t} \\ & + \beta_{12} H_{j,t} + \beta_{13} Days\_last\_REV_{i,j,t} + \varepsilon_{i,j,t}, \end{aligned} \quad (3)$$

where $nextREVdays_{i,j,t}$ is equal to the number of days required for a financial analyst to revise his/her earnings forecast for year *t*+1 (the first revision) after a company announces its earnings for year *t*. We also control for $Days\_last\_REV_{i,j,t}$, which is defined as the number of days between the day the most recent forecast revision for firm j issued by analyst i before a company announces its earnings for year *t* and the earnings announcement day. We control this variable because once an analyst has revised his/her earnings forecast for firm *j*, he/she is unlikely to revise the forecast again for the firm within a short period. The definitions of all other variables conform to those of Model 1.

In this section, we follow O'Brien et al. (2005) to apply the hazard model of Cox regression developed by Cox (1972) to examine the timely response of financial analysts to the news of an earnings announcement in a 14-day window following the day of the announcement. To implement the hazard model, we define the subsequent revision date as the period that starts with the day of the earnings announcement and ends with either the early date of the next revision or the end of the window. In the Cox model, the hazard ratio of $nextREVdaysi,j,t$ is estimated, which represents instantaneous risk of forecast revision for analyst *i*. The negative relation between the $nextREVdaysi,j,t$ and uncertainty under the Hardzard model indicates higher degree of uncertainly is linked with slower adjustment of revision. An advantage of this method is that we can obtain unbiased and asymptotic estimates of the coefficients.

4. EMPIRICAL RESULTS

4. 1 DATA AND SAMPLE SELECTION

The data on the earnings and earnings forecasts for this study are obtained from the Institutional Broker Estimate System (I/B/E/S) detail history tape and cover the period of 1991 to 2010. We adjust the dilution effect on the actual earnings and earnings forecasts to primary basis. An analyst may report more than one earnings forecast for the same year on the same company, and only the most recent forecast before the end date of the fiscal year is reserved. Clement (1999) documents that some analysts may herd other analysts' forecasts close to the date of the earnings announcement; therefore, the current study ignores earnings forecasts made after the fiscal end date. Stock returns and prices are obtained from the Center for Research in Security Price (CRSP). Variables regarding financial statements and segments originate from Compustat. Upon merging the three aforementioned databases and excluding the missing data, the sample for this study consists of 82,496 observations.

4.2 SUMMARY STATISTICS

This research employs three regressions to verify the three hypotheses. Table 1 shows the descriptive statistics and distributions of all variables. The mean accuracy is 0.01, whereas mean optimism is close to 0.00. On average, an analyst requires approximately 10 days to revise earnings forecasts (*nextREVdays*) after an earnings announcement. The 10^{th} percentile of RD is 0, thus indicating that amount of R&D expenses in more than 10% of the companies in this sample show a very low figure. Such expenses are typically greater than advertising expenses are. The mean values of *nextREVdays* and *days_last_REV* are approximately 10 and 80 days, respectively, thus suggesting that financial analysts revise their forecasts quickly after the day of the earnings announcement. *DaysElap* indicates the days between two estimated dates of different forecasts for the same company. The mean of this variable is roughly 79, which is considerably higher than that of *nextREVdays*; therefore, when financial analysts receive new information (such as earnings announcements), they revise prior forecasts instantly.

The mean for firm-specific experience is approximately four years, but the 75^{th} percentile is only five years. This outcome indicates that most of the financial analysts (75%) do not follow the same company for more than five years. *BrokerSize* refers to the total number of analysts employed by a brokerage house; the mean value of this variable is approximately 80, the 50^{th} percentile is 55, and the 75^{th} percentile is 120. Therefore, this sample consists of many small and few large brokerage houses. Appendix 1 exhibits the correlation coefficients of the regression variables; the results suggest that certain independent variables are highly correlated (e.g. *GExp* and *FExp*, *RD* and *IndSpec*). Therefore, we estimate Model 1 to Model 3 by several auxiliary regressions that ignore highly correlated variables.

Table 1. Descriptive statistics and distributions of regression variables

Variable	Mean	Std.	P25	Median	P75
Accuracy	0.011	0.023	0.001	0.003	0.009
Optimism	0.004	0.025	-0.003	0.000	0.002
nextREVdays	10.888	5.700	3.000	15.000	16.000
RD	0.117	0.108	0.012	0.084	0.213
ADE	0.038	0.047	0.008	0.021	0.054
AT	18230	33042	858	3494	16773
ForHorizon	223.643	225.196	64.000	80.000	231.000
DaysElap	83.292	61.453	40.000	83.000	91.000
IndSpec	0.359	0.293	0.101	0.266	0.620
NCom	16.260	8.019	11.000	16.000	20.000
BrokerSize	83.620	70.820	27.000	56.000	122.000
GExp	8.072	4.238	4.000	8.000	11.000
FExp	4.092	2.440	3.000	4.000	6.000
AnalystFollowing	26.818	14.562	12.000	22.000	34.000
Dispersion	0.459	0.416	0.091	0.188	0.398
H	0.390	0.294	0.000	0.470	0.693
lagAccuracy	0.005	0.013	0.001	0.002	0.005
lagOptimism	0.000	0.013	-0.002	0.000	0.001
days_last_REV	81.065	60.569	41.000	82.000	92.000

Notes: This table presents descriptive statistics for all variables. The number of observations is 82,496. Accuracy is the forecast error = $|\text{forecast} - \text{actual}|/P_{j,t-1}$. Optimistic=(forecast-actual)/$P_{j,t-1}$. NextREVdays is equal to the number of days required for a financial analyst to revise his/her earnings forecast for year t+1 (the first revision) after a company announces its earnings for year t. AT_t is the logarithm of the total assets of company *j* in year *t*; $ForHorizon_t$ is the number of calendar days between the forecast issue date and the fiscal end date; *DaysElap* denotes the days between the date on which the present earnings forecast was issued by analyst *i* and the date on which the most recent forecast was issued by other analysts for the same firm in the same year; $IndSpec_{i,j,t}$ measures industrial specialization, which is defined as the number of companies in the industry to which the firm *j* belongs covered by analyst *i* divided by the number of companies covered by analyst *i* in year *t*; $Ncom_{i,j,t}$ is defined as the number of companies covered by analyst *i* in year *t*; *BrokerSize* is the total number of analysts employed by the brokerage house to which analyst *i* when the forecast was issued in the year *t*; *GExp* is general experience and is defined as the number of years analyst *i* exists in I/B/E/S before year *t*; *FExp* is firm-specific experience, which is represented by the number of years analyst *i* issues a forecast to firm *j* before year *t*; *AnalystFollowing* is the number of analysts following company *j* in year *t*; *Dispersion* is the variance of all forecasts issued by different analysts for company *j* in year *t* within 90 days before the fiscal year end date; *H* is an assets-weighted measure of Herfindahl-based indices that is applied to determine firm diversification which is classified according to the business segment; *lagAccuracy* is the accuracy of the forecast issued by analyst *i* for company *j* in the previous year *t−1*; *lagOptimism* is the $Optimism_{i,j,t}$ for analyst *i* in relation to firm *j* in year *t−1*;*Days_last_REV* which is defined as the number of days between the day the most recent forecast revision for firm j issued by analyst i before a company announces its earnings for year *t* and the earnings announcement day.

4.3 Regression Results

The results for Model 1 are reported in Table 2. In consideration of the multicollinearity problem, this regression is also divided into three parts: columns A, B, and C. As predicted, the coefficients for RD is positive and significant, whereas the coefficient for ADE is positive but not always significant. Thus, issuing accurate earnings forecasts is difficult for

financial analysts if a company has high levels of uncertainty represented by R&D expenses. The coefficient for AT is negative and significant, thereby indicating that the information is more transparent if a company has a high level of total assets, and the earnings forecasts are accordingly accurate. The result of Table 2 shows that analyst forecast inaccuracy increases when the degree of firm uncertainty increases; therefore, the first conclusion is that company uncertainty negatively influences financial analysts' forecast accuracy.

Table 2. Regression results on forecast accuracy

Variable	(A)	(B)	(C)
Intercept	0.004	0.0061	0.0014
	(3.45)***	(4.87) ***	(3.41) ***
RD	0.0314	0.0049	0.0061
	(4.68) ***	(13.65) ***	(6.25) ***
ADE	0.0069	0.00818	0.0068
	(0.21)	(9.54) ***	(1.93) *
AT	-0.0095		-0.0042
	(-6.87) ***		(-6.84) ***
ForHorizon	0.0036	0.0075	0.0056
	(7.32) ***	(11.62) ***	(7.29) ***
DaysElap	0.0066	0.0086	0.0046
	(8.45) ***	(0.35)	(2.35) **
IndSpec	-0.0083		-0.0064
	(-3.69) ***		(-4.68) ***
NCom		-0.0061	
		(-5.62) ***	
BrokerSize	-0.0046	-0.0016	-0.0067
	(-3.98) ***	(-6.57) ***	(-2.36) **
GExp		-0.0091	-0.0034
		(-3.21) ***	(-1.84) *
FExp	-0.0098		
	(-4.87) ***		
AnalystFollowing		-0.0023	
		(-6.94) ***	
Dispersion	0.0264	0.0341	0.0161
	(9.46) ***	(11.68) ***	(8.14) ***
H	0.006	0.0028	
	(7.65) ***	(7.62) ***	
lagAccuracy	0.5692	0.5136	0.4592
	(7.92) ***	(6.84) ***	(6.54) ***

Notes: Table 2 presents the regression coefficients for accuracy. The t-values are in parentheses. ***, ** and * indicate statistical significance at the 1 percent, 5 percent and 10 percent two-tailed confidence levels, respectively.

The results for Model 2 are listed in Table 3. The coefficient of RD and ADE are both positive and significant in columns A, B, and C; thus, when a company has a high degree of uncertainty, financial analysts more easily report optimistic forecasts. These results suggest that if a company's R&D or advertising expense accounts for a significant portion of its total operating expense, then financial analysts also easily report optimistic forecasts. The coefficient of AT is negative and significant; therefore, reporting optimistic forecasts to such large, stable companies is usually difficult for financial analysts. Table 3 concludes that company uncertainty positively influences the optimism degree of analyst forecasts, and the second hypothesis is confirmed. In addition, the earnings forecasts of such analysts are generally and persistently overoptimistic. Reporting accurate earnings forecasts is difficult for financial analysts given a highly degree of uncertainty company; thus, such analysts tend to report optimistic forecasts to favor management.

Table 3. Regression results on analyst optimism

Variable	(A)	(B)	(C)
Intercept	0.00485 (4.69) ***	-0.0041 (-4.65) ***	-0.0496*** (-7.56)
RD	0.0013 (1.86) *	0.0076 (6.25) ***	0.0047 (8.23) ***
ADE	0.0064 (6.23) ***	0.0243 (8.41) ***	0.0037 (4.68) ***
AT	-0.0094 (-4.58) ***		
ForHorizon	0.0071 (9.45) ***	0.0096 (9.65) ***	0.0096 (7.63) ***
DaysElap	0.0061 (0.35)	0.00001158 (0.61)	0.0031 (5.14) ***
IndSpec	-0.0034 (-5.61) ***		-0.0067 (-6.85) ***
NCom		-0.0412 (-0.07)	
BrokerSize	0.0035 (0.54)	-5.10E-07 (-0.63)	0.0047 (0.21)
GExp		-0.0016 (-5.61) ***	-0.0018 (-6.47) ***
FExp	-0.0013 (-3.68) ***		
AnalystFollowing		-0.0071 (-5.37) ***	
H	0.0069 (2.35) **	-0.0063 (-1.60)	0.0062 (6.59) ***
Dispersion	0.0413 (11.56) ***	0.0341 (8.45) ***	
lagOptimistic	0.5612 (5.69) ***	0.4623 (6.75) ***	0.0043 (7.236) ***

Notes: Table 3 presents the regression coefficients for optimistic. The t-values are in parentheses. ***, ** and * indicate statistical significance at the 1 percent, 5 percent and 10 percent two-tailed confidence levels, respectively.

The results for Model 3 are displayed in Table 4. This regression is conducted in three models: columns A, B, and C. The coefficient of RD and ADE are negative and significant; therefore, a company with low R&D or advertising expense will permit financial analysts to adjust their earnings forecasts quickly once some important public information is provided. The coefficient of AT is positive and significant, thereby suggesting that financial analysts adjust their earnings forecasts in a timely manner once important public information has been presented when the total assets of the target firm are high. The results of Table 4 indicate that the timely response of analysts to public news decreases with company's degree of uncertainty, because an analyst requires much time to interpret whether the new information obtained regarding a highly uncertain company is positive or negative. As a result, these analysts need additional time to revise their earnings forecasts; hence, the third hypothesis is confirmed.

Table 4. Regression results on analyst speed of revision

Variable	(A)	(B)	(C)
RD	-0.6852 (2.51) **	-0.1385 (4.65) ***	-0.0436 (8.62) ***
ADE	-0.4256 (2.53) **	-0.4268 (6.51) ***	-0.1425 (5.25) **
AT	0.0075 (5.68) ***		
DaysElap	-0.0046 (0.41)	-0.004265 (1.25)	-0.0046 (0.62)
IndSpec	0.0675 (6.84) ***		0.4263 (4.62) ***
NCom		-0.0043 (9.64) ***	
BrokerSize	0.0476 (4.56) ***	0.0049 (7.36) ***	0.0071 (4.59)***
GExp		0.0137 (3.54) ***	0.0635 (7.61) ***
FExp	0.0327 (7.51) ***		
AnalystFollowing		0.0048 (6.17) ***	
Dispersion	-0.0468 (8.69) ***	-0.0672 (9.41) ***	-0.0468 (4.55) ***
H	-0.04692 (8.27) ***	-0.0486 (4.75) ***	-0.0142 (5.51) **
Days_last_REV	0.0072 (0.69)	-0.0072 (0.95)	-0.0018 (0.94)

Notes: Table 4 presents the regression coefficients for adjustment timeliness. The Chi-Square-values are in parentheses. ***, ** and * indicate statistical significance at the 1 percent, 5 percent and 10 percent two-tailed confidence levels, respectively.

5. CONCLUSION

This study investigates the effect of the uncertainty degree of a target company on the forecast behavior of analysts in three aspects: forecast accuracy, degree of forecast optimism, and the speed of earnings forecast revision. To this end, we use the R&D and advertising expenses act as proxy variables for uncertainty. When a company has a high degree of uncertainty, an analyst must spend much time and effort to process and analyze the related information. Thus, our empirical results indicate that the future earnings of a firm are difficult to predict when the uncertainty level is high. Hence, earnings forecast accuracy is diminished. Due to uncertainty, an analyst does not respond in a timely manner to new information. Nonetheless, analysts are likely to issue optimistic forecasts to a highly uncertain company because his/her willingness to add the coverage of a high R&D and advertising expenses company implies a belief that the firm has good prospects. Thus, our findings conclude that the degree of uncertainty of a firm results in earnings forecasts that are not very accurate and are optimistic in addition to a response to earnings announcement news that is not very timely. Our results provide an important reference to market participants in making investment decisions as well as convey important messages to policy makers. In addition, we fill in the gap in the literature on the degree of a firm's uncertainty in association with the earnings forecasts of analysts.

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Appendix 1. Correlation coefficients of regression variables

Variable	Acc	Opt	NRD	RD	ADE	AT	FH	DE	IS	NCom	BS	GExp	FExp	AF	Dis	H	Lacc	Lopt	DLR
Acc	1.00																		
Opt	0.71	1.00																	
NRD	0.21	0.12	1.00																
RD	0.04	0.05	-0.06	1.00															
ADE	-0.06	0.01	0.00	0.04	1.00														
AT	-0.11	-0.06	-0.01	0.03	0.21	1.00													
FH	0.36	0.20	0.46	0.01	0.01	0.02	1.00												
DE	-0.03	0.01	0.05	0.00	0.03	0.02	-0.01	1.00											
IS	-0.07	-0.06	-0.04	0.45	0.04	0.15	0.01	-0.03	1.00										
NCom	-0.04	-0.02	-0.01	0.02	0.02	-0.08	-0.09	0.07	-0.19	1.00									
BS	0.02	0.02	-0.03	-0.03	0.00	0.05	0.04	-0.07	0.06	0.00	1.00								
GExp	-0.04	-0.03	-0.03	-0.06	-0.05	0.04	-0.02	-0.01	-0.05	0.20	0.08	1.00							
FExp	-0.05	-0.02	-0.02	0.01	0.01	0.12	0.02	0.03	-0.01	0.12	0.06	0.56	1.00						
AF	-0.19	-0.13	-0.08	0.47	0.29	0.36	-0.03	-0.02	0.33	0.00	-0.02	-0.01	0.09	1.00					
Dis	0.38	0.27	0.03	-0.04	-0.05	0.02	0.06	-0.07	-0.11	-0.02	0.07	0.02	0.02	-0.02	1.00				
H	0.05	0.02	-0.02	-0.02	0.12	0.36	-0.01	0.04	0.02	-0.01	0.04	0.03	0.09	0.17	0.03	1.00			
LAcc	0.40	0.22	0.10	-0.03	-0.06	-0.07	0.22	-0.03	-0.04	-0.02	0.01	-0.01	-0.01	-0.16	0.23	-0.05	1.00		
LOpt	0.26	0.31	0.05	-0.05	-0.02	-0.03	0.12	-0.01	-0.04	-0.01	0.01	-0.01	0.02	-0.07	0.14	0.00	0.59	1.00	
DLR	-0.03	0.01	0.05	0.00	0.03	0.02	-0.01	1.00	-0.03	0.07	-0.07	-0.01	0.02	-0.02	-0.07	0.04	-0.03	-0.01	1.00

Notes: Appendix 1 shows the Pearson Correlation Coefficients for all the regression variables. Acc is Accuracy. Opt is Optimistic. NRD is nextREVday. LAcc is lagAccuracy. FH is ForHorizon. DE is DaysElap. IS is IndSpec. BS is BrokerSize. AF is AnalystFollowing. Dis is Dispersion. LOpt is lagOptimistic. DLR is days_last_REV. Accuracy is the forecast error = $|\text{forecast} - \text{actual}|/P_{j,t-1}$. Optimistic=(forecast-actual)/$P_{j,t-1}$. NextREVdays is equal to the number of days required for a financial analyst to revise his/her earnings forecast for year t+1 (the first revision) after a company announces its earnings for year t. *AT* is the logarithm of the total assets of company *j* in year *t*; *ForHorizon* is the number of calendar days between the forecast issue date and the fiscal end date;

DaysElap denotes the days between the date on which the present earnings forecast was issued by analyst *i* and the date on which the most recent forecast was issued by other analysts for the same firm in the same year; *IndSpec* measures industrial specialization and is defined as the number of companies in the industry to which the firm *j* belongs covered by analyst *i* divided by the number of companies covered by analyst *i* in year *t*; *BrokerSize* is the total number of analysts employed by the brokerage house to which analyst *i* when the forecast was issued in the year *t*; *GExp* is general experience and is defined as the number of years analyst *i* exists in I/B/E/S before year *t*; *FExp* is firm-specific experience, which is represented by the number of years analyst *i* issues a forecast to firm *j* before year *t*; *AnalystFollowing* is the number of analysts following company *j* in year *t*; *Dispersion* is the variance of all forecasts issued by different analysts for company *j* in year *t* within 90 days before the fiscal year end date; *H* is an assets-weighted measure of Herfindahl-based indices that is applied to determine firm diversification which is classified according to the business segment; *lagAccuracy* is the accuracy of the forecast issued by analyst *i* for company *j* in the previous year *t−1*; *lagOptimism* is the $Optimism_{i,j,t}$ for analyst *i* in relation to firm *j* in year *t−1*;*Days_last_REV* which is defined as the number of days between the day the most recent forecast revision for firm j issued by analyst i before a company announces its earnings for year *t* and the earnings announcement day.

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THE IMPACT OF RESEARCH AND DEVELEOPMENT ON REVENUE GENERATION AND INVESTMENT VALUATION OF INFO-TECH CORPORTIONS

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ABSTRACT

In today's rapidly changing business world, it has become imperative for companies to be innovative, in order to stay in business. At the heart of this approach is research and development (R&D). While, R&D practices differ across industries and companies, we recognize that the practice is prevalent in the pharmaceutical and the information technology (IT/ info-tech) industries. Despite the fact, that much research has been done on R&D in the pharmaceutical industry, there is limited literature and research on the subject in the information technology industry. Consequently, this study is our effort to assess the impact of R&D on revenue generation and investment valuation of IT corporations. In this study, we investigate the impact of R&D on revenue generation and investment valuation of 40 United States (U.S.) based information technology corporations. We find that info-tech companies that invest more on R&D generate more revenue. We also find that investors place higher value on corporations that invest larger parts of their revenues on R&D. This suggests that investors expect higher earnings growth in the future of companies that invest greater parts of their revenues on R&D.

1. INTRODUCTION

For companies to survive in today's competitive domestic and global business environments, they must engage in practices that enable them to keep producing high quality products that can satisfy the complex and constantly changing needs of customers. Consequently, each year, many businesses in the commercial world spend vast amounts of money, on the research and development (R&D) of products and services. By developing products and services that satisfy and meet the needs of customers, businesses hope to enhance their profits (ACCA, 2007).

The importance of research and development is so great that countries are divided into developed and undeveloped countries, based on the funds devoted to R&D (ACCA, 2007). Accountants and various researchers have used different methods of research in their attempt to assess the contribution of research and development expenditures (cost) on economic growth: historical case studies and econometric estimates of production functions containing R&D variables (Griliches, 1979).

In addition, to enhancing a firm's profit, investing in research and development can also stimulate economic growth and social development (Abdi, 2007). Furthermore, R&D is one of the few variables, which public policy can affect in the future and has affected in the past (Griliches, 1979). As a result, the amount of money a business devotes to R&D can be influenced by public policy.

At the moment, 78% of global research and development occurs in five countries; the United States of America (USA), Japan, Germany, France and the United Kingdom (UK) (The R&D Scoreboard, 2010). Globally, five sectors continue to dominate spending on R&D. Three of the sectors are also among the five largest-spending sectors in both the USA and the UK: pharmaceuticals and biotechnology, software and computer services and automobiles and parts. Technology hardware and equipment, and electronic and electrical equipment complete the global top five R&D sectors (R&D scoreboard).

Despite the fact, that much research has been done on R&D in the pharmaceutical industry, there is limited literature and research on the subject in the information technology industry. This is a rather curious situation, considering that we live in the information age, in which technology permeates every aspect of business. For example, there are significant relationships among technology use, social networks, completed projects and revenues for projects-based information workers (Aral et al., 2007). In fact, since the 1990s, one of the main tools that have been transforming businesses, the way Taylorism (production efficiency methodology) once did, is information technology, the capabilities offered by computers, software applications and telecommunications (Davenport & Short, 1990).

As Luftman, Lewis and Oldbach (2010) stated, "the strategic use of information technology is now and has been a fundamental issue for every business". Hence, it is of considerable importance that we increase our knowledge on this important subject, by studying how it affects the information technology industry. In this paper, we study the efficacy of research and development costs on revenue generation and on investment valuation of 40 U.S. based information technology corporations. To begin, we provide definitions of key words; and then present the theoretical principles and empirical literature on the relationship between R&D spending and the financial performance of business entities.

We also point out in this paper what certain research approaches on the effects of R&D spending can and cannot accomplish. For example, given good data, the production approach can tell us about the average returns on R&D investments in the past and whether they appear to be changing over time. The production approach may be able to indicate the industries where returns have been especially high or low, but it will not be able to indicate whether a particular R&D proposal is a good bet or not (Griliches, 1979).

To the extent that the output of invention-using industries is well measured, the returns to research and development can be found in the aggregate data (Griliches, 1979). However, in many important invention-using industries, such as health, education and government, where output is difficult to measure, the contribution of R&D may be hard to determine. Since, the information technology industry does not fall within this category; we do not face the aforementioned challenge in this study.

The U.S Office of Management and Budget (OMB, 2015) defines research and development as creative work that is undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. Research and development costs include all the resources spent for the activities that are particularly suitable for the production of the planned products and services. These activities can either be outsourced by a single organization or performed by an independent unit within the organization (Britt, 2007).

According to the United States Federal Accounting Standards Advisory Board (FASAB, 2015), "Investment in research and development" refers to those expenses incurred to support the search for new or refined knowledge and ideas and for the application or use of such knowledge and ideas for the development of new or improved products and processes with the expectation of maintaining or increasing national economic productive capacity or yielding other future benefits. Research and development is composed of:

- Basic research: systematic study to gain knowledge or understanding of the fundamental aspects of phenomena of observable facts without specific applications toward processes or products in mind.

- Applied research: systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met; and

- Development: systematic use of knowledge and understanding gained from research for the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes. *Statement of Federal Financial Accounting Standards No. 8: Supplementary Stewardship Reporting*, chapter 7, paragraph 96, is devoted to research and development.

Innovation is the translating of ideas into products and services that create worth for which customers are willing to pay (Business dictionary, 2015). Incremental innovations occur in the form of product and service enhancements and radical innovations result in the creation of new products and services (Laura, 2000).

Investment valuation is the process of determining the current worth of an asset or a company (investopedia, 2015). The most well known investment valuation method is the use of the price-to-earnings (P/E) ratio, which compares the current price of a company's shares to the amount of earnings it generates. The purpose of this ratio is to give users an idea of how much they are paying for each dollar of earnings.

Thong and Yap (1995) defined information technology as "computer hardware and software that provide support for operations, management and strategists in organizations." Two years later, Boar (1997) defined it as "those technologies engaged in the operation, collection, transport, retrieving, storage, access, presentation, and transformation of information in all its forms." Hollander et al. (1999) posited that information technology can be regarded as technological aspects of information as it is reported. All these definitions broadly capture what information technology encompasses. Sarasoza and Zowghi (2003) added to the definition by asserting that "information technology is aimed for the creation of computer-based systems of information by using computer systems." Recently, Tan et al. (2009) defined it as "the application of information and communication technology tools including computer network, software and hardware required for internet connection." The idea of creating brings research and development at the core of information technology. Info-tech corporations, therefore place significant importance on R&D which leads to innovation. The term information technology also includes any computer application and required packages of hardware, computer-aided manufacturing, computer-aided design, electronic data interchange, enterprise resource planning that positively affect the productivity of an organization (Oon & Sorooshian, 2013).

2. LITERATURE REVIEW

Perry and Grinaker (1994) studied profitability expectations, discretionary research and development costs in the United States of America. In their study, they investigated the ratio between R&D and profitability of 90 major USA companies. Their results showed that the profitability of research and development is effective. This effect was more than a quarter of the total impact on profitability. Also, research and development has been associated with an increase in prosperity, but in times of recessions, it has been reduced. Franzan and Radhakrishnan (2009) evaluated the relationship between R&D costs and profitability or loss. They applied the residual earnings model to illustrate that the multiplier for R&D costs would probably be negative (positive) for profit (loss) generating firms. This is due to the fact that the dynamics of linear information in the residual earnings model is mostly appropriate for profit generating firms rather than for loss generating ones. Also, the income statement for income generating firms includes information on future benefits of R&D; while no such information is presented in the income statement of loss generating firms. Empirical evidence approves predictions made by researchers for loss generating firms. Rockoff (2009) believes that the high value of a product is not necessarily due to the traditional strategies of high risk R&D activities, however he asserted that, concentration on activities with economic merits and the control of the cost of production and assets would not be possible without the application of R&D strategies. Asthana and Yinqi (2006) applied the Olson evaluation model to examine the relationship between R&D costs and the persistence of abnormal earnings. According to their research which was carried out from 1982 to 2001, contrary to previous studies which considered the industry as an R&D index, R&D costs were divided into two categories. The first category included average industry R&D costs (industry influenced)

and the second involved companies focused on R&D costs (company influenced). Ultimately, the effects of both categories on the persistence of abnormal earnings were studied. They found that both categories have a positive relationship with abnormal earnings. Moreover, the positive effect of the efficiency of R&D costs on earnings persistence and the creation of a competitive merit are quite more significant than the negative effects of R&D project risks. Also it is not only the industry which plays a role in predicting earnings persistence, but rather it is the investment of the owners in R&D costs that is indicative of the firm's efforts in producing diverse and different products and the measurement of earnings persistence.

Nvark (2001) investigated the relationship between growth, profitability and costs of research and development using simultaneous equations model. In his study, the relationship between firm size and R&D, and other factors affecting research and development in its various forms were investigated. The results of his study show a significant and positive effect of firm size on research and development, and mutual profitability and growth in profitability. Jones (2000) looked at the effect of profit and other information in assessing the companies that have research and development costs. His sample included 144 companies in four industries in 1977: market value by the variable operating profit, operating assets, book value, profit sharing and other data were considered. The results showed that operating profit and the persistence of abnormal profit of firms with research and development expenses are higher than for those that lack such expenses.

Laura (2000) showed that more innovations occur in the form of enhancements and radical innovations in the form of new products for companies that spend more on R&D. The results of her study also show that input, behavior, and output controls enhance radical innovation, and input and output controls enhance incremental innovation. Due to the importance of R&D, over time, it has reached and held a central place in the discourses and policies on science, technology and innovation (Godin & Lane, 2012)

3. DATA AND METHODOLOGY

In this study, we use data compiled by Business Week for the top 100 information technology companies in the world. Business Week's financial data comes from Standard & Poor's (S&P), a division of the McGraw-Hill Companies that has computerized information on 10,000 publicly traded corporations. To qualify for our sample, companies had to have revenues of at least $300 million. For our sample, we selected all the U.S. based corporations that made the 2014 Business Week's list of top 100 global information technology companies. After selecting all the U.S. based corporations, we eliminated those that did not have publicly published financial statements. We also eliminated companies that did not report information on R&D. All the companies in our sample stated in their annual reports that they strongly depend on R&D to keep producing innovative products. Finally, we arrived at 40 U.S. based companies, all of which have publicly published financial records available on www.sec.gov and www.last10k.com. Using these two websites, for each company, we compiled data on 2010 R&D spending,

2010 Revenue, 2010 R&D intensity (calculated by dividing 2010 R&D spending by 2010 Revenue), 2014 R&D spending, 2014 Revenue and 2014 R&D intensity (R&D intensity is denoted as R&Di). We obtained price-to-earnings (P/E) ratios of the companies in our sample from S&P 500, and www.yahoofinance.com. After obtaining the data, we entered it into an Excel spreadsheet. Please see Appendix 1. We used 2014 revenue to test for the effect of 2010 R&D spending because R&D matures in four years i.e. its effect is expected to manifest four years after incurring the cost (Hajiheydari et. al, 2011). We ranked the companies into four categories, i.e. high R&D and low R&D, high R&D intensity and low R&D intensity (Appendix 2). The first two categories were used to investigate whether companies that spend more on R&D (dollar value) generate more revenue than those that spend less. The last two categories were used to test for whether investors place more value on companies that spend greater parts of their revenues on R&D than those that spend smaller parts of their revenues on R&D. We used each company's 2015 P/E ratio for this test. This enabled us to assess how investors valued R&D when making investment decisions in 2015.

To rank the companies into high and low R&D categories, we sorted the companies in descending order in the Excel spreadsheet based on 2010 R&D spending. The first twenty companies formed the high R&D category, while the remaining twenty companies made up the low R&D category. We used these rankings to test for difference in the means of the 2014 revenues generated by the high and the low R&D companies. To rank the companies into high and low R&D intensity categories, we sorted the companies in descending order based on 2014 R&D intensity. The first twenty companies formed the high R&D intensity category, while the remaining twenty companies made up the low R&D intensity category. We used these two rankings to test for differences in investment valuations of the high versus the low R&D intensity companies. This was done by testing for the difference of means of 2015 P/E ratios of the high and low R&D intensity companies. Appendix 2 displays the categorization of the companies as previously described.

