The DynamicRelationshipsbetween Stock MarketCapitalization Rate and Interest Rate in Turkey

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Abstract

This paper investigates the long term and short term relationships between stock market capitalization rate and interest rates in Turkey over the period 1998-2012. Prior to conducting the analysis in time series, in order to test the stability of the series, a unit root test was initially applied. It is determined that both stock market capitalization rate and interest rate series are not stationary. Long-term relationship is tested by Johansen Cointegration tests and casual relationship is tested by Granger Causality tests. According to the results of the study, there is long term relationship between stock market capitalization rate and interest rates while there is not causal relationship between stock market capitalization rate and interest rates in short term.

Keywords: Stock Market Capitalization Rate, Interest rates, Cointegration, Vector error, Correction model (VECM), Causality.

Introduction

Two critical factors of economic growth are stock exchange and interest rate. The effects of interest rate on stock exchange ensure important implications for monitory policy towards financial markets. The relationship between stock market capitalization rate (SMCR) and interest rate have preoccupied the minds of economists since they both play important roles in influencing a country's economic development (Aydemir and Demirhan, 2009).

Theoretically, interest rates have negative impact on stock market performance. An increase in interest rates would avoid investors making high risk stock market investments comparing to low risk interest bearing security investments such as fixed deposits, savings certificates, treasury bills etc (French et al., 1987). In other words, demand for high risk stock market investments would fall if the interest rates are high. As a result, fall in demand for shares would eventually reduce its prices. In contrast, lower interest rate would cause opposite effects such as higher demand for stock investment and increase of share prices.

On the other hand, Central Banks usually use interest rates as a tool to dominate inflation in a country. If Central Bank changes interest rates, it would indirectly affect the stock market performance. It eventually would have an impact on overall economic development of the country. Thus, determination of ideal interest rate is a very important policy decision that a country has to consider regularly (Pallegedara, 2012).

Objective of this study is to investigate the long term and short term relationships between SMCR and interest rates. In the first section of the study, aliterature review is made in order to introduce the variables and the models appliedfor different countries. In the second section, data set and variables of the model areexplained. In the third section, a VAR (Vector Autoregression) model is used toexplain the relationship between interest rates and SMCR. The last section of the study evaluates the results of the model and concludes the paper.

Literature Review

The relationship between the stock market and macroeconomic factors has been a key study concern in the literature. For instance, the relationship between inflation and stock market returns was investigated by Fama (1981). In his study, it is argued that expected inflation is negatively correlated with anticipated real activity, which in turn is positively related to returns on the stock market. A negative correlation between stock market returns and expected inflation was introduced. Conversely, the influence of the long term interest rate on stock prices stems directly from the present value model through the influence of the long term interest rate on the discount rate.

Zhou (1996) analyzed the relationship between interest rates and stock prices with a regression analysis. He found that over the long term, interest rates have a significant effect on stock returns. In addition, his results point out that long term interest rates explain a major part of variation in price-dividend ratios and bring up that the high volatility of the stock market is related to the high volatility of long term bond yields and may be accounted for by changing forecasts of discount rates.

Maysami and Koh (2000) used a VECM model using monthly data between 1988-2003 to examine the long term equilibrium relationships between selected macroeconomic variables and stock indices of Singapore, Japan and the United States. They found that changes in Singapore's stock market levels cause a cointegration relationship with changes in price levels, money supply, short and long term interest rates, and exchange rate except industrial production and trade. And also they detected that Singapore stock market is significantly and positively cointegrated with stock markets of Japan and the United States. Hondroyiannis and Papapetrou (2001) investigated the dynamic relationships between the real stock returns, oil prices, and economic activity. They performed a VAR model using monthly data between 1984:1–1999:9. They found that stock prices do not lead to changes in real economic activity but the macroeconomic activity and foreign stock market changes partially explained Greek stock price movements. They also found that oil price changes explain Greek stock price movements and have a negative impact on economic activity.

Arango, Gonzales and Posada (2002) exhibited some evidence of the nonlinear and inverse relationship between the share prices on the Bogota stock market and the interest rate. They used daily data from January 1994 up to February 2000. They attained that their model captured the stylized fact on this market of high dependence of returns in short periods of time.

Simpson and Evans (2003) analyzed the dynamic interactions and long term relationships between banks share returns and interest rates with a VAR model including Granger Causality and cointegration analysis. They concluded that there is no long term

relationship between bank shares returns, bank share returns and exchange returns. However, a causality from bank share returns and to exchange rates and interest rates.

