Yönetim, Yıl: 19, Sayı: 59, Şubat 2008

STOCK RETURNS AND VOLATILITY: SOME EVIDENCE FROM ISTANBUL STOCK EXCHANGE

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This paper investigates the firm-level and portfolio-level relationships between stock market returns and their forecast volatilities in Istanbul Stock Exchange (ISE). Expected volatility is derived from symmetric and asymmetric conditional volatility models: ARCH(p), GARCH(1,1), EGARCH(1,1) and GJR-GARCH(1,1). The out-of-sample forecasts are used as a proxy for monthly expected volatilities over the period of January 1991 to December 2006. Expected and unexpected volatilities are found to have a positive or negative effect in a few cases with low R^2 values. The results of this study do not provide any support for a relationship between stock returns and volatility in ISE.

Key Words: Risk-return relation, conditional heteroscedasticity models, ISE, out-of-sample forecast.

HİSSE SENEDİ GETİRİLERİ VE DEĞİŞKENLİK: İMKB ÜZERİNE BİR ÇALIŞMA

Bu çalışmada, hisse senedi getirileriyle bu getirilerin tahminî değişkenlikleri arasındaki ilişki, İMKB Hisse Senetleri Piyasası için firma ve portföy düzeyinde araştırılmıştır. Beklenen değişkenlik değerleri, simetrik ve asimetrik koşullu değişkenlik modelleri olan ARCH(p), GARCH(1,1), EGARCH(1,1) ve GJR-GARCH(1,1) ile hesaplanmıştır. Ocak 1991 – Aralık 2006 dönemi için yapılan çalışmada, aylık beklenen değişkenlik değerleri örneklem-dışı tahmin değerlerinin bir göstergesi olarak kullanılmıştır. Beklenen ve beklenmeyen değişkenlikler ile getiriler arasında pozitif veya negatif ilişkinin olduğu durum sayısı oldukça azdır ve R^2 değerleri düşük düzeylerdedir. Bu çalışmanın sonuçlarına göre, İMKB'de getiri ve risk arasında anlamlı düzeyde bir ilişki bulunmamaktadır.

Anahtar Sözcükler: Getiri-risk ilişkisi, koşullu değişkenlik modelleri, İMKB, örneklem-dışı tahmin.

INTRODUCTION

The relationship between risk and return has long been an important subject of financial research. It has been a general agreement among researchers that investors require larger returns from riskier securities.

However, investors may not always require larger risk premium because time periods which are relatively more risky could coincide with time periods when investors are better able to bear particular types of risk. Further, a larger risk premium may not be required because investors may want to save relatively more during periods when the future is more risky (Glosten, Jagannathan and Runkle, 1993, p:1780). Hence a positive as well as a negative relation between risk and return would be consistent with the theory. Besides, the reported findings of the existing empirical studies support this conflicting fact. French, Schwert and Staumbaugh (1987), Campbell and Hentschel (1992) and Scruggs (1998) report a positive relation whereas Pindyck (1984), Chou (1988), Breen, Glosten and Jagannathan (1989), Nelson (1991), Cheung and Ng (1992) and Glosten *et al.* (1993) find a negative one. Baillie and DeGennaro (1990) and Chan, Karolyi and Stulz (1992) report no significant relation. Harrison and Zhang (1999) uncover a significant positive risk and return relation at long holding intervals, such as one and two years, which is nonexistent at short holding periods such as one month. All these studies employ U.S. data. In contrary, evidence from other developed and emerging markets is rare. Poon and Taylor (1992) find that returns have a positive but not statistically significant relationship between expected volatility in the UK market. In their study, where ten industrialized countries are investigated, Theodossiou and Lee (1995) find no relationship between conditional volatility and expected returns in any of the national stock markets (Australia, Belgium, Canada, France, Italy, Japan, Switzerland, The United Kingdom, the United States, and West Germany). Mougoné and Whyte (1996) find no relation for Germany and France. De Santis and Imrohoroglu (1997) study the dynamics of expected stock returns and volatility in emerging markets in addition to Germany, Japan, the UK and the USA. They detect a risk-reward relation in Latin America but not in Asia. Salman (1999) reports that return is positively associated with risk in the Istanbul Stock Exchange. Girard (2001) finds that returns have a positive, though not statistically significant relationship with expected volatility for Asian financial markets. Balaban, Bayar and Kan (2001) report that the estimated conditional volatility in terms of standard deviation has a positive and significant effect on the index returns in Australia, Canada and Japan; a negative but insignificant effect in Finland and a positive but insignificant effect in the rest of the 15 industrialized markets. Cao, Heras and Saavedra (2004) mention that the conclusions differ from one volatility model to the other in analyzing the trade-off between risk and return in the Spanish stock market. Balaban and Bayar (2005) find that expected volatility has a significant negative or positive effect on country returns in a few cases. Unexpected volatility has a negative effect on weekly stock returns in six to seven countries and on monthly returns in nine to eleven countries depending on the volatility forecasting model. Leon, Nave and Rubio (2005) study the risk-expected return trade-off in several European stock indices and report that, in most indices, there is a significant positive relation. Koulakiotis, Papasyriopoulos and Molyneux (2006) report a weak relationship for the specific stock markets of industrialized countries.

