THE DAY OF THE WEEK EFFECT ON STOCK MARKET VOLATILITY : ISTANBUL STOCK EXCHANGE

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Abstract: This study investigates the day of the week effect on return and volatility for Istanbul Stock Exchange (ISE) throught the period 1986 and 2003. Using generalized autoregressive conditional heteroskedasticity (GARCH) model, we find statistically significant evidence to report that there is the day of the week effect. Friday has the highest effect on return with 0,015 while Monday has the lowest return with-0,003 compared to return on Wednesday. When volatility of return is concerned, Monday has the highest volatility with 0,933 and Tuesday has the lowest volatility with –0,716 compared to return on Wednesday.

JEL classification: G10, G12, C22
Keywords: Day of the week effect, volatility, GARCH, Emerging Market.

1 INTRODUCTION

Effect of the calendar anormalies have been widely studied in finance literature. These studies have shown us that return of stocks vary by the day of the week and this is known as the day of the week effect. Cross (1973), French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984), Lakonishok and Levi (1982) and Rogalski (1984), Balaban (1995) are researches that showed the day of the week effect.

Other researches have worked on the time series of stock market through generalized autoregressive conditional heteroskedasticity model. Among them are Akgiray (1989), Camphell and Hentschel (1992), French, Schwert and Stambaugh (1987), Glosten, Jaganathan and Runkle (1993) and Hamao, Masulis and Ng (1990). These studies lead us to the decision that unexpected returns and enexpected volatilities are in negative relation. Camphell and Hentschell (1992) report that an increasing stock market volatility raises the required rate of return on common stocks and hence lowers stock prices. The common point of all these studies are they report returns in stock market is time varying and conditionally hetereskodastic. But, these studies haven't considered the day of the week effect for volatility.

It is expected from an investor to look at the return of the stock while buying it. But there is also an other condition that can't underestimated is the volatility of the stock price. It is very important know if high volatility of stock price is related with high volatility for a given day. İf investors could identify a certain pattern for the days, they could revise their position in the stock market to avoid high volatility in their portfolio. Kiymaz and Berument (2003) report that volatility varies by the day of the week for developed countries.

Our study investigates the day of the week effect on return and volatility for the Istanbul Stock Exchange (ISE) with a GARCH model from 1986 to 04.08.2003. our studies lead us to the result that we can say that there is the day of the week effect. Part 2 gives a brief review of literature and Part 3 gives information about data nad our model. Part 4 is the conclusion part then comes our appendix.

2 LITERATURE REVIEW

Returns and how they are related with the days of the week is a popular study area in finance literature. Cross (1973), French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984), Lakonishok and Levi (1982) and Rogalski (1984) may be given as examples from the literature for the day of the week effect. An interesting result from these studies is that average returns on Monday are less than the other days of the week. This day of the week effect isn't only an issue for the U.S. equity market, researches have forund interesting results for equity, fixed income, derivative market for other countries and U.S. Among them are Aggarwall and Rivoli (1989), Athanassakos and Robinson (1994), Chang, Pinegar and Ravichandran (1993), Dubois (1986), Kato and Schallheim (1985), Jaffe and Westerfield (1985a,1985b) and Solnik and Bouquet (1990) and they showed that the foreign stock market returns varies by the day. Also, Corhay, Fatemi and Rad (1995), Flannary and Protopapadakis (1988), Gay and Kim (1987), and Gesser and Poncet (1997) pointed that the return of the future and foreign exchange rate varies by the day. Balaban (1995) reports that the validity of the day of the week effect for ISE. He states that Friday has the highest return for ISE for the period 1988-94.

The studies mentioned above focus on the mean return, also an other way to investigate the return and the day of the week effect is the GARCH model. There are lots of specifications for this in the literature. For example, French et al. (1987) went through the relationship between stock return and volatility and shown that unexpected returns are negatively related with unexpected movements in volatility. Camphell and Hentschel (1992) report similar results and add that high volatility increases required rate of return but with lowering the stock prices. Glosten et al. (1993) and Nelson (1991) report that positive unanticipated return decreases conditional volatility but unanticipated negative returns increase the conditional volatility. Baillie and DeGennaro (1990) didn't find any evidence to relate mean return with volatility. Again, Chan, Karolyi and Stultz (1992) find no significant relationship between conditional expected excess return on S&P 500 and its variance. Corhay and Rad (1994) and Theodossiou and Lee (1993) report no significant evidence between stock market volatility and its expected return. Studies mentioned above report that the expected return on stock market is time varying and conditionally heteroskedastic.