Gan et al. (2006) examined the relationship between the New Zealand Stock Index and certain macroeconomic variables between 1990- 2003. They used monthly data to perform the cointegration tests. They found that the New Zealand Stock Index is consistently determined by the interest rate, money supply and real GDP but no proof could be found whether the New Zealand Stock Index is a leading indicator for changes in macroeconomic variables.

Kurihara (2006) analyzed the relationships between Japan stock index and macroeconomic factors with using daily data Japan among March 2001 and September 2005. His study included various variables such as Japan stock index prices, USA stock index prices, Yen/USD exchange rates, Japan interest rates. As a result, he found that interest rates have no effect on Japan stock prices but, exchange rates and USA stock prices have effects on Japan stock prices.

Ologunde et al. (2006) employed a time series analysis to examine the effect of interest rate on some certain variables such as SMCR and government development stock rate between 1981-2000 years. They used the ordinary least-square (OLS) regression method and used yearly data. They found that interest rates have a positive influence on SMCR and a negative influence on government development stock rate. They also found that government development stock rate has a negative influence on SMCR.

Mahmudul and Gazi (2009) investigated the relationship between interest rate and stock price for 15 developed and developing countries including Australia, Bangladesh, Canada, Chile, Colombia, Germany, Italy, Jamaica, Japan, Malaysia, Mexico, Philippine, S. Africa, Spain, and Venezuela. They used monthly data from 1988 to 2003. They found that interest rates have a significant and negative relationship with share prices for most of the countries. Only six countries -Malaysia, Japan, Bangladesh, Colombia, Italy, and S. Africa are found that changes of interest rates have a significant and negative relationship with changes of share price.

Büyükşalvarcı (2010) analyzed the effects of certain macroeconomic variables on share index by arbitrage pricing model. The model contains seven macroeconomic variables (consumer price index, money market interest rates, industrial production index, gold prices, oil prices, exchange rates, money supply) and Istanbul Stock Exchange 100 Index returns. The dynamics between the seven variables and Istanbul Stock Exchange 100 Index returns are introduced by a multiple regression method. As a conclusion, interest rates, industrial production index, oil prices and exchange rates have negative effects on Istanbul Stock Exchange 100 Index returns, but money supply has a positive effect on Istanbul Stock Exchange 100 Index returns. Inflation rate and gold prices have no significant effect on Istanbul Stock Exchange 100 Index returns.

4. Methodology

In this section of the study, the relationships between SMCR and interest rates in Turkey over the period 1998-2012 is analyzed using time series methods of co-integration and Granger Causality. For that purpose, data set will be defined first, and then time series properties of the series will be tested.

4.1. Data Description

In the study, an empirical analysis was made to detect the relationships between the ISE SMCR and interest rate with a VAR model. For this purpose, quarterly data between 1998:Q1 and 2012:Q3 periods were included.

Market Capitalization data is obtained from the website of ISE or at present name Borsaİstanbul. The SMCR is defined as market capitalization data divided by GDP. Data for the interest rate was retrieved from the website of the TCMB (Central Bank of Turkey). Data set and definitions can be seen in Table 1.

Table 1: Data Set

Variable	Definition	
dMSC	SMCR	Ratio of stock market capitalization to GDP
dintr	Interest rate	2 to 14 days weighted average interest rate

4.2. Methodology and Empirical Results

Initially we graph the series, it is seen that there is no stationarity for both of the series. If the series are not stationary in level, variance and covariance of the series are not fixed in the research period.

Graph 1: Variables Volatility
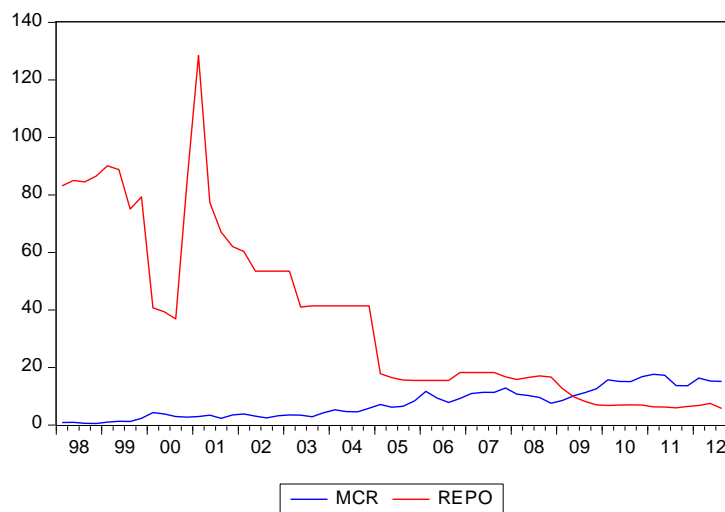
After an observational look, the stationary of each variable were tested by unit root tests to determine their level of stationarity. Stationary variables could be used in the model. Then, a VAR model is estimated, granger causality, impulse- response functions and variance decomposition were tested in order to emphasize the dynamic properties of the system.