We define our hypotheses as below:

The null hypothesis H_o states that there is no relationship between R&D spending (dollar value) and revenue generation four years after incurring the cost.

The alternate hypothesis H_1 states that there is a relationship between R&D spending (dollar value) and revenue generation four years after incurring the cost. We define further hypotheses to test for the study as below:

H_2 states that companies that spend more on R&D (dollar amount) generate more revenue than those that spend less on R&D.

H_3 states that companies that have high R&D intensity values are valued higher by investors than those that have low R&D intensity values. In other words, companies that spend larger parts of their revenues on R&D are valued higher by investors compared to those that spend smaller parts of their revenues on R&D.

To test for H_1, we used a two-variable regression test. To test for H_2 and H_3, we used a two sample T-test. For these statistical tests, we set our confidence level at 95% and alpha equals 5%. We used Microsoft Excel to run our statistical tests.

4. RESULTS

From Table 1 below, Y = 8837 + 10.4X, where Y is the dependent variable, i.e. revenue four years after R&D spending, and X is R&D spending. From this result, R&D is shown to have a positive relationship with revenue generation four years after incurring the cost. Therefore, we reject H_o, the null hypothesis and fail to reject H_1, the alternate hypothesis. Table 2 shows the outcome of the difference of means of the revenues of the high R&D spending companies versus the low R&D spending companies. If t Stat < -t Critical two-tail or t Stat > t Critical two-tail, then the difference between the two means is statistically significant.

Table 1: Regression Test for the Relationship between R&D Spending and Revenue Generation

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.544023324
R Square	0.295961377
Adjusted R Square	0.277434045
Standard Error	30126.39208
Observations	40

ANOVA

	df	***SS***	***MS***	***F***
Regression	1	14498277223	14498277223	15.974312
Residual	38	34488780985	907599499.6	
Total	39	48987058207		

	Coefficients	***Standard Error***	***t Stat***	***P-value***
Intercept	8836.72983	6066.04793	1.456752392	0.1533989
X Variable 1	10.40146108	2.602455263	3.996787661	0.0002851

From Table 2 below, t Stat = 2.965, which is greater than t Critical two tail = 2.079. This indicates that the difference between the means of the revenues generated by the high R&D spending and the low R&D spending companies is statistically significant. This implies, companies that spend more on R&D generate more revenue than those that spend less on R&D. Therefore, we fail to reject H_2.

Table 2: T-Test: Two-Sample Assuming Unequal Variances

	Variable 1	***Variable 2***
Mean	39018.605	8678.1
Variance	1995078304	98689894.95
Observations	20	20
Hypothesized Mean Difference	0	
Df	21	
t Stat	2.965333223	
P(T<=t) one-tail	0.003691698	
t Critical one-tail	1.720742871	
P(T<=t) two-tail	0.007383396	
t Critical two-tail	2.079613837	

Table 3 below denotes the outcome of the difference of means of the P/E ratios for high versus low R&D intensity companies. If t Stat < -t Critical two-tail or t Stat > t Critical two-tail, then the difference is statistically significant. From Table 3, t Stat = 2.424, which is greater than t Critical = 2.086. This indicates that the difference between means of the P/E ratios of high R&D intensity companies and low R&D intensity companies is statistically significant. From this, we find that the mean of the P/E ratios of the high R&D intensity companies is statistically and significantly higher than the mean of the P/E ratios of the low R&D intensity companies. This implies that investors place higher value on companies that invest more of their revenues on R&D than those that do not. Therefore, we fail to reject H_3.

Table 3: T-Test: Two-Sample Assuming Unequal Variances

	Variable 1	***Variable 2***
Mean	41.022	17.7225
Variance	1801.336	45.76507237
Observations	20	20
Hypothesized Mean Difference	0	
Df	20	
t Stat	2.424467	
P(T<=t) one-tail	0.012464	
t Critical one-tail	1.724718	
P(T<=t) two-tail	0.024929	
t Critical two-tail	2.085963	

5. CONCLUSION

From the results of our study, we find that when R&D costs mature, companies that spent more on R&D generate more revenues than those that spent less. In addition, we find that investors value companies differently based on R&D intensity. Compared to companies that invest less of their revenues on R&D (low R&D intensity companies), investors' place more value, on those companies that invest more of their revenues on R&D (high R&D intensity companies). Therefore, when making investment decisions, investors are willing to pay more for high R&D intensity companies. This implies that by paying more for these companies i.e. those that have high R&D intensity indices, investors are actually investing in R&D. The reason for this is because investors expect higher growth in the future earnings of companies that spend larger parts of their revenues on R&D. In other words, investors invest in the future expected benefits of R&D when making investment decisions. The results of our findings are in-line with prior studies that document increases in revenue generation and profitability due to R&D (Grobowskey and Muller 1978; Franzan and Radhakrishnan 2009; Asthana and Yinqi 2006; Laura 2000; Nvark 2001; Jones 2000; Hajiheydari et. al 2011). One of the reasons that R&D leads to the generation of more revenues is that it leads to the creation of innovative and new products that in turn, contribute to greater sales revenue. It is important to note that all the companies in this study affirm to the benefits of R&D in their annual reports. For example, Applied Materials executives in the corporation's 2015 Analysts' meeting that was held on July 15, 2015 in San Francisco, showed how increasing R&D investments over the past several

years are resulting in innovative new products that are enabling the key technology inflections in the semiconductor and display equipment industries (Applied Materials Inc., 2015). Our study adds to the existence body of knowledge on R&D, by showing that IT companies also greatly benefit from investing in R&D. It also adds to the body of knowledge by showing that IT companies that spend more of their revenues on R&D are valued higher by investors than those that spend less. In effect, we have demonstrated that R&D increases company valuation. From this study, we have demonstrated that information technology companies can benefit from both R&D spending (dollar amount) and R&D intensity.

6. LIMITATIONS OF OUR STUDY

The results of our study apply to information technology corporations that generated revenue of at least $300 million and may not be applicable to corporations that generate less revenue, without adjustments. Our findings are also limited to the information technology companies in the United States. If replicated, findings of the same study may be different in other parts of the world and in different industries. For further studies, we recommend replicating the same study for information technology companies the world over. Future studies can also be done on how R&D affects different industries. Studies can also be done comparing and contrasting R&D practices among different industries, for example the pharmaceutical industry versus the information technology industry. Lastly, we recommend studying the trends of financial performance based on R&D investments over time.

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Appendix 1: Study Sample Data

	CORPORATIONS	R&D SPENDING 2010 ($millions)	Revenue 2010($millions)	R&Di (R&D/Rev 2010)	R&D SPENDING 2014 ($millions)	Revenue 2014 ($millions)	R&Di (R&D/Rev 2014)	P/E (2015)
1	Autodesk Inc	457	1713.7	0.266674447	725	2273.9	0.318835481	167.74
2	Marvel Technology	828.2	3611.9	0.229298	1164	3707	0.31400054	15.56
3	Broadcom	1762	6818.3	0.258422187	2373	8428	0.281561462	45.36
4	Yahoo	1082	6324.7	0.171075308	1207	4618.1	0.261362898	5.36
5	Electronic Arts Inc	1153	3589	0.321259404	1094	4515	0.242303433	27.11
6	Amgen	2894	15053	0.192254036	4297	20063	0.214175348	22.27
7	Facebook	144	1974	0.072948328	2666	12466	0.213861704	93.94
8	Qualcomm	2450	10982	0.223092333	5477	26487	0.206780685	15.19
9	Intel	6576	43623	0.150746166	11537	55870	0.206497226	12.12
10	Vmware	653		0.228561	1239	6035	0.205302403	38.44
11	Adobe Systems Inc	680.3	3800	0.179026316	844.4	4147.1	0.203612163	112.13
12	Analog Devices	492	2761.5	0.178164041	560	2864.8	0.195476124	27.68
13	Intuit	573	3091	0.185376901	714	4506	0.158455393	95.63
14	Symantec	857	5985	0.143191312	1039	6676	0.155632115	18.22
15	Google	3762	29321	0.128303946	9832	66001	0.14896744	29.96
16	LAM Research	373.3	3237.7	0.115298	716	5259.3	0.13613979	19.43
17	Oracle	3254	26820	0.121327368	5151	38275	0.134578707	17.84
18	Ebay	908	9156.3	0.099166694	2000	15198	0.131596263	14.71
19	Microsoft	8714	62484	0.139459702	11381	86833	0.131067682	18.9
20	Activision	642	4447	0.144367	571	4408	0.129537205	22.85
21	SanDisk	422.6	3566.8	0.118481552	852	6627.7	0.128551383	16.4
22	CA technology	476	4195	0.113468415	574	4515	0.127131783	15.85
23	EMC	1888	17015	0.110960917	2991	24440	0.122381342	20.16
24	Western Digital	611	9850	0.062030457	1661	15130	0.10978189	12.02
25	Seagate Technology	875	10971	0.079756	1428	13739	0.103937696	9.36
26	Lexmark International	369	4199.7	0.087863419	355	3710.5	0.095674437	32.69
27	Micron technology	624	8482	0.073567555	1371	16358	0.083812202	5.99
28	Teradata	147	1936	0.07593	206	2732	0.075402635	15.08
29	Verisign	53.7	681	0.078855	68	1010	0.067326733	27.16
30	Xerox	821	19650	0.04178117	1231	19540	0.062998976	13.96
31	Automatic Data Processing Inc	137.7	9879.5	0.013937952	595.4	12206	0.048779289	27.83
32	Cisco Systems	5273	40040	0.131693307	1593	47142	0.033791523	16
33	Apple	1782	65225	0.027320813	6041	182795	0.03304795	15.56
34	Commscope	120	3189	0.037629	125	3829.6	0.032640485	27.69
35	Hewlett-Packard	2959	126033	0.023477978	3447	111454	0.030927558	12.27
36	Applied Materials	1144	9549	0.119803	338	13739	0.024601499	14.82
37	Lockhead Martin	638	45671	0.013969	751	45600	0.016469298	18.31
38	General Dynamics	1056	31964	0.033037	358	30852	0.011603786	16.46
39	Jabil Circuit	28.1	12607.8	0.002228779	29	15762.1	0.001839856	22.53
40	SAIC	49	4893	0.010014	4	4121	0.000970638	14.31

Appendix 2: Categorization of Companies for Statistical Testing

20 High R&D ($ amount) 2010	20 Low R&D ($ amount) 2010	20 High R&D Intensity 2014	20 Low R&D Intensity 2014
Microsoft	Adobe Systems	Autodesk Inc.	San Disk
Intel	VMware	Marvel Technology	CA Technology
Cisco Systems	Activision	Broadcom	EMC
Google	Lockheed Martin	Yahoo	Western Digital
Oracle	Micron Technology	Electronic Arts Inc.	Seagate
Hewlett Packard	Western Digital	Amgen	Lexmark International
Amgen	Intuit	Facebook	Micron Technology
Qualcomm	Analog Devices	Qualcomm	Teradata
EMC	CA Technology	Intel	VeriSign
Apple	Autodesk Inc	VMware	Xerox
Broadcom	SanDisk	Adobe Systems	Automatic Data Processing Inc.
Electronic Arts Inc	LAM Research	Analog Devices	Cisco Systems
Applied Materials	Lexmark International	Intuit	Apple
Yahoo	Teradata	Symantec	Commscope
General Dynamics	Facebook	Google	Hewlett-Packard
EBay	Automatic Data Processing Inc.	LAM Research	Applied Materials
Seagate Technology	Commscope	Oracle	Lockheed Martin
Symantec	VeriSign	EBay	General Dynamics
Marvel Technology	SAIC	Microsoft	Jabil Circuit
Xerox	Jabil Circuit	Activision	SAIC

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CORPORATE GOVERNANCE AND FIRM PERFORMANCE IN THE OIL AND GAS INDUSTRY OF RUSSIA

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Corporate Governance, firm performance, Russia, Oil and Gas Industry

JEL Classification

C10, G30, M10

ABSTRACT

This study explores corporate governance practices in Russian oil and gas companies over the 2009-2012 periods and examines the relationship between accounting performance measures and corporate governance mechanisms. Our findings suggest that managerial ownership and foreign ownership are positively associated with firm performance. Similarly, the results on government ownership also support our initial hypothesis and indicate that government ownership positively affects accounting performance. However, our findings suggest that board size and independent directors on the board do not appear to affect firm performance. This study demonstrates that corporate governance practices implemented in developed markets have some relevance and synergies to transition economies such as Russia.

1. INTRODUCTION

In recent years, corporate governance issues have received increased attention among scholars, practitioners and regulators worldwide (Jackling and Johl, 2009; Sami et al., 2011; Bozec and Bozec, 2011). For example, Brown et al (2011) report that their electronic search through Google Scholar provided approximately 287,000 results using 'corporate governance' as keywords in 2010. Hannifa and Hudaib (2006), Bhagat and Bolton (2008), Brown et al. (2011) also note that a wide range of accounting and finance studies have contributed to governance literature examining the relation between corporate governance and firm performance. Most prior studies document that effective corporate governance practices positively affect firm performance (Kiel and Nicholson, 2003; Haniffa and Hudaib, 2006; Jackling and Johl, 2009). However, another strand of governance literature concludes that corporate governance is negatively associated with performance (Yermak, 1996; Hutchinson and Gul, 2003; Mashayekhi and Bazaz, 2008). Interestingly, another strand of literature reports no association between corporate governance and firm performance (Bhagat and Black, 2008). Based on the existing research problem, this study focuses on the Russian market analyzing the relation between corporate governance practices of oil and gas companies and their operating performance. Therefore, the

objective of this study is to explore corporate governance practices in Russia and investigate the association between governance structures and firm performance in oil and gas industry.

Russia has significantly improved its performance in recent years (KPMG, 2011). The country has reached the best results in different sectors of economy. Primarily this applies to the mining industry. Specifically, the oil and gas sector plays an important role in the economic growth of Russia. Furthermore, a large number of oil and gas companies such as Gazprom and Lukoil are located in Russia. This study attempts to contribute to the existing literature by exploring governance practices in the oil and gas industry of Russia, and examining the association between corporate governance and firm performance. In particular, we focus on the effects of individual corporate governance variables, namely board of directors, independent directors, management, foreign and government ownership characteristics, and auditing company.

The remainder of the paper is divided into six sections. The next section discusses the development of corporate governance and the Code of Corporate Governance in Russia. Section 3 reviews the relevant literature and also sets out the hypotheses for testing. Section 4 describes the data, variables and the research methodology, which is followed by a discussion of the results in the next section. Finally, the summary and conclusions are presented in Section 6.

2. CORPORATE GOVERNANCE IN RUSSIA

Russia for the first time has faced with the concept of corporate governance at the end of the twentieth century. The main reasons of its development were increased interest to the corporate governance in USA and others countries in 1980's and the world financial crisis of 1997-1998 and corporate problems in emerging countries (Румянцев, 2010).
The first step toward improving corporate governance in Russia was the adoption of the Principles of Corporate Governance in 1999 by the organization for economic cooperation and development (Румянцев, 2010). By that time, these principles were the first set of standards and guidelines in the fields of corporate governance. Later, this document was replaced by the Code of Corporate Governance. The Code of Corporate Governance (hereinafter Code) is a set of the rules, which are designed for securities market participants. In the Russian Federation, Code of corporate governance has been recommended by Federal Financial Markets Service (formerly the Federal Commission for Securities Markets) with the participation and support of the representatives of the Western business community, domestic issuers and professional participants of the securities market on April 4, 2002 (http://www.ecgi.org). Earlier, in November 2001, the Code was approved at a meeting of the Russian Government. Before the economic crisis of 2008, Russian system of corporate governance was flexible and not completely formed (KPMG, 2011). Because of this, the system has undergone a lot of changes. Before the 2008, many companies mostly formally complied with the basic requirements of the law and other corporate governance standards dictated by the existing codes, and other requirements of regulators, stock exchanges, and etc. In a sense, there was a mechanical adherence to the rules, which was to ensure the effective management of the company in

terms of application mechanisms of corporate governance. This confidence among companies was supported by the investment attractiveness factor, expressed in the growth rate of shares of public companies. During the crisis, the corporate governance has ceased to be a tool of external investment attractiveness and companies shifted focus towards the development of corporate governance systems. Because of the economic crisis, owners of most public companies realized the necessity of improving the internal efficiency of their business processes (KPMG, 2011).

Economic and financial crisis has contributed to self-determination of the Russian model of corporate governance, which should not be imposed by legislation, but should be formed based on the experience of companies and then secured at the legislative level. Development and compliance with corporate governance standards in most of top Russian companies are assigned to a single person or a structure, and not distributed over various company departments within their direct action (Lazareva et al., 2007). Often this function is performed by the board of directors, directors of corporate governance and corporate secretaries.

After economic crisis of 2008, the Russian business community realized the importance of effective of corporate governance practices in achieving good results in strategic planning and risk management. One of the advantages of corporate governance in Russia is an appearance of independent directors on the board that is considered like a sign of a formal compliance with generally accepted standards. Analysis of corporate governance practices shows that one of its major problems is the contradiction between fixed procedures and actual decision-making processes. Management decisions are often not accepted in a comprehensive basis and implemented without the use of modern management techniques. The next significant weaknesses, which are noted by Румянцев (2010), are lack of transparency and low efficiency of monitoring over senior management activities.

3. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

3.1 Board size and firm performance

According to the resource dependency theory, a board of directors is an important governance mechanism that affects firm performance positively. Larger boards are more productive in the decision making process (Dalton et al., 1998), have more knowledge and skills (Van den Berghe and Levrau, 2004) and diversified (Pearce and Zahra, 1992; and Goodstein et al., 1994). Similarly, Henry (2008) reports statistically significant and positive relationship between board size and the Q-ratio. However, Haniffa and Hudaib (2006) conclude that large board is seen as less effective and could also be costly for companies. Based on the results of the majority of prior studies and the resource dependency theory, it is hypothesized that:

H1*: There is a positive relationship between board size and firm performance.*

3.2 Board composition and firm performance

Agency theory states that the majority of independent directors on the board of directors leads to the agency cost reduction because it is easier to control managers' actions (Fama and Jensen, 1983). Weir et al. (2002), Ho and Williams (2003), and Gupta and Fields (2009) provide evidence that firms with high percentage of independent directors deliver higher performance. However, other studies argue that the percentage of independent directors is not associated with firm performance (e.g., Fosberg, 1989; Klein, 1998; Bhagat and Black, 2002). Based on the agency theory and the findings of most prior studies, it is hypothesized that:

H2: *There is no relationship between the proportion of independent directors on the board and firm performance.*

3.3 Managerial ownership and firm performance

There are two views on the management ownership issue. According to the agency theory, prevailing managerial ownership can be very risky, and it is not beneficial for a company (Beatty and Zajac, 1994). In contrast, if managers are also shareholders of the company, the majority of their actions tend to support company interests. Douma et al. (2006) find a positive relationship between performance and management ownership. Hence, our next hypothesis is:

H3: *There is a positive relationship between the management ownership and firm performance.*

3.4 Foreign ownership and firm performance

Barbosa and Louri (2005) conclude that foreign ownership has a positive impact on firm performance due to many reasons such as geographical expansion, product differentiation, and economies of scale. Foreign ownership also improves firm performance because it requires more corporate disclosure and transparency in financial reporting system of a company (Patibandla, 2006). To examine this relationship, our fourth hypothesis is:

H4**:** *There is a positive relationship between the presence of the foreign shareholders and firm performance.*

3.5 Government ownership and firm performance

Government ownership is another common feature of Russian business environment. State is interested in the economic growth; therefore here is a positive relation between government ownership and firm performance (Hart et al., 1997). Ang and Ding (2006) conclude that government linked companies show higher market valuation than non–government linked companies. Hence, our next hypothesis is:

H5: *There is a positive relationship between the presence of the government and firm performance.*

3.6 External auditors and firm performance

External auditors play a significant role in corporate governance of a firm. Large audit firms are bigger targets for litigation, and hence, they attempt to be more conservative and more diligent, thereby meaning there is a greater association between higher audit quality and larger audit firms. The financial audit provides shareholders with transparent information on the current performance of the company. According to Ojo (2009), an improvement of corporate governance in Europe, in the aftermath of Enron, would require the involvement of intermediaries such as external auditors. Therefore, it is hypothesized:

H6: *There is a positive relationship between the auditing company size and firm performance.*

4. DATA AND METHODOLOGY

4.1 Sample Selection

The sample of this study includes 20 the biggest Russian companies in the oil and gas industry. The study focuses on the post crisis period between 2009 and 2012. The data for two companies are not available for 2009 and 2012 respectively; therefore, the full sample includes 78 observations for four years. Data research variables are mainly extracted from the annual reports and other recourses, which provide information on financial data and corporate governance variables.

4.2 Description of Variables

The dependent variable is a firm performance which represents accounting performance variables include including equity to assets ratio (proxy for capital adequacy measurement), asset growth (proxy for asset management measurement), sales to asset ratio (proxy for management measurement), return on assets and return on equity ratios (proxies for earnings measurement), current ratio and quick ratio (proxies for liquidity measurement). The independent variables consist of six corporate governance variables. They are board size, number of independent directors on the board, management ownership, foreign ownership, government ownership, and auditing company. Size and age are control variables. Description and measurement of research variables are presented in Table 1. To analyze the relationship between the firm performance and individual corporate governance mechanisms, the following model is used:

$$PERFORMANCE = \alpha 0 + \beta 1BSIZE + \beta 2INDIR + \beta 3MANOWN + \beta 4FOROWN + \beta 5GOVOWN + \beta 6AUDIT + \beta 7SIZElog + \beta 8AGE + \varepsilon,$$

where:

PERFORMANCE - one of the alternative operating performance measures, BSIZE - board size, INDIR – the number of independent directors, MANOWN – managerial ownership, FOROWN - foreign ownership, GOVOWN - state ownership, AUDIT – the type of auditing company, AGE – company age, and SIZE - company size.

Table 1: Research Variables Definition/Measurement

Variables	*Acronym*	*Operationalization*
Dependent variables		
Accounting performance		
Capital Adequacy	CAPAD	Equity to Assets ratio. This ratio is a proxy for accounting measure of financial strength and stability.
Asset Growth	GROWTH	Asset growth is a proxy for firm growth. Total Assets of the current year minus Total Assets of the previous year divided by Total Assets of the previous year.
Management	MNGT	Sales to Asset ratio (also known as Asset Turnover ratio). It shows the amount of sales generated per dollar of assets.
Return on Asset	ROA	Net Income divided by Total Assets
Return on Equity	ROE	Net Income divided by Equity
Current Assets Ratio	CA	Current Assets divided by Current Liabilities.
Quick Ratio	QA	Current Assets minus Inventory divided by Current Liabilities.
Independent variables		
Board size	BSIZE	Total number of directors on the board of the company.
Independent directors	INDIR	Total number of the independent directors on the board of the company.
Management ownership (%)	MANOWN	The proportion of the shares owned by the managers of the company.
Foreign ownership (%)	FOROWN	The proportion of the shares owned by the foreign shareholders of the company.
Government ownership (%)	GOVOWN	The proportion of the shares owned by the government.
Auditing company	AUDIT	Dichotomous with 1 if auditing company that tests the observed company is one of the Big Four and 0 otherwise.
Control variables		
Company size	SIZE log	Natural log of total Assets of the company.
Company age	AGE	Number of years since foundation of the company.

5. FINDINGS AND ANALYSIS

Table 2 presents the summary statistics of the dependent, independent, and control variables based on 78 observations. Several observed companies had a negative growth during some years, therefore the minimum value for GROWTH is -13%. The mean values for ROA and ROE are 10.49% and 38.11% respectively. In terms of liquidity, the mean values of CA and QA are 5.88 and 5.63 times respectively.

Table 2: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
CAPAD (%)	0.11	97.87	58.15	25.478
GROWTH (%)	-13.10	1448.11	46.31	174.51
MGMT	.00	7.01	.8319	1.05994
ROA (%)	-2.15	71.21	10.49	9.816
ROE (%)	-12.01	983.11	38.11	117.16
CA (times)	.45	225.73	5.8863	25.56747
QA (times)	.34	225.48	5.6369	25.54811
BSIZE	.00	15.00	7.9103	3.76307
IND	.00	7.00	2.2051	2.25837
MANOWN	.00	1.75	.0899	.32382
FOROWN	.00	100.00	7.5762	22.79623
GOVOWN	.00	100.00	23.3670	36.31862
AUDIT	.00	1.00	.6923	.46453
SIZElog	1.50	13.00	8.7244	2.43722
AGE	1.00	21.00	15.2436	4.31604

Table 3. Pearson correlation. Up scripts * and ** indicate two-tailed significance levels of 0.05 and 0.01 respectively.

	CAPAD	GROWTH	MGMT	ROA	ROE	CA	QA	BSIZE	INDIR	MANOWN	FOROWN	GOVOWN	AUDIT	SIZElog	AGE
CAPAD	1	-.282*	-.470**	.233*	-.396**	.270*	.265*	.108	.183	.135	-.336**	.395**	-.174	.162	.477**
GROWTH	-.282*	1	.536**	.068	.273*	-.030	-.029	-.157	-.176	-.023	.643**	-.041	-.246*	-.378**	-.525**
MGMT	-.470**	.536**	1	-.049	.554**	-.093	-.092	-.118	-.200	-.100	.722**	-.211	-.093	-.246*	-.510**
ROA	.233*	.068	-.049	1	.018	.146	.145	-.037	-.045	.102	-.131	.421**	-.237*	-.201	.082
ROE	-.396**	.273*	.554**	.018	1	-.032	-.030	-.166	-.171	-.041	.563**	-.078	-.043	-.234*	-.380**
CA	.270*	-.030	-.093	.146	-.032	1	1.000**	-.064	-.041	-.038	-.059	.309**	-.248*	-.074	.053
QA	.265*	-.029	-.092	.145	-.030	1.000**	1	-.064	-.042	-.038	-.058	.308**	-.247*	-.075	.052
BSIZE	.108	-.157	-.118	-.037	-.166	-.064	-.064	1	.431**	.081	-.096	.076	.385**	.612**	.316**
INDIR	.183	-.176	-.200	-.045	-.171	-.041	-.042	.431**	1	.441**	-.208	.177	.110	.627**	.322**
MANOWN	.135	-.023	-.100	.102	-.041	-.038	-.038	.081	.441**	1	-.093	-.181	.030	.101	.229*
FOROWN	-.336**	.643**	.722**	-.131	.563**	-.059	-.058	-.096	-.208	-.093	1	-.132	-.145	-.294**	-.635**
GOVOWN	.395**	-.041	-.211	.421**	-.078	.309**	.308**	.076	.177	-.181	-.132	1	-.184	.107	.157
AUDIT	-.174	-.246*	-.093	-.237*	-.043	-.248*	-.247*	.385**	.110	.030	-.145	-.184	1	.517**	.252*
SIZElog	.162	-.378**	-.246*	-.201	-.234*	-.074	-.075	.612**	.627**	.101	-.294**	.107	.517**	1	.544**
AGE	.477**	-.525**	-.510**	.082	-.380**	.053	.052	.316**	.322**	.229*	-.635**	.157	.252*	.544**	1

Table 3 shows Pearson's correlation results for variables used in this research. Significant correlations among independent and control variables may potentially lead to multicollinearity problems. To test for presence of multicollinearity, we have checked variance inflation factors (VIF) for all variables in all the regression models and identified that maximum number is 2.297 (Age variable) which is far below of 5.00, thereby suggesting that no multicollinearity is present. The finding signals better performance with the presence of the government as a shareholder. As expected, auditing company is negatively associated with firm performance indicating more conservative reporting for companies audited by Big 4. The negative correlation of SIZE log with ROA supports the study of Weir et al. (2002), suggesting that smaller companies are better performers.

Table 4 shows the regression results for the effects of operating performance on governance practices and the control variables. Contrary to Hypotheses H_1 and H_2, BSIZE and INDIR are not associated with any of operating performance variables. Consistent with H_3, management ownership has a significant and positive relationship with ROA. This

result is contrary to Beatty and Zajac (1994), but supports Douma et al. (2006) that management ownership positively affects the company's earnings. The regression results for FOROWN indicate that there is a positive relationship between the presence of the foreign shareholders and operating performance. This is consistent with the findings of Barbosa and Louri (2005) and Patibandla (2006). With regard to government ownership, the empirical results show that there is a positive and significant association between GOVOWN and performance variables including CAPAD, ROA, CA, and QA. Finally, AUDIT is negatively associated with CAPAD, CA, and QA. This indicates that companies audited by Big 4 disclose more conservative financial reports which result in much more conservative operating performance indicators. Overall, the empirical findings indicate that corporate governance practices including managerial ownership, foreign ownership, and government ownership had a positive impact on operating performance variables in the post-crisis period.

Table 4. Regression Analysis. Upscripts *, **, and * indicate significance of 0.10, 0.05, and 0.01 respectively.**

	CAPAD	GROWTH	MGMT	ROA	ROE	CA	QA
(Constant)	.213	1.958	.905	.157	.500	2.723	2.600
	(1.627)*	(2.332)**	(1.902)**	(2.971)***	(.793)	(.174)	(.167)
BSIZE	.004	.021	-.010	.004	-.039	.055	.060
	(.489)	(.407)	(-.342)	(1.291)	(-.990)	(.056)	(.061)
INDIR	-.086	.356	.028	-.059	.097	-19.148	-18.915
	(-.524)	(.340)	(.048)	(-.901)	(.123)	(-.983)	(-.971)
MANOWN	.097	.323	-.162	.075	.077	6.410	6.384
	(1.027)	(.532)	(-.471)	(1.956)**	(.169)	(.569)	(.566)
FOROWN	-.001	.040	.031	-.001	.029	-.043	-.041
	(-.447)	(4.554)***	(6.203)***	(-1.034)	(4.335)***	(-.260)	(-.248)
GOVOWN	.002	.003	-.004	.001	.001	.205	.204
	(2.914)***	(.596)	(-1.352)	(4.306)***	(.332)	(2.353)**	(2.345)**
AUDIT	-.142	-.171	.004	-.015	.336	-13.279	-13.103
	(-2.143)**	(-.400)	(.015)	(-.546)	(1.050)	(-1.674)*	(-1.651)*
SIZE log	.002	-.149	.006	-.013	-.041	.971	.923
	(.083)	(-1.204)	(.088)	(-1.635)*	(-.444)	(.423)	(.402)
AGE	.025	-.048	-.013	.001	.003	.184	.190
	(2.929)***	(-.855)	(-.401)	(.324)	(.068)	(.178)	(.183)
Adj. R-square	33%	41%	48.8%	25.1%	26.4%	5.2%	5.1%
F-stat	5.742	7.701	10.167	4.220	4.444	1.533	1.514

6. CONCLUSION

This study explores corporate governance practices in Russian oil and gas companies in the post-crisis period and examines the relationship between accounting performance measures and corporate governance mechanisms. The results indicate that the board size and independent directors on the board do not appear to affect firm performance. This result supports Fosberg (1989), Bhagat and Black (2002), Klein (1998) who find no linkage between number of independent directors and firm performance. Moreover, our results indicate that management ownership has a positive impact company performance. This implies that managerial ownership increases earnings and therefore improves the performance of oil and gas companies in Russia. The findings on foreign ownership suggest that foreign ownership is positively associated with firm performance. The empirical evidence shows that foreign owners were able to improve asset growth, management quality and liquidity. The results on government ownership also support our initial hypothesis and indicate that better government ownership positively affects accounting performance. One of the features of Russian corporate governance is a government involvement in the business process (Lazareva et al., 2007). The analysis confirmed that the government as a stakeholder is a prosperous mechanism of corporate governance of the Russian companies in the oil and gas industry.