An other question why there is volatility has been asked by reseraches. And it is accepted that the reasons for volatility lies on two aspects. The fist one is that volatility is caused by the arrival of the public information and the other one is that public information. This public information can be accepted as macroeconomic news. French and Roll (1986) report that stock prices are more volatile during trading hours than non-trading hours and variances of the days after holidays are larger than the other days. Their explanation to this result is that traders are receiving public information during trading hours and are willing to trade while they can. Harvey and Huang (1991) report higher volatility in interest rates and foreign exchange future markets during the first trading hours on Thursday and Friday.their interpretation to this result is that public information arrives more on Thursdays and Fridays. Balaban (1995) indicates that Monday is the most volatile day for ISE through the years 1988-94 and also for each individual year.

Two millestone studies on the public information arrival and time-dependent patterns are Admati and Pfleiderer (1988) and Foster and Viswanathan (1990). Both studies show how information is incorporated into pricing and how investors effect prices. The main point is that how liquidity and informed traders effect volume and volatility. The difference between these two studies is the trading asumption of the informed and liquidity traders. Admati and Pfleiderer (1988) assumes that informes nad liquidty traders trade together, while Foster and Viswanathan model says that public information is short lived and liquidity traders avoid to trade with informed traders. So the implications of the model are different Foster and Viswanathan say that liquidity traders avoid to trade with informed traders when public information is intense. Then volume must be low and volatility must increase. Admati and Pfleiderer trading volume is high when price volatility is high.

An other study by Berument and Kiymaz (2001) find that there is difference of volatility across the days of the week and the highest volatility is observed on Fridays.

This study investigates the day of the week effect for return and volatility through a GARCH model for Istanbul Stock Exchange

3 DATA AND METHODOLOGY

Day consists of ISE 100 index including the time period from 23 October 1986 to 4 August 2003. Return is calculated as follows:

$$R_t = [\log(P_t) - \log(P_{t-1})] \tag{1}$$

We could have used standard OLS procedure as done in the literature for calculating the return and volatility of the stock market. But this model has two drawbacks. First, errors in the model may be autocorrelated and second drawback is that variance of the error terms may not be constant over time. Especially, to solve the second drawback variance of the error terms are allowed to be time dependent so as to include conditional heteroskedasticity. So, error terms have zero mean and variance that is changing with the time h_t^2 [$\varepsilon_t \sim (0, h_t^2)$].

There are different types of conditional heteroskedasticity models suggested in the literature. The main two are ARCH and GARCH models. ARCH model developed by Engle (1982) permits the variances of the forecasted return terms to change with the squared lag values of the previous error terms.

$$h_t = V_c + \sum_{j=1}^{q} V_j \varepsilon_{t-j}^2 \tag{2}$$

The generalized version of the ARCH model seen above is developed by Bollerslev (1986) adding also the h_t^2 terms.

$$h_t = V_c + \sum_{j=1}^{q} V_{ja} \varepsilon_{t-j}^2 + \sum_{j=1}^{p} V_{jb} h_{t-j}^2 \tag{3}$$

This model is known as GARCH(p,q). Conditional variance may effect stock market return. So, we hire various models to find out the relationship between return and volatility. Following Berument &Kiymaz:

$$R_t = \alpha_0 + \alpha_M M_T + \alpha_T T_T + \alpha_H H_T + \alpha_F F_T + \sum_{I=1}^{n} \alpha_i R_{t-i} + \varepsilon_t \tag{4a}$$

$$h_t^2 = V_c + V_{1a} \varepsilon_{t-1}^2 + V_{1b} h_{t-1}^2 \tag{4b}$$

R_t represents return and M_T, T_T, H_T, F_T are dummy variables for Monday, Tuesday, Thursday and Friday. We exclude Wednesday to avoid dummy trap. Here, it is is necessary to note that lagged values of squared residuals and the conditional variance may be too restrictive.[1]

It is also possible to include exogeneous variables to the GARCH model and its specifications are usually used in the literature. Karolyi (1995) includes the volatility of foreign stock returns while investigating the conditional variance of the home country stock market. Hseieh (1998) includes the day of the week effect in volatility. we model conditional variability by icluding the day of the week effect into our volatility equation. Following Kiymaz and Berument (2003) our model is written as:

$$R_t = \alpha_0 + \alpha_M M_t + \alpha_T T_t + \alpha_H H_t + \alpha_F F_t + \sum_{I=1}^{n} \alpha_i R_{t-i} + \varepsilon_t \qquad (5a)$$

$$h_t^2 = V_c + V_M M_t + V_T T_t + V_H H_t + V_F F_t + V_{j1} \varepsilon_{t-1}^2 + V_{1b} h_{t-1}^2 \qquad (5b)$$

Here, we use the quasi-maximum likelihood estimation (QMLE). That was developed by Bollerslev and Wooldridge (1992) to estimate parameters.