4.2.1. Unit Root Test

Stationarity of the time series is a salient pre-condition in future estimations. That is related to the fact that if the analysis is conducted with non-stationary time series, spurious regression problem occurs. In such a case, series with no actual interrelationship may seem as if they are interrelated (Özata and Esen, 2010). In this study stationarity of the variables

are tested by unit root tests of Augmented Dickey-Fuller (ADF), Philips-Peron (PP) and KPSS. None of the series is found to be stationary as a result of ADF, PP and KPSS test results. All of the series become stationary when their first differences are taken. Therefore, all of the series are first-order integrated I (1). As a consequence, differenced series are used in the analysis. Results of the unit root tests are presented in Table 2.

Table 2: Unit root test results

TEST	dMCR	dINT
ADF(c)	-7.610268	-5.406468
ADF(t)	-7.539280	-5.548979
PP (c)	-8.225866	-14.92046
PP(t)	-8.173137	-18.86397
KPSS(c)	-0.099097	0.500000
KPSS(t)	0.105651	0.500000
*c with constant term but no trend.		
***t** with constant term and trend.		

4.2.2. Cointegration Test

Unit root tests revealed that the series are stationary at first level, so they are integrated. But, even the series are integrated; it does not guarantee that they behave in the same direction in the long term. Long term relationships between two non-stationary series can be detected by cointegration analysis. There are certain tests to perform cointegration analysis. In this study, long term relationship between the cointegrated series is tested by a Johansen cointegration test (1988). Johansen cointegration test provide us to determine the number of cointegration relationship and the parameters of this relationship (Özata and Esen, 2010).

Prior to the implementation of the Johansen Cointegration Test, the unrestricted Vector Autoregression (VAR) model was applied on the series to determine lagged ratios. Lagged ratio is taken as 2 according to the SC, HQ and LR criteria. The Johansen Cointegration test results, the Trace Test and the Maximum Eigenvalue test results are illustrated in Table 3 and Table 4.

Table 3: Trace Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	%5 Critic Value	Probability
None (r=0)	0.430888	49.95243	15.49471	0.0000
At most 1 (r≤1)	0.291460	18.95016	3.841466	0.0000

Table 4: Maximum Eigenvalue Test Results

Hypothesized No. of CE(s)	Eigenvalue	Maximum Eigenvalue Statistics	%5 Critic Value	Probability
None (r=0)	0.430888	31.00227	14.26460	0.0001
At most 1 (r≤1)	0.291460	18.95016	3.841466	0.0000

Trace test and Maximum Eigenvalue test results shows that we can reject the null hypothesis:

Ho: There is no cointegration,

As a conclusion, we can state that there is a long term relationship between the variables.

Engle and Granger (1987) emphasized that an error correction model can be set when there is long term relationship between the variables. In other words, a bias of the long term equilibrium can be corrected. Correction of the bias in the regression can be made by an error correction term (ECT). Therefore, Granger causality of the model should be based on an error correction model (VECM).

4.2.3 Vector Error Correction Model

The main advantage of the error correction model is that it enables to benefit the sub information of the series in the short term and long term. It also provides to eliminate the spurious regression (Sevüktekin and Nargeleçekenler, 2010).

Therefore, for long term relationship, a dynamic specification of error correction (VECM) model can be defined as:

$$\Delta Y_{1t} = \alpha_0 + \sum_{J_{\overline{k}=1}}^{k} \alpha_{1j}\Delta Y_{1t-j} + \sum_{J_{\overline{k}=1}}^{k} \alpha_{2j}\Delta Y_{2t-j} + \lambda_1 ECT_{t-1} + \varepsilon_{1t} \tag{1}$$

$$\Delta Y_{2t} = \beta_0 + \sum_{J=1} \beta_{1j}\Delta Y_{1t-j} + \sum_{J=1} \beta_{2j}\Delta Y_{2t-j} + \lambda_2 ECT_{t-1} + \varepsilon_{2t} \tag{2}$$

ECT_{t-1} is the lagged value of error correction model. Coefficients λ_1 and λ_2 show the equilibrium ratio. When cointegration is considered, α_{1j} from the equation 1 and β_{1j} from the equation are tested whether they are significant in group by F-test and also coefficients of the error correction model λ_1 and λ_2 are tested whether significant or not (Özata and Esen, 2010).