The study indicates that companies audited by Big 4 issue more conservative financial reports which result in much more conservative accounting performance indicators. The control variables like firm size and age have significant relationships with firm performance. For example, size is negatively associated performance thereby suggesting that small companies on average outperform large firms. We acknowledge several limitations of this research that suggest further investigation of the topic. Firstly, only six independent variables were tested in this study. It is possible to consider other variables such as the presence of different committees, CEO duality, CEO education, etc. Secondly, sample size is relatively small due to a small number of companies and only four years included in this study. One of possible directions for future research can be to extend time period and conduct a comparative analysis of the pre-crisis and post-crisis periods. Third, this study considers Oil and Gas industry only. Further and deeper insights can result from a comparative study conducted on inter-industry dataset. And finally, this study tests the correlation of corporate governance indices only with accounting performance variables. Therefore, considering market performance, for example, using Tobin's Q ratio can highlight other aspects of the governance – performance relations.

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A TEST OF SECOND-ORDER STOCHASTIC DOMINANCE WITH DIFFERENT WEIGHTING METHODS: EVIDENCE FROM BIST-30 and DJIA

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ABSTRACT

Portfolio optimization is one of the most important steps in asset allocation procedure. Having optimized portfolios with Markowitz Mean-Variance, recently Stochastic Dominance method is taking place as a preliminary test in efficient asset allocation procedure. In some studies, it is even used as an alternative method to replace mean-variance theory in portfolio selection. In this research, distribution-based Stochastic Dominance method applied to discover the dominant individual stocks of DJIA and BIST-30 indices. We conducted Second-order Stochastic Dominance (SSD) method with various weighting logic Equal, Simple and Logarithmic. This paper concerns about two concepts; firstly, investigating market efficiency with SSD in one emerging and one developed market, Borsa Istanbul and New York Stock Exchange, respectively. Secondly, the impact of different weighting methods in dominant portfolios. Results illustrate that, there are differences in dominant portfolios with various weighting methods. Further, NYSE seems more efficient market than BIST.

1. INTRODUCTION

All investors concerned about how to select optimal portfolio that fulfill the investment objectives over the investment horizon. The importance of decision making based on expected return of financial assets is one of the most controversial topics in investment. In this respect, decision theory can be seen as the field that describes and formalizes the process of making a choice among several possible uncertain alternatives (Castellano & Cerqueti, 2013). Basically there are two asset allocation approaches; heuristic and quantitative. In the former method the investor selects portfolio based on his or her feelings and expectations, but in the latter method assets are being allocated using mathematical optimization methods.

As a quantitative method, Markowitz (1952) proposed his genesis model of return and risk in portfolio selection, which initiated the Modern Portfolio Theory. Because of its

simplicity, this model is commonly used in asset allocation and practical funding decisions. He concluded that, asset's performance should be measured in two specific dimensions: the mean describing the expected return, and the variance which measures the uncertainty and volatility of the return. However, he also suggested other measures of risk e.g. semi-variance (Markowitz, 1959). Although, describing the risk of an asset in term of variance is due to its straightforward computation, the variance is not a satisfactory measure of risk. Firstly, due to its symmetric behavior, i.e. variance penalizes gains and losses equally. Secondly, variance cannot describe the risk of low probability events such as, default risk. (Copeland, Weston, & Shastri, 1998). In the Markowitz mean-variance approach, efficient portfolios are selected from the universe of all possible portfolios; then for a given value of the return the risk will be minimized or, analogously, for a given level of risk, the mean will be maximized. With this method the portfolio selection procedure could be formulated as a parametric optimization problem, which assists the trade-off between risk and return. (Markowitz, 1952).

On the other hand, Stochastic Dominance method is taking place as a preliminary test in efficient asset allocation procedure. In some papers, it is even used as an alternative method to replace mean-variance theory in portfolio selection (Guran & Tas, 2013). First-order and Second-order stochastic dominance was introduced independently by Hadar and Russell (1969), Hanoch and Levy (1969), Hadar and Russell (1969), and also the Third-order stochastic dominance suggested by Whitmore (1970). The concept of stochastic dominance is related to models of risk-averse preferences (Sisson, 1965). It initiated from the theory of majorization for the discrete case (Marshall, Olkin, & Arnold, 2011) and later extended to general distributions, and is now vastly applied in economics and finance (Hanoch & Levy, 1969). According to Kroll and Levy (1980), Levy (1992), stochastic dominance is a central concept in a wide variety of applications in economics, finance and statistics. An important reason of this, is it does not need two or more portfolios to compare. It is possible to evaluate just a portfolio by second order stochastic dominance. Stochastic dominance tries to compare random variables in the sense of stochastic order expressing the common preferences of rational decision-makers. It is an alternative theoretical approach to the mean-variance portfolio selection problem.

This study applies distribution-based second-order stochastic dominance, which proposed by Dentcheva and Ruszczyski **(2003)**, Dentcheva and Ruszczysk **(2006)** and Kopa and Chovanec **(2008)**. We proceed analogously to Tas and Guran **(2015)** on Borsa Istanbul (BIST-30) and Dow Jones Industrial Average (DJIA) to discover the dominant portfolios of these indices. We conduct this method with various weighting techniques. This work investigates market efficiency with SSD in one emerging and one developed market, then it looks after the impact of different weighting methods in dominant portfolios.

2. LITERATURE REVIEW

Many studies have been done to measure performance of portfolios based on second-order stochastic dominance. Best et al. (2000) states value portfolios second order stochastically dominate growth portfolios. Fong (2009) concludes that in Chinese stock market A-shares second-order stochastically dominate B-shares. It means that all risk

averse investors will prefer A-Shares to B-Shares**.** Tas and Ugurlu (2015) examined Turkish mutual funds based on Second-order Stochastic Dominance and compared with conventional portfolio performance measures. Isiker et al. (2014) compares 12 ethical and 12 conventional stocks from Borsa Istanbul with SSD efficiency test. According to the results, ethical stocks seems more efficient than conventional ones.

Guran et al. (2013) observes the efficiency of BIST-30 Index portfolio by second order stochastic dominance. Data is used from 03.12.2010 to 05.07.2013 on weekly basis. All 30 stocks are second order stochastically pairwise compared. Only 12 of 30 stock are not second orderly dominated and can be used in an efficient portfolio of BIST-30. Total weight of these 12 stocks are 34.64%. In accordance with these results, BIST-30 is not an SSD efficient index. The underlying desire behind this study was to have a look on SSD portfolios with various weighting tactics.

3. DATA AND METHODOLOGY

The First-order stochastic dominance – which is rare in financial instruments – is defined as

$$F_i(t) \leq F_j(t) \; \forall_t \; For \; all \; t \; ,$$

reveals that asset i stochastically dominants asset j in first order. In other words asset i is preferable on asset j. FSD does not require any restriction on investors' utility function. Further Second-order noted as

$$\int_{-\infty}^{X} F_i(t) \, dt \leq \int_{-\infty}^{X} F_j(t) \, dt$$

considers that investors are risk-averse. The definition of second-order stochastic dominance relation uses comparisons of either twice cumulative distribution functions, or expected utilities (Levy, 1998). Alternatively, one can define SSD relation using cumulative quantile functions or conditional value at risk (Ogryczak & Ruszczyn, 2002). Daily returns of BIST-30 and DJIA from 1 Jan 2012 until 1 Jan 2014 were studied, it worth to mention; due to lack of historical prices, Pegasus Airlines eliminated from BIST-30 and it considered with 29 stocks.

$$r_t = \frac{P_{t+1}}{P_t} - 1$$

Then the stochastic dominance process were applied on both indices. The key different point from the Tas et al. (2014) work is that, in finding dominant assets we applied three weighting tactics. First one is Equal-weighted, which assigns the same significance to all returns within time horizon. Second tactic is Simple-Weighted, which assign the significance to return based on time of occurrence. The last one is somehow same to the simple-weighted, however the significance assigned regarding to Logarithmic-Weighted.

Equal-Weighted: $w_i = \frac{1}{t}$, t stands for time horizon.

Simple-Weighted: $w_i = \frac{z}{\sum_{i=1}^{t} z_i}$, z stands for order of occurrence

Logarithmic-Weighted: $w_i = \frac{Log(z)}{\sum_{i=1}^{t} Log(z_i)}$, z stands for order of occurrence

By applying this procedure for both of indices, the output is four cluster of stocks for each index:

- Cluster 1. The stocks which dominate at least one stock and are not dominated by any other.
- Cluster 2. The stocks which are dominated by at least one stock and do not dominate any other stock.
- Cluster 3. The stocks which are dominated by at least one stock and dominate at least one other stock.
- Cluster 4. The stocks which are not dominated by any stock and do not dominate any other stock.

Obviously, stock which taking place in 1st cluster are the dominant stocks. In the previous studies Tas et al. (2014) and Tas and Guran (2015) took all assets in 1st and 4th clusters to make dominant portfolios, however, in this study for purpose of back-testing only stock in 1st were taken to construct portfolio. Daily returns 1 Jan – 1 Apr 2014 were used to make equally weighted portfolios with individual stocks in Cluster 1 and also mutual stocks between three weighting tactics for each indices. The return of these portfolios are compared via excess return from index's return.

4. RESULTS

Table 1 shows the components of Borsa Istanbul 30 Index (BIST-30). Pegasus Airlines, which does not have full data in the examination period is excluded.

Table 1. BIST-30 Components

Symbol Reference		
1. AKBANK	11. TURKIYE IS BANKASI 'C'	21. TURK HAVA YOLLARI
2. ARCELIK	12. KOC HOLDING	22. TEKFEN HOLDING
3. BIM BIRLESIK MAGAZALAR	13. KOZA ALTIN ISLETMELERI	23. TOFAS TURK OTOM.FABK.
4. DOGAN SRKGRBU.HLDG.	14. KARDEMIR 'D'	24. TRAKYA CAM SANAYI
5. EMLAK KONUT GAYRIMENKUL YATOTA.	15. MIGROS TICARET	25. TURK TELEKOMUNIKASYON
6. ENKA INSAAT VE SANAYI	16. PETKIM PETROKIMYA HLDG.	26. TUPRAS TKI.PEL.RFNE.
7. EREGLI DEMIR CELIK	17. HACI OMER SABANCI HLDG.	27. ULKER BISKUVI SANAYI
8. FORD OTOMOTIV SANAYI	18. TKI.SISE VE CAM FKI.	28. VAKIF FINANSAL KIRALAMA
9. TKI.GARANTI BKSI.	19. TAV HAVALIMANLARI	29. YAPI VE KREDI BANKASI
10. TURKIYE HALK BANKASI	20. TURKCELL ILETISIM HZM.	

Tables 2 and 5 illustrate the clustering stocks' results of BIST-30 and DJIA respectively. Obviously, the 4th cluster of DJIA does not contain any stocks, which means that all components are whether dominant or dominated-by. However, stock No.27 in BIST-30 does not dominate any stock and it is not dominated by any individual component.

Table 2. Second Order Stochastic Dominant and Dominated Stocks

Equally Weighted													
Cluster 1.	2	3	12	16	19	20	21						
Cluster 2.	4	8	9	10	13	14	22	23	28				
Cluster 3.	1	5	6	7	11	15	17	18	24	25	26	29	
Cluster 4.	27												
Simple Weighted													
Cluster 1.	7	12	16	19	20	21	24						
Cluster 2.	4	8	9	10	13	22	23	28					
Cluster 3.	1	2	3	5	6	11	15	17	18	25	26	27	29
Cluster 4.	14												
Logarithmic Weighted													
Cluster 1.	1	13	16	23	24	28	30						
Cluster 2.	4	8	9	10	13	14	22	23	28				
Cluster 3.	1	5	6	11	15	17	18	24	25	26	29		
Cluster 4.	27												

Table 3 and 6 represent the constructed portfolios from dominant stocks. In both indices, Equally weighted SSD portfolios have the highest excess return. Since the Simple and Logarithmic weighted tactics assign priority on recent returns, Equally weighted portfolios rejected the idea of the higher excess returns with much recent information.

Table 3. Dominant Portfolios' and Excess Returns

Dominant Portfolio	Return	Excess Return
Equally Weighted	-5.28%	0.73%
Simple Weighted	-6.78%	-0.77%
Logarithmic Weighted	-5.40%	0.61%
Mutual Assets	-5.39%	0.62%
BIST 30	-6.01%	

In the bearish backtesting period, BIST-30 loses 6.01% and equally weighted, logarithmic weighted and mutual portfolios outperform the BIST-30 Index. On the other hand, performance of the simple weighted portfolio cannot exceed the performance of BIST-30 Index.

Table 4 gives the components of Dow Jones Industrial Average (DJIA).

Table 4. DJIA Components

Symbol Reference		
1. 3M	11. GENERAL ELECTRIC	21. NIKE 'B'
2. AMERICAN EXPRESS	12. GOLDMAN SACHS GP.	22. PFIZER
3. ATandT	13. HOME DEPOT	23. PROCTER and GAMBLE
4. BOEING	14. INTEL	24. TRAVELERS COS.
5. CATERPILLAR	15. INTERNATIONAL BUS.MCHS.	25. UNITEDHEALTH GROUP
6. CHEVRON	16. JOHNSON and JOHNSON	26. UNITED TECHNOLOGIES
7. CISCO SYSTEMS	17. JP MORGAN CHASE and CO.	27. VERIZON COMMUNICATIONS
8. COCA COLA	18. MCDONALDS	28. VISA 'A'
9. E I DU PONT DE NEMOURS	19. MERCK and COMPANY	29. WAL MART STORES
10. EXXON MOBIL	20. MICROSOFT	30. WALT DISNEY

Table 5. Second Order Stochastic Dominant and Dominated Stocks

Equally Weighted																	
Cluster 1.	1	13	16	24	26	28	30										
Cluster 2.	5	7	12	14	15	17	20										
Cluster 3.	2	3	4	6	8	9	10	11	18	19	21	22	23	25	27	29	
Cluster 4.																	
Simple Weighted																	
Cluster 1.	1	13	16	18	21	23	24	25	28	29	30						
Cluster 2.	5	7	12	14	15	17	20										
Cluster 3.	2	3	4	6	8	9	10	11	19	22	26	27					
Cluster 4.																	
Logarithmic Weighted																	
Cluster 1.	1	13	16	23	24	28	30										
Cluster 2.	5	7	12	14	15	17	20										
Cluster 3.	2	3	4	6	8	9	10	11	18	19	21	22	25	26	27	29	
Cluster 4.																	

Table 6. Dominant Portfolios' and Excess Returns

Dominant Portfolio	**Return**	**Excess Return**
Equally Weighted	2.12%	2.82%
Simple Weighted	1.97%	2.67%
Logarithmic Weighted	0.75%	1.45%
Mutual Assets	2.34%	3.05%
DJIA	-0.70%	

DJIA performs better than BIST-30 in backtesting period, however it still has a negative return. Results of both indexes correspond with each other, which means that equally weighted portfolios and mutual assets perform better than other methods. Equally weighted portfolio is the best among three different weighting methods. The portfolio, which consists of all methods' mutual stocks has also very similar return levels with equally weighted portfolio.

5. CONCLUSION

In this paper, Second-order Stochastic Dominance portfolios from BIST-30 and DJIA components have been analysed with different weighting methods. First, exclusively dominant stocks are found to construct dominant portfolios. The stocks dominance revealed using different weighting tactics. Equally weighted tactic takes the historical returns with equal significance. Simple and Logarithmic weighting assign more significance on recent returns. DJIA's components did not take place in 4^{th} cluster, which means all stock are whether dominator or dominated by.

Next result shows that there is difference between various weighting methods. The highest excess return belongs to Equally weighted method. However, mutual stocks portfolio seems to have better performance. BIST-30's Simple-Weighted dominant portfolio performed with negative excess return which might be a sign of an inefficient market in Turkey. In the future, in light of these findings, stocks that make up these portfolios can be analysed with different time frequencies and different periods i.e. before financial crisis and post-crisis. One might study appropriate sample of indices to draw strong trend and relation between developed vs. developing markets and efficient vs. inefficient markets, as well.

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AN APPLICATION OF CLAIM FREQUENCY DATA USING ZERO INFLATED AND HURDLE MODELS IN GENERAL INSURANCE

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ABSTRACT

Modelling is a key issue to get a fair pricing in insurance. Poisson distribution is the basic model for count data when the assumptions of Poisson process are assured. Since the insurers tend not to state the small claims to get the deductibles and no claim discounts, insurance data has more zeros than expected which makes the contradictions of the Poisson process assumptions that is the equality mean and variance value. However, not to take account excess zeros makes the knowledge deficiency to get the better pricing for the portfolio. In this paper we will compare Poisson Models and Zero Inflated Models which account for this fact for claim frequency data. Also we will review the models in use for count data and also compare Hurdle Models as an alternative to Zero Inflated Models. Our results represent that Hurdle Models are better fit than the other models we compare. We used Akaike's Information Criteria(AIC) as model selection measures.

1. INTRODUCTION

Modelling is a key issue in insurance to get a fair pricing which is the major task for the actuaries. In this concept, the distribution of the data set which is investigated is very important. Poisson distribution is the basic model to be applied to count data. However, the equivalence of mean and variance assumption of the Poisson process is not satisfied for insurance data because the insurers tend not to state the small claims to get the deductibles and no claim discounts which cause insurance data set generally has more zeros than expected. In that reason overdispersion which is the situation of that the variance is greater than the mean is seem to be main problem for the insurance dataset. Negative Binomial Model is developed as an alternative to handle overdispersed count data. However, the Negative Binomial Model can also be violated by overdispersion when the variance is greater than the calculated value of $\mu + \alpha\mu^2$. Overdispersion can be occurred in two ways as apparent and real overdispersion. Missing variables, outliers, requiring interaction term or misspecified link function can cause apparent overdispersion

while the violation of distributional assumptions can cause real overdispersion. Zero Inflated Models developed to handle inflated zero values for the dependent variable which cause the violation of distribution assumptions (Hilbe,2012).

2. LITERATURE REVIEW

Zero Inflated Poisson Models are developed by Lambert (1992) to handle zero-inflated count data. Zero Inflated Models combine two sources of zero outcomes which are called "true zeros" and "excess zeros". Greene(1994) has investigated Zero Inflated Models as modifications of the Poisson and the Negative Binomial models. He also presents the test procedure to separate the zero inflation and overdispersion. Fahrmeir and Echavarria (2006) developed structured additive regression models for overdispersed and zero inflated data. They applied the models to the patent data and also motor insurance data to investigate good indicators for patent. Boucher, Denuit and Guillen (2009) presented different risk classification models for panel count data based on the Zero Inflated Poisson distribution. They suggested a new approximation taking account the behavior of insureds. Zhao&Zhou (2012) discussed longitudinal models of claim counts with excess zeros. They modelled claim counts by using copula function.

Mullahy (1986) has first discussed in the econometric literature hurdle count data models which is also called two part models by Heilbron (Heilbron, 1994). Gurmu (1998) introduced a Generalized Hurdle Model for the handling of overdispersion and also underdispersion which is the situation of that the variance is less than the mean. Ridout et al.(1998) reviewed some zero inflated models and hurdle models and gave an example on biological count data. Saffari, Adnan and Greene (2012) suggested using a Hurdle Negative Binomial Regression Model to overcome the problem of overdispersion. They introduced a censored Hurdle Negative Binomial Model on count data with many zeros. Greene (2007) has compared Zero Inflated and Hurdle Models. In this work it is also described several extensions of the models and is presented an application to health care demand data for comparison the models. Hurlimann (1990) presented the usage of parametric models on the claim frequency distribution with extra zeros. Yip&Yao (2006) present application of Zero Inflated Models to insurance claim frequency data. They reviewed the development of Zero Inflated Models and take attention that there is very few application on claim frequency data in the literature. Flynn (2009) compared traditional Poisson and Negative Binomial models to the Zero Inflated Models. He applied Zero Inflated Models and some data mining techniques to claim frequency data and also attached efficient preprocess procedure for the categorical variables. Morata (2009) examined a priori ratemaking procedure for the portfolios include different types of claims by using bivariate Poisson Models with Zero Inflated Models. Bermudez and Karlis (2011) extended this work based on Bayesian inference by using multivariate Poisson Regression Models with their zero inflated versions. Mouatassim and Ezzahid(2012) compare poisson model to the zero inflated model and applied to health insurance data set. Mouatassim, Ezzahid and Belasri(2012) analized operational risk to the zero inflated data and assess the impact of ZIP distribution on the operational capital charge. They concluded that the zero inflated Poisson distribution is better fit then Poisson distribution for modeling operational risk frequency.

In this paper, we are motivated from Yip and Yau (2006) and try to extend their results with different data set. We used a company specific data with four independent variables. In the next section, we give a brief literature and then we continued with quick explanation about traditional Poisson and Negative Binomial Models beside Zero Inflated and Hurdle Models. We give descriptive statistics and counts for our dependent variable which is claim frequency to monitor our data set. Finally we present and summarized our results in the last section.

3. DATA AND METHODOLOGY

Data

The data set that we considered in this paper contains claim frequencies for automobile portfolio of a Turkish insurance company occurred between 2012 and 2014. The data contains information from 10.814 policyholders and it is a company-specific data. There are four independent variables which are insureds gender, marital status, age and vehicles age. Below Figure1 presents histogram of claim frequencies of policyholders on the left hand side. The histogram of Claim Frequencies represents that the dataset contains very large proportion of zeros which refers to overdispersion. Claim counts are also seen on the right hand side in Table1.

Figure 1: Histogram of Claim Frequency

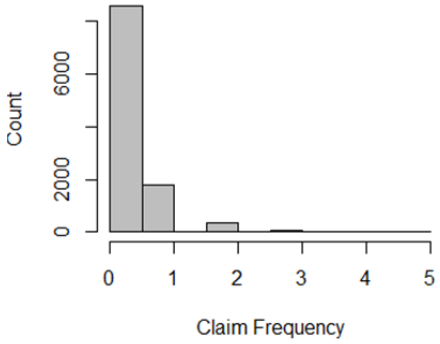

Table 1: Counts of Claim Frequencies

Claim Frequency	Count
0	8544
1	1796
2	370
3	81
4	22
5	1

According to the Table1 given above, the data set contains 8.544 zero counts which is 79% of the data set. Also, 3 and greater than 3 claim frequencies form approximately 1% of the data set. Below it is given the distribution of counts and ratios according to the explanatory variables by codes in Table2. According to the Table 2, looking at the insureds characteristics, 72% of the data set are male and 28% of the data set are female. In addition, 78% are married, 15% are single, 5% are divorced and 2% of the data set are widow. Furthermore, insureds aged between 36 and 50 years filed about 38% of total claims and 31% of the insureds are younger than 35. And, 3% of the insureds are older than 71 years old. Looking at the vehicles properties, it is seem that 80% of the vehicles are between 0 and 5 years old, 19% of the vehicles are between 6 and 10 years old, 1% of the vehicles are between 11 and 15 years old.

Table 2: Summary of the dataset

Variables	Code	Groups	Claim Frequency	Ratio
Gender	1	Female	3047	28
	2	Male	7767	72
Marital Status	1	Single	1617	15
	2	Married	8457	78
	3	Divorced	503	5
	4	Widow	237	2
Vehicle Age	1	0-5	8637	80
	2	6-10	2011	19
	3	11-15	155	1
	4	16-20	11	0
Insureds Age	1	0-35	3397	31
	2	36-50	4108	38
	3	51-70	2940	27
	4	71-100	369	3

Methodology

In this section, we first lay out the Probability Mass Function (PMF) for the Poisson and Negative Binomial model. Then we continued with the same for Zero Inflated Poisson, Zero Inflated Negative Binomial and the Hurdle Model. Poisson and Negative Binomial distribution is traditionally used the claim count distribution in general insurance.

Poisson distribution

The Poisson probability distribution function is formulated as

$$P(Y = y|\lambda) = \frac{e^{-\lambda}\lambda^{y}}{y!} \qquad y = 0, 1, 2, \ldots$$

λ is the expected value and the variance of Poisson distribution.

Likelihood function for the Poisson Model:

$$L(\beta|y, X) = \prod_{i=1}^{N} P(Y = y_i|\lambda_i) = \prod_{i=1}^{N} \frac{e^{-\lambda_i}{\lambda_i}^{y_i}}{y_i!}$$

where $\lambda_i = E(y_i|x_i) = e^{x_i\beta}$.

Poisson Regression Model provide a standard framework for the analysis of count data with unignorable assumptions. One of the assumptions of the Poisson distribution is the mean and the variance equivalence. In practice, however, count data often exhibit larger

variance than predicted by the mean (overdispersion). Therefore count data will be more convenient to use the Negative Binomial distribution is not provided on the assumption of the Poisson distribution (Hardin&Hilbe, 2011) (Loeys et al., 2012).

Negative Binomial Distribution

$$P(Y = y|\lambda, \alpha) = \frac{\Gamma(y + \alpha^{-1})}{y!\,\Gamma(\alpha^{-1})} \left[\frac{\alpha^{-1}}{\alpha^{-1} + \lambda}\right]^{\alpha^{-1}} \left[\frac{\lambda}{\alpha^{-1} + \lambda}\right]^{y}$$

λ is the expected value and the variance of the distribution. α is the over dispersion parameter, when $\alpha = 0$ the Negative Binomial distribution is the same as Poisson distribution. Likelihood function for the Negative Binomial Model:

$$L(\beta|y, X) = \prod_{i=1}^{N} P(y_i|x_i) = \prod_{i=1}^{N} \frac{\Gamma(y + \alpha^{-1})}{y!\,\Gamma(\alpha^{-1})} \left[\frac{\alpha^{-1}}{\alpha^{-1} + \mu_i}\right]^{\alpha^{-1}} \left[\frac{\mu_i}{\alpha^{-1} + \mu_i}\right]^{y_i}$$

where $\mu_i = E(y_i|x_i) = e^{x_i\beta}$ and parameter values of count models are estimated using maximum likelihood. One of the most common specifications for Negative Binomial Model is to allow the ratio of the variance to the expected value of Y to vary according to the following specification:

$$\frac{Var(Y_i)}{E(Y_i)} = 1 - \alpha E(Y_i)$$

where α = ln(σ) and σ is the "over dispersion parameter". Under this specification, when α= 0 (i.e. σ = 1) the model reduces to the Poisson. Because the Negative Binomial and Poisson models are nested in this way, t-tests for σ = 1, or a Likelihood-Ratio or Wald test, can be used to test for the presence of significant amounts of over dispersion (Zorn, 1996).

Zero-Inflated Models

The other problem with Poisson Regression Models having far more zeros than expected by the distributional assumptions of the Poisson and Negative Binomial models result in incorrect parameter estimates. (Hardin& Hilbe,2012) Using Zero Inflated Poisson (Lambert, 1992) or Zero Inflated Negative Binomial models are proposed as a solution for this problem (Loeys et al., 2012).

In general, count responses having two kinds of zeros “true zeros” and “excess zeros”, at that point Zero Inflated Models attempt to account for excess zeros. Zero Inflated Models estimate two equations, one for the count model and one for the excess zeros.

$$\mathrm{P}(\mathrm{Y} = \mathrm{y}|\lambda, \pi) = \begin{cases} \pi + (1 - \pi)\mathrm{e}^{-\lambda}, & \mathrm{y} = 0 \\ (1 - \pi)\dfrac{\mathrm{e}^{-\lambda}\lambda^{y}}{\mathrm{y}!}, & \mathrm{y} = 1, 2, \ldots \end{cases} \quad (1)$$

λ is the expected value of Poisson distribution and π is the over dispersion parameter.

Hurdle Models

Hurdle Models were developed by Mullahy(1986) to deal with count responses having more zeros than allowed by the distribution assumptions of Poisson and Negative Binomial regression, like Zero Inflated models. (Hardin& Hilbe,2012) The differences between the Hurdle Models and the Zero Inflated Models are that zero and non-zero counts are separately modelling in the Hurdle Models(Loeys et al., 2012) and also Hurdle model assumes that all zero counts are true zeros(Potts&Elith, 2006).

The Hurdle Model of count data can be expressed as follows for the Poisson and Negative Binomial distribution.

The Poisson Hurdle Model Specification

We consider a Hurdle Poisson Regression Model in which the response variable Y has the distribution

$$\mathrm{P}(\mathrm{Y}=\mathrm{y}|\lambda,\pi_0)=\begin{cases}\pi_0 & \mathrm{y}=0\\ \dfrac{(1-\pi_0)\,\mathrm{e}^{-\lambda}\lambda^{y}}{(1-\mathrm{e}^{-\lambda})\mathrm{y}!} & \mathrm{y}>0\end{cases}$$

Zero inflated Poisson distribution is parameterized as given by Equation (1) with $\pi_0=\pi+(1-\pi)e^{-\lambda}$.

The Negative Binomial Hurdle Model Specification

We consider a Hurdle Negative Binomial Regression Model in which the response variable Y has the distribution

$$\mathrm{P}(\mathrm{Y}=\mathrm{y}|\lambda,\alpha,\pi_0)=\begin{cases}\pi_0 & \mathrm{y}=0\\ (1-\pi_0)\dfrac{\mathrm{g}}{1-(1+\alpha\lambda)^{-\alpha^{-1}}} & \mathrm{y}>0\end{cases}$$

where $g=g(y;\lambda,\alpha)=\frac{\Gamma(y+\alpha^{-1})}{\Gamma(y+1)\Gamma(\alpha^{-1})}\,(1+\alpha\lambda)^{-\alpha^{-1}-y}\,\alpha^{y}\lambda^{y}$.

Maximum Likelihood Estimation (MLE) method is used to estimate parameters in the Zero Inflated Models.

This study includes Poisson, Negative Binomial, ZIP, ZINB, Hurdle and Hurdle NB to accommodate the excess zeros for insurance claim count data. In this paper, Akaike's information criteria (AIC) and log-likelihood values are used for model selection measures. It is also used dispersion parameters to test for overdispersion. The generalized Pearson χ2 statistic which is the standard measure of goodness of fit is used to evaluate the sufficiency of the analyzing methods. It has the calculated value as follows;

$$\chi^2=\sum_{i=1}^{n}\frac{(Y_i-\mu_i)^2}{Var(Y_i)}$$

This statistic follows a χ^2 distribution with $n-k$ degrees of freedom, where n is the total number of observations and k is the number of parameters (Cameron&Trivedi, 1998).
Akaike's information criteria (AIC) and log-likelihood are basic methods of assessing the performance of the models and model selection. The AIC is defined as follows:

$$AIC = -2\,log\,likelihood + 2k$$

where k = number of parameters. In general, the smaller AIC value refers to the better model.

4. RESULTS

In this section we follow analysis of our data set. We applied zero inflated and hurdle models to the insurance data set and compare to the poisson and negative binomial models. Parameter estimates of models is given in Appendix 1. Below it is given Akaike information criteria and log-likelihood values to select best model of the data set in Table 3.