4 EMPIRICAL RESULTS

Table 1 reports the descriptive statistics on the day of the week effect on the ISE returns. The resurn series are calculated as the logarithmic first difference of the ISE 100 indexs where the index is gathered from the data delivery system of the Central Bank of the Republic of Turkey. The data span cover the observations from 23 October 1987 to 4 Agust 2003. It is seen that Friday has the highest return with 0,00306 on average. Following it, we see Thursday's return with 0,00170 on average. Then comes Wednesday with a return of 0,00091on average. Monday and Tuesday have negative eexpected return. Tuesday has a negative return with 0,00013 and Monday has a return of –0,00052. When we look at the standard deviations of the returns as a volatility measure, Friday has the highest volatility on return. The volatilities of other days are similar to each other. Another striking result is that when skewness and kurtosis statisticsare concerned Mondays' return is very similar to

[1] One may allow to include the volatility in the return equation with GARCH-in-means. However, Muradoglu, Berument and Metin (1999) argues that this effect is not robust across sub-periods. Hence, this effect is not considered in this paper.

normal distribution. The other days statistics are far from being similar to normal distribution.

Table 2 reports the estimated parameters for the mean and variance specification as in Equations (4a) and (4b) for the full sample. Note that as we excuded Wednesday in our return equation to avoid dummy trap, the estimates are interpreted by comparing the one of Wednesday. We allow our variance to change with time (with a GARCH specification) and control the serial correlation with the lag dependent variable of the return variable.[2] The first column reports the estiamtes for the full sample. Friday has the highest return and the estiamted coefficent is statistically significant(note that we report the *p*-values in paranthesis under the corresponding coefficient.[3] This suggest that Fridays has higer returns compare to wednsdays. And Fridays is followed by Monday, Thursday and Tuesday but the retuns of these days are not statistically significantly different from Wednesday. Muradoglu et al. argue that the full sample covera a range that has different chracteristics. Thus, next we consider various sub-samples.

The very first sub-sample that we consider is the pereiod prior to self-inflicted financial crises of 1994. This includes saplle from 2 Januray 1990 till 31 December 1993.[4] For this period, even if the Fridays has the higest return, we could not find any statistical evidence that any single day has a different retur than one of Wednseday. The second sub period covers the post 1994 crises starting from 2 Jamuray 1995 but end the sample in 31 October 2000 when there was another cries in November of 2000. The results are again paralel with first subsample: Friday has the higest return but none of the days has a statistically significantly different returns than ones in wedsdays. The last subsample covers the era that has relatively stable eceonomic environment. This includes the observations from 2 January 2000 till 4 August 2003. Mondays and Tuesdays have negative, and Thursday and Friday have positive estimated coefficents for these days. However none of thesecoefficents are statistically significant.

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[2] Final Prediction Error (FPE) ciriteria suggests the lag order to be one. This is important. FPE determines the lag length such that the residuals are no longer autocorrelated. The autocorrelated residuals suggests the presence of the ARCH effect even if the ARCH effect is not present when the ARCH-LM test is performed (see Cosimano, and Jansen, 1988.)

[3] The level of signifigance is at the 5% level, unless otherweise noted.

[4] We also strat the sample from the 20.October 1987, the results are robust. The reason that we start to sample from 1990 is that period prior to 1990 could be interpreted as the erly stages of the financial markets developments and market could have a different chravcteristics.

Last we look at the estimates of the variance (GARCH) specification for robustness. Even if the magnitudes are small, the estimated coeffiecbts for the constants are positive. Next the estimated coefficents for the V_{1a} and V_{1b} are positive. Thse satisfies the non-negativity conditions of the variance specification. Moreover, sums of V_{1a} and V_{1b} is less than 1 for all time periods in our analysis. Thus, these estimates satifies the non-expolsiviness of the implied variances

Beside we perform battery of thespecification tests. Namely 4 non-parametric Bised tests. Sign Bias test, Negative Size Bias Test, Positive Size Bias tests and Joint tests. When we look at the overall, we could reject the null hypothesis. But only for the full sample time period, we fail to reject null hypothesis for negative sign test. The Ljung-Box Q statistics of all time periods are are also reported in the table. We cannot rewject any of the statistics for autocorrelation. When we look at the ARCH-LM tests (see Engle, 1982) , for Table 2 we fail to reject our null hypothesis that is there is no heteroskedasticity except for the full sample period. Thus, both Ljung-Box Q, and ARCH-LM tests supports our specification.