4.2.3. Granger Causality Test

Results of the Granger Causality test using vector error correction model is presented in Table 5.
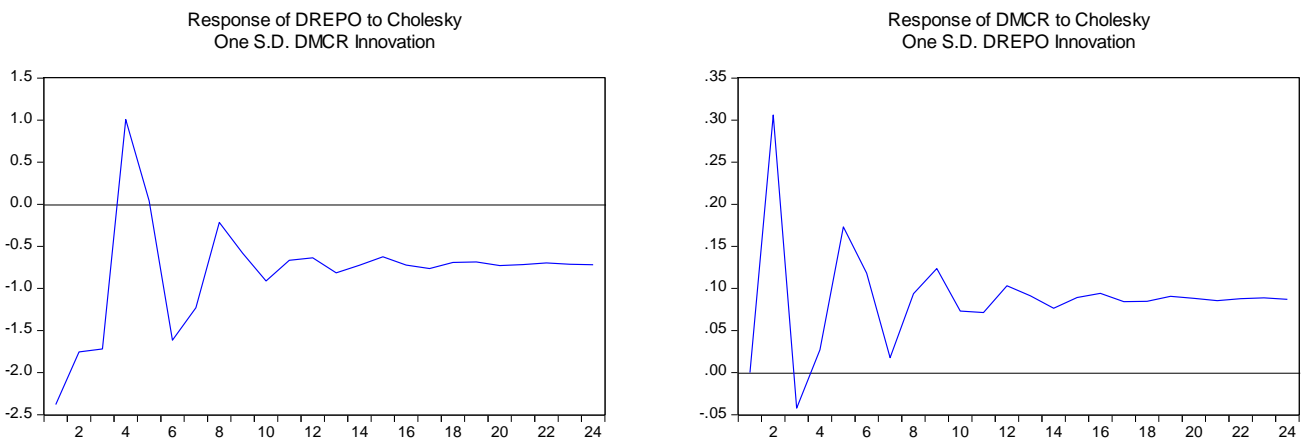
Table 5: Granger Causality Test Results

Hypothesis	Test Statistics	P Value
		m=2
SMCR does not Granger Cause interest rate	0.08698	0.9168
Interest rate does not Granger cause SMCR	0.08871	0.9153

The Granger Causality test results pointed at an inelastic relationship between SMCR and interest rate. Therefore, changes in the SMCR are not sensitive to changes in interest rates. In the contrary case, changes in the interest rates are not sensitive to changes in the SMCR.

4.2.4. Impulse-Response Functions

After testing causality, responses of the indices to an impulse in crude oil prices are analyzed. Impulse response functions reveal the effects of an unexpected shock given to a variable on the future values of its own and also other variables. As a result of impulse response functions, dynamic relationships can be observed among the variables and also the adjustment process can be detected.

Graph 2: Graphs of Impulse-Response Functions

Response of DREPO to Cholesky One S.D. DMCR Innovation

Response of DMCR to Cholesky One S.D. DREPO Innovation

According to the impulse response functions, an unexpected change of SMCR has an impact on interest rate during 16 periods and afterwards the effects disappear. And also an unexpected change of interest rate has an impact on SMCR during 17 periods. These results support the long term relationship between the two determinants.

4.2.5. Variance Decomposition

Variance decomposition indicates the amount of information each variable contributes to the other variables in a vector autoregression (VAR) model (Lütkepohl, 2007). In other words, variance decomposition determines how much of the forecast error variance of each variable can be explained by exogenous shocks to the other variables. Accordingly, the results of the variance decomposition of our variables are as given in Table 6 and Table 7.

Table 6: Variance Decompositions of SMCR

Period	DMCR	DINTR
1	100	0
6	97.36711	2.632890
12	97.87258	2.127417

Variance decomposition of SMCR is shown in table 6. As a result of the variance decomposition tests, 100 % of the forecasting error variance of SMCR is explained by itself in short term. In midterm 2.633 % forecasting error of the SMCR can be explained by interest rate, 97.367 % is explained by itself and in the long term 2.127 of SMCR can be explained by interest rate and 97.872 % is explained itself.

Table 7: Variance Decompositions of Interest Rate

Period	DMCR	DINTR
1	3.452237	96.54776
6	7.815995	92.18401
12	9.433681	90.56632

Variance decomposition of interest rate is shown in table 7. According to table 7, in short term 3.452 % of the forecasting error variance of interest rate is explained by SMCR and 96.547 % of forecasting error variance is explained by itself. In midterm 7.815 % of forecasting error variance of interest rate is explained by SMCR and 92.184 is explained by itself. At the last, in the long term, 9.433 % of forecasting error variance of interest rate is explained by SMCR and 90.566 is explained by itself.