This paper aims to provide empirical evidence for the risk-return relationship in an emerging market. In this study firm-level and portfolio-level relationships are investigated for a sample of 10 time series for Turkish stocks and ISE National-100 Price Index. The out-of-sample forecasts generated by different conditional volatility models are used as a proxy for monthly expected and unexpected volatilities over the period of January 1991 to December 2006. In this context, this paper is the first attempt that provides a larger range of time period and employs different conditional heteroscedasticity models to forecast out-of-sample volatility of an emerging financial market index (firm) that will be used to test the relationship between risk and return.

The rest of the paper is organized as follows: Section I introduces data and methodology used. The empirical results are presented in Section II. Finally the last part concludes the paper.

I. METHODOLOGY

A. Data

For the portfolio-level relationship, daily closing prices of ISE National-100 Price Index are used over the period of January 2, 1991 to December 29, 2006. ISE National-100 Price Index is a value-weighted index which represents the 85.97 % of the stock market as of January 2, 2005. During the research period, the methodology of calculation and the coverage of index have substantially changed.

Firm-level relationship is investigated for a sample of 10 stocks traded in ISE. The main selection principle of these stocks is the inclusion in ISE National-100 Price Index for the whole period. 7 of these stocks were continuously included in ISE National-100 Price Index over the period of 1991 to 2006. Whereas the other 3 stocks were included in the index during the same time period except one quarter. Below is the list of the selected stocks and their sectors:

Table 1. Selected Firms and Their Sectors

Firms	Sector	Inclusion In ISE National-100 Price Index
Arcelik (ARCLK)	Industrial	Whole period
Aselsan (ASELS)	Industrial	Whole period except one quarter
Aygaz (AYGAZ)	Industrial	Whole period except one quarter
Eczacibasi Ilac (ECILC)	Industrial	Whole period
Eczacibasi Yatirim (ECZYT)	Financial	Whole period
Eregli Demir Celik (EREGL)	Industrial	Whole period
Ford Otosan (FROTO)	Industrial	Whole period
Koc Holding (KCHOL)	Financial	Whole period
Migros (MIGRS)	Service	Whole period except one quarter
Yapi Kredi Bankasi (YKBNK)	Financial	Whole period

B. Methodology

The hypothesis of this study is that there is a relationship between stock returns and their conditional volatility.

The analysis involves monthly volatility forecasts. Daily index (firm) returns are calculated as follows:

$$R_{M,T} = LN\,(P_{M,T}/P_{M,T-1}) \quad (1)$$

where $r_{m,t}$ denotes the continuously compounded return of the index (firm) on trading day t; $P_{m,t}$, closing price of the index (firm) on trading day t and $P_{m,t-1}$, closing price of the index (firm) on trading day t-1.