Table 3: Information criteria for models

Models	AIC	Log-likelihood
Poisson	14277	-7127,4
Negative Binomial	14040	-7008,2
Zero Inflated Poisson	14068	-7011,9
Zero Inflated Negative Binomial	14052	-7003,2
Hurdle	14067	-7011,7
Hurdle Negative Binomial	14052	-7003,2

According to the Table 3, Poisson Model is not best performing model for the data set with the biggest AIC value. Since the Negative Binomal model has the smallest AIC value, one can say that Negative Binomial Model is the best model for the data set. However, dispersion parameter for the Negative Binomial Model is 1,0405 and dispersion parameter for the Poisson Model is 1,201623 which represent that dependent variable claim frequency is overdispersed. On the other hand, we used Vuong test if the zero inflated model is above the poisson model and zero inflated negative binomial model is above the negative binomial model. The Vuong test (Vuong, 1989) is a test to compare Zero inflated methods to the non-nested models for counts data. For the poisson part, computed statistic of Vuong's test is V= -6,722759 (p value = 8,91579e-12) which indicates that Zero Inflated Poisson regression fits better than standard Poisson regression and for the Negative Binomial part, computed statistic of Vuong's test is V= -1,569072 (p value = 0,0583156) which indicates that Zero Inflated Negative Binomial Model fits better than standard Negative Binomial Model. We can also state that zero inflated poisson model is above the standard poisson model and zero inflated negative binomial model is above the negative binomial model. Because Zero Inflated Negative Binomial Model and Hurdle Negative Binomial Model have the same AIC and log-likelihood value, we can say that

these models perform best for our data set. Parameter estimates of all models are represented below in Appendix1. Using parameter estimates in Appendix1, it is possible to interpret the variables. Male drivers were found to be involved in crashes 11.35%($1 - e^{0,1076}$) according to the zero inflated poisson model, 11.9% ($1 - e^{0,1131}$) according to the hurdle negative binomial model, 11.04% according to the zero inflated negative binomial model less compared to female drivers. It is possible to excess the results for all covariates. Here, we would like to take attention that these models has approximately close AIC values and log-likelihood results. Looking at the covariates these models gives the approximately close results. It is more reasonable to say for the decision maker, which model is the best for the data depends on the data structure. If all of the zeros are excess zeros then hurdle model is more appealing. On the other hand, if zero counts consist of both true and excess zeros that makes zero inflated models are more appealing(Xie et.al.,2013).

5. CONCLUSION

Modelling is fundamental to get a fair pricing in insurance. In that reason, analyzing the distribution of the data set is crucial for the actuaries. Especially insurance data set has more zeros than expected refers analysts to work with zero inflated models. In this paper, poisson and negative binomial models which are traditional methods to analyze count data and zero inflated poisson, zero inflated negative binomial, hurdle model with hurdle negative binomial model are applied to automobile insurance data. There are four independent variables which are insureds gender, marital status, age and vehicles age. Plot analysis presents that the dataset contains very large proportion of zeros which refers to overdispersion. Dispersion parameter is used to see if there is oversdispersion and Vuong test is used to compare non-nested models. AIC and log-likelihood values is used to compare models. We concluded that zero inflated poisson model is superior to the standard poisson model and zero inflated negative binomial model is superior to the negative binomial model. Since zero inflated negative binomial model and hurdle negative binomial model have the same AIC and log-likelihood value, we can say that they perform best for our data set. However, it is more reasonable to say for the decision maker, which model is the best for the data is depend on the data structure. Male drivers were found to be involved in crashes 11.35% according to the zero inflated poisson model, 11.9% according to the hurdle negative binomial model, 11.04% according to the zero inflated negative binomial model less compared to female drivers. It is possible to excess the results for all covariates. As a future research we intend to extend the analysis with longitudinal data to compare several zero models for insurance data.

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Appendix 1: Parameter estimates of models

Parameters	Poisson Model	Negatif Binomial M.	ZIP	ZINB	HURDLE	NBHURDLE
(Intercept)	-1,2848	-1,2852	-0,7048	-1,1671	-0,7509	-1,2656
	< 2e-16***	<2e-16***	<6,4e-10***	2,1e-11***	4,6e-10***	4,6e-07***
genderMALE	0,1112	0,1125	0,1076	0,1262	0,1131	0,1249
	0,0109*	0,0214*	0,2387	0,1050	0,2289	0,2477
ıaritlstatusMARRIED	0,0036	0,0415	-0,0780	-0,1153	-0,0175	-0,0230
	0,9491	0,9475	0,5296	0,3110	0,8842	0,8675
maritlstatusDIVORCED	0,1972	0,1996	0,2956	0,1845	0,3821	0,4121
	0,0452*	0,0739	0,1354	0,3240	0,0448*	0,0703
maritlstatusWIDOW	0,1378	0,1425	-0,1504	-0,1727	-0,0636	-0,0817
	0,3347	0,3726	0,6634	0,4920	0,8448	0,8235
vehicleage6-10	-0,1767	-0,1774	-0,3156	-0,2143	-0,3655	-0,3874
	0,0006***	0,0018**	0,0066**	0,032*	0,0027**	0,0043**
vehicleage11-15	-0,3209	-0,3217	-0,9987	-0,5339	-0,8408	-0,8896
	0,0868	0,1146	2,3e-07***	0,023*	0,1408	0,1440
vehicleage16-20	-1,0264	-1,0221	-1,6924	-1,2397	-5,6895	-8,3310
	0,3049	0,3266	0,0913	0,2330	0,8686	0,9466
insrdsage36-50	-0,0759	-0,0776	0,0515	0,0861	0,0510	0,0501
	0,1028	0,1392	0,6260	0,3490	0,6060	0,6609
insrdsage51-70	-0,2424	-0,2438	-0,0059	0,0080	-0,0387	-0,0428
	6,4e-06***	0,00005***	0,9611	0,9480	0,7387	0,7482
insrdsage71-100	-0,3843	-0,3873	-0,2942	-0,2365	-0,2020	-0,2233
	0,0017**	0,0041**	0,2842	0,2900	0,4773	0,4831
(Intercept)			-0,2480	-2,5090	-0,2603	-1,2603
			0,2840	0,2300	<2,6e-16***	<2,6e-6***
genderMAN			-0,0125	0,1670	0,1106	0,1106
			0,9470	0,7600	0,0444*	0,0444*
maritlstatusMARRIED			-0,1910	-1,1560	0,0075	0,0075
			0,4660	0,0700	0,9163	0,9163
maritlstatusDIVORCED			0,1790	-0,5040	0,1221	0,1221
			0,6260	0,5200	0,3455	0,3455
maritlstatusWIDOW			-0,7050	-10,8460	0,1942	0,1942
			0,4160	0,9500	0,2771	0,2771
vehicleage6-10			-0,3280	-0,2760	-0,1286	-0,1286
			0,2210	0,6600	0,041*	0,041*
vehicleage11-15			-12,10	-15,6060	-0,2246	-0,2246
			0,9840	1,0000	0,3020	0,3020
vehicleage16-20			-21,10	-15,1410	-0,9111	-0,9111
			1,0000	1,0000	0,3856	0,3856

Appendix 1: Parameter estimates of models (continued)

insrdsage36-50	0,2990	1,7970	-0,1142	-0,1142
	0,1970	0,2900	0,0551	0,0551
insrdsage51-70	0,5350	2,3140	-0,2960	-0,2960
	0,034*	0,2100	1,2e-05***	1,2e-05***
insrdsage71-100	0,2020	1,6150	-0,4336	-0,4336
	0,7410	0,4100	0,0036**	0,0036**

*Significant at the 5% level, ** Significant at the 1% level, ***Significant at the 0,1% level

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VISION AND ITS IMPACT ON TEAM SUCCESS

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ABSTRACT

A strong vision is a main predictor for both organizational and team success. Although many studies conclude that vision is important at the organizational level, the impacts of vision on innovation/teams have received far less attention. The purpose of this paper is to discuss vision components and explore its impacts on team performance. After studying the vision on a series of 12 innovations at three companies (Apple, IBM, and HP), we empirically tested the impact of the three components of vision on overall team performance. Data were collected from 75 team members. We found that Vision Clarity and Vision Stability have a positive effect on team performance. We also found that, Vision Support is not significantly related to team performance.

1. INTRODUCTION

The concept of teams and teamwork is increasingly becoming an important concept key to new product development, productivity and quality in the workplaces. At the same time, the process of team building has become more complex and requires more sophisticated management skills (Revilla and Cury, 2009). The team may be composed of individuals closely tied within organizational and functional boundaries (e.g., marketing), or teams may be cross-functional (e.g., marketing, accounting, and production), where individuals originate from a variety of disciplines and responsibilities (Hansen, 1994). Teams span many functional areas including engineering, marketing, manufacturing, finance, etc., and new product teams must frequently be composed of individuals from different backgrounds and perspectives (Revilla and Rodriguez, 2011). Recent empirical research shows that most firms have implemented cross- functional teams for the majority of new product development projects undertaken (Hong, Vonderembse, Doll, and Nahm, 2005). Team vision is a shared purpose and plan of action that clarifies strategic fit and sets project targets and priorities that are consistent with the firm's design, manufacturing capabilities, and market requirements (Clark and Wheelwright, 1994). Ray and Bronstein (1995), state that in successful teams the individual members are not controlled, managed, or supervised. Instead, team members are led by a shared vision of the goals and purpose of the organization. In teams with a strong shared vision, members have a common sense

of purpose and agreed- upon goals, and are more likely to feel motivated, empowered, and committed to their teams' collective future (Levine and Moreland, 1991; Hackman, 1992; Kirkman and Rosen, 1999; Liden, Wayne, and Sparrowe, 2000; Zhang, Waldman, and Wang, 2012). Zhang and Doll (2001) state that, especially in new product development studies, product quality and manufacturing cost are mainly determined by the end of the product concept stage, before most of the design begins. Therefore, a strong team vision a final gate to proceed new product development, is very important. Similarly, many researchers explained and confirmed the positive impacts of team vision on team performance (Naylor and Ilgen, 1984; Eden, 1988).

In teams, decisions are frequently made by team members. But team members may have a different vision or interpretation of the same event, may be pursuing different priorities or goals, and hence may be in conflict with one another regarding data acquisition, interpretation and dissemination (Zhang and Doll, 2001). Because in a team, individuals from various functional areas often have different ideas about the project, without effective team vision these individuals generally pull the project in different directions and thereby adversely affect the performance of the team (Ancona and Caldwell, 1992). Thus, in order to minimize the adverse effects of the various diversities in a team and to promote better performance, it is important to develop a common view among team members (Revilla and Rodriguez, 2011).

Team vision indicates the extent to which the team has a clear, shared, attainable vision or set of objectives (Gibbon et al., 2002). When the team has a vision, objectives can be set and the effectiveness of these objectives determined. Shalley and Gilson (2004), assert that a communicative vision can maximize the creativity of individuals by affecting team and organizational conditions that foster innovation. By enabling the enactment of a shared team vision, concurrent development facilitates downstream coordination, enhances product integrity, and improves product development success (Koufteros, Vonderembse, and Doll, 2002). Thus, if the team is to be effective, it will need to be driven forward by either an implicit or explicit shared vision, which has been developed from within the group, is valued by the group and deemed to be attainable and realistic. Khurana and Rosenthal (1998) identified that the common team problem areas in the front end include: (1) unclear project strategy and projects not prioritized, (2) unclear tradeoff of project objectives and unsuitable assignment of people to projects and, (3) unclear interface of subsystems and the lack of team members' direction.

Vision is derived from Latin Vide "to see!" The exclamation point implies something other than seeing by ordinary sight (Lynn and Akgun, 2001). It implies knowledge and foresight (Cummings and Davies, 1994). It is a statement of the desired future state of something (Rice, O'Conner, Peters, and Morone, 1998). Brown and Eisenhardt (1995), for instance, describe vision from the perspective of new product development teams and define it as the meshing organization's competencies and strategies with the needs of market to create an effective product concept. In this same line, team vision is seen as a shared purpose and plan of action that clarifies mission, strategic fit and sets of project targets and priorities that are consistent with the firm's internal capabilities and the market place

realities (Clark and Wheelwright, 1993). Based on the above premises, this study identifies three components in the concept of vision. It should be vision clarity, vision stability, and vision support. Other scholars have also emphasized similar vision components. Hamel and Prahalad (1989), for example, assert that an effective organizational vision has three components. It must be (a) clear, (b) supported by others in the organization, and (c) stable. Similarly Lynn and Akgun (2001), identified three component of vision (clarity, stability, and support) and empirically tested its impact on team success. Niemes (1996), for example, asserts that clarity is critical for teams. Vaughan (1997) and McAlister (1998) emphasize vision clarity and agreement or support is important, and Giordan (1995) stresses clarity and company support. These components together allow the development of a team vision that will guide the efforts of the team in a common direction, despite the differences among team members.

The first component, vision clarity (VC), refers to having a well-articulated, easy-to-understand target- a very specific goal that provides direction to others in the organization. For Canon, the corporate vision was to "Beat Xerox;" for Honda, it was to become second to Ford in automotive innovation (Hamel and Prahalad, 1989); for United States of America's space program it was to "put a man on the moon and return him safely to the earth by the end the of the decade;" and for Dennis Connor and his America's Cup Team, the vision was to "bring it back" (Niemes, 1996). These visions create a clear image of what the organization is trying to do. Vision clarity is the first step in creating an effective vision. It provides the goal which others can shoot. Without a clear vision, it is unlikely that others will support it because they don't know what they are supporting, nor is the vision likely to be stable and endure over time.

The second vision component, vision stability (VS), means that a company's vision remains consistent over time. Having a stable vision reduces confusion within an organization. If an organizational vision changes repeatedly – like "the flavor of the day" – people can become frustrated and confused about what they are supposed to do. Lipton (2003) points out that a vision should be stable. If not, one may not have created an appropriate vision for the organization. Nystrom (1990), for example, says that a change in market vision during the project helps other firms to capture that market niche due to confusion and misunderstanding those results from these changes.

The third vision component, vision support (VSP), implies securing the commitment from people throughout an organization for what the company is trying to do. It indicates that people are willing to pitch in to help accomplish the vision – to do whatever it takes to achieve the goal. Hanson and Lubin (1988) suggested that for team building to be successful is necessary that all members must be committed to the effort and willing to take responsibility. In other words, without a supported vision by the people on the team, others, on and off the team, will continually question its direction and will try to change the vision as the project progress. The net results will be delays, confusion and diminished effectiveness.

Although these three vision components (clarity, support and stability) appear compelling at an organizational level, there are conflicting arguments regarding their importance for organizations in general and even greater questions regarding their applicability at the team level. To illustrate, Collins and Porras (1995) assert that VC was absent at many of the greatest companies that they studied. For example, in 1937, when Bill Hewlett and Dave Packard formed HP, they decided to start their company first and then overtime figured out what they would produce. Similarly, in 1945, when Masaru Ibuka formed Sony, he had no specific product idea. After he formed Sony, he and his seven initial employees, conducted a series of brainstorming sessions to figure out what they would produce. The list goes on: Sam Walton and Wal-Mart, J. Willard Marriott and Marriott, Nordstrom, Merck, Procter and Gamble. These companies did not begin with a clear specific vision in mind. The organizational vision emerged over time.

Although the concept of vision is receiving increased attention at the organizational level, there is a great deal we still do not know regarding vision at the team level. As Brown and Eisenhardt (1995) state, although this aspect of the team is considered critical, our understanding of exactly what team vision is, what an effective product is, and its link with product development performance is very weak. Crawford and Di Benedetto (2000) also note that there is surprisingly little research in vision in teams. For their project-level research, Lynn and Akgun (2001) developed scales and definitions for three project vision components - clarity, support, and stability—and tested these for impact on performance of radical innovation and incremental innovation. However, we do not know if their findings are applicable for team performance that is measured by objective/quantitative variables. Zhang and Doll (2001) state that for success new product development, the team vision factor is the most critical one needs to be explored in the future research.

In light of the conflicting literature on vision and its components at the organizational level and the limited empirical research on vision at the team level, the general objective of this study was to explore the impact of vision clarity, vision stability and vision support on team performance. Consistent with our general objective, firstly, we conducted investigations on 12 sequential real innovation teams in the computer industry within three companies – Apple, IBM and HP- on team vision and its components. Products included the Apple II, IIe, III, Mac, and Lisa; Hp85, 125, 150 and Vectra; IBM DataMaster, PC, and PSjr. Secondly, after studying on a series of thirteen real innovation teams, we empirically tested the impact of vision clarity, vision stability and vision support on overall team performance.

2. THEORY and HYPOTHESES

2.1. Vision Clarity (VC)

The first component, VC, refers to the extent of communication, understanding, and acceptance of a set of project goals that guide development efforts (Hong, Doll, Nahm, and Li, 2004). The team goals must be well articulated and clearly understood and shared among team members. Zhang and Doll (2001) stated that in order to develop new products successfully the project team has to deal with the uncertainty from customer,

technology and competitors. Although the uncertainty is beyond management's control, at least the teams can focus on clear team vision building and knowledge sharing (Zhang and Doll, 2001). Lynn, Abel, Valentine, and Wright (1999) found that one of the two factors considered most critical of the new product development success was a clear project vision. The individual learning literature argues that if individuals have a clear goal, they learn their tasks faster (Covey, 1997). Lucas (1998), for example, states that a clearly defined vision helps individuals arrange their various priorities and keeps them focused on the task, enabling the individual to learn faster. Having a clear team vision should help team members focus better on market, technology, and environmental changes that can be obstacles for rapid team learning and success. Eisenhardt (1989) states that teams having a clear vision can reduce cycle time. Conversely, Kessler and Chakrabarti (1996) argue that teams without a clear vision (having ambiguous project concepts) promote suspicion and conflict on a team regarding what should be produced, which can result in time-consuming, readjustments, and debates.

In our initial study of 12 real innovation teams in Apple, IBM and HP, all the extraordinarily successful innovations had a clear vision – the team members knew what the team was trying to do- the features, target market, price point was clear. Though not everything was spelled out, team members knew what they were trying to do –what their mission was. As an example, the IBM PC team had a crystal clear vision of its goal. As Larry Rojas, the Director of Planning for the IBM PC team recalls: "We were trying to out Apple Apple." The PC was to be a personal computer that would be versatile enough to be used in the home, at school as well as by small businesses. The PC's vision was established by a task force, many of whom were recruited from the DataMaster (the precursor to the PC). The vision or blueprint was a plan of when the PC should be launched, what features and benefits it should provide, who the target market would be, and where it would be sold. The plan was established, understood, and agreed to by Frank Cary, IBM's CEO, Bill Lowe the initial project leader, and the other members of the PC task force team. The team's objective, as Jan Winston, one of the early PC task force members describes, "to go execute the task – force plan." The result of this process was that the PC team had a very clear vision and sense of purpose. In contrast to the extraordinarily successful new product teams, the failed Apple Lisa project lacked a clear vision. The vision on the Lisa was ambiguous and vague. The overarching goal of Lisa was be an office productivity tool, but an office productivity tool can be anything from a fax machine to a ruler. As a result, team members did not agree on what the vision of Lisa was supposed to be nor what it was supposed to do. Over time, the vision changed; the features and functionality of the Lisa grew, and with it, so did the cost. What began as a $2,000, 8-bit computer, became a $9,995, 16-bit computer. Unfortunately, the market was not ready for a $10,000 personal computer; sales for the first year fell woefully below forecast. The first year Lisa forecast called for 1983 sales to reach 50,000 units, but only 11,000 units were actually sold. Repeated attempts to revive to Lisa failed, and in April 1985, at an Apple Board meeting, the Lisa was cancelled and dropped entirely. Consistent with literature in VC and our study of 12 innovations, we hypothesize:

Hypothesis 1: Vision clarity is positively related to team performance.

2.2. Vision Stability (VS)

A clear vision is important, but if the vision changes repeatedly during the project, it can confuse and frustrate team members (Lynn and Akgun, 2001). VS means the extent to which a vision is unlikely to be changed by any market or technology development (Kantabutra, 2008; Kantabutra and Avery, 2007). Hanson and Lubin (1988) argued that team building is an effort in which a team studies its own process of working together and acts to create a climate in which members' energies are directed toward problem solving and maximizing the use of all members' resources for this process. Similarly, Khurana and Rosenthal (1997) argued that an explicit, stable product definition and an understanding of the trade-offs among customer requirements, technology, and resource/cost constraints are important factors for speed and productivity of new product development. More importantly, an effective vision should represent a general idea and not change dramatically over time (Gabarro, 1987; Tichy and Devanna, 1986). A vision which changes dramatically over time negatively affects planning and ongoing implementation of an existing vision, and unstable visions also bring about confusion among followers who are executing strategies and plans, eventually leading to deterioration in follower commitment to vision and organizational performance (Kantabutra, 2009). Similarly, Parikh and Neubauer (1993) state that by expressing an unstable vision, the moment followers start doubting the seriousness of the manager toward implementing the vision, cynicism is invariably the consequence.

In our initial study of 12 real innovation teams, we saw that in the unsuccessful projects the visions were noticeably unstable. For example, the IBM PC jr. was initially given a clean sheet of paper allowing the team to design the best home computer it could – independent of compatibility. But as the project progressed, senior management changed the rules and required the IBM PCjr. to be 100% compatible with the IBM PC. Although the original IBM PCjr. task force recommended that the computer be targeted to the consumer market at a price of $695, over time the distribution and sales strategy changed to include both retailers and IBM's traditional distribution network. The latter added substantially to the price, as did the need to be fully compatible with the IBM PC. These changes pushed the price higher and higher. By the time the IBM PCjr. was finally launched, its retail price for a useable system was over $1,200 and that was not price competitive.

On all the initial successful projects (of the 12 studied) – the projects remained stable from the early go ahead until launch. For example, the vision on the IBM PC remained constant from the time the task force received formal approval for development until it was commercialized. When the IBM PC team presented the final product release plan to IBM's senior management, most of the charts used during the initial task force proposal presentation were used again one year later for a presentation to the executive management committee just prior to launch. As Lowe recalls:

> *He [Don Estridge, the overall project manager], called me frequently and I remember the day he got approval to announce the project, he called and said,*

> *'what you'd be proud of is that, of the charts we presented for approval, 80% of them are the identical same charts you used a year ago.*

The HP85-Controller demonstrates one of the differences in a project's vision depending on the type of innovation. The other successful projects, Apple IIe, Mac and HP Vectra were incremental innovations and the IBM PC was a marketing innovation. These types of innovations have far fewer technical uncertainties than technical or radical innovations. These types of innovations may require a different vision profile. As background, HP launched its first "personal computer", called the HP85, in 1980. It sold for $3,250. The HP85 came out of HP's calculator division. It had a 40-character 5" CRT screen, with up to 32K of RAM, a tape storage drive and a thermal printer. The unit was compact and portable because it was designed by many of the same people who developed the HP35 and HP65 portable calculators. Unfortunately, the size and weight design parameters of the HP85 limited its performance and functionality. Although a 5" screen was large for a calculator, it severely restricted the HP85's use as a personal computer.

During this time, the PC market was growing, but it was not clear to HP engineers nor to their marketers what a personal computer should be or for whom it should be targeted. A formal external competitive market and technical analysis of Apple and other personal computer companies were never conducted. As a result, the initial vision for the HP85 as a personal computer was somewhat unclear to team members. As Dan Terpack, the Division Marketing Manager for the HP85 recalls:

> *[Vision] Clarity wasn't there. I think fuzzy is the right word. You have to put it in the context of that time frame where there was talk about PCs, but not a lot of agreement to it.*

As the HP85 project progressed, Bob Watson, who had a background in instrument controllers for HP, was brought in as the new divisional manager. When Watson learned about the HP85 and its capabilities, he thought that, with minor alterations including adding plug-in interface ports and a more convenient numeric entry keypad, the HP85 could be used as an equipment controller (e.g., to turn a piece of equipment on or off). The team agreed to implement Watson's changes and to simultaneously pursue the controller market with the HP85. The HP achieved success as a controller by capitalizing on HP's existing sales force. As a controller, the HP85 was successful, but as a personal computer is fell short in both sales and profit expectations. HP85 raises the issue that perhaps when dealing with technological innovations, much more flexibility is required in terms of project vision. It is reasonable to assume that given all the uncertainties for technical or radical innovations, an initial vision can remain stable … and succeed? Thus consistent with literature in VS and our study of sequential innovations in computer industry, we hypothesize:

Hypothesis 2: Vision stability is positively related to team performance.

2.3. Vision Support (VSP)

A clear and stable vision is two components of an effective vision; the vision must also be shared and supported by others on the team. VSP allows members in the team to understand how they might work together or align themselves to play a role in realizing that vision. Lewis (2001) explains, if everyone does not agree on the vision, each person will try to achieve the outcome he or she imagines, often with disastrous results. Teams with an innovative team climate are characterized by a high cohesion between team members, high levels of support and challenge, good sharing and implementing of new ideas, and clarity of tasks and objectives (Anderson and West, 1998; Bain, Mann, and Pirola-Merlo, 2001). Briner, Geddes, and Hastings (1996), state that the most significant success factor for project teams is that they have a common and shared idea of what difference they are trying to make as a result of the project. Rose, Ahuja, and Jones (2006), for example, states that promoting a unified team vision would seem to be important; professionals need to work at generating an atmosphere of trust between team members and then developing problem-solving methods where all members of the team are encouraged to contribute. Similarly, Katzenbach and Smith (1992), identify four team basics that need to be present for teams to perform well. Te team must: (1) Have a common purpose, (2) establish goals and individual and collective accountability, (3) agree a common to getting the work done, and (4) have complementary skills.

In our study of 12 sequential innovations, two examples of projects that secured good support or buy-in for the vision were the successful IBM PC and Apple IIe. For the IBM PC, by having Cary as the PC's executive sponsor, by default, the vision had top management support. And by having virtually all the people who had formulated the initial vision from the task force, being in the actual PC team, the vision was supported by the team members as well. On the Apple IIe, team members similarly bought the vision of the project. Mike Connor, who was the project leader succeeding from Taylor Pohlman, describes the vision on the Apple IIe: "There was a clear sense of mission that everyone really bought." Barry Yarkoni, a marketing manager on the Apple IIe, concurs, "There was absolute agreement by everybody on the vision of the IIe."

In contrast, the unsuccessful projects, such as the Apple III, HP's 125 and 150, and the IBM PCjr exhibited a different pattern. On the Apple III, individual team members had vision about what the Apple III should be and who would be the target market; unfortunately, these visions varied for different team members in different functional disciplines. The marketing people had one vision and the engineering people had another. As Yarkoni, who was the early marketing manager for the Apple III explains:

> *The engineering people had a certain vision of what the product should be which was basically souped up Apple II. The marketing people were saying, 'oh my gosh we've got a cash cow in the Apple II that's generating pot-fulls of money. The last thing we want to do is to start cannibalizing it for no good reason. We want a product that will take us into some new markets and give us some potential new customers that are not being serviced that are not buying Apple*

> *II's and we want the Apple III to be a professional machine.' So meanwhile the engineers had loaded it up with goodies in terms of graphics and sound and we much preferred goodies that made it oriented toward businesses professionals. So, right off the bat we had a major war going on between where we needed the product to go from a business point of view and where engineering wanted the product to go because it was fun.*

The lack of vision support was one of the primary reasons that it took Hewlett Packard over 12 years to succeed in the personal computer marketplace. HP experienced a series of setbacks in its efforts to compete in the PC business. The main source of the trouble was that engineers at HP had a mindset to be innovative- "to make a substantial technical contribution" despite a vision that was established by HP's consultants that indicated HP's PC must be fully IBM compatible. The idea of being an IBM clone maker was repugnant to most engineers at HP and they refused to accept it. Larry Kelly, the HP 125 and 150 RandD Lab Manager explains:

> The test [at HP] always used to be, when you had an idea or were working on a project – what's the contribution? What have you done that nobody's done before? That [mentality] works fine for instruments but that's in direct contrast with being compatible. So you've got a company that's 35 or 40 years old at the time with $1 or $2 billion in revenue. And you've got all these engineers thinking. 'You can't wear your boots unless you know [that] you've done something nobody else's done – you can't come to work.' Overcoming that mentality was very hard. It took them [HP engineers up to its senior management] four or five years to realize that it [an HP PC] had to be compatible [with IBM] first and then maybe you could innovate after that.

As a result, many of the HP engineers did not buy-into the vision of designing and building a clone of the IBM PC. In a somewhat similar example, the initial vision for the IBM PCjr. was a powerful, versatile home computer that could compete with the PC at the low-end for home/personal use. But senior management did not agree with the team's vision and as a result, a conflict arose. Bill Sydnes, the IBM PCjr. System Manager (the overall project manager), recalls his team's versus management's position:

> *The IBM PCjr. was originally intended to have a large number of peripherals on it that would have allowed it to compete at the low end of the PC product line. It would have obliterated the low end of the PC product line. IBM's position was, we're not going to allow you to do that.*

Behind the scene, another dynamic was unfolding. IBM was having second thoughts about selling a home / game computer. Company executives were concerned about being perceived as a home computer company. After all, they were International "Business" Machines; not International "Home" Machines. As David O'Connor, who took over from Sydnes as the PSjr.'s System Manager, recalls:

> There were some guys at the top of the corporation who really believed that they didn't want the IBM logo in the retail or consumer distribution channel at the time. [They said] 'IBM is not a consumer company. They are a business company. They sell to professionals and businesses and large corporations … and this home computer stuff is not for us.' The instant there was any problem with the program, it gave those who felt IBM should not be in that market reason to suggest that we delay the program.

What began as a skunk works quickly changed to include a high degree of involvement from top management. Senior management came in and altered the rules. They required that the PCjr. be 1) fully compatible with the PC, 2) de-functionalized so not to cannibalize the low-end of the PC market, and 3) geared to both the home and as well as the business markets. The result of mid-course changes was that Sydnes left. His leaving created a void that was difficult to fill. His leaving combined with the changes, delayed the project, altered its target market and reduced its technical capabilities. Needless to say, the product failed. Therefore consistent with literature in VSP and our study of 12 innovations, we hypothesize:

Hypothesis 3: Vision support is positively related to team performance.

3. METHODOLOGY and ANALYSIS

3.1. Sample and Data Collection

Data were collected from executive masters students in a business program at a university in the Northeast Region of the United States. To avoid common method bias, we designed a research protocol that involved surveying executive masters students enrolled in several sections in a Marketing Strategy course. For this Marketing course, students competed in teams of four to six students in a computer simulated marketplace for six periods or rounds over eight weeks. The computer simulation was specially created and written for this course and is used by several leading business schools such as Insead and Wharton. Students were surveyed after they had completed the simulation – six rounds. Also prior to completing the six "real" rounds, two practice round were played. Their survey-responses were matched to their final results from the simulation, e.g., sales, profits and market share. The outcomes were objective/quantitative measures calculated by the simulation.

We first pilot - tested the survey with ten students from three different Masters of Business programs. After receiving the returned surveys, we corrected several questions in which respondents had difficulty answering or indicated were unclear. These pilot surveys were not used in the final dataset. Once the surveys were refined, we sampled 75 students who were in two sections of Marketing Strategy in an Executive Masters of Business program. We received a 95% response rate. These students were all full-time working professionals with a mean age of 31.8 and standard deviation of 9.2. They came from locations across the United States – from New Jersey to California.

3.2. Measures

To test the our hypotheses, a questionnaire was developed based on previous research from several disciplines including (1) new product development (e.g., Cooper and Kleinschmidt, 1987; Meyer and Pruser, 1993; Millson, Raj, and Wilemon, 1992; Nijssen, Arbouw, and Commandeur, 1995; Karagozoglu and Brown 1993; Bacon, Beckman, Mowery, and Wilson, 1994; Chiessa, Coughland, and Voss, 1996), (2) marketing (e.g., Day, 1994; Moorman 1995), (3) knowledge management (e.g., Davenport and Prussak 1998; Lynn, 1998; Roth and Kleiner 1998) and (4) psychology (e.g., Larson and LaFasto 1989; Locke, Shaw, Saari, and Latham, 1981; O'Leary-Kelly, Martocchio, and Frink, 1994).

VC was measured with six items. An example item was: 'Prior to beginning the real rounds (after the practice rounds), the team had a clear vision of the required product features'. (Prior to completing the six "real" rounds, two practice round were played). VS was measured with three items. An example item was: 'The vision for our company remained stable from the start of the real rounds through the end of the game'. VSP was measured with one item. The item was: 'Overall, team members supported the vision of our company'. Each construct was measured using multiple items and Likert type 0 to 10 scale (0 = strongly disagree to 10 = strongly agree). The dependent variable (Team Performance) was measured with cumulative profit – and was calculated by the simulation at the end of the game in terms of Dollars ($). (Our constructs are shown in Appendix).