Table 3 is for the estiamtes of the return and volatility specifications where the day of the week effecct is present for the volatility specifications: Equations (5a) and (5b). In our full sample, Mondays and Tuesdays have negative and statistically significant coefficients. Thursday and Friday have positive estimated coefficients but these estimated coefficients are not significant. Thus like the previos specifiaction Friday has the higest retun but unlike the previous one this coefficient is not statistically significant. For the subsamples the overall conclusion is the same but for the 1995-2000 era, the higest return is observed for Thursdays but not Fridays.

About volatility, we have statistical evidence to report for Mondays and Fridays volatilities are higher and for Tuesdays and Thursdays are lower than Wensdays. This evidence is statistically significant for Mondays, Tuesdays and Fridays. When one look at the evidence for the sub samples. For the pre crises and post criese periods Mondays higestsn and Tuesdays have lowest volatilities. For the post 2002 era, we could not find any evidence that the day of the week effect is present for the volatility.

The estimated coefficinet for the constant term, V_{1a} and V_{1b} of the GARCH(1,1) specification are always positive. This satifies the non-negativity of the variance specification. When we look at the sum of V_{1a} and V_{1b} it is seen that their sum is less than 1 for all time periods except for the full sample period (for the full sample we caoont reject the null hypothesis that the sum of V_{1a} and V_{1b} is less than one) This suggestst that the variance is non-explosive. As an robustness test, we look at the sign and size biased tests, we fail to reject our null hypotheses. Next we look at Ljung-Box Q autocorrelation tests. The presence of autocorrelation is present for the full sample and 1995-2000 era but not for others. We disregard this statistics because 1. the estiamtes reported in Table 3 is estension of Table 2 where the autocroorelation was not problem, and more importantly 2. other robustness tests was satisfactory for the specification that we had. Last, when we look at the ARCH tests, for Table 3 we fail to reject our null hypothesis that there is heteroskedasticity.

5 Conclusion

There is a new set of evidence that day of the week effect is present for both returns and volatility for the develeoped economies. Our study investigates this topic for ISE by using a GARCH specification. By using daily observation we show that higest volatility is observed for Mondays and lowest for Fridays. Moreover, Friday hasthe highest return and Monday has the lowest return.

Table 1: Descriptive Statistics on ISE Returns.

	ALL DAYS	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Average	0.00100	-0.00052	-0.00013	0.00091	0.00170	0.00306
Stad. Dev.	0.02050	0.01558	0.01270	0.01345	0.01356	0.03643
Skewness	27.53990	0.10174	0.35734	-0.59163	0.94564	24.44077
Kurtosis	1329.78817	3.04303	2.72543	6.14418	11.41341	664.01911

Table 2: Return Statistics with GARCH Specification

	FULL SAMPLE	BETWEEN 90-94	BETWEEN 95-2000:11	BETWEEN 2002-2003:8
Mean				
Constant	-0.008	0.001	0.013	-0.001
	(0.126)	(0.446)	(0.001)	(0.764)
α_M	0.008	-0.003	-0.010	-0.007
	(0.214)	(0.156)	(0.080)	(0.129)
α_T	0.001	-0.002	-0.009	-0.006
	(0.927)	(0.475)	(0.119)	(0.222)
α_H	0.002	-0.002	-0.005	0.005
	(0.742)	(0.271)	(0.362)	(0.286)
α_F	0.015	0.001	-0.005	0.002
	(0.034)	(0.510)	(0.404)	(0.683)
R_{t-1}	0.270	0.201	-0.027	-0.025
	(0.016)	(0.001)	(0.796)	(0.720)
Variance				
Constant	0.000	0.000	0.000	0.000
	(0.005)	(0.001)	(0.548)	(0.326)
V_{1a}	0.951	0.326	0.154	0.121
	(0.002)	(0.001)	(0.175)	(0.044)
V_{1b}	0.000	0.603	0.832	0.714
	(0.999)	(0.000)	(0.000)	(0.001)
D	1.384	1.381	1.124	1.488
	(0.000)	(0.000)	(0.001)	(0.000)
Skewness	1.037	0.176	-0.821	0.401
Kurtosis	6.226	4.772	5.283	3.847
Function value	306.944	2123.914	233.656	578.841
Sign Bias Test	-1.485	-0.267	-0.386	0.217
	(0.139)	(0.789)	(0.700)	(0.828)
Negative Size Bias Test	-2.122	0.931	0.479	0.639
	(0.035)	(0.352)	(0.633)	(0.523)
Positive Size Bias Test	-1.044	-1.228	0.598	0.084
	(0.298)	(0.219)	(0.551)	(0.932)
Joint Test	1.893	0.810	0.829	0.170
	(0.133)	(0.488)	(0.481)	(0.916)
Q-statistics				