Hence the "realized volatility" estimate is defined as the within-month variance of continuously compounded daily returns as follows:

$$\sigma_T^2 = \frac{1}{n-1}\sum_{t-1}^{n}\left(r_{m,t} - \bar{r}_m\right)^2 \quad (2)$$

$$\bar{r}_m = \frac{1}{n}\sum_{t=1}^{n} r_{m,t} \quad (3)$$

where T denotes a month; σ_T^2, realized monthly volatility; n, number of trading days in a month and $\bar{r}_m$, mean of a month.

The value of realized volatility depends on the assumption of a daily trading.

The basic methodology involves the estimation of the volatility models' parameters using an initial set of data and the application of these parameters to later data, thus forming out-of-sample forecasts (Brailsford and Faff, 1996 and Balaban, 2000). The whole period is divided into two equal subperiods: estimation period (January 1991 to December 1998) and forecast period (January 1999 to December 2006).

The hypothesis of this study is tested by using symmetric and asymmetric conditional heteroscedasticity models: ARCH(p), GARCH(1,1), GJR-GARCH(1,1) and EGARCH(1,1). Before estimating the variances, the conditional mean model is defined as AR(1) process depending on the properties of the observations. The symmetric models are:

ARCH(P) MODEL: $a_t = \varepsilon_t \sigma_t$

$$\sigma_t^2 = \omega + \sum_{i=1}^{m} \alpha_i a_{t-i}^2 \quad (4)$$

In the previous studies, various p values are tested for an optimal value of ARCH(p). In this paper, ARCH(6) model fits better to the index return data for different periods of time (whole period, estimation period and forecast period) by using evaluation criteria of AIC, SIC and kurtosis values. By using the same criteria, the best p values are determined for the selected stocks.

GARCH(1,1) Model: $a_t = \varepsilon_t \sigma_t$

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i a_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (5)$$

The asymmetric models are specified as follows:

EGARCH (1,1) Model:

$$\log(\sigma_t^2) = \omega + \sum_{i=1}^{q} \alpha_i a_{t-i} + \gamma_i \left[\,|a_{t-i}| - E|a_{t-i}|\,\right] + \sum_{j=1}^{p} \beta_j \log\left(\sigma_{t-j}^2\right) \quad (6)$$

GJR-GARCH(1,1) Model:

$$\sigma_t = \omega + \sum_{i=1}^{q} \alpha_i \left[(1-\gamma_i)\,a_{t-i}^{+} - (1+\gamma_i)\,a_{t-i}^{-}\right] + \sum_{j=1}^{p} \beta_j \sigma_{t-j} \quad (7)$$

The estimation procedure is exactly the same for all the conditional models. It is important to point out that the daily observations are used to forecast variance. For example, when calculating a monthly variance, the parameters are determined by using daily returns. Then daily variance forecasts are obtained and these forecasts of daily variances are summed up to obtain monthly total variance. Dividing the last figure by the number of trading days in each month gives within-month variance. Monthly variance can also be calculated by using monthly returns but there are no ARCH effects in monthly returns. Besides, the rolling estimation procedure is used in the whole study.

In order to determine the relationship between the market (firm) returns and their own expected volatilities, a regression analysis is employed:

$$\bar{r}_m = \alpha + \beta_f \sigma^2_{f,m} + e_m \quad (8)$$

If $\alpha = 0$ and $\beta_f > 0$, the index (firm) returns have a relationship between the predicted variances.

The market (firm) returns and their unexpected volatilities are regressed by:

$$\bar{r}_m = \alpha + \beta_u \sigma^2_{u,m} + e_m \quad (9)$$

Unexpected volatility is simply the difference between forecast volatility and observed volatility for each month.