3.3. Reliability and Validity

An exploratory factor analysis was performed to assess the dimensionality of the constructs of VC and VS by using principle component with Varimax Rotation. Unidimensionality was exhibited in this two constructs as only one factor surfaced in each set of analyses. Appendix shows the constructs whose eigenvalues are greater than one, factor loadings and variation explained by each item. Additionally before doing any further analysis, the reliability and validity of constructs items were tested. Appendix also includes crombach's alpha for each construct. Alpha coefficients of constructs are greater than 0.75 which indicates good reliability as suggested by Nunnally (1978).

Additionally to evaluate the convergent validity of the model constructs, a confirmatory factor analysis with three factors constructs, namely VC, VS and VSP, with a total of 75 measures, was conducted. The model was assessed using several goodness-of-fit indices (Table 1). The chi-square (X2)/degrees of freedom (df) value was less than 3.0, indicating an good fit (Arbuckle, 2006). The incremental fit index (IFI), goodness of fit index (GFI) and comparative fit index (CFI) values were all at least 0.90, representing a good model fit (Bentler, 1990), and the root mean square error of approximation (RMSEA) value was less than 0.08, indicating a reasonable model fit (Browne and Cudeck, 1993). A satisfactory fit was attained: X2/df (1.57), IFI (0.984), GFI (0.908), CFI (0.984), RMSEA (0.08). Additionally, as can be seen in Table 1, all observed variables had significant loadings ranging from 0.47 to 0.92. Consequently, a valid measurement model was obtained.

Table 1. CFA Testing of Vision Components

Factors /items	Standardized loads	t-values	R^2
Vision Clarity			
VC1	0.78	7.94	0.611
VC2	0.73	7.20	0.537
VC3	0.72	7.10	0.523
VC4	0.64	6.09	0.412
VC5	0.80	8.21	0.639
VC6	0.92	10.28	0.849
Vision Stability			
VS1	0.92	8.75	0.780
VS2	0.67	6.31	0.455
VS3	0.47	4.03	0.218
Vision Support			
VSP	1.00	12.33	1.00
X^2=41.33; DF= 26; CFI=0.984; GFI=0.908; IFI=0.984 X^2/df=1.57; RMSEA=0.08			

3.4. Analysis and Results

The means, standard deviations, and the correlation coefficients for all constructs were displayed in Table 2. The results indicated that team performance for cumulative profit was significantly correlated with VC, VS, and VSP at a confidence level of α=0.01.

Table 2. Correlation Matrix and Descriptive Statistics

Variable	Mean	S. Dev.	1	2	3	4
(1) Cumulative Profit ($million)	58	36	1.000			
(2) Vision Clarity	7.75	1.79	0.431*	1.000		
(3) Vision Stability	7.52	1.96	0.433*	0.583*	1.000	
(4) Vision Support	8.59	1.74	0.304*	0.534*	0.666*	1.000

Note. *Significance at α= 0.01, (two-tailed), N=75.

To test team performance as an outcome variable for VC, VS and VSP, we performed Hierarchical Regression Analysis (Table 3). Predictor variables were entered in blocks. The predictor, VC, was entered first, followed by VS. VSP was entered finally to conclude the full model. Correlations between the team performance and each predictor variable, when the linear effects of the other predictor variables in the model were removed as the predictor variable, were shown in the part correlation column of Table 3. Results from the full model (model 3) revealed that VC (t=2.140, p<.05), and VS (t=2.012, p<.05) are positively associated with the team performance for cumulative profit. But VSP is not positively associated with cumulative profit. We found that of the three constructs, VC is the most significant predictor (p = 0.000) - contributing 18,6% to the variability in team performance. Thus, hypothesis 1 and hypothesis 2 are supported. But hypothesis 3 is not.

Table 3. Hierarchical Regression Results Predicting Team Performance

Models and variables	Regression coefficient	Standard error	Sig.	Partial correlation	Part correlation
(1) Vision Clarity	8.689.123	2.127.120	0.000	0.431	0.431
(2) Vision Clarity	5.460.745	2.553.944	0.036	0.244	0.220
Vision Stability	5.058.554	2.332.736	0.033	0.248	0.223
(3) Vision Clarity	5.666.478	2.648.145	0.036	0.246	0.222
Vision Stability	5.514.659	2.962.927	0.048	0.232	0.209
Vision Support	-954.522	2.741.298	0.748	-0.038	-0.033

Also, the summary of models was presented in Table 4. As can be seen in Table 4, The model 1 is significant, F(1, 73) = 16.687, p = 0.000, and explained 18.6% of the variance in team performance. The model 2 is significant, F(2, 72) = 11.118, p = 0.000, and explained 23.6% of the variance in team performance. Similarly the full model (model 3) is significant, F(3,71) = 7.354, p = 0.000, and explained 23.7% of the variance in team performance.

Table 4. Models' Specifications Summary Predicting Team Performance.

Model	R^2	ΔR^2	ΔF	Sig. ΔF
1[a]	0.186	0.186	16.687	0.000
2[b]	0.236	0.050	4.702	0.033
3[c]	0.237	0.001	0.104	0.748

Note. [a] Predictors: (constant), Vision Clarity (F(1,73) = 16.687; p = 0.000)).
[b] Predictors: (constant), Vision Clarity, Vision Stability (F(2,72) = 11.118; p = 0.000)).
[c] Full model, predictors: (constant), Vision Clarity, Vision Stability, Vision Support (F(3,71) = 7.354; p =0.000))

To validate our results, in addition to using Cumulative Profit, we also used Cumulative Profit Rank as a measure of team performance (ordered team rank according to their cumulative profit; 1=greatest cumulative profit to 4=lowest cumulative profit). Thus, to test the relationships between the Team Vision Components (VC, VS, and VSP) and team performance for cumulative profit rank, we performed ordinal logistic regression analysis with the logit link (Table 5).

According to the fitting statistics for model with the logit link; the -2LL of the Vision Components model with only intercept is 237.483 while the -2LL of the model with intercept and independent variables is 209.970. In this case, the difference between the -2 log likelihoods—the chi square—has an observed significance level of less than 0.01 (X2 = 27.513 with d.f. of 3 and p = .000). This means that the variables in the model do indeed have joint significance. Thus we can conclude that model for Vision Components is significant. The goodness of fit statistics is intended to test whether the observed data are consistent with the fitted model (Hair, Black, Babin, and Anderson, 2010). According to the results of the goodness of fit statistics for model with the logit link; the Deviance's chi-square (X2 = 209.970 with d.f. of 245 and p = .949) for the model indicated that the observed data were consistent with the estimated values in the fitted model. In this case,

the results of our analysis suggest that the Vision Components model does fit very well (p>.05). The pseudo R square indicated that the proportion of variations in the cumulative profit rank variable was accounted for by the Vision Components variables. The larger the pseudo R square was, the better the model fitting was (Hair et al., 2010). In this mean the values of pseudo R-square for Cox and Snell, Nagelkerke and McFadden for team vision components model with the logit link are 0.307, 0.321, and 0.116 respectively.

The Parameter estimates results are the core of the output, telling us specifically about the relationship between our explanatory variables and the outcome. The estimate values labeled Location are coefficients for the predictor variables. Using the model with the logit link, Table 5 shows that the team performance for cumulative profit rank is significantly associated with the VC (β=-.396, p<.01) and the VS (β=-.329, p<.05). In other words, VC and VS exhibited negative regression coefficients, indicating that team members who rated higher levels of VC and VS are likely to rate a higher performance for the cumulative profit rank. However, team performance for cumulative profit rank is not significantly associated with the VSP (p>.05). As seen, the results for cumulative profit consistent with the results for cumulative profit rank. As a result, VC and VS were significantly associated with team performance for both cumulative profit and cumulative profit rank. But, we did not find any direct and significant association between VSP and Team Performance for either Cumulative Profit or Cumulative Profit Rank.

Table 5. Ordinal Regression Analysis

	Parameter	Estimate	Std. Error	Wald	df	p
Threshold	1	-7.21	1.49	21.40	1	.000**
	2	-6.03	1.43	17.81	1	.000**
	3	-5.33	1.39	14.65	1	.000**
	4	-4.31	1.35	10.24	1	.003**
Location	Vision Clarity	-0.40	0.16	6.04	1	.004**
	Vision Support	-0.05	0.17	0.08	1	.822
	Vision Stability	-0.33	0.16	4.23	1	.048*

Dependent variable: Team performance for cumulative profit rank

X^2=27.51 Cox and Snell R^2=0.31 Nagelkerke R^2=0.32 McFadden R^2=0.12 p = .000

Note. **p<0.01, *p<0.05, , Link function: Logit.

4. DISCUSSION

As a result of our analysis, we found that VC was significantly associated with team performance. This finding is consistent with the scholarship and business press citing the importance of "vision" to success (Baum, Locke, and Kirkpatrick, 1998; Lynn and Akgun, 2001; Revilla and Cury, 2009; Revilla and Rodriguez, 2011; Patanakul, Chen, and Lynn, 2012). For example, Revilla and Cury (2009), in their empirical study, have revealed that clarity of project purposes has a positive influence in the new product performance in terms of process outcomes and teamwork. Patanakul et al. (2012), by studying 555 new product development projects, found that among the control variables, vision clarity is the

most important predictor of project performance. For their project-level research, Lynn and Akgun (2001) developed scales and definitions for three project vision components - clarity, support, and stability—and tested these for impact on performance of radical innovations. Their findings indicate that project vision clarity is significantly associated with new product success. Song and Montoya-Weiss (1998), by studying 169 radical projects, found that strategic planning which they related to vision is positively associated with new product success. Cole, Harris, and Bernerth (2006) explored the relationship of vision and employees' commitment to the change initiative that was addressed in the vision and found that VC was significantly related to increased job satisfaction, reduced role ambiguity, and lowered intent to turn over among employees, even among those who doubted the appropriateness of the changes or felt that the changes were poorly executed. Similarly, Revilla and Rodriguez (2011), studying the team vision on 78 new product development, found that in low ambidexterity strategies clarity dimension is significantly associated with teamwork. Schein (1993), state that in order for organizations to succeed in unfamiliar environments, companies must reduce their anxiety by providing a clear vision of what has to be accomplished and by creating a psychologically safe environment. Similarly, Rice et al. (1998) found that for successful radical innovation, teams should have a clear vision, but be flexible with their project plans.

In this study, we also found that VS was significantly associated with Team Performance. This finding is consistent with prior research (Hanson and Lubin, 1988; Baum et al., 1998). For example, Baum et al. (1998) are among the first group of researchers who investigated the relationship between the vision attributes and organizational performance in American new ventures. They found that vision attributes of brevity, clarity, future orientation, stability, challenge, abstractness, desirability or ability to inspire impacted venture growth positively, both directly and indirectly, via vision communication. Lynn and Akgun (2001) found that vision stability is positively associated with success for incremental innovation. Slater and Narver (1995), state that robust stable vision is required to finish a project successfully and on time. Carmen, Maria, and Salustiano (2006), by studying with 960 Spanish firms, found that Top Management Team's strategic vision alone does not explain companies' innovation performance. Innovation also requires the existence of diverse, cohesive, and autonomous work teams whose members engage in fluent informal communication. Similarly, Jassawalla and Sashittal (1998), for instance, note that managers who provide guidance, encourage creativity, create a supportive environment that fosters exchange of ideas and cooperation, and develop a culture of consensus and continuous improvement are linked with effective new product development process.

In this study, we did not find any direct and significant association between VSP and Team Performance. This finding is somewhat contradictory to the existing scholarship. For example, Bessant, Caffyn, and Gallagher (2001), by investigating six incremental innovations, for instance, found that team VSP impacts success for continuous innovation improvements. Zhang et al. (2012), by studying multisource and multimethod data collected at 3 points in time (361 followers in 74 work teams), found that team shared vision is positively associated with individual performance and team effectiveness. Similarly, Yukelson (1997), states that core components to consider in building a successful

team include having a shared vision and unity of purpose, collaborative and synergistic teamwork, individual and mutual accountability, an identity as a team, a positive team culture and cohesive group atmosphere, open and honest communication processes, peer helping and social support, and trust at all levels. However some studies are consistent with our finding. For example, for their project-level research, Lynn and Akgün (2001), in the case of project vision support, the link to new product success has been found to depend on where the support comes from (i.e., team members, team managers, or top management), and found that vision support by team manager is significantly associated with new product success, whereas the support by team members and by top management is not. Reid and Brentani (2010), state that the findings on VSP are equivocal and pointing to need to further investigate the support dimension. Perhaps what is happening here is that teams typically have little knowledge about market and technology, therefore vision agreement or support may vary depending on the team members. Perhaps another way to look at this is team members can voice support for a new product program, but actions speak louder than words.

5. IMPLICATIONS

First of all, this study has explored the impact of vision components on team performance at the team level. Although this concept has been largely discussed at the organizational level, only recently the discussion of the impact of team vision on team performance has started and there are still some empirical issues to be tapped. This is an attempt to fill some of those gaps that will allow the development of the team vision, as well as how exactly it impacts on team performance.

This study helps to understand the important components of vision on team level that contribute to development team success. Furthermore, the empirical analysis found that team vision is vital for team performance. These findings emphasized the importance of a clear and a stable vision to minimize the effects of team diversity and to promote team success. From this study, the implications for manager and human resources practitioners are three fold. First, human resources practitioners could play a more proactive role in identifying teams that could benefit from team building. Specifically, the finding that the VC and VS components improved performance over the other team vision components could benefit human resources practitioners and organizational managers by providing increased clarity and stability into ways in which leaders may best direct their teams (i.e., being clear about vision and setting goals). Second, for the more successive teams, managers either need to set up to the plate be a visionary and create a clear vision for the team or allow/force the team to develop the vision themselves. Either way, these types of teams will be more successful if teams have a clear vision. In other words, team members must be clear about objectives and obtain feedback on the achievement of these objectives. Conflicting goals will impede integrated work, because team members are likely to be distracted by conflict and unclear about objectives.

Third, this research also finds that stable vision has a positive effect on team success. If team vision changes repeatedly, individuals on team can become frustrated and confused

about what they are supposed to do. Therefore, managers should resist the temptation to change the team vision pre-launch. It becomes critical to get to market with the initially envisioned product and only after launch, when customers have had an opportunity to buy and try the product, should the team entertain changing the vision.

6. LIMITATION and DIRECTION for FUTURE RESEARCH

Our study has a few limitations. Those limitations, however, offer future research opportunities. We have identified five such opportunities. First and one potential limitation of our study is the use of a student sample, which may weaken the generalizability of the results to teams in organizations that exist for longer periods of time and have a stronger impact on teammates' real lives. But, in many studies, related to the team performance, student samples were used (Schippers, Homan, and Knippenberg, 2012; Pieterse, Knıppenberg, and Dierendonck, 2013). It is unlikely that students differ from other populations in their behavior in achievement settings (Brown and Lord, 1999; Dipboye, 1990; Locke, 1986). To maximize generalizability to organizations, we sampled master students who were working professionals with a mean age of 31.8. They came from locations across the United States – from New Jersey to California. At the same time, we should recognize that another concern might be that the teams involved were student teams, rather than teams in organizations, which may raise the question of whether these findings can be generalized to field contexts. However, complementing experimental research with evidence from teams in organizations would thus seem equally important for future research.

Second, past studies on team performance suggests that there are several factors such as team characteristics (e.g. team size) and socio-demographics (e.g. team age) that influence the team successes (He, Butler, and King, 2007; Rico, Sanchez-Manzanares, Gil, and Gibson, 2008; Gallert and Kuipers, 2008; Choi, Lee, and Yoo, , 2010). Control variables such as team size and team age weren't used in our study. Future research should take into consideration the more direct effects of these factors as they examine the impact of vision components on team performance.

Third, our study treated vision as a three dimensional construct. In future research, the vision constructs can be expanded and empirically tested. For instance, as Lynn and Akgun (2001) state, 'perceived-correctness' and 'time/place-in-development' of vision can be added to the vision components in our model. For instance, when the project progresses over time, the team's perception of the vision as being 'correct' may change.

Fourth, in our study, team performance was measured with cumulative profit value. Past studies on team visioning clearly suggest that team vision has a significant impact on different innovation type (Lynn and Akgun, 2001). Future research should take into consideration, how vision impacts the product development process and team effectiveness for different innovation type. For instance, how VC impacts teamwork, top management support, and incremental, radical and evolutionary innovation types are question that merit further investigation.

Fifth, and finally, in our study, the use of a one-item scale to measure VSP may be problematic. The item has not been shown to demonstrate adequate psychometric properties. However, our finding regarding to the VSP is consistent with a number of findings on the impact of vision support on team performance (Lynn and Akgun, 2001; Reid and Brentani, 2010). Regarding VSP, future research should replicate the current findings with other measures of VSP.

7. CONCLUSION

Team vision is important, however, we surprisingly know little about it. In this research, we tried to shed light on team vision, its components and its impact on team performance. Within this context, we empirically tested the impact of the three components of vision (VC, VS and VSP) on team performance. We found that VC and VS have a positive effect on the team performance. We also found that, VSP has not a significant effect on the team performance.

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APPENDIX: Factor and Reliability Analysis

Constructs	Items	Factor loading
Vision clarity	**VC1)** Prior to beginning the real rounds (after the practice rounds), the team had a clear vision of the required product features.	0.922
	VC3) Prior to beginning the real rounds, the team had a clear understanding of target customers' needs and wants.	0.896
	VC6) Our overall business goals were clear.	0.861
	VC2) Prior to beginning the real rounds, the team had a clear vision of the target market.	0.850
	VC5) Our sales volume goals were clear.	0.777
	VC4) Before we began playing SABRE for real (after the practice rounds) a few statements were established that helped guide our efforts (e.g., target price, target market, etc.)	0.756
	Percent of variance explained = 71.535 **Crombach's alpha = 0.917**	
Vision stability	**VS2)** The vision for our company remained stable from the start of the real rounds through the end of the game.	0.875
	VS1) Our technical goals of the product were clear.	0.819
	VS3) Our target market remained stable from Real Round 1 through the end of the game.	0.777
	Percent of variance explained = 67.950 **Crombach's alpha = 0.753**	
Vision Support	**VSP)** Overall, team members supported the vision of our company	Single item construct

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REVISITING THE INTERACTIONS BETWEEN THE BALANCE SHEET ACCOUNTS OF US TELECOMMUNICATIONS and TRANSPORTATION SECTORS: EMPIRICAL EVIDENCE FROM PANEL-VAR MODELS

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ABSTRACT

In the wake of the financial liberalization phenomena, the activities of firms can generate signals for financial and macroeconomic situation and the relationship between financial and macroeconomic variables can be captured by firm-based empirical evidence. In this respect, we employ Panel Vector Autoregression (PVAR) modeling to analyze the interactions between the balance sheets accounts of firms in US telecommunications and transportation sectors. Our results expose that investments, gross fixed capital formation and output in US telecommunications and transportation sectors can be highly dependent on the level of money capital and thus it is important for the firms in these sectors to maximize their output under the financing constraint. It is also revealed that increases in total assets and property may lead to a rise in economic value added, the profitability of a firm which in turn lowers the current liabilities. According to our estimations, we suggest that an optimal empirical framework should be derived to capture the microeconomic origins of macroeconomic developments in terms of effects of total productivity shocks in US telecommunications and transportation sectors.

1. INTRODUCTION

Since Schumpeter (1934), Hicks (1969), McKinnon (1973) and Shaw (1973) asserted that the industrial revolution was due to the expansion of financial systems allowing the applications of new technologies; it is widely recognized by the policy-makers that building and maintaining a well-functioning financial system have a crucial role on economic and financial stability. Within this context, there is substantial empirical evidence supporting the view that financial sector development has positive impact on real economic activity in the long-run such as (Demirguc-Kunt and Levine 1996; Singh 1997; Levine and Zervos 1998; Vuyyuri 2005; Adjasi and Biekpe 2006). On the contrary, Robinson (1952), Kuznets (1955) and Friedman and Schwartz (1963), stated that there existed causality from economic growth to financial development. More precisely, economic development

determines demands for financial agreements, and financial system aims to respond to these demands (Zhang, 2000). However, the importance of financial system for economic activity cannot be underestimated when the prevalent economic and financial liberalization process over the last two decades are considered.

Due to the rapid development and integration of financial markets, determination of the effects of financial variables on macroeconomic performance by quantitative and econometric techniques is of great interest (Bhargava 2014; Pradhan et. al. 2014; Kwon and Shin 1999; Kuosmanen et al. 2015; Fricke and Menkhoff 2015; Maio and Philip 2015). Along with other econometric techniques, researchers give growing interest in panel-type econometric models to expose the dynamics of financial and macroeconomic variables and thus to analyze the future macroeconomic activities of these countries (Pradhan et al. 2015; Hernandez Tinoco and Wilson 2013; Martinsen et al. 2014; Brauning and Koopman 2012). On the other hand, it can be put forward that macroeconomic dynamics can be captured by considering the firm-specific and other financial variables in the prevalent economic, financial integration and development process (Alifiah 2014; Bhattacharjee and Han 2014; Memon et al. 2015; Kero 2013; Poghosyan 2013; Claessens et al. 2014). In terms of the level of the financial markets, USA is an important case which has developed money and capital markets. Accordingly, it can be asserted that interactions between stock market indices not only reflect the relationship between the sectors of the economy but also their consequences on economic performance in the USA. In this respect, NASDAQ Telecommunications Index and Transportation Index are two of the most developing sector indices in the last decade due to globalization and increasing accessibility to the technology. Additionally, Telecommunications and Transportation sectors are important cases to be analyzed since it is recognized that they are both essential in terms of maintaining the well functioning of the market economy and promote the volume of domestic and foreign trade.

In the USA, the level of economic interactions among telecommunications and transportation sectors is also high like other developed economies; thence the main aim of this research is to analyze the interactions between the balance sheets accounts of the firms in these sectors. Since the stocks in NASDAQ Telecommunications and Transportation Indices are major examples also reflecting the industrial activity, our study indirectly attempts to expose the relationship between industrial companies and analyze the dynamics of industrial activity. Within telecommunications and transportation sectors; we use the data of the first 10 firms with the highest assets, whereupon we investigate the financial and economic consequences in a plausible econometric methodology. In this study, we use Panel Vector Autoregression (PVAR) modeling since balance sheets accounts of firms in telecommunications and transportation sectors can be treated as simultaneous, that is, one or more of the explanatory variables can be jointly determined with the dependent variable. The main hypothesis of this research is to test whether balance sheets accounts of firms in telecommunications and transportation sectors have significant effects on each other. The major theoretical contribution of our study to the existing literature is that we assert the dynamics of different balance sheets accounts on the basis of both macroeconomic and managerial perspectives in with PVAR models.

Within this framework, the paper also contributes to the existing literature by making future suggestions for the researchers and policy-makers.

The rest of the paper is organized as follows. Section 2 reviews the previous literature analyzing the dynamics of financial variables. In Section 3, the empirical data and methodology is presented. Section 4 shows the unit root properties of the data, and evaluates the performance of indices. The empirical results and findings of the paper are discussed briefly in Section 5. Finally, Section 6 concludes and discusses some implications for further researches.

2. LITERATURE REVIEW

The dynamics financial variables can be determined and thus the possible interactions between financial and macroeconomic variables can be interpreted also with firm-based empirical evidence. The first contribution in this context can be recognized by Bagchi et al. (2002) who divided into groups according to their dividend payout ratios. They employed a panel data analysis and used a simultaneous equations model with the data of 600 Indian firms from 1991-92 to 1997-98. Moreover, a high dividend payout ratio indicated a low cost of information faced by the firm and vice versa. Although early works in developed countries showed that high-cost group faced with financial constraints and severity of constraint decreased with decreasing cost of information, Bagchi et al. (2002) suggested that medium dividend payout ratios were constrained in the loans market. Apart from the probability of firms determining the investments which in turn influence macroeconomic aggregates, other economic fundamentals and financial factors should be examined. Within this context, Das (2008) used VAR methodology with dynamic panel approach and formulated econometric model included investment, marginal profit, cash flow and balance sheet variables of Indian firms. Focusing on the dynamic adjustments of variables due to the shocks and impulse responses, Das (2008) revealed that the effect of marginal productivity of capital shock on investment was slightly larger for smaller firms, while the impact of cash flow was more for larger firms than for the smaller firms. In addition, Das (2008) found that cash flow had role to play as a fundamental variable in the sense it contained information about future values of the fundamental variables. Expectations related to cash-flows were incorporated into empirical analysis by Vuolteenaho (2002) who used VAR modelling to decompose an individual firm's stock return into changes in cash-flow expectations and changes in discount rates by providing data from NYSE, AMEX, and Nasdaq stocks. Vuolteenaho (2002) found that firm-level stock returns were mainly driven by cash-flow expectations (cash-flow news) rather than changes in discount rates (expected-return news). Furthermore, Vuolteenaho (2002) exposed that the variance of cash-flow news was more than twice that of expected-return news. Using panel techniques, Memon et al. (2015) underlined the role of firm-specific variables, macroeconomic factors, and firms' heterogeneity in determining the debt levels of non-financial listed firms of Pakistan. Their results showed that profitability, tangibility, and size of the firm affect debt level significantly across different proxies and different estimation techniques. Moreover, Memon et al. (2015) also revealed that the interest rate and inflation are significant determinants of debt in fixed effect estimation. The impact of firm-specific and macroeconomic factors on financial stress is another feature gaining

ground on empirical approaches in that extent. Hernandez Tinoco and Wilson (2013) developed a risk model for listed companies that predict financial distress and bankruptcy using a sample of 23,218 company-year observations of listed companies. Their results indicated the utility of combining accounting, market and macro-economic data in financial distress prediction models for listed companies. In a similar effort, Bhattacharjee and Han (2014) implemented an economic model of financial distress using their own firm-level measure of distress for Chinese listed companies and they found important effects of firm characteristics, macroeconomic instability and institutional factors on the hazard rate of financial distress. Most recently, Alifiah (2014) intended to analyze the financial distress in trading and services sector in Malaysia using financial distress companies as the dependent variable and macroeconomic variables and financial ratios as the independent variables. According to Alifiah (2014) debt ratio, total assets turnover ratio, working capital ratio, net income to total assets ratio and base lending rate could help to predict the future financial distress.

The relationship between the financial ratios and firm value is also a critical issue to be taken into consideration. In this respect, Birgili and Düzer (2010) analyzed Istanbul Stock Exchange by using panel data analysis for 21 ratios. Results showed that 16 ratios had a significant impact on the firm value. Birgili and Düzer (2010) concluded that liquidity, debt and market ratios had a great influence on firm value while asset management ratios and some of profitability ratios did not have an impact. Yener and Karakuş (2012) also performed panel data analysis with the data Istanbul Stock Exchange and they attempted to study the relationship of leverage ratios and firm value. Yener and Karakuş (2012) found no empirical evidence for the relationship between capital structure and firm value, but also they rejected the hypothesis stating the positive relationship between leverage ratios and firm value. Similarly, Küçükkaplan (2013) analyzed the relationship between the market value and financial ratios of 111 manufacturing firms quoted in Istanbul Stock Exchange. By using panel data analysis, he found that 23% of the market value can be interpreted by firm's financial ratios and debt ratio affected the market value negatively. Findings of Küçükkaplan (2013) also showed that sectorial level analysis raised the explanatory power of the variables on the market value. Therefore, Küçükkaplan (2013) concluded that sectorial differences should be taken into account when studying about the relationship between firm market value and internal variables. In a similar effort to Küçükkaplan (2013), Apergis et al. (2012) used a detailed approach by revealing the impact of accounting information on the excess returns via cost of capital using a sample of US manufacturing firms.

Apergis et al. (2012) showed that components of accounting information had an impact on the cost of capital, which directly affected stock returns. According to their results, accounting information had an influence on firm's cost of capital and it tended to have a negative impact on the firm's excess stock returns. Rahman and Hassan (2013) enhanced the previous approaches by dealing the relationship between microeconomic, macroeconomic and financial variables. They analyzed the relationship between firm fundamentals and stock prices in an emerging Asian stock market sample by using firm-level panel data. According to Rahman and Hassan (2013), it was possible to interpret the relationship between the variations in stock returns and firm fundamentals in a simple

present value framework. Rahman and Hassan (2013) showed that firm fundamentals explained a significant part of firm-specific return variation in most of the emerging markets in Asia. Most recently, Claessens et al. (2014), constructing an enhanced investment model, predicted the interaction between financial frictions at the firm level and through the required rate of return at the macro level. Basing on some 78,000 firm–year observations from 40 countries over the period, their results revealed that with respect to cross-country differences in firm investment, frictions related to shareholder rights were more relevant than debt-related frictions.

On the other hand, it is recognized by policy-makers and researchers that microeconomic decisions can generate signals for the analysis of macroeconomic trends and thus the activities of firms. In a sense, Pradhan et al. (2015) examined the linkages between economic growth, oil prices, depth in the stock market and other macroeconomic variables for the G-20 countries. The results revealed that in the long run, real economic growth responded to any deviation in the different measures of stock market depth, oil prices, and the other macroeconomic variables. Despite the mixed short-run causality evidence, Pradhan et al. (2015) emphasized that real economic growth responded to various measures of stock market depth, allowing for real oil price movements and changes in macroeconomic variables. Within Dynamic Stochastic General Equilibrium (DSGE) model framework, Meh and Moran (2010) assumed that the capital position of banks had influence on their ability to attract loanable funds and therefore affected the business cycle and firms' activities through a bank capital channel of transmission. In line with their assumptions, Meh and Moran (2010) concluded that the bank capital channel triggered and propagated the effects of technology shocks on output, investment and inflation. Similarly, Christensen et al. (2011) analyzed the role of countercyclical bank balance sheet regulation for the stabilization of financial and economic cycles by constructing a DSGE model. Christensen et al. (2011) implied that countercyclical bank leverage regulation could have stabilizing impacts on thus firm values when shocks in financial system were an important source of real business cycles. Christensen et al. (2011) also exposed that the appropriate contribution of countercyclical capital requirements to stabilization in the activities of firms depended on the size of the externality and impacts of total factor productivity shocks and on the conduct of the monetary authority. Most recently, Sandri and Valencia (2013) developed a DSGE with financial frictions on both financial intermediaries and goods-producing firms. Sandri and Valencia (2013) found that welfare gains of financial intermediates from their recapitalization were larger when recapitalization funds are raised from the household rather than the real sector. Sandri and Valencia (2013) also exposed that welfare gains were similar to the elimination typical business cycle fluctuations. Furthermore, Sekkel (2015) exposed the balance sheets of leveraged financial institutions had out-of-sample predictive power for future economic activity, while financial variables had very little predictive power during periods of economic expansion, with predictability arose mainly during the financial crisis period. Moreover, Davis (2014) expanded the approach in international basis by showing empirically that debt market integration has a positive effect on co-movement, implying that balance sheet effects are the main conduit for international transmission through integrated debt markets. His paper is of crucial importance with respect to firm-based data and international macroeconomics.

3. DATA AND METHODOLOGY

3.1. Empirical Model

Vector autoregression (VAR)-type models are based on simultaneous equation models and they can be used to identify the transmission mechanism of financial and macroeconomic variables to economic activity empirically. In this study, we employ Panel-VAR modeling with the data for the period from 2000 to 2013, to show the interactions between; cash ($cash_t$), common equity ($cequ_t$), current liabilities ($clia_t$), number of employee ($nemp_t$), property (pro_t), total assets ($asset_t$) due to availability of data. In this respect, we estimate 6 Panel-VAR models to show the model parameters and test whether the coefficients of the models are in line with the theoretical assumptions and expectations. All the series are derived using the statistical database of Thomson Reuters Datastream and EViews 8.0 is used to conduct the empirical exercise.