As a conclusion; results of the variance decompositions of SMCR show that there is no short term, midterm and long term significant relationship between SMCR and interest rate. But variance decomposition of interest rate result is consistent with the results of the cointegration analysis. If the time becomes longer, the relationships become more visible.

5. Summary and Concluding Remarks

This study examined the relationship of interest rates on the SMCR in ISE over the period 1998-2012 with VAR model. Time series of the data are found non-stationary so that the long term relationships between the two variables are tested with cointegration analysis. According the results of the model, there is a long term relationship between the SMCR and interest rate but contrarily there is no granger causality relationship. The results showed that, crisis in the stock market are precluded with the control of interest rate in the long term.

The findings of the Variance Decomposition tests indicate that 2.127 % of forecasting error variance of the SMCR can be explained by interest rate, 97.87 % is explained by itself; likewise 90.56 % of interest rate is determined by itself and 9.43 % is explained by the SMCR.

The cointegration relationship between the interest rates and SMCR is inconsistent with the inferences of the efficient market hypothesis. Mainly, stock market can be estimated under the efficient market hypothesis. If the economic policies implemented by the policy makers do not influence the stock market as planned, they have to revise these economy policies. If the policy makers try to cure the economic problems like high inflation or unemployment, they have to consider the extensive effects of these policies because adverse effects can be observed in stock markets. As a result, capital formation may decrease and economy may disrupt.

REFERENCES

Arango, L., Gonzalez, A.& Posada, C. (2002). Returns and interest rate: A nonlinear relationship in the Bogota stock market. *Applied Financial Economics*, 12(11), 835–842.

Aydemir, O. &Demirhan, E., (2009).The relationship between stock Prices and exchange rates evidence from Turkey.*International Research Journal of Finance and Economics,* 23, 208-215.

Büyükşalvarcı, A. (2010).The effects of macroeconomics variables on stock returns: Evidence from Turkey. *European Journal on Social Science.*14(3), 404–416.

Engle, R.F. & Granger, Cwj. (1987).Cointegration and error correction: Representation, estimation and testing. *Econometrica,* 55, 251–276.

Fama, E. F.(1981). Stock Return, real activity, inflation, and money. *American Economic Review*, 71(4), 545–65.

French KR., Schwert GW.&Stambaugh RE (1987). Expected stock returns and volatility. *Journal of Finance Economics*. 19, 3–29.

Gan,C., Lee, M., Yong, H.H.A., & Zhang, J. (2006). Macroeconomic variables and stock market interactions: New Zealand evidence. *Investment Management and Financial Innovations,*3(4), 89–101.

Hondroyiannis, G.&Papapetrou, E. (2001). Stock market performance and macroeconomic experience in Greece.*Greek Economic Review*, 21 (2), 65–84.

Johansen, S.(1988). Statistical analysis of cointegration vectors.*Journal of Economic Dynamics and Control,* 12, 231–254.

Kurihara, Y. (2006), The relationship between exchange rate and stock prices during the quantitative easing policy in Japan, *International Journal of Business*, 11(4), 375–386.

Lütkepohl, H. (2007). Econometric Analysis with Vector Autoregressive Models*, European University Institute Working Paper ECO*, 43.

Mahmudul, A.&Gazi Salah, U. (2009). The relationship between interest rate and stock price: Empirical evidence from developed and developing countries. *International Journal Of Business And Management*. 4(3), 43–51.

Maysami, R.C.&Koh, T.S.(2000). A vector error correction model of the Singapore stock market.*International Review of Economics and Finance*, 9, 79–96.

Ologunde, A.O., Elumilade, D.O.&Asaolu, T.O. (2006). Stock market capitalization and interest rate in Nigeria: A Time Series Analysis.*International Research Journal of Finance and Economics,* 4, 154–167.

Özata, E. &Esen, E. (2010). Reel ücretlerileistihdamarasındakiilişkininekonometrikanalizi. *Journal OfAnadolu University Social Sciences.* 10, 55–70.

Pallegedara, A. (2012). Dynamic relationships between stock market performance and short term interest rate empirical evidence from Sri Lanka. *University Library of Munich, MPRA Paper 40773,* Germany.

Sevüktekin, M.&Nargelecekenler, M. (2010). *Ekonometrikzamanserilerianalizi: Eviewsuygulamalı*. Ankara, Nobel Pres.

Simpson, J.L. & Evans, J.P. (2003).Banking stock returns and their relationship to interest rates and exchange rates: Australian Evidence.*University of Wollongong in Dubai Working Paper*, 5, 1–35.

Zhou, C., (1996). Stock market fluctuations and the term structure.*Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series*, 96/03.