II. EMPIRICAL RESULTS

The empirical results of the tests are presented by two tables. Table 2 shows the results for the relationship between market (firm) returns and their expected volatilities. When ARCH (p) model is used in predicting expected volatilities, only ARCLK and FROTO exhibit a significant positive relation at the 10 % level. The R^2 value for both of the stocks is 2.9 %. If expected volatility is derived from the GARCH(1,1) model, for ISE-100 and FROTO a positive relation is reported, significant at 5 % and 10 % respectively. Same as the GARCH(1,1) model, the variances of ISE-100 and FROTO calculated by GJR-GARCH(1,1) model have a positive sign with the returns significant at 5 % and 10 % respectively. If volatility forecasting depends on the EGARCH(1,1) model, a positive relation is found for ISE-100 and FROTO both significant at 5 % level. The coefficients of MIGRS and YKBNK have a negative sign in all the models, but they do not have any significance. FROTO has the highest explanatory power of 3.3 % in EGARCH and GJR-GARCH models.

Table 3 presents the results for the relationship between market (firm) returns and their unexpected volatilities. When ARCH (p) model is used in predicting unexpected returns, only ASELS exhibits a significant negative relation at the 5 % level. The R^2 value for the stock is 4.7 %. If unexpected volatility is derived from the GARCH(1,1) model, for ASELS a negative and for YKBNK a positive relation are reported both significant at 5 % level. Same as the GARCH(1,1) model, the variances of ASELS calculated by GJR-GARCH(1,1) model have a negative and YKBNK calculated by GJR-GARCH(1,1) model have a positive sign with the returns significant at 5 % level. If volatility forecasting depends on the EGARCH(1,1) model, a negative relation is found for ASELS and a positive relation is found for YKBNK significant at 5 % and 1 % levels respectively. YKBNK has the highest explanatory power of 11.2 % in EGARCH(1,1) model.

Table 2. Results of The Relationship Between Index (Firm) Returns and Expected Volatilities.

	ARCH (p)			GARCH(1,1)			EGARCH(1,1)			GJR-GARCH(1,1)		
Index-Firm	α	β	R^2	α	β	R^2	α	β	R^2	α	β	R^2
ISE-100	-0.0039	5.1692	0.032	-0.0006	2.2149**	0.026	-0.0012	3.1149*	0.026	-0.0006	2.1819**	0.024
	(0.0035)	(3.3835)		(0.0011)	(1.0678)		(0.0014)	(1.6725)		(0.0011)	(1.0834)	
ARCLK	-0.0077	4.7726*	0.029	-0.0020	1.9865	0.022	-0.0014	1.7319	0.013	-0.0017	1.8131	0.019
	(0.0054)	(2.8464)		(0.0024)	(1.3567)		(0.0027)	(1.5854)		(0.0024)	(1.3373)	
ASELS	-0.0008	1.2499	0.004	0.0007	0.5569	0.002	0.0004	0.7195	0.002	0.0007	0.5845	0.002
	(0.0042)	(1.9608)		(0.0029)	(1.3895)		(0.0032)	(1.5516)		(0.0028)	(1.3719)	
AYGAZ	-0.0024	2.2316	0.017	-0.0004	1.1016	0.010	-0.0010	1.5342	0.018	-0.0003	1.0138	0.009
	(0.0029)	(1.7423)		(0.0018)	(1.1117)		(0.0019)	(1.1752)		(0.0017)	(1.0907)	
ECILC	-0.0009	1.2932	0.005	0.0007	0.5177	0.002	0.0002	0.7766	0.003	0.0006	0.5212	0.002
	(0.0036)	(1.8124)		(0.0024)	(1.3094)		(0.0026)	(1.4396)		(0.0024)	(1.3028)	
EREGL	-0.0029	2.6079	0.028	-0.0005	1.5025	0.019	-0.0002	1.3325	0.011	-0.0005	1.4830	0.018
	(0.0030)	(1.5800)		(0.0020)	(1.1220)		(0.0022)	(1.3039)		(0.0020)	(1.1240)	
ECZYT	-0.0028	2.1476	0.014	0.0000	0.8109	0.005	0.0004	0.5799	0.002	0.0001	0.7592	0.005
	(0.0038)	(1.8685)		(0.0022)	(1.1721)		(0.0022)	(1.1956)		(0.0022)	(1.1633)	
FROTO	-0.0044	3.4740*	0.029	-0.0007	1.7656*	0.029	-0.0014	2.1470*	0.033	-0.0009	1.8681*	0.033
	(0.0039)	(2.0432)		(0.0019)	(1.0507)		(0.0021)	(1.1996)		(0.0019)	(1.0411)	
KCHOL	-0.0021	1.9019	0.012	-0.0010	1.3795	0.012	-0.0012	1.5448	0.011	-0.0008	1.2637	0.010
	(0.0032)	(1.7686)		(0.0022)	(1.2648)		(0.0025)	(1.4865)		(0.0023)	(1.2948)	
MIGRS	0.0013	-0.1753	0.000	0.0015	-0.3652	0.002	0.0018	-0.5757	0.002	0.0016	-0.4184	0.003
	(0.0016)	(1.0315)		(0.0012)	(0.8190)		(0.0016)	(1.2275)		(0.0012)	(0.8220)	
YKBNK	0.0016	-0.1576	0.006	0.0018	-0.2372	0.003	0.0013	-0.1219	0.000	0.0019	-0.2704	0.004
	(0.0015)	(0.2111)		(0.0020)	(0.4488)		(0.0031)	(0.8992)		(0.0020)	(0.4455)	