3.2. Econometric Estimation

The point of departure of panel data analysis depends on the linear panel data regression model expressed as below;

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where the dependent and independent variables of the model are represented by Y_{it} and X_{it}, respectively. Y_{it} and X_{it} are both with i and t subscripts, referring to $i = 1, 2, ..., N$ sections and $t = 1, 2, ..., T$ time periods. The coefficients of the model (α and β) specified in (1) are without subscripts since they will be the same for all unit and samples. Finally, ε_{it} refers to the error term of the panel data model in (1). Assuming that there are no differences among the data matrices of the cross-sectional dimension N, the model (1) can be estimated by pooled OLS method with a common constant for all cross-sections (Asteriou and Hall, 2007). The error term of panel data model in (1) is critical since it determines whether the panel data model can be estimated with fixed effects or random effects. In a fixed effects model, it is assumed that the error term varies non-stochastically over i and t. On the other hand, the error term is assumed to be varying stochastically in random effects model. Therefore, types of models as in (1) can be estimated using a pool object.

$$Y_{it} = \alpha + X_{it}^{'}\beta_{it} + \delta_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where Y_{it} is the dependent variable, X_{it} is a vector of k regressors, and ε_{it} are the error terms for cross-sectional units, $t = 1, 2, ..., T$. In model (2); the constant term is denoted by α, while the cross-section or period specific effects (random or fixed) are represented by δ_i and γ_t. Within this framework, we can place restrictions on β coefficients [common (across cross-section and periods), cross-section specific and period specific regressor parameters] to identify the panel data model (E-Views 7 User's Guide 1,

2010). For instance, M cross-sectional equations each with T observations stacked on top of one another can be expressed as below.

$$Y_{it} = \alpha I_T + X_{it}^{'}\beta_{it} + \delta_i I_T + I_T \gamma_t + \varepsilon_t \quad (3)$$

In model (3), I_T is the $T-$element identity matrix and the vector $\gamma^{'} = (\gamma_1, \gamma_2, ..., y_T)$ includes all the period effects (E-Views 7 User's Guide 1, 2010). Similarly, we can specify as a set of T period specific equations, each with M observations stacked on top of one another as in (4);

$$Y_{it} = \alpha I_T + X_t^{'}\beta_{it} + I_M \delta_i + \gamma_t I_M + \varepsilon_t \text{ for } i = 1, 2, ..., M \quad (4)$$

In model (4), I_M refer to the $M-$element identity matrix and all of the cross-section effects $\delta^{'} = (\delta_1, \delta_2, ..., \delta_T)$ are included in the vector δ.

On the other hand, PVARs have the same structure as VAR models, in the sense that all variables are assumed to be endogenous and interdependent, but a cross-sectional dimension is incorporated into the representation (Canova and Ciccarelli, 2013). PVAR models specified in (5) can be estimated jointly with the fixed effects or, alternatively, independently of the fixed effects after some transformation with (OLS).

$$Y_{it} = Y_{i,t-1}A_1 + Y_{i,t-2}A_2 + Y_{i,t-p+1}A_{p-1} + Y_{i,t-p}A_p + X_{i,t}B + u_{i,t} + e_{i,t} \quad (5)$$

where Y_{it} is a $(1\times k)$ vector of dependent variables and $X_{i,t}$ is a $(1\times l)$ vector of exogenous covariates. Dependent variable-specific fixed-effects and idiosyncratic errors of the model (5) are denoted by $(1\times k)$ vectors $u_{i,t}$ and $e_{i,t}$, respectively. Finally, the $(k\times k)$ matrices $A_1, A_2, ..., A_{p-1}, A_p$ and the $(l\times k)$ matrix B are parameters of model (5) to be estimated (Abrigo and Love, 2015). Accordingly, lags of all endogenous variables of all units enter the model for cross-section i, $u_{i,t}$ are generally correlated across i and the intercept, the slope and the variance of the shocks $u_{1,i,t}$ may be cross-section specific (Canova and Ciccarelli, 2013).

4. RESULTS

4.1. Empirical Data

For the specification of appropriate type of the panel data model, alternative panel unit root tests with different theoretical assumptions are to be implemented. Assuming that the persistence parameters are common across cross-sections, the panel unit root tests of Levin, Lin and Chu (LLC), Breitung and Hadri are applied. On the other hand, persistence parameters vary across cross-sections in the panel unit root tests of Im, Pesaran and Shin (IPS), Fisher-ADF and Fisher-PP. In Table 1 below, we summarize the results of Levin, Lin

and Chu, Im, Pesaran and Shin, Fisher-ADF and Fisher-PP applied to the variables included in our empirical exercise.

Table 1: Panel Unit Root Test Results

	Levin, Lin and Chu		**Im, Pesaran and Shin**		**Fisher-ADF**		**Fisher-PP**	
	Statistic	***Prob.***	***Statistic***	***Prob.***	***Statistic***	***Prob.***	***Statistic***	***Prob.***
$cash_t$	-0.52	0.29	0.55	0.70	45.93	0.23	44.44	0.29
$\Delta cash_t$	-12.28	0.00	-10.74	0.00	172.31	0.00	245.76	0.00
$cequ_t$	-1.24	0.10	0.68	0.75	39.27	0.41	53.94	0.04
$\Delta cequ_t$	-8.67	0.00	-6.85	0.00	121.99	0.00	144.31	0.00
$clia_t$	0.55	0.71	3.70	0.99	20.17	0.99	33.40	0.76
$\Delta clia_t$	-11.61	0.00	-9.08	0.00	161.63	0.00	226.80	0.00
$nemp_t$	0.38	0.64	2.76	0.99	25.73	0.96	21.27	0.99
$\Delta nemp_t$	-7.07	0.00	-4.85	0.00	90.19	0.00	83.19	0.00
pro_t	-0.08	0.46	3.86	0.99	43.69	0.31	28.82	0.90
Δpro_t	-8.18	0.00	-6.01	0.00	107.88	0.00	115.96	0.00
$asset_t$	0.14	0.55	3.90	1	25.82	0.95	15.69	0.99
$\Delta asset_t$	-7.09	0.00	-5.54	0.00	99.77	0.00	117.60	0.00

Source: Authors' calculations

According to Table 1, the Levin, Lin and Chu, Im, Pesaran and Shin, Fisher-ADF and Fisher-PP tests reveal that all the variables are non-stationary in levels and stationary in first-differences. In this case, the possibility of panel cointegration relationships among the variables can be explored. We applied Engle-Granger based Pedroni and Kao tests as in Table 2.

Table 2: Panel Cointegration Tests' Results

Series: $cash_t$, $cequ_t$, $clia_t$, $nemp_t$, pro_t, $asset_t$

No. of Included Lags (Levels):1 (Automatic lag length selection based on Schwarz Information Criterion (SIC) with a max lag of 1)
Included observations: 280
Cross-sections included: 20
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend

Pedroni Test: Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	***Prob.***	***Weighted Statistic***	***Prob.***
Panel v-Statistic	-2.87	0.99	-2.55	0.99
Panel rho-Statistic	2.61	0.99	3.81	0.99
Panel PP-Statistic	-5.93	0.00	-4.28	0.00
Panel ADF-Statistic	-0.02	0.49	-1.78	0.03
Pedroni Test: Alternative hypothesis: common AR coefs. (between-dimension)				
	Statistic	***Prob.***		
Group rho-Statistic	5.32	1.00		
Group PP-Statistic	-7.95	0.00		
Group ADF-Statistic	-0.13	0.44		
Kao Residual Cointegration Test				
	t-Statistic	**Prob**		
ADF	0.32	0.37		

Source: Authors' calculations

According to Table 2, majority p-values of the Pedroni and Kao tests indicate that no cointegration relationship among the variables in our empirical exercise exists. Thus, we employ PVAR modeling instead of panel cointegration models. However, the variables included in PVAR model are in differences since panel unit root tests reflect that all variables we consider are stationary in first-differences.

4.2 The Case for NASDAQ Telecommunications, Transportation Index and Relevant Data

Technology-based NASDAQ stock exchange is the second largest stock exchange according to market capitalization in the U.S. and world, behind the NYSE. It began trading at 1971 as the world's first electronic stock market. Today, market-cap weighted NASDAQ includes more than 5000 stocks. NASDAQ has many indices, such as well-known NASDAQ-100 Index and NASDAQ Composite Index. There are also some sector indices: Bank, biotechnology, computer, financial-100, industrial, insurance, other finance, telecommunications and transportation (Kann, 2002).

NASDAQ Telecommunications Index and Transportation Index are the sub-indexes of NASDAQ Composite Index. NASDAQ Transportation Index consist of 52 securities, which work in the areas of delivery services, marine transportation, railroads, transportation services, trucking and airlines. The market-cap weighted Transportation Index was designed to measure the performance of transportation securities in NASDAQ. Index was developed in February 1971 with base point of 100. NASDAQ Telecommunication Index includes 115 stocks, providers of fixed-line and mobile telephone services, makers and distributors of high-technology communication products. Name of the NASDAQ Utility Index was changed to NASDAQ Telecommunications Index on November 1, 1993.

4.3 Empirical Results and Discussion

As for the empirical exercise, we use the balance sheet items of firms in Telecommunications and Transportation sectors quoted in NASDAQ. By estimating six PVAR models, we analyze the interrelations among cash, common equity, current liabilities, number of employees, property and total assets in terms of the lagged values of coefficients. More precisely, we integrate the effects of firms' liquidity, activity, debt, profitability and market performance into PVAR framework with the selection and usage of these variables. In order to specify the appropriate estimation method of our PVAR models, we employed Hausmann Test. Accordingly; two of the six PVAR models are estimated with fixed effects, while four PVAR models are estimated with random effects. On the other hand, optimal lag lengths of the all models are imposed by the Akaike Information Criterion (AIC) and SIC as 3. In a sense, possible effects of these balance sheet items on macroeconomic variables are also considered with PVAR(3) models.

Table 3: Estimation results of PVAR model using $\Delta cash_t$ as dependent variable

Dependent Variable: $\Delta cash_t$
Method: Panel Least Squares
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
R-squared: 0.694904
Adjusted R-squared: 0.625222

Variables	Coefficient	Std.Error	t -Statistic	Prob.
c	8.84E+08	1.37E+08	6.433534	0.0000
$\Delta cash_{t-1}$	-0.503362	0.078436	-6.417490	0.0000
$\Delta cequ_{t-1}$	0.036699	0.106685	0.343994	0.7313
$\Delta clia_{t-1}$	-0.373933	0.117124	-3.192629	0.0017
$\Delta nemp_{t-1}$	-9986.956	17530.12	-0.569703	0.5697
Δpro_{t-1}	-0.198105	0.059342	-3.338355	0.0010
$\Delta asset_{t-1}$	0.125216	0.025177	4.973511	0.0000
$\Delta cash_{t-2}$	-0.136330	0.093358	-1.460294	0.1461
$\Delta cequ_{t-2}$	-0.151340	0.129392	-1.169625	0.2439
$\Delta clia_{t-2}$	-0.725605	0.117059	-6.198637	0.0000
$\Delta nemp_{t-2}$	33277.08	16173.20	2.057544	0.0412
Δpro_{t-2}	-0.169393	0.111271	-1.522349	0.1299
$\Delta asset_{t-2}$	0.101556	0.040579	2.502684	0.0133
$\Delta cash_{t-3}$	0.258968	0.070966	3.649191	0.0004
$\Delta cequ_{t-3}$	-0.202777	0.101492	-1.997964	0.0474
$\Delta clia_{t-3}$	-0.240103	0.122211	-1.964661	0.0512
$\Delta nemp_{t-3}$	27196.50	15554.98	1.748411	0.0823
Δpro_{t-3}	0.170112	0.122868	1.384514	0.1681
$\Delta asset_{t-3}$	-0.058463	0.048856	-1.196638	0.2332

Source: Authors' calculations

According to Table 3, our PVAR model specification including cash as dependent variable indicates that cash maybe under the influence of its own lags. More precisely, cash

account does not have a deterministic way of impact on itself in future periods. We can assert that changes in the cash account of firms quoted in NASDAQ do not induce future change in cash. In this respect, other financial variables that may influence cash accounts should be taken into consideration seriously. Particularly, changes in cash capital reflect the activity of firms and thus may indirectly affect their cash position since they provide labor and physical capital and make R&D. Unlike our theoretical assumptions, our panel estimations show that the change in common equity does not have a significant impact on the change in cash account. We can interpret this finding as a possible use of common equity in fixed asset investments or long-term borrowing. The coefficients of current liabilities can be accepted as statistically significant at 10% confidence level, exposing that change in raising leverage has a direct effect in the change of cash account due to the future interest expenses. The signs of the coefficients of property and total assets for the lags 1 to 3 indicate that there is no significant impact on cash for the firms quoted in NASDAQ. Cash is found as unrelated to the other asset accounts, namely total assets and property, and asset accounts do not alternate to each other. This phenomenon expose that the change in cash maybe influenced by liability accounts. Our panel estimations reflect that, despite it is theoretically assumed that increases in labor affect cash position of firms negatively due to increased wage expenditures, the majority of the coefficients of employee variable is positive meaning a rising productivity level. The coefficient of employee is in line with Harrod neutral production function approach, more precisely technological progress can be accepted as labor–augmenting.

Table 4: Estimation results of PVAR model using $\Delta clia_t$ as dependent variable

Dependent Variable: $\Delta clia_t$
Method: Panel Least Squares
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
R-squared: 0.726805
Adjusted R-squared: 0.664409

Variables	Coefficient	Std.Error	t -Statistic	Prob.
$\Delta cequ_{t-1}$	0.121101	0.075478	1.604449	0.1106
$\Delta cash_{t-1}$	0.295724	0.055492	5.329092	0.0000
$\Delta clia_{t-1}$	-0.207341	0.082864	-2.502203	0.0133
$\Delta nemp_{t-1}$	10675.87	12402.33	0.860795	0.3906
Δpro_{t-1}	-0.202255	0.041984	-4.817452	0.0000
$\Delta asset_{t-1}$	-0.070274	0.017812	-3.945269	0.0001
c	2.88E+08	97261467	2.957033	0.0036
$\Delta cequ_{t-2}$	0.102880	0.091543	1.123836	0.2627
$\Delta cash_{t-2}$	0.179073	0.066049	2.711204	0.0074
$\Delta clia_{t-2}$	-0.089585	0.082818	-1.081717	0.2810
$\Delta nemp_{t-2}$	-9992.622	11442.33	-0.873303	0.3838
Δpro_{t-2}	0.304766	0.078723	3.871378	0.0002
$\Delta asset_{t-2}$	-0.222200	0.028709	-7.739740	0.0000
$\Delta cequ_{t-3}$	-0.011372	0.071804	-0.158371	0.8744
$\Delta cash_{t-3}$	0.138225	0.050207	2.753073	0.0066
$\Delta clia_{t-3}$	0.225615	0.086463	2.609391	0.0099
$\Delta nemp_{t-3}$	7023.227	11004.95	0.638188	0.5243
Δpro_{t-3}	0.217761	0.086927	2.505087	0.0132
$\Delta asset_{t-3}$	-0.089783	0.034565	-2.597536	0.0103

Source: Authors' calculations

According to Table 4, it can be asserted that the change in past values of current liabilities do not have a significant impact direction on itself despite past values of liabilities may induce variations on the current values of liabilities. More precisely, the change in the liability account arises from firms' other accounts. In our PVAR model all the coefficients of cash account from lag 1 to 3 are statistically significant and in line with the theoretical assumptions. In corporate finance, the debt management suggests that the cash account needs to be kept positive in order to meet firms' short-term obligations. Therefore, a positive change in cash account results in a positive change in current liabilities account which is also reflected in our findings. Liabilities are related to the activities of firms (investment, inventory management, sales etc.) rather than its common equity. The level of common equity is not a precise and a deterministic factor of leverage in the future. Our findings reveal that the change in total assets has a negative effect on the change in current liabilities. We can interpret this empirical evidence with the help of an increase in total factor productivity and thus in firms' economic value added which in turn has a direct impact on profitability and therefore on retained earnings resulting in a decrease in current liabilities. In this respect, we suggest the transmission mechanism of total factor productivity shock on firm performance with DSGE framework. However, the coefficients of property account do not support the interpretations based on the coefficients of total assets. Specifically, the change in property has a positive impact on the change in current liabilities suggesting that the fixed asset investments are financed by debt borrowing. Furthermore, property account is not a current account and thus does not have a total factor productivity generating effect both in the short- and medium-term. On the other hand, the change in productivity level of employees does not have an impact on the change in current liabilities since we found insignificant coefficients.

Table 5: Estimation results of PVAR model using $\Delta cequ_t$ as dependent variable

Dependent Variable: $\Delta cequ_t$
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances
R-squared: 0.591741
Adjusted R-squared: 0.551141

Variables	Coefficient	Std.Error	t -Statistic	Prob.
$\Delta cash_{t-1}$	-0.012609	0.040627	-0.310349	0.7567
$\Delta clia_{t-1}$	-0.033511	0.079818	-0.419845	0.6751
$\Delta nemp_{t-1}$	-7487.392	12240.17	-0.611707	0.5415
Δpro_{t-1}	-0.111217	0.039955	-2.783537	0.0059
$\Delta asset_{t-1}$	0.021180	0.015919	1.330492	0.1850
$\Delta cequ_{t-1}$	0.704064	0.075428	9.334275	0.0000
c	17011606	68323881	0.248985	0.8037
$\Delta cash_{t-2}$	0.046641	0.043791	1.065095	0.2883
$\Delta clia_{t-2}$	-0.392065	0.082421	-4.756882	0.0000
$\Delta nemp_{t-2}$	72940.06	10850.23	6.722445	0.0000
Δpro_{t-2}	0.358788	0.071436	5.022495	0.0000
$\Delta asset_{t-2}$	-0.072306	0.023140	-3.124747	0.0021
$\Delta cequ_{t-2}$	-0.553471	0.089635	-6.174735	0.0000
$\Delta cash_{t-3}$	0.071936	0.041217	1.745312	0.0826
$\Delta clia_{t-3}$	-0.254089	0.079447	-3.198240	0.0016
$\Delta nemp_{t-3}$	-32467.78	10472.03	-3.100428	0.0022
Δpro_{t-3}	0.044473	0.071541	0.621648	0.5350
$\Delta asset_{t-3}$	0.014553	0.028309	0.514075	0.6078
$\Delta cequ_{t-3}$	-0.186369	0.069286	-2.689859	0.0078

Source: Authors' calculations

According to Table 5, the coefficients of the change in common equity are statistically significant and indicate that increases in common equity lead to the decrease of common equity in future periods and thus increase the need of capital. Moreover, this implication is in line with the coefficient of common equity in the PVAR model specification using cash as dependent variable (Table 3). Additionally, it can be suggested that firms in these sectors frequently uses its capital in its operations. Our findings have mixed results in terms of coefficients, implying that property account does not have an impact on common equity. This implication is also verified by the coefficients of property account in Table 4 where the dependent variable is current liabilities. More precisely, increases in property are financed by current liabilities in future periods since property is a long-term investment. On the other hand, changes in total assets do not have a direct, significant effect on changes in common equity suggesting that there is a possible financing of common equity by current liabilities. In detail, a decrease in the change of current liabilities will cause an increase in the change of common equity which is also in accordance with the corporate finance theory. Similarly, the change in the cash account does not have a direct, significant effect on changes in common equity which is also consistent to that of total assets. According to the coefficients of number of employees, a mixed effect on common equity is detected. Despite labor-augmenting technological progress may increase the total profit in the long-run; increase in the number of employees does not have a significant influence on common equity. Possible increases of profitability are reflected by other balance sheet components.

Table 6: Estimation results of PVAR model using Δpro_t as dependent variable

Dependent Variable: Δpro_t
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances
R-squared: 0.613172
Adjusted R-squared: 0.574703

Variables	Coefficient	Std.Error	t -Statistic	Prob.
$\Delta cequ_{t-1}$	-0.085189	0.142425	-0.598131	0.5505
$\Delta cash_{t-1}$	0.229232	0.076714	2.988156	0.0032
$\Delta clia_{t-1}$	1.052750	0.150714	6.985069	0.0000
$\Delta nemp_{t-1}$	38419.67	23112.18	1.662312	0.0982
Δpro_{t-1}	0.148824	0.075444	1.972625	0.0501
$\Delta asset_{t-1}$	-0.125950	0.030059	-4.190115	0.0000
c	24856646	1.29E+08	0.192671	0.8474
$\Delta cequ_{t-2}$	0.015597	0.169250	0.092152	0.9267
$\Delta cash_{t-2}$	-0.599006	0.082687	-7.244268	0.0000
$\Delta clia_{t-2}$	0.040120	0.155629	0.257793	0.7969
$\Delta nemp_{t-2}$	33776.54	20487.66	1.648628	0.1010
Δpro_{t-2}	-0.464507	0.134887	-3.443661	0.0007
$\Delta asset_{t-2}$	0.091109	0.043693	2.085213	0.0385
$\Delta cequ_{t-3}$	-0.113202	0.130827	-0.865278	0.3880
$\Delta cash_{t-3}$	0.090947	0.077827	1.168590	0.2441
$\Delta clia_{t-3}$	0.458292	0.150013	3.055014	0.0026
$\Delta nemp_{t-3}$	23498.64	19773.55	1.188388	0.2362
Δpro_{t-3}	0.008796	0.135085	0.065112	0.9482
$\Delta asset_{t-3}$	-0.014300	0.053455	-0.267519	0.7894

Source: Authors' calculations

Property is a critical account in terms of showing fixed asset investments which in turn can be determinative on firms' investment capabilities. More precisely, fixed asset investments are alternate to current assets accounts such as inventory etc. Firms' investment decision into current or long-term assets may vary according to firm's financial equity structure. Table 6 indicates that the change in the property account may cause variations in the value of the fixed asset portfolio and thus properties. Similarly, increases of the past values of cash account have a mixed effect on the values of property account. The increase in the change of cash account may not have a positive effect on the change in property account as the second lag suggests. This may be caused by an alternative use of cash such as in Table 4 in terms of current liabilities. On the other hand, we found that the change in common equity does not have a significant influence on the change in properties. As we've mentioned above previously, issuing new capital stock are alternate to fixed asset investments. We can assert that firm's investment decisions are made considering this phenomenon. Additionally, the change in current liabilities has a significant positive effect on the change in fixed asset investments. This shows that the firms, using their leverage effects, invest in fixed assets by borrowing short-term debts and financing their growth. Total assets consist of accounts such as cash, current assets, inventory, property etc. The change in total assets may not have a direct impact on the change in property account as Table 6 shows. Moreover, the coefficients of the lags of cash account are in line with this finding. Additionally, changes in fixed asset investments can cause an increase in labor demand and thus employment. Labor can also trigger total factor productivity, especially in the cases when production function is labor-augmenting. According to our PVAR estimations, it is implied that increase in the number of employees does not lead to an increase in total productivity that may affect the value of fixed investments positively.

Table 7: Estimation results of PVAR model using $\Delta asset_t$ as dependent variable

Dependent Variable: $\Delta asset_t$
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances
R-squared: 0.654732
Adjusted R-squared: 0.620396

Variables	Coefficient	Std.Error	t -Statistic	Prob.
$\Delta cequ_{t-1}$	-0.387824	0.281180	-1.379271	0.1695
$\Delta cash_{t-1}$	1.664570	0.151451	10.99081	0.0000
$\Delta clia_{t-1}$	0.940827	0.297546	3.161954	0.0018
$\Delta nemp_{t-1}$	116192.4	45628.98	2.546462	0.0117
Δpro_{t-1}	-0.727849	0.148945	-4.886686	0.0000
$\Delta asset_{t-1}$	0.157417	0.059343	2.652644	0.0087
c	4.73E+08	2.55E+08	1.858765	0.0647
$\Delta cequ_{t-2}$	-0.632842	0.334141	-1.893938	0.0598
$\Delta cash_{t-2}$	-1.228264	0.163244	-7.524117	0.0000
$\Delta clia_{t-2}$	-0.346084	0.307248	-1.126399	0.2615
$\Delta nemp_{t-2}$	225009.6	40447.54	5.562998	0.0000
Δpro_{t-2}	-0.788786	0.266300	-2.962018	0.0035
$\Delta asset_{t-2}$	-0.021271	0.086261	-0.246592	0.8055
$\Delta cequ_{t-3}$	-0.061024	0.258284	-0.236268	0.8135
$\Delta cash_{t-3}$	-0.014174	0.153648	-0.092252	0.9266
$\Delta clia_{t-3}$	1.222549	0.296161	4.127982	0.0001
$\Delta nemp_{t-3}$	6666.839	39037.71	0.170779	0.8646
Δpro_{t-3}	-0.302789	0.266691	-1.135355	0.2577
$\Delta asset_{t-3}$	-0.070200	0.105532	-0.665196	0.5068

Source: Authors' calculations

The total assets account is a balance sheet account which reflects the economic and financial activities of the firm. Financial and economic activities may follow autoregressive process, more precisely economic and financial decisions made by the firms may be under the influence of their past decisions and/or their economic and financial positions. We analyzed the lagged values of total assets and found that there is no significant impact on the future value of total assets because of the coefficients. In terms of the cash account, we found that there is no significant impact direction on total assets. Variations in total assets may arise from other components of total assets. According to corporate finance theory, it's expected that a change in total assets may have a direct effect on the change in current liabilities due to the balance sheet equation. Our results suggest a positive relationship between the changes in current liabilities and the changes in total assets. On the other hand, we can infer that changes in total assets are not related to the changes in common equity according to the relevant coefficients of common equity which can be accepted as in contrast to the corporate finance theory. It is generally assumed that property, as a part of total assets, is not efficiency generating and profit maximizing when compared to the other types of investments. Our PVAR results suggest a negative relationship between the change in property and the change in total assets which is in line with this assertion. In line with the detected effects of employment on property, our coefficients indicate that labor force of firms may generate a total factor productivity increase and thus profit.

Table 8: Estimation results of PVAR model using $\Delta nemp_t$ as dependent variable

Dependent Variable: $\Delta nemp_t$
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 2004 2013
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances
R-squared: 0.615776
Adjusted R-squared: 0.577566

Variables	Coefficient	Std.Error	t -Statistic	Prob.
$\Delta cequ_{t-1}$	5.25E-06	4.25E-07	12.36862	0.0000
$\Delta cash_{t-1}$	-1.71E-07	2.29E-07	-0.748036	0.4554
$\Delta clia_{t-1}$	1.02E-06	4.49E-07	2.264985	0.0247
$\Delta nemp_{t-1}$	-0.086847	0.068912	-1.260260	0.2092
Δpro_{t-1}	-1.16E-06	2.25E-07	-5.150439	0.0000
$\Delta asset_{t-1}$	1.21E-07	8.96E-08	1.347350	0.1796
c	821.3081	384.6622	2.135141	0.0341
$\Delta cequ_{t-2}$	-3.77E-06	5.05E-07	-7.471232	0.0000
$\Delta cash_{t-2}$	6.36E-07	2.47E-07	2.579740	0.0107
$\Delta clia_{t-2}$	2.06E-07	4.64E-07	0.444876	0.6569
$\Delta nemp_{t-2}$	0.386306	0.061087	6.323907	0.0000
Δpro_{t-2}	1.03E-06	4.02E-07	2.553656	0.0115
$\Delta asset_{t-2}$	-2.00E-07	1.30E-07	-1.536468	0.1262
$\Delta cequ_{t-3}$	-1.78E-07	3.90E-07	-0.455514	0.6493
$\Delta cash_{t-3}$	1.89E-08	2.32E-07	0.081405	0.9352
$\Delta clia_{t-3}$	-5.26E-07	4.47E-07	-1.174925	0.2416
$\Delta nemp_{t-3}$	0.091351	0.058957	1.549447	0.1230
Δpro_{t-3}	2.47E-07	4.03E-07	0.613373	0.5404
$\Delta asset_{t-3}$	7.30E-08	1.59E-07	0.457756	0.6477

Source: Authors' calculations

Labor is an important factor for firms since the structure of the production function may be labor-augmenting. Thus, labor can influence the balance sheet accounts of the firms and vice versa. According to the lagged coefficients of the number of employees, we can infer that the employment policy of firms does not have a significant impact on its current policy. Hereby, it is not possible to expose the pattern of labor productivity and the effect on firms' profitability. Balance sheet accounts, which are dependent variables in our panel VAR model, shed light on firms' economic activity which in turn may be determinative on labor demand. The majority of the coefficients in Table 8 are insignificant revealing that the pattern of labor demand cannot be explained by balance sheet accounts. First and second lags of common equity and property are significant, but signs of their coefficients are in contrast to each other. Thus, it is difficult to make an accurate comment.

5 CONCLUSION

In this study, we employed VAR-type of models allowing to analyze a variable's lagged values since their coefficients are computed. In this respect, via our panel VAR estimations it was possible to detect the effects of previous years' financial statements on their current ones. Within this empirical framework, we found that the lagged values of the change in equity account have both negative and positive signs and they are all statistically significant which indicates that firms frequently use their capital in their operations. It can also be inferred that investments, gross fixed capital formation and output in these sectors can be highly dependent on the level of money capital. Indeed, it is critically important for the firms in these sectors to maximize their output under the financing constraint.

Due to the working capital management, liquidity of a firm infers the ability to make the short-term obligations with respect to firm's current assets. In our study, the change in cash account has a significant and positive effect on the current liabilities which shows that firms in these sectors are sufficient enough to make their short-term payments. Additionally, the change in total assets and property has a statistically significant and negative impact on the change in current liabilities which is in line with the debt management of a firm where an increase in total assets, creating an economic value added, raises the profitability of a firm which in turn lowers the current liabilities. In this respect, it can be asserted that it is critically important for the firms in these sectors to determine the relationship between total factor productivity, physical capital and labor. Thereby, plausible production function formulation can be obtained and possible effects of total productivity shocks in these sectors on macroeconomic aggregates can be detected within DSGE framework. Our PVAR estimations suggest that the positive change in current liabilities may reflect itself in the investment in property account. However, according to the signs of the coefficients of current liabilities showing the effects on total assets, it can be put forward that the firm cannot use the leverage effect and thus cannot trigger a financial growth by incurring liabilities. Furthermore, our results indicated that increasing the amount of current liabilities affects the equity negatively in line with the theoretical expectations. As a result, it is stressed that generating total productivity shocks, investment specific shocks and making innovation are obligatory in order to

increase the profitability of the firms and promote the sectors. In this respect, we suggest that economic policy-makers should focus on sustaining financial and economic stability. Generally, our PVAR results show mixed results between different balance sheet accounts. This pattern may arise from the uncertainty and volatility of the financial markets and economic situations which makes interrelating the accounts difficult via quantitative techniques. Thus, it can be inferred that economic fragility and financial volatility may induce a negative impact on firms. In conclusion, we suggest that decreasing the volatility in financial markets and economic fragilities will provide sustainable growth in these sectors.

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TIME-VARYING COUNTRY BETA APPROACH IN MODELLING COUNTRY RISK OF TURKEY

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ABSTRACT

This paper analyses Turkey's country risk using a time-varying country beta market model incorporating various macroeconomic variables over the period January 2004 to August 2015. To our knowledge this is the first study exploring Turkey's country risk using country beta approach. We confirmed that Turkey's country beta is time-varying and demonstrates a huge amount of volatility especially between 2004 and 2007. We find that government and private sector external debt and market interest rates are the significant macroeconomic factors that have influenced Turkey's country beta during the analysis period. These findings reveal an important structural macroeconomic change in Turkish economy that is concerns about the sustainability of government debt and public finances have shifted to private sector related issues. Specifically, while private sector external debt, which increased rapidly during this period, has a significant positive impact on Turkey's country beta, substantially lowered levels of government external debt (as a percentage of GDP) acts as a risk-reducing macroeconomic factor.