Notes: Numbers in parantheses are standard errors. ***,** and * indicate statistical significance at the levels of 1 %, 5 % and 10 % respectively.

Table 3. Results of The Relationship Between Index (Firm) Returns and Unexpected Volatilities.

	ARCH (p)			GARCH(1,1)			EGARCH(1,1)			GJR-GARCH(1,1)		
Index-Firm	α	β	R^2	α	β	R^2	α	β	R^2	α	β	R^2
ISE-100	0.0012	1.0627	0.015	0.0013	1.6038	0.031	0.0013	1.3526	0.021	0.0013	1.5640	0.029
	0.0010	1.1579		0.0009	1.0931		0.0009	1.1143		0.0009	1.0918	
ARCLK	0.0012	0.0832	0.000	0.0012	0.4428	0.003	0.0012	0.1642	0.000	0.0012	0.3852	0.002
	0.0011	0.7979		0.0010	0.8480		0.0010	0.8284		0.0010	0.8336	
ASELS	0.0023**	-1.3163**	0.047	0.0021**	-1.3247**	0.048	0.0021**	-1.2528**	0.045	0.002128**	-1.2776**	0.046
	0.0011	0.6108		0.0010	0.6093		0.0010	0.5943		0.0010	0.6009	
AYGAZ	0.0010	0.2474	0.000	0.0011	0.3373	0.002	0.0010	0.4968	0.004	0.0011	0.3117	0.002
	0.0009	0.8179		0.0009	0.7979		0.0009	0.8190		0.0009	0.7959	
ECILC	0.0015	0.0348	0.000	0.0016	-0.0272	0.000	0.0015	0.0252	0.000	0.0016	-0.0241	0.000
	0.0010	0.8181		0.0010	0.8441		0.0010	0.8620		0.0010	0.8541	
EREGL	0.0019**	-0.1597	0.000	0.0019**	-0.0722	0.000	0.0019**	-0.3165	0.002	0.001905**	-0.0839	0.000
	0.0009	0.7671		0.0009	0.7909		0.0008	0.7862		0.0009	0.7915	
ECZYT	0.0015	-0.1540	0.000	0.0015	-0.1758	0.000	0.0015	-0.2677	0.001	0.0015	-0.1885	0.000
	0.0010	0.7135		0.0009	0.7391		0.0009	0.7281		0.0009	0.7332	
FROTO	0.0024**	-0.8283	0.012	0.0021**	-0.4683	0.003	0.0021**	-0.5215	0.004	0.002113**	-0.3744	0.002
	0.0010	0.7769		0.0009	0.8746		0.0009	0.8492		0.0009	0.8673	
KCHOL	0.0015	-0.7059	0.006	0.0016*	-1.3437	0.022	0.0014	-0.6315	0.004	0.0014	-0.5675	0.004
	0.0010	0.9307		0.0010	0.9342		0.0010	0.9347		0.0010	0.9224	
MIGRS	0.0013*	-0.6722	0.013	0.0012*	-0.7198	0.017	0.0012*	-0.8531	0.019	0.001229*	-0.7374	0.018
	0.0007	0.5935		0.0007	0.5593		0.0007	0.6313		0.0007	0.5567	
YKBNK	0.0016	-1.4028	0.019	0.0001	0.6644**	0.052	-0.0002	1.2529***	0.112	0.0001	0.6563**	0.050
	0.0013	1.0464		0.0012	0.2916		0.0012	0.3633		0.0012	0.2938	