1. INTRODUCTION

Harvey (1991) measured country risk as conditional sensitivity (covariance) of the country's equity returns to a global stock market index. Using Harvey's (1991) approach, Harvey and Zhou (1993) estimated country betas for the first time for developed markets. In vein of Harvey (1991) and Harvey and Zhou (1993), Lessard (1996) suggested that the beta of an offshore investment project with respect to the investing company's benchmark portfolio can be estimated directly by regressing returns on relevant local shares against the home-market portfolio (adjusting for financial and operational leverage). Beta also can be measured indirectly by estimating the beta of the project relative to the local market portfolio and multiplying the result by the country beta, the beta of the local market portfolio relative to the home-market portfolio. Although above studies provide a rationale for using country beta as a measure of country risk, Harvey (1995a) found that country

betas were lower than unity and statistically insignificant in many emerging countries and concluded that global standard asset pricing models like CAPM (which assume a complete integration of stock markets worldwide) fail to explain emerging stock market returns. Godfrey and Espinosa (1996) argue that, because of low correlation between emerging and global stock market returns, individual country betas (as measured with respect to a global stock index) do not reflect country-specific risks. Instead of using country betas as a systematic risk measure, they proposed a (relative) volatility measure (adjusted beta) as a total risk indicator that reflects the volatility of the local stock market relative to the volatility of the global stock market.

As the pace of globalization gained momentum, the degree of integration between emerging and global markets has increased significantly. Bekaert and Harvey (2014) argues that over the last 15 years, emerging markets transformed from an asset class exhibiting very low correlation with the rest of the world to one with a relatively high world market beta: risky but high expected returns which implies that country betas now reflect country-specific risks better. According to Phylaktis and Ravazzolo (2005), strengthened and increased financial linkages between open and semi-open markets during 1990's compared to 1980's, suggests that the relaxation of foreign ownership restrictions might have enhanced links with global markets. Voronkova (2004) provided evidence for the existence of significant long-run relations between the emerging Central European countries within the region and globally. Pukthuanthong and Roll's (2009) extensive study also documents strong evidence of growing integration for 51 countries around the world. Further, they found that the pace of integration over time varies between countries. Members of the European community, plus a few others such as South Korea, have experienced the largest increases while in contrast, several countries have gone in the opposite direction, toward less integration (such as Bangladesh, Nigeria, Pakistan, Sri Lanka, and Zimbabwe). All of these findings suggest that over time country beta might have become a more accurate measure of a country's risk.

Abell and Kruger (1989) demonstrated that the prediction of future betas using a time-varying beta model, which also incorporates significant economic variables, is more accurate than utilising historical betas. In addition to political, economic and financial variables, Erb et al. (1996a, 1996b) argue that country beta is also an important determinant of country credit ratings. Notably, Gangemi et al. (2000) drew attention to the point that for countries with a foreign debt that is predominantly official, country risk can be measured relatively easily by independent credit ratings (e.g. Somerville and Taffler, 1994; Afonso et al., 2011; Hilscher and Nosbusch, 2010). However, for countries with an important or larger amount of private sector external debt more refined or better country risk measures are needed. This point is especially relevant and important for the case of Turkey since after 2000–2001 economic crises private financial and non-financial corporations' external debt has increased to unprecedented levels reaching 35.4 per cent of GDP as compared to government's external debt of 14.7 per cent in 2014 (18.7 per cent and 28.0 per cent in 2002).

In this study, using macroeconomic variable-augmented country beta approach we have estimated Turkey's country risk during 2004–2015 period using monthly observations. The remainder of the paper is structured as follows: Section 2 reviews previous work on country beta while Section 3 presents the empirical methodology and estimation results. Section 4 concludes.

2. LITERATURE REVIEW

There are relatively a limited number of empirical studies modelling country risk using country beta approach. Gangemi et al. (2000) analysed Australia's country-specific risk using country beta model in the spirit of Harvey and Zhou (1993) and Erb et al. (1996a, 1996b). They investigated the impact of macroeconomic factors, with a special focus on open economy variables, using a time-series regression-based approach. They found that the only macroeconomic variable which has impacted on Australia's country risk significantly was exchange rates. Using various economic variables Wdowinski (2004) found that exchange rates and interest rates as indicators of monetary policy stance have relatively more power than real economic variables in explaining country beta of Poland. Using country beta approach, Verma and Soydemir (2006) investigated whether local and global risk factors influence Latin American (Mexico, Brazil, Argentina and Chile) country risk. They found that while domestic money supply and exchange rates are significant variables affecting country-specific risk, real interest and inflation rates of G-7 countries have a negative impact on individual country betas. Andrade and Telles' (2006) static empirical model confirms that monetary policy has a significant and stable effect on Brazil's risk as measured by country beta. Furthermore, they found that international reserves had a significant impact only in the fixed exchange rate period. In their paper Marshall et al. (2009) used time-varying beta estimates, extended by a dynamic conditional correlation GARCH model, as a proxy for country risk in emerging markets (EM). After confirming beta is time varying in twenty EM over the period 1995M01 to 2008M12, they found that their modelling strategy produces the lowest forecast errors among alternatives. The evidence also suggests that individual dynamic betas across EM are strongly associated with each country's and US interest rates, the Consumer Price Index and to a lesser extent the exchange rates.

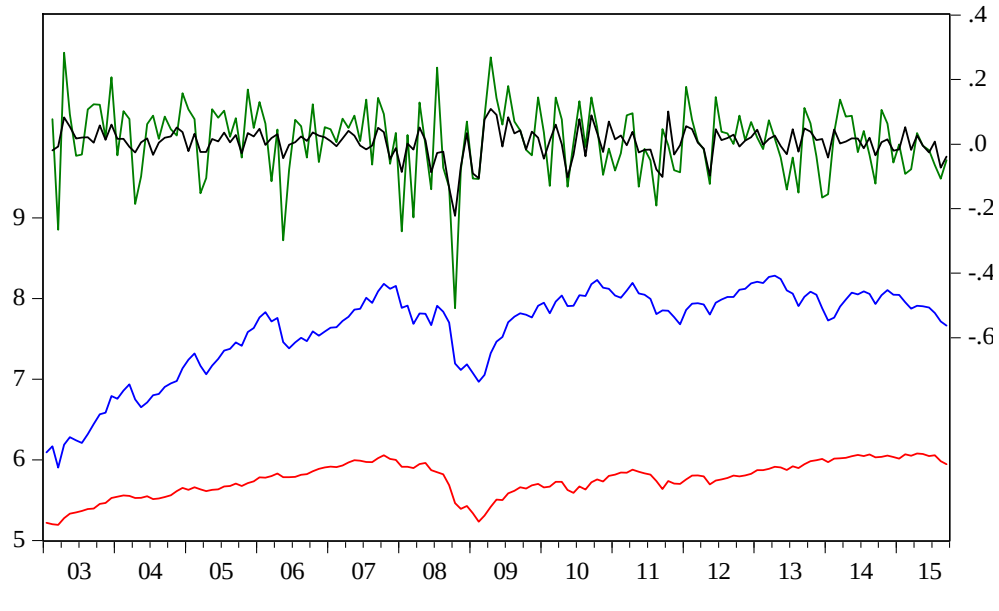
3. DATA AND METHODOLOGY

In this article we have employed the country beta model as our baseline specification for estimating Turkey's country risk. In this context, we have made the assumption that the country risk can be modelled in terms of the relationship between the returns on Turkish stock market and the world equity markets. In this regard, XU100 (BIST100) USD based return index and MSCI All Country World Equity Index have been used as proxies for Turkish and world equity markets, respectively. Using the conditional CAPM relationship on an international setting, the time-varying standard country beta model is defined as:

$$r_{tr,t} = \alpha + \beta_t r_{w,t} + e_t \quad (1)$$

where r_{tr} represents the rate of return on domestic equities, r_w represents the rate of return on the global stock index and e_t is the random disturbance term. The parameter β is the basic country risk measure; as interpreted in standard CAPM when β increases, the country risk and hence the required (or expected) rate of return on domestic equities increases in relation to the global equities. The sample period chosen for analysis includes the recent global financial crisis which affected national stock markets to varying degrees. In order to account for possible impact of the crisis upon country beta we have utilised a crisis dummy. The breakpoint date was chosen by graphical observation of the data (Figure 1) and Zivot-Andrews and Perrron unit root tests with one structural break. Zivot-Andrews and Perron tests indicate a break point on July 2008 which is clearly seen from Figure 1 as well.[1]

Figure 1: Time Series Plot of Turkish and World Equity Indices and Returns



Accordingly, we have also estimated the above model with a crisis dummy which takes the form:

$$r_{tr,t} = \alpha + \beta_t r_{w,t} + \gamma D_c r_{w,t} + \varepsilon_t \qquad (2)$$

[1] Test results were not presented here for space considerations but are available upon request from the authors.

where D_c is a dummy variable taking the value of unity in July 2008 and zero otherwise.

However, empirical findings suggest that the expected returns of financial assets depend on the macroeconomic variables within the economic cycle (Fama and French, 1989; McQueen and Roley, 1993). Moreover, Ferson and Harvey (1991) and Jagannathan and Wang (1996) suggest that beta risk is time varying in part as a result of business cycles and the evidence presented by Dumas (1994), Erb et al. (1994, 1996a) and Diemonte et al. (1996) support this argument.

Within this framework, it is expected that the relation between the returns on domestic equities and the returns on the global equities be strongly related to macroeconomic variables, and consequently the parameter beta is also expected to vary significantly, as a response to macroeconomic shocks. The issue that needs to be addressed in this context is not related to the endogeneity of the country risk, since this is well established, but which and how macroeconomic variables are capable of significantly influencing the country risk (Andrade and Teles, 2006). In this sense, the central aim of this paper is to build an econometric model to evaluate the explanatory power of various macroeconomic variables in explaining Turkish country risk under the country beta approach. Based on this argument a time varying beta risk can be expressed as:

$$\beta_t = b_0 + \sum_{i=1}^{N} b_i E_{it} + u_t \qquad (3)$$

where b_0 and b_i are the parameters to be estimated; E_{it} is the ith economic risk factor affecting beta at time t and u_t being the independent and identically distributed random disturbance term.

In modelling the relationship between stock market returns and macroeconomic risk factors, various indicators have been proposed and used in the relevant literature. Factors that potentially influence country risk include industrial production, real economic growth, productivity, unemployment, interest rates, inflation, current account balance related variables, public debt stock and other local factors (Fama, 1970; Chen et al., 1986; Abell and Kruger, 1989; Andersen et al., 2005; Jorion, 1991; Groenewold, 1997; Ely and Robinson, 1997; Kwon and Shin, 1999; Serra, 2000). Our guidance on the selection of explanatory variables comes from Gangemi et al. (2000), Andrade and Teles (2006), Verma and Soydemir (2006), Bilson et al. (2001) and Ferson and Harvey (1991). Bilson et al. (2001) find that domestic money supply, goods prices, real activity, and exchange rates are statistically significant in their association with emerging equity returns. Bilson et al. (2001) did not include interest rate as an important explanatory factor. However, they argued that it is not the interest rate itself but the yield and default spread that are more likely to influence equity returns. Since, there is an active secondary market for government debt securities in Turkey and the Central Bank of the Republic of Turkey's (CBRT) main monetary policy instrument is the short-term interest rate we used treasury average domestic borrowing rate as a potential risk factor explaining Turkish equity

returns. The variables Turkish Lira–US Dollar exchange rate *(USD)*, foreign currency basket calculated as 'TL value of 1 USD+0.70 EURO' *(FXB)* and real effective exchange rate index *(REER)* were used as alternative measures for exchange rates but surprisingly none of them found to be statistically significant under different model specifications. This maybe due to the fact that we used the USD based rate of returns for Turkish stocks.

Based on the discussion above, time-varying model of Turkish country beta can be expressed as follows:

$$\beta_t = b_0 + b_1 CPI_t + b_2 EXGD_t + b_3 BUD_t + b_4 RATE_t + b_4 EXPD_t + b_5 REER_t + b_6 XM_t + b_7 RES_t + b_8 LOAN_t + b_9 IPI_t + v_t \quad (4)$$

where all variables are defined as their unanticipated components as estimated by ARIMA modelling of the variables. The abbreviations and brief descriptions for the variables are given in Table 1 below. However, the time-varying equation of beta as represented in Eq. (4) cannot be estimated since beta is not directly observable. The parameters of the model can be estimated by substituting Eq. (4) in time-varying standard country beta model, i.e. Eq. (1). Accordingly, the specific time-varying beta market model of Turkey's country risk to be estimated is:

$$r_{tr,t} = a + b_0 r_{w,t} + b_1 CPI_t r_{w,t} + b_2 EXGD_t r_{w,t} + b_3 BUD_t r_{w,t} + b_4 RATE_t r_{w,t} + b_4 EXPD_t r_{w,t} + b_5 REER_t r_{w,t} + b_6 XM_t r_{w,t} + b_7 RES_t r_{w,t} + b_8 LOAN_t r_{w,t} + b_9 IPI_t r_{w,t} + b_{10} D_c r_{w,t} + \epsilon_t \quad (5)$$

Since Eq. (5) is entirely in terms of observable variables, the values of parameters in Eq. (4) can indirectly be estimated.

Our sample period covers the period from January 2003 to August 2015 in monthly intervals.

Table 1: List of Potential Explanatory Economic Variables

Symbol	Description of the Variable	Data Source
RW (r_w)	MSCI All Country World Index Close Value	Bloomberg
RTR (r_{tr})	Istanbul Stock Exchange XU100 USD Based Return Index Close Value	BIST
DUM	Dummy variable for the 2007 – 2008 Global Financial Crises	–
CPI	Turkey Consumer Prices Index (2003=100)	SIS
EXGD	Government External Debt Stock (million TL) deflated by CPI	Treasury
BUD	Ratio of central government budget revenues to budget expenditures	Min. of Finance
RATE	Public Sector Average Domestic Borrowing Rate	Treasury
EXPD	Private Sector Long Term External Debt Stock (million USD)	CBRT
REER	Real Effective Exchange Rate, CPI Based (2003=100)	CBRT
XM	Ratio of Goods and Services Exports to Imports	CBRT
RES	CBRT International Reserves (million USD)	CBRT

LOAN	Total Bank Loans to Private Sector (2003 Constant Consumer Prices, Thousand TL)	CBRT
IPI	Industrial Production Index (2010=100)	SIS

We transformed the data in the following manner. First, Turkish Lira denominated variables were deflated by *CPI* and all data series were expressed in natural logarithms except *BUD, RATE* and *XM* were expressed in percentage terms. Second, variables were adjusted for seasonality. Then we take the first differences of all logarithmic variables to obtain continuously compounded rates of return and growth rates. Descriptive statistics of the variables employed in the study are presented in Table 2.

Table 2: Descriptive Statistics of the Return Series and Macroeconomic Variables

	Mean	Median	Max.	Min.	SD	Skew.	Kurt.	JB	Prob.	Obs.
BUD	0.9131	0.9327	1.5296	0.5296	0.1323	0.1230	5.5702	42.2204	0.0000	152
CPI	0.0068	0.0066	0.0255	-0.0063	0.0049	0.4201	3.9315	9.9012	0.0071	151
EXGD	0.0023	0.0020	0.0489	-0.0443	0.0162	-0.0428	3.0612	0.0698	0.9657	151
EXPD	0.0120	0.0117	0.1015	-0.0486	0.0228	0.7693	5.0846	42.2360	0.0000	151
IPI	0.0041	0.0075	0.1386	-0.2356	0.0542	-0.7573	6.4710	90.2345	0.0000	151
LOAN	0.0171	0.0153	0.0889	-0.0465	0.0188	0.5146	5.0195	32.3244	0.0000	151
REER	0.0004	0.0033	0.0624	-0.1083	0.0290	-0.9379	5.1653	51.6362	0.0000	151
RES	0.0091	0.0107	0.1314	-0.0766	0.0333	0.3204	4.0148	9.0631	0.0108	151
RATE	0.1589	0.1294	0.5993	0.0569	0.1047	2.2650	8.8432	346.2088	0.0000	152
RTR	0.0107	0.0284	0.2834	-0.5085	0.1134	-0.8585	5.2877	51.4758	0.0000	151
RW	0.0051	0.0110	0.1087	-0.2220	0.0459	-1.1839	6.8028	126.2608	0.0000	151
XM	0.7228	0.7208	0.9737	0.5836	0.0676	0.5775	4.0894	15.9647	0.0003	152

Then, we checked the time series properties of each variable by performing unit root tests. Test results are presented in Table 3. Results clearly indicate that *CPI, EXGD, EXPD, IPI, REER* and *RES* are I(1) while *RTR* and *RW* are I(0), as expected. Results for *BUD, LOAN, XM* and *RATE* are somewhat mixed, so we further investigated the stationarity of these series by applying breakpoint unit root tests under alternative model specifications and the results are presented in Table 4. For *BUD*, although ADF and PP tests indicate that the series is I(0), the null hypothesis of stationarity under KPSS test can be rejected. On the other hand, the null hypothesis of unit root process is rejected under different trend and break specifications so we regard *BUD* as I(0). According to ADF and KPSS tests *XM* seems to be I(1) but the null hypothesis of unit root process is strongly rejected under the PP test. All specifications of unit root with break tests confirm the result that the series is I(1). *RATE* is expected to be I(0) *a priori* like the other return series but the null hypothesis of stationarity under KPSS test is strongly rejected again. Considering possible breaks and referring to unit root with break test results we decided that this series is also I(0). Unit root with break test for *LOAN* under the model specification including trend and intercept indicates that the null hypothesis of unit root cannot be rejected and this result led us to include this variable as I(1).

Table 3. Unit Root Test Results

	ADF		PP		KPSS	
	Trend+Interc.	**Intercept**	**Trend+Interc.**	**Intercept**	**Trend+Interc.**	**Intercept**
BUD: Level	-10.03*** (0.0000)	-9.36*** (0.0000)	-0.2137*** (0.0000)	-9.9811*** (0.0000)	0.1477*	0.5456**
1st Dif.	-9.79*** (0.0000)	-9.72*** (0.0000)	-63.01 (0.0001)	-58.08*** (0.0001)	0.1205*	0.2470
CPI: Level	-3.1713* (0.0942)	-1.2918 (0.6327)	-3.3691* (0.0595)	-1.2679 (06437)	0.2870***	1.4952***
1st dif.	-10.83*** (0.0000)	-10.83*** (0.0000)	-10.98*** (0.0000)	-10.86*** (0.0000)	0.0410	0.1589
EXGD: Level	-2.8893 (0.1690)	-1.5338 (0.5139)	-2.8808 (0.1717)	-1.5271 (0.5173)	0.0976	1.4370***
1st dif.	-13.30*** (0.0000)	-13.27*** (0.0000)	-13.32*** (0.0000)	-13.37*** (0.0000)	0.0367	0.0847
EXPD: Level	-0.7959 (0.9629)	-2.0544 (0.2636)	-0.8797 (0.9546)	-1.7775 (0.3905)	0.3186***	1.2178***
1st dif.	-7.8186*** (0.0000)	-3.8448*** (0.0031)	-8.3103*** (0.0000)	-8.0814*** (0.0000)	0.1521**	0.4200*
IPI: Level	-2.8812 (0.1716)	-1.8638 (0.3487)	-5.0023*** (0.0003)	-1.3272 (0.6161)	0.1331*	1.2993***
1st dif.	-24.01*** (0.0000)	-24.02*** (0.0000)	-26.42*** (0.0000)	-26.09*** (0.0000)	0.0566	0.0597
LOAN: Level	-2.1848 (0.4942)	-3.5026*** (0.0092)	-1.7366 (07302)	-2.7258* (0.0720)	0.2490***	1.4355***
1st dif.	-10.2804*** (0.0000)	-4.0277*** (0.0000)	-10.5312*** (0.0000)	-10.1392*** (0.0000)	0.0911	0.4749**
XM: Level	-2.2467 (0.4600)	-2.4170 (0.1388)	-5.7871*** (0.0000)	-5.3027*** (0.0000)	0.1077	0.3932**
1st dif.	-13.8397*** (0.0000)	-13.8250*** (0.0000)	-25.8519*** (0.0000)	-25.2201*** (0.0000)	0.0726	0.1866
REER: Level	-3.0508 (0.1222)	-2.8366* (0.0556)	-2.8916 (0.1682)	-2.8878** (0.0491)	0.2965***	0.3200
1st dif.	-9.2668*** (0.0000)	-9.0469*** (0.0000)	-9.1805*** (0.0000)	-9.0699*** (0.0000)	0.0328	0.2952
RES: Level	-0.9846 (0.9421)	-1.7893 (0.3847)	-1.3407 (0.8738)	-1.6809 (0.4389)	0.1968**	1.3858***
1st dif.	-12.1543*** (0.0000)	-11.9286*** (0.0000)	-12.2212*** (0.0000)	-12.1019*** (0.0000)	0.0598	0.2233
RATE: Level	-4.2476*** (0.0049)	-5.4158*** (0.0000)	-4.0601*** (0.0088)	-4.9304*** (0.0001)	0.2004**	1.1369***
1st dif.	-9.8127*** (0.0000)	-9.3271*** (0.0000)	-10.0764*** (0.0000)	-9.7680*** (0.0000)	0.1122	0.4677**
RTR: Level	-11.5953*** (0.0000)	-11.4027*** (0.0000)	-11.5888*** (0.0000)	-11.4027*** (0.0000)	0.0363	0.3256
1st dif.	-10.2683*** (0.0000)	-10.3027*** (0.0000)	-70.2321*** (0.0001)	-65.9535*** (0.0001)	0.2389***	0.2390
RW: Level	-9.8510*** (0.0000)	-9.8074*** (0.0000)	-10.0289*** (0.0000)	-9.9949*** (0.0000)	0.0719	0.1182
1st dif.	-12.2051*** (0.0000)	-12.2481*** (0.0000)	-21.4553*** (0.0000)	-21.5348*** (0.0000)	0.0185	0.0245

Critical values for KPSS unit root test at 1%, 5% and 10% are 0.2160, 0.1460 and 0.1190 for the model with trend and intercept; 0.7390, 0.4630 and 0.3470 for the model with only intercept, respectively. ***, ** and * indicate the rejection of null hypothesis at 1%, 5% and 10% significance levels. Values in parentheses are the associated one-sided p-values for the relevant test statistic.

Table 4: Unit Root with Break Test Results

Trend specification		Intercept	Trend and intercept		
Break specification		Intercept[1]	Intercept[2]	Trend[3]	Both[4]
BUD	Level	-11.2419***	-11.5995***	-11.3811***	-12.2708***
		2005M01	2008M08	2005M10	2008M08
	First Difference	-11.4738***	-11.4138***	-9.9901***	-11.7439***
		2007M03	2007M03	2004M07	2007M03
LOAN	Level	-4.6681**	-3.7106	-3.6797	-3.8636
		2010M02	2005M03	2005M12	2005M06
	First Difference	-11.1837***	-11.1550***	-10.6318***	-11.1417***
		2005M12	2005M12	2008M12	2009M08
XM	Level	-3.5609	-3.4127	-2.6585	-4.1358
		2009M10	2010M06	2011M06	2010M06
	First Difference	-14.4820***	-15.2178***	-13.8513***	-4.1358
		2009M02	2009M02	2015M08	2010M06
RATE	Level	-5.9593***	-4.5286	-4.3970*	-4.3787
		2008M11	2008M11	2015M02	2015M02
	First Difference	-10.2957***	-10.2739***	-10.6255***	-11.0281***
		2005M02	2005M02	2004M07	2006M07

***, ** and * indicate the rejection of the null hypothesis at 1%, 5% and 10% significance levels, respectively. Values in parentheses for ADF t-statistics are Vogelsang (1993) asymptotic one-sided p-values.

(1) Test critical values at 1%, 5% and 10% significance levels are -4.9491, -4.4436 and -4.1936, respectively.

(2) Test critical values at 1%, 5% and 10% significance levels are -5.3476, -4.8598 and -4.6073, respectively.

(3) Test critical values at 1%, 5% and 10% significance levels are -5.0674, -4.5248 and -4.2610, respectively.

(4) Test critical values at 1%, 5% and 10% significance levels are -5.7191, -5.1757 and -4.8940, respectively.

In an efficient financial market, it is expected that the stock market reacts only to unanticipated components of macroeconomic variables. Although earlier studies on the efficiency of the Turkish stock market provides evidence against market efficiency (Balaban, 1995; Balaban et al., 1996; Balaban and Kunter, 1997; Metin et al., 1997), using variance-ratio test statistics (which have better size properties and power than ADF test statistic) Ozdemir (2008) states that the Turkish stock market is efficient in later periods. As Elton et al. (2014) and Chen et al. (1986) argue, all the relevant explanatory factors in a multi-factor or multi-index asset pricing model should be measured as surprises or innovations, i.e. the unanticipated (unexpected) component of the variables. Before the estimation of the multi-factor model employed in this study, following the previous literature (e.g. Gangemi et al., 2000; Bilson et al., 2001; Verma and Soydemir, 2006; Andrade and Teles, 2006), first we measured the unanticipated components as the residuals from ARIMA models fitted to the macroeconomic data. A further advantage to using unanticipated components (residuals of the ARIMA models) of the macroeconomic risk factors as possible explanatory variables is that the potential problem of multi-collinearity is minimised (Gangemi et al., 2000). As displayed in Table 5, the highest correlations are around 0.38–0.39 for *RW–EXGD, RW–EXPD, RES–EXPD* and *RATE–REER*. All other correlations are around or less than 0.30 in absolute value.

Table 5: Correlations Between Unexpected Components of the Macroeconomic Variables (Residuals of the ARIMA Models), Sample: 2004M02 – 2015M08

	BUD	CPI	EXGD	EXPD	IPI	LOAN	XM	REER	RES	RATE
CPI	0.05775	1.0000								
EXGD	-0.1885	-0.0129	1.0000							
EXPD	0.2080	0.0205	0.2968	1.0000						
IPI	0.0794	0.0421	-0.0298	0.0045	1.0000					
LOAN	0.0294	-0.2436	-0.1500	-0.0921	0.1947	1.0000				
XM	-0.0786	-0.0448	-0.0614	-0.1693	-0.0591	-0.0432	1.0000			
REER	-0.0063	-0.0075	0.1159	0.0470	-0.0085	-0.0656	-0.1283	1.0000		
RES	-0.0452	-0.1541	0.2788	0.3802	-0.0187	-0.0017	-0.0032	0.3100	1.0000	
RATE	0.2549	0.1157	0.0141	0.0701	0.0095	-0.0306	0.0824	-0.3765	-0.0385	1.0000
RW	-0.0239	0.0055	0.3735	0.3858	0.0894	-0.0535	-0.2598	0.2695	0.3274	-0.1469

The most appropriate ARIMA models were identified by using various information criteria and by examining the autocorrelation of the residuals of each model fitted. The summary of the estimation results of the ARIMA models are provided in Appendix 1.

4. RESULTS

Single-Index Market Model without and with the Dummy Variable

Before the estimation of the full model expressed in equation (5), the results of the single index market model (SIMM) regressions with and without the crisis dummy variable are reported in Table 6. Referring to the table, SIMMs (without and with the crisis dummy, which takes the value of 1 in 2008M07, and 0 otherwise) were found to be significant in explaining Turkish USD based stock market returns with adjusted R^2 values of 45 per cent and 49 per cent, respectively. Indeed, Turkey's estimated betas of 1.5960 and 1.6248 were found to be statistically significant at the 1% level under both models. As expected, the recent global financial crisis had a positive (positive in the sense that Turkey's relative country risk had diminished) effect on Turkish stock market returns. Under both models, Turkey's estimated country betas are very high in this period, which renders support to the findings of Harvey (1995a), (1995b), Verma and Soydemir (2006) and Bekaert and Harvey (2014). Bekaert and Harvey (2014) demonstrates that in 2000's emerging market betas have increased compared to 1990's as a result of increased integration with the world capital markets, fluctuating between 1.2–1.6 band, making them a risky, high expected return asset class. High R^2 values indicate that global stock market returns have significantly high power in explaining USD based Turkish stock market returns. To the extent that world economic indicators explain global stock returns, they may explain the variability in Turkish stocks' returns due to increased integration. This issue is beyond the scope of this paper and will be the subject of another research.

Serial autocorrelation tests show no autocorrelation in residuals, with Durbin–Watson values around 2. The Breusch–Godfrey LM tests also indicate no evidence of autocorrelation up to lag lengths of 12. Breusch-Pagan-Godfrey unconditional heteroskedasticity tests indicate the existence of heteroskedasticity at 5% and 10% significance levels for model (1) and model (2), respectively. In contrast, LM tests for ARCH effects produced statistically insignificant values up to lag lengths of 12. We also test the stability of the estimated parameters of both models using the CUSUM and CUSUM of squares tests. Results suggest the parameters are stable for both models. (Figure 2 and Figure 3)

Table 6: SIMM Regression Results with and without the Crisis Dummy Variable

		Model 1 SIMM	**Model 2 SIMM with Dummy**
Constant	Coefficient	0.0018	–0.0003
	Std. Error	0.0070	0.0067
	t-Statistic	0.2617	–0.0439
	Probability	0.7940	0.9650
RW	Coefficient	1.5960***	1.6248***
	Std. Error	0.1497	0.1439
	t-Statistic	10.6630	11.2914
	Probability	0.0000	0.0000
RW*DUM	Coefficient	—	–10.2405***
	Std. Error	—	2.8745
	t-Statistic	—	–3.5625
	Probability	—	0.0005
Adjusted R^2		0.4495	0.4928
F-statistic		113.6986	68.0467
Prob (F-stat.)		0.0000	0.0000
D–W stat.		2.0347	2.0174
Breusch–Godfrey Serial Correlation LM Test	F(1,136)	0.0562	0.0200
	Prob.	[0.8130]	[0.8877]
	F(4,133)	1.0988	0.5749
	Prob.	[0.3599]	[0.6813]
	F(8,129)	1.6646	1.4834
	Prob.	[0.1131]	[0.1694]
	F(12,125)	1.1774	1.2774
	Prob.	[0.3064]	[0.2401]
Breusch-Pagan-Godfrey Heteroskedasticity Test	F(2,136)	4.5218**	2.3519*
	Prob.	[0.0353]	[0.0990]
ARCH(1)	F(1,136)	0.1385	0.1393
	Prob.	[0.7104]	[0.7095]
ARCH(4)	F(4,130)	0.3372	0.4186
	Prob.	[0.8525]	[0.7950]
ARCH(8)	F(8,122)	0.6299	0.7004
	Prob.	[0.7514]	[0.6907]
ARCH(12)	F(12,114)	0.5834	0.7300
	Prob.	[0.8518]	[0.7196]
J–B Normality Test	J–B test stat.	3.8901	4.7971*
		[0.1430]	[0.0908]

Figure 2: CUSUM and CUSUM of Squares Tests for Model 1 (SIMM)

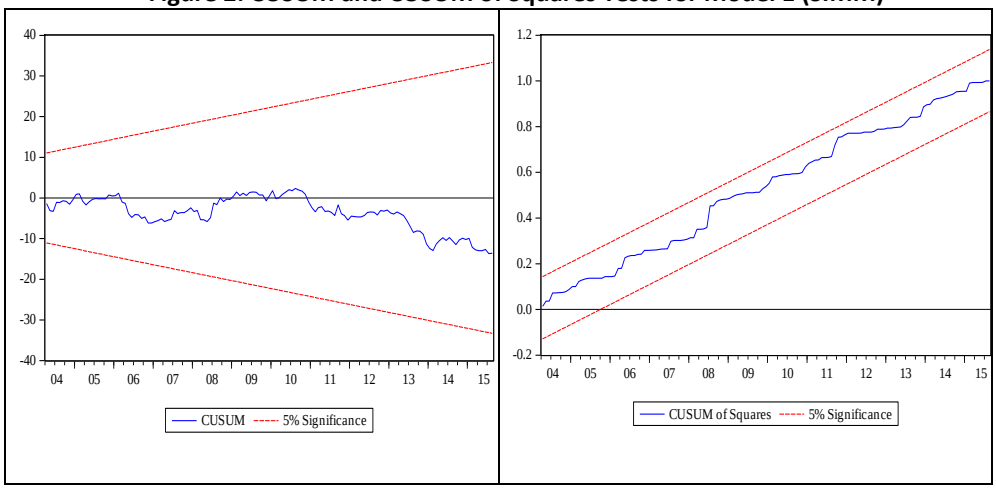
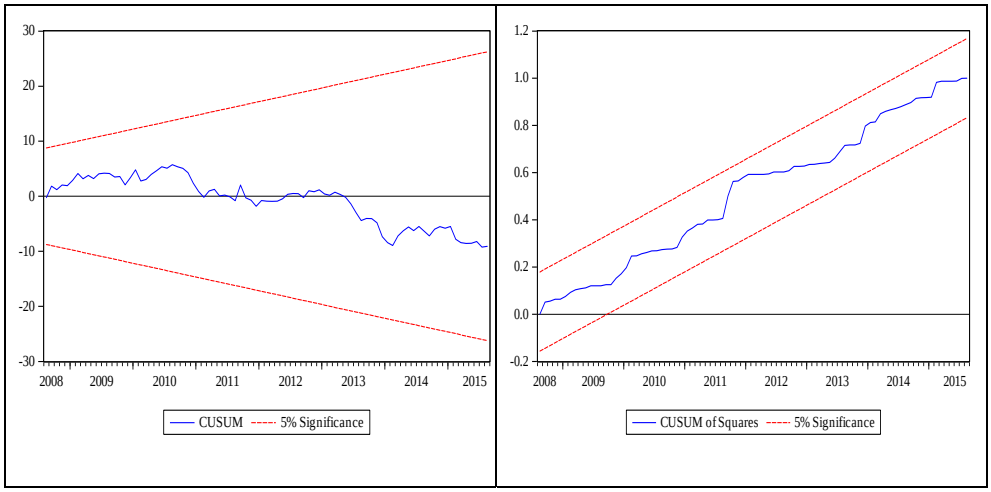


Figure 3: CUSUM and CUSUM of Squares Tests for Model 2 (SIMM with the break)



Macroeconomic Variable Augmented Country Beta Model

For the estimation of the full model in accordance with equation (5), we created new variables by interaction of global stock market returns and the unanticipated components of the macroeconomic variables. The sample period used in estimating equation (5) after adjustments spans over the period from February 2004 to August 2015. The estimation results of the full model are reported in Table 7. These results show that of the interactive macroeconomic variables, government external debt stock *(EXGD)*, government domestic borrowing interest rate *(RATE),* private sector long-term external debt stock *(EXPD)* and the dummy variable *(DUM)* have significant effect in explaining Turkish country beta and

stock returns. This model explains 45 percent (adjusted R^2) of the variation in Turkish stock returns. The Durbin–Watson statistic takes a statistically insignificant value of 2.2425, which is consistent with the Breusch–Godfrey LM test results up to 12 lags. The Breusch-Pagan-Godfrey heteroskedasticity test value of 4.5218 indicates the presence of unconditional heteroskedasticity at 5% significance level. However, an absence of conditional heteroskedasticity is indicated by the statistically insignificant values of the ARCH LM tests up to 12 lags.

Table 7: Full Model Estimation Results

Variable		Coefficient	Std. Error	t-Statistic	Probability
C		0.0061	0.0057	1.0823	0.2812
RW		1.1729	0.1259	9.3141	0.0000
CPI*RW		-0.3243	33.5934	-0.0097	0.9923
EXGD*RW		-27.0264	9.8427	-2.7459	0.0069
BUD*RW		-0.7054	1.3553	-0.5205	0.6037
RATE*RW		38.7547	15.4814	2.5033	0.0136
EXPD*RW		26.4623	9.6093	2.7538	0.0068
REER*RW		4.1288	6.0391	0.6837	0.4954
XM*RW		2.4838	2.5432	0.9766	0.3306
RES*RW		7.4175	6.0916	1.2177	0.2256
LOAN*RW		-3.9623	13.8999	-0.2851	0.7761
IPI*RW		-2.1214	3.5341	-0.6003	0.5494
DUM*RW		-6.7761	2.2192	-3.0534	0.0028
Adjusted R^2		0.4501			
F-statistic		10.4142			
Prob (F-stat.)		0.0000			
D–W stat.		2.2125			
Breusch–Godfrey Serial Correlation LM Test	F(1,125)	1.8373			
	Prob.	[0.1777]			
	F(4,122)	0.7775			
	Prob.	[0.5419]			
	F(8,118)	1.5160			
	Prob.	[0.1588]			
	F(12,114)	1.2725			
	Prob.	[0.2444]			
Breusch-Pagan-Godfrey Heteroskedasticity Test	F(12,126)	4.5218**			
	Prob.	[0.0461]			
ARCH(1)	F(1,136)	0.0767			
	Prob.	[0.7823]			
ARCH(4)	F(4,130)	0.1622			
	Prob.	[0.9571]			
ARCH(8)	F(8,122)	0.6602			
	Prob.	[0.7255]			
ARCH(12)	F(12,114)	0.9870			
	Prob.	[0.4657]			
J–B Normality Test	J–B test stat.	1.3472			
	Prob.	[0.5099]			

Given that the full model includes a number of statistically insignificant variables, a more parsimonious model was estimated, whereby the significant macroeconomic variables along with the structural break dummy variable were included. The estimation results for this parsimonious model is reported in Table 8. Once again, along with the structural break dummy, those macroeconomic variables found to be significant in the full model estimation namely *EXGD*, *RATE* and *EXPD*, proved to be statistically significant in explaining Turkish country beta and stock returns under the parsimonious model. This model explains 54.64 percent of the variation in Turkish stock market returns.

The explanatory power of the parsimonious model increased significantly, as indicated by adjusted R^2's, over both single index market models (without and with the dummy variable) and full macroeconomic variable augmented market model. The Durbin–Watson statistic of 1.9694 indicates an absence of autocorrelation in residuals. This absence of autocorrelation is supported by Breusch–Godfrey serial correlation LM tests as well. The Breusch-Pagan-Godfrey and Glejser heteroskedasticity F test statistics take statistically insignificant values, supporting the absence of unconditional heteroskedasticity. Besides, insignificant ARCH LM conditional heteroskedasticity F test statistics enable us to reject the null hypothesis of conditional heteroskedasticity. On the other hand, the residuals from the estimated model seem to be non-normal as the Jarque–Berra test statistic takes a value of 5.3009 which is significant at 10%. Overall, with respect to the results of the diagnostic tests the estimated parsimonious model seems to be well-specified.

Table 8: Parsimonious Macroeconomic Model Estimation Results

Variable		Coefficient	Std. Error	t-Statistic	Probability
C		-0.0009	0.0068	-0.1369	0.8913
RW		1.6661	0.1484	11.2266	0.0000
EXGD*RW		-24.7575	10.0163	-2.4717	0.0147
RATE*RW		34.8123	13.0256	2.6726	0.0085
EXPD*RW		31.6754	9.6039	3.2982	0.0012
DUM*RW		-9.3797	2.7264	-3.4403	0.0008
Adjusted R^2		0.5464			
F-statistic		34.2428			
Prob (F-stat.)		0.0000			
D–W stat.		1.9694			
Breusch–Godfrey Serial Correlation LM Test	F(1,132)	0.0114			
	Prob.	[0.9150]			
	F(4,129)	0.5622			
	Prob.	[0.6905]			
	F(8,125)	1.1879			
	Prob.	[0.3115]			
	F(12,121)	0.8621			
	Prob.	[0.5870]			
Breusch-Pagan-Godfrey Het. Test	F(5,133)	0.3000			
	Prob.	[0.9121]			
Glejser Heteroskedasticity Test	F(5,133)	0.7175			
	Prob.	[0.6114]			
ARCH(1)	F(1,136)	0.6068			
	Prob.	[0.4373]			
ARCH(4)	F(4,130)	0.3843			
	Prob.	[0.8195]			
ARCH(8)	F(8,122)	0.5182			
	Prob.	[0.8409]			
ARCH(12)	F(12,114)	0.7073			
	Prob.	[0.7416]			
J–B Normality Test	J–B test stat.	5.3009			
	Prob.	[0.0706]			

The stability of the estimated parameters of both models using the CUSUM and CUSUM of squares test results suggest the parameters are stable for both models. (Figure 4 and Figure 5)

Figure 4: CUSUM and CUSUM of Squares Tests for the Full Model

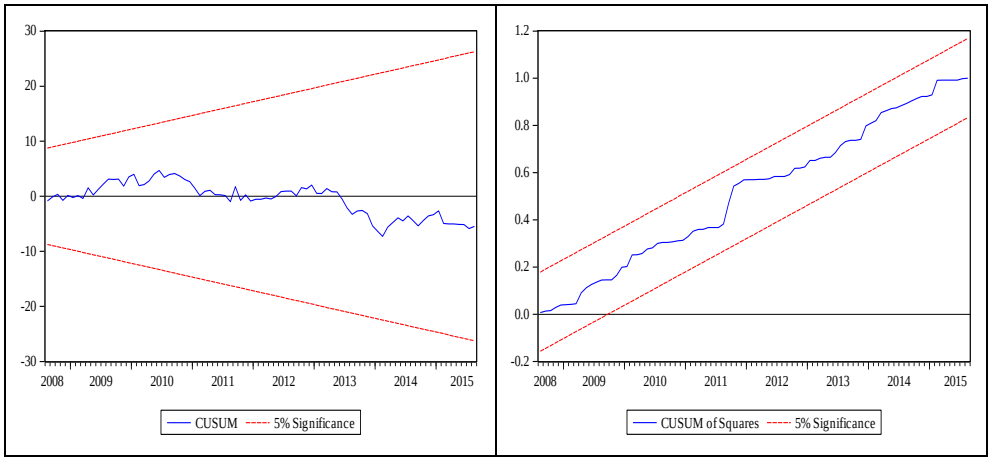
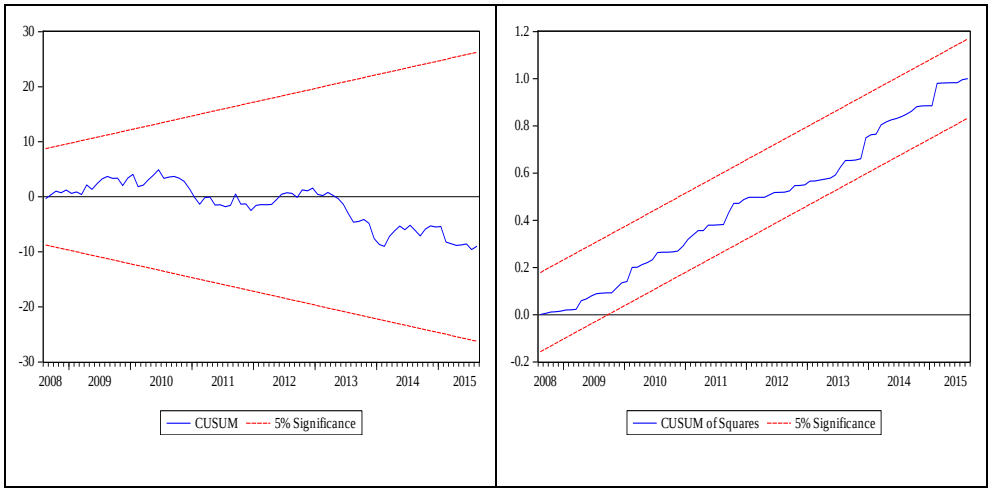


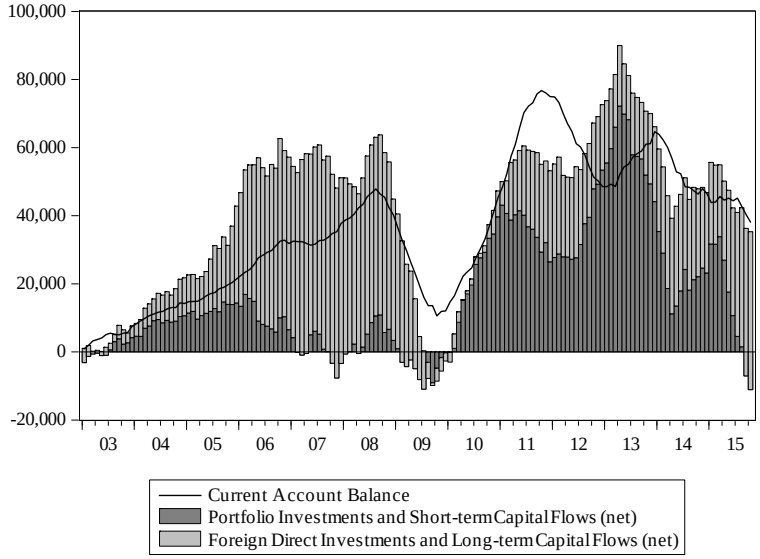
Figure 5: CUSUM and CUSUM of Squares Tests for the Parsimonious Model



According to the outcome of our preferred parsimonious model the base value for Turkey's country beta is 1.6661. Further, the results suggest that Turkey's country beta is affected negatively by a positive change in external government debt stock while a change in long-term external private debt stock has a positive impact on the beta. Turkey's structural current account deficits (especially resulting from heavy dependence on intermediate goods imports) have been a constraint on her economic growth (Elitok and Campbell, 2008; Halicioglu, 2012) and necessitates foreign capital inflows to finance domestic demand. Political and economic stability achieved after the economic crises of 2000–2001 and favorable global liquidity conditions in 2000's until the collapse of the global financial markets and hence the world economy, enabled Turkish banks and corporations to raise foreign currency denominated funds in international financial

markets. While increased access to international financial markets had favourable impact on Turkey's economic growth, increased reliance on foreign external financing led to increased foreign exchange risk and balance sheet fragility of the corporate sector. Thus, sustainability of current account deficits has been a serious concern for policymakers, international institutions and investors. These concerns may have led to an increase in country risk premium and hence may have had a positive impact on country risk. In Figure 6 we plot Turkey's current account deficits and net short- and long-term capital flows in million USD.

Figure 6: Turkey's Current Account Deficits and Foreign Capital Flows (Million USD, 12 months cumulative)



At first glance, the negative relationship between the changes in government external debt stock and the country beta may be surprising or contradictory but because, the private sector external debt stock has increased rapidly relative to the government debt stock after 2000–2001 economic crises, concerns seem to shift from government finances to the sustainability of private sector external debt and current account deficits. Increased confidence in Turkish economy as reflected in decreasing country risk premium, made the government sector (including monetary policy) as the soundest pillar of Turkish economy together with the banking system. This positive relationship between the government external debt and the country risk may simply reflect these developments. This interpretation is reinforced by the above discussion about the private sector external debt stock. Indeed, when we excluded *EXGD* from our parsimonious model estimation, *EXPS*'s coefficient still took a statistically significant positive value. We also estimated the model without the *EXPD* and found that *EXGD*'s coefficient took a negative but insignificant value. Furthermore, besides being the benchmark market interest rate, movements in government's domestic borrowing rate in this period mainly stemmed from monetary policy operations and developments in international politics and world economy. Figure 7

plots the public sector borrowing requirement and public and private sector gross external debt stock as percentages of GDP.

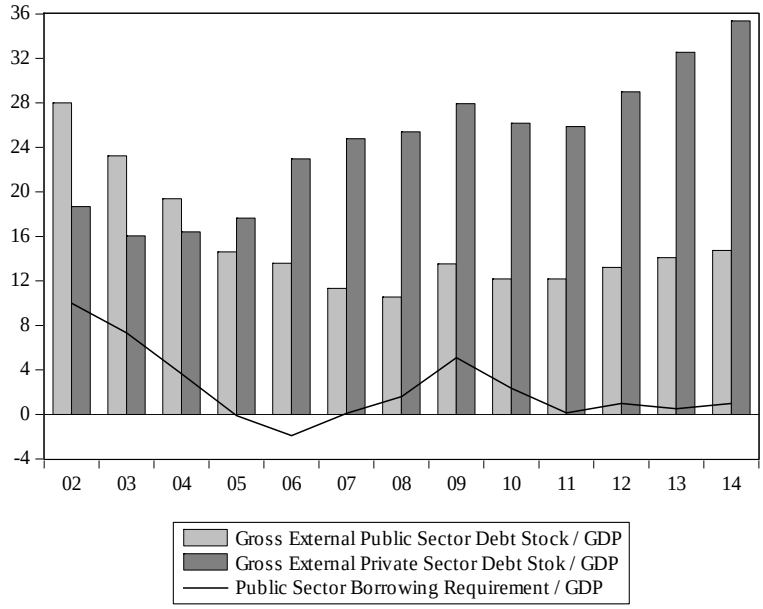


Figure 7: Government Budget Balance, Government and Private External Debt Stock (%)

Since the interest rate on government domestic debt securities *(RATE)* is regarded as the risk-free rate, its statistically significant positive coefficient estimate is in line with the fundamental notion of risky asset pricing theories, i.e. risky assets are priced as risk premium over risk-free rate. The coefficient on the break dummy is again statistically significant and takes a negative value as in SIMM with the break and full model estimations. In July 2008 (break date) while the global stock prices fell 2.75 per cent, Turkish stock market USD based index rose by 23.69 per cent of which about 5 per cent is attributable to the appreciation of Turkish Lira against USD in this month. As a result, the time-varying country beta estimate takes a negative value of -8.64 in July 2008 (Figure 8). We also produced the plot of Turkey's country beta by using our preferred parsimonious model. Figure 8 shows Turkey's country beta over the period 2004M02–2015M08, including the structural break, while Figure 9 shows the same plot excluding the break dummy. Table 9 shows associated summary statistics for the conditional beta series produced.

Figure 8: Turkey's time-varying country beta (Parsimonious model, including the break)

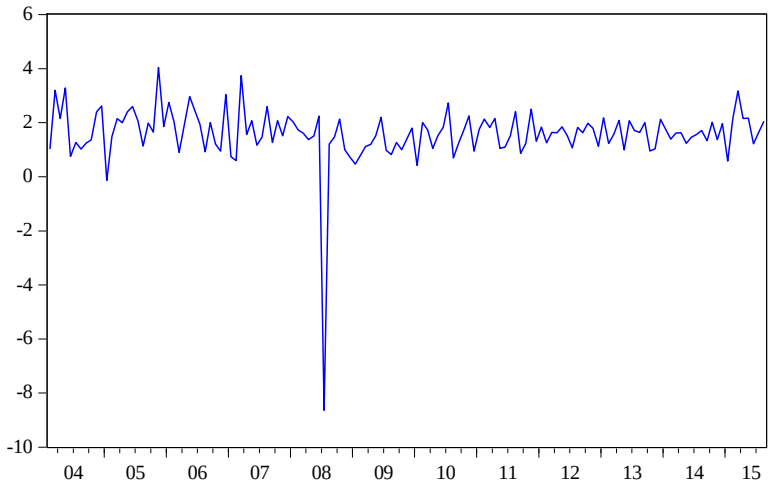
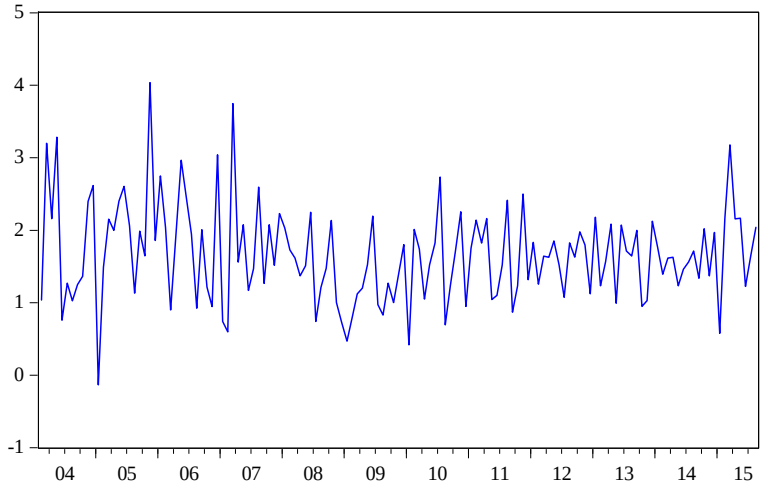


Figure 9: Turkey's time-varying country beta (Parsimonious model, excluding the break)



According to statistics presented in Table 9, we see that the average time-varying beta is 1.5954 (1.6629 with the break excluded). These averages are higher than the point estimate of 1.6661 reported in Table 9. Further, we see that (aside from the crash beta) betas vary between a low of -0.1334 to a high of 4.0341. Hence, while the point estimate accurately captures the mean effect of beta over the period, it ignores the time-varying nature of Turkey's country beta.

Table 9: Descriptive statistics for the time-varying country beta estimated using the parsimonious mode, 2004M02–2015M08

	Including the Break Dummy	Excluding the Break Dummy
Mean	1.5955	1.6629
Median	1.6272	1.6272
Maximum	4.0341	4.0341
Minimum	-8.6389	-0.1334
Std. Dev.	1.0970	0.6672
Skewness	-5.6985	0.5983
Kurtosis	55.8825	4.0338
Jarque-Bera	16,949.04	14.4821
Probability	0.0000	0.0007
Sum	221.7671	231.1468
Sum Sq. Dev.	166.0709	61.4276
Observations	139	139

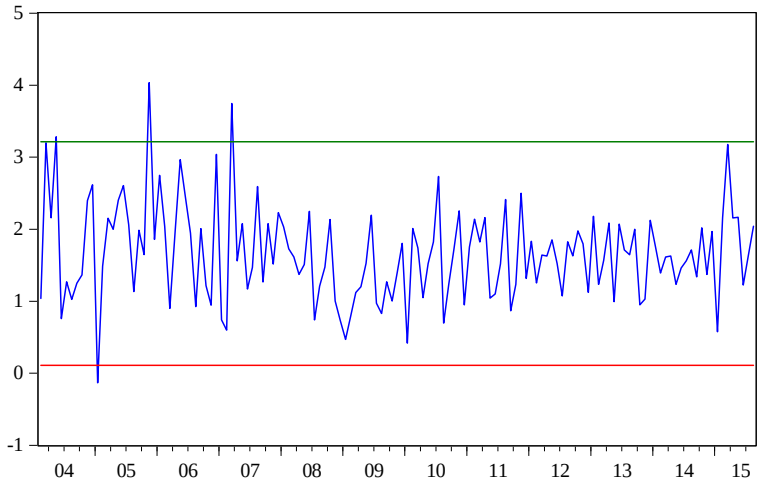
It is quite clearly visible from Figure 8 that, apart from the break date denoting the recent global crisis, the model produces several outliers. Also it is apparent that Turkey's country beta fluctuates more between 2004 and early 2008, compared to the later period. Since the 2004–2007 period is a period of economic and financial restructuring and relatively improving political and macroeconomic stability, concerns and uncertainties regarding whether the government's commitment to pursue sound economic policies and willingness to undertake structural reforms (especially fiscal discipline, price stability and current account deficits) would continue in the future might have caused risk perceptions to be higher in this period.[2]

With respect to outlier betas some are worth mentioning. In Figure 10 we plot the forecasted beta (excluding the break) produced by our parsimonious model and 99% confidence interval bands. From the figure, notably three outlier betas are easily detectable, namely January and November 2005 and March 2007 beta estimates. In January 2005, when the estimated beta takes its minimum value over the whole period, the decline in beta mainly was the result of a decline in interest rates due to a lowering of official O/N borrowing and lending rates by the CBRT which were transmitted rapidly to market interest rates and, a decrease in private sector external debt compared to its previous increasing trend. In November 2005, a large unanticipated increase (6% over the previous month) in private sector external debt accounted for almost all of the positive

[2] Using simple structural breakpoint unit root tests we found that there is a structural break around the first half of 2008 in estimated time-varying country beta (excluding the break) series. We divided the whole sample into two subsamples (2004M02 – 2008M03 and 2008M04 – 2015M08) and compared the descriptive statistics of the series. Not surprisingly we found that the average beta and its standard deviation is 1.86 and 0.82 for the first subsample and 1.55 and 0.52 for the latter. Further, beta series are non-normal for the whole sample but normally distributed for the two subsample periods.

change in beta. Finally, in March 2007 unanticipated increases in both private sector external debt and interest rates caused beta to jump to 3.75. Overall, the fluctuations first in unanticipated changes in private sector external debt and then interest rates caused Turkey's country beta to exhibit large volatility in the period considered.

Figure 10: Turkey's time-varying country beta within 99% confidence intervals



5. CONCLUSION

In this paper, following Harvey (1991), Harvey and Zhou (1993), Erb et al. (1996a, 1996b), Gangemi et al. (2000), Verma and Soydemir (2006) and Andrade and Teles (2006), we analysed Turkey's country risk using a time-varying country beta market model incorporating various macroeconomic variables over the period January 2004 to August 2015. In this context, Turkey's country beta is allowed to vary as a function of a set of domestic macroeconomic variables. To our knowledge this is the first study exploring Turkey's country risk using country beta approach. Instead of using observed values of those macroeconomic variables, we tried to decompose the anticipated (expected) and unanticipated (unexpected) components by employing ARIMA models based on the notion that in an efficient market, stock prices only react to unanticipated movements in economic variables.

Among the macroeconomic variables used, only government and private sector external debt and market interest rates found to be statistically significant in influencing Turkey's country beta during the analysis period. According to the outcome of our preferred parsimonious model, the base value for Turkey's country beta is 1.6661. Further, findings suggest that Turkey's country beta is modified in a negative direction by a positive change in external government debt stock while a change in external private debt stock has a positive impact on the beta. These findings reveal an important structural macroeconomic

change in Turkish economy during this period. The considerable growth in Turkish private sector's external debt after 2000–2001 economic crises which is inseparably related with increasing current account deficits, has raised concerns on its sustainability and opened up a policy debate regarding its potential adverse effects on the economy. In a period of decreasing domestic private savings but favorable global liquidity conditions and increasing economic and political stability, heavy reliance on foreign capital inflows helped to finance domestic demand and boosted economic growth while current account deficits reached unprecedented levels as a percentage of GDP. On the other hand, due to strengthened fiscal discipline, substantially lowered levels of government external debt (as a percentage of GDP) have acted as a risk-reducing macroeconomic factor. Consequently, it seems to us that concerns about the sustainability of government debt and public finances have shifted to sustainability of private sector external debt and current account deficits.

Another important result revealed in the study is large fluctuations in Turkey's estimated country betas, varying between a low of -0.1334 to a high of 4.0341 excluding the crash dummy. Especially this is more pronounced between 2004 and 2007. Since this sub-period is a period of economic recovery and transformation, concerns regarding the government's commitment to undertake structural reforms, pursue fiscal discipline and high economic and financial fragility may have caused risk perceptions to persist at high levels even under favorable global liquidity conditions.

Finally, the coefficient on the break dummy was statistically significant and takes a negative value as in SIMM with the break and economic variable-augmented model estimations. In July 2008 (break date) while the global stock prices fell 2.75 per cent, Turkish stock market USD based index rose by 23.69 percent of which about 5 percent is attributable to the appreciation of Turkish Lira against USD in this month. As a result, the time-varying country beta estimate takes a negative value of -8.64 in July 2008. This negative coefficient may reflect, relatively sound macroeconomic and financial fundamentals of Turkey vis-à-vis the advanced countries where the economies affected most adversely.

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Appendix 1. ARIMA Modelling of Macroeconomic Variables to Estimate Unanticipated Components

	Macroeconomic Variable				
	BUD	**CPI**	**EXGD**	**EXPD**	**IPI**
Constant	0.9277***	0.0067***	0.0016	0.0149	0.0039**
	(0.0047)	(0.0002)	(0.0017)	(0.0123)	(0.0016)
AR(1)	1.0149***	—	—	0.1931***	–0.5480***
	(0.0187)			(0.0585)	(0.0684)
AR(3)	—	—	0.1517**	0.2384***	—
			(0.0817)	(0.0701)	
AR(4)	—	–0.1981**	—	–0.3271***	—
		(0.0762)		(0.0731)	
AR(7)	—	—	—	0.2241***	—
				(0.0613)	
AR(9)	—	—	–0.1476**	0.4845***	—
			(0.0817)	(0.0694)	
AR(10)	—	–0.4140***	—	—	—
		(0.0994)			
AR(11)	—	—	—	—	0.2194***
					(0.0694)
AR(12)	–0.0763***	—	0.2300***	—	—
	(0.0156)		(0.0816)		
MA(1)	-0.9878***	—	—	—	—
	(0.0093)				
MA(2)	—	—	—	0.3200***	—
				(0.0616)	
MA(4)	—	—	—	0.2850***	—
				(0.0627)	
MA(6)	—	—	—	0.4239***	—
				(0.0559)	
MA(8)	—	—	—	0.1516**	—
				(0.0631)	
MA(9)	—	—	—	–0.6199***	—
				(0.0565)	
MA(10)	—	0.4266***	—	—	–0.1842***
		(0.0769)			(0.0425)
MA(11)	—	—	—	—	–0.6345***
					(0.0499)
MA(12)	—	–0.5138***	—	—	0.4113***
		(0.0722)			(0.0456)

Standard errors in parentheses. ***, **, * denote significance at 1%, 5% and 10%, respectively.

Appendix 1 continued. ARIMA Modelling of Macroeconomic Variables to Estimate Unanticipated Components

	Macroeconomic Variable				
	LOAN	**XM**	**REER**	**RES**	**RATE**
Constant	0.0131***	0.0002	–0.0008	0.0085**	–0.0478
	(0.0016)	(0.0010)	(0.0008)	(0.0040)	(0.0861)
AR(1)	—	–0.7205***	0.8379***	–0.1987***	—
		(0.0655)	(0.0559)	(0.0739)	
AR(3)	—	0.9569***	—	—	—
		(0.0282)			
AR(4)	0.4606***	0.4548***	—	—	—
	(0.0494)	(0.0744)			
AR(5)	0.5985***	—	—	—	—
	(0.0713)				
AR(8)	—	—	—	–0.5962***	—
				(0.0731)	
AR(10)	–0.2044***	—	—	—	0.3270***
	(0.0634)				(0.0686)
AR(11)	0.2141***	—	—	—	—
	(0.0508)				
AR(12)	–0.2497***	—	—	—	—
	(0.04848)				
MA(1)	—	0.1638***	–0.5321***	0.2196***	—
		(0.0178)	(0.0839)	(0.0537)	
MA(2)	0.3471***	–0.1618***	–0.4385***	0.1516***	—
	(0.0477)	(0.0184)	(0.0777)	(0.0380)	
MA(3)	0.3036***	–0.9717***	—	0.3368***	—
	(0.0582)	(0.0138)		(0.0786)	
MA(4)	–0.7017***	—	—	0.2210***	—
	(0.0688)			(0.0560)	
MA(5)	–0.3446***	—	—	—	0.2816***
	(0.0537)				(0.0658)
MA(8)	—	—	—	0.8199***	—
				(0.0416)	
MA(10)	—	—	—	—	–0.7000***
					(0.0692)
MA(11)	–0.4652***	—	—	0.2206***	—
	(0.0141)			(0.0793)	
MA(12)	–0.0850***	—	—	—	—
	(0.0237)				

Standard errors in parentheses. ***, **, * denote significance at 1%, 5% and 10%, respectively.