Notes: Numbers in parantheses are standard errors. ***,** and * indicate statistical significance at the levels of 1 %, 5 % and 10 % respectively.

CONCLUSION

This paper investigates the out-of-sample risk-return relationship in the Turkish stock market over the period of January 1991 to December 2006. Firm-level and portfolio-level monthly volatility estimates depend on both symmetric and asymmetric conditional volatility models. This is a first attempt to test risk-return relation in the Turkish stock market using conditional heteroscedasticity models and an out-of-sample estimation procedure.

Expected volatility has a significant positive effect on monthly returns of ISE-100 Index and FROTO according to GARCH(1,1), EGARCH(1,1) and GJR-GARCH(1,1). The ARCH(p) model adds ARCLK to this category. However ISE-100 returns do not have any relationship with the expected volatilities calculated by ARCH(p) model. The highest R^2 of 3.3 % belongs to FROTO in this group. Expected volatility has no significant negative effect on monthly stock returns of ISE.

Unexpected volatility has a positive effect on monthly returns of YKBNK if the volatility forecasts are derived from GARCH(1,1), EGARCH(1,1) and GJR-GARCH(1,1). The conditional volatility of YKBNK has the highest explanatory power of 11.2 % in EGARCH(1,1) model. Unexpected volatility has a negative effect on monthly returns of ASELS under all conditional volatility models. The highest R^2 value for the stock is 4.8 % when the volatility forecasts are derived from GARCH(1,1) model.

Overall, the results of this study show that there are few cases where the relation between risk and return is significant. The R^2 values of conditional volatilities in these cases are very low (at most 11.2 %). In particular, the findings of this study are in accordance with the findings of Balaban and Bayar (2005) where the conditional volatility models and estimation procedure used were the same with this study. Balaban and Bayar (2005) claimed that expected volatility was found to have a significant negative or positive effect on industrialized country returns in a few cases. Besides, the findings of this study are consistent with two studies which employed the emerging markets data: De Santis and Imrohoroglu (1997) and Girard (2001). These researchers have employed GARCH(1,1) and TGARCH(1,1)-M respectively and used in-sample estimation procedure different from this paper.

However, the results of this paper are inconsistent with the results of Salman (1999) where the stock returns of Istanbul Stock Exchange were found to be positively associated with risk. This contradiction may be stemmed from the different conditional volatility model (GARCH-M) or the different estimation procedure (in-sample) used in that study. Also the period investigated in Salman (1999) is very short compared to this paper.

The results of this paper do not provide any support for the claim that investors, within a given time period, require a larger expected return from a riskier security. Many explanations may be given for this fact. One of them is that the return variance may not be an appropriate measure of risk. Future research could examine the association of stock price returns and volatility using other measures of risk such as semi-variance.

Besides, other versions of GARCH like GARCH-M, EGARCH-M, TGARCH-M etc. should be used to derive forecast volatility. Furthermore, longer holding periods like two-years should be employed in analyzing time-varying risk and relations with stock returns. Finally, extending the stocks used in this study will be of some help.

Other than these explanations, stock returns may be predicted by using fundamentals or they may contain some other noise series so that risk may not be a crucial factor in determining return.

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