Q(5)	2.652	2.571	3.091	1.006
	(0.753)	(0.765)	(0.685)	(0.962)
Q(10)	3.661	7.614	11.287	5.666
	(0.961)	(0.666)	(0.335)	(0.842)
Q(20)	16.765	15.355	25.017	16.415
	(0.668)	(0.755)	(0.200)	(0.690)
Q(60)	75.564	50.826	64.700	53.481
	(0.084)	(0.794)	(0.316)	(0.711)
ARCH-LM (5)	1.854	3.951	1.687	4.379
	(0.868)	(0.556)	(0.890)	(0.496)
ARCH-LM (10)	8.483	6.281	2.208	8.075
	(0.581)	(0.791)	(0.994)	(0.621)
ARCH-LM (20)	42.505	11.687	7.943	10.042
	(0.002)	(0.926)	(0.992)	(0.967)
ARCH-LM (60)	61.594	62.472	38.000	44.759
	(0.418)	(0.388)	(0.988)	(0.929)

p-values are reported under the corresponding coefficints or statistics.

Table 3: Return and Volatility Statistics with GARCH Specification.

	FULL SAMPLE	BETWEEN 90-94	BETWEEN 95-2000:11	BETWEEN 2002-2003:8
Mean				
Constant	0.002	0.001	0.001	0.000
	(0.037)	(0.249)	(0.073)	(0.786)
α_M	-0.003	-0.001	-0.002	-0.003
	(0.009)	(0.191)	(0.013)	(0.121)
α_T	-0.002	-0.001	-0.001	-0.002
	(0.044)	(0.323)	(0.172)	(0.265)
α_H	0.000	-0.001	0.001	0.002
	(0.828)	(0.135)	(0.087)	(0.358)
α_F	0.001	0.000	0.000	0.001
	(0.477)	(0.594)	(0.563)	(0.685)
R_{t-1}	0.120	0.196	0.044	-0.013
	(0.000)	(0.001)	(0.046)	(0.848)
Variance				
Constant	0.789	0.000	0.000	0.000
	(0.000)	(0.145)	(0.001)	(0.577)
V_M	0.480	0.933	0.350	-0.212
	(0.001)	(0.001)	(0.046)	(0.662)
V_T	-0.446	-0.425	-0.716	0.072
	(0.001)	(0.051)	(0.001)	(0.922)
V_H	-0.129	0.045	-0.210	0.016
	(0.280)	(0.799)	(0.337)	(0.979)
V_F	-0.315	-0.175	-0.498	-0.341
	(0.002)	(0.220)	(0.002)	(0.515)
V_{1a}	0.450	0.327	0.200	0.106
	(0.000)	(0.001)	(0.000)	(0.086)
V_{1b}	0.879	0.549	0.669	0.740
	(0.000)	(0.000)	(0.000)	(0.001)
D	1.379	1.519	1.371	1.509
	(0.000)	(0.000)	(0.000)	(0.000)
Skewness	-0.168	0.173	-0.143	0.394
Kurtosis	6.017	3.830	4.670	3.865
Function value	8944.181	2932.347	6603.841	794.728

Sign Bias Test	-1.829	0.204	-0.187	0.369
	(0.067)	(0.838)	(0.851)	(0.712)
Negative Size Bias Test	-0.745	1.038	-0.599	0.700
	(0.456)	(0.299)	(0.549)	(0.484)
Positive Size Bias Test	-1.423	-1.054	-0.397	0.183
	(0.154)	(0.292)	(0.691)	(0.855)
Joint Test	1.226	0.746	0.241	0.189
	(0.298)	(0.524)	(0.868)	(0.903)
Q-statistics				
Q(5)	18.020	2.753	16.097	0.996
	(0.002)	(0.738)	(0.006)	(0.962)
Q(10)	26.609	7.126	26.664	5.815
	(0.003)	(0.713)	(0.002)	(0.830)
Q(20)	34.322	15.470	40.126	16.761
	(0.024)	(0.748)	(0.004)	(0.668)
Q(60)	73.829	53.362	71.717	54.042
	(0.108)	(0.715)	(0.142)	(0.692)
ARCH-LM (5)	4.934	2.298	3.111	7.084
	(0.424)	(0.806)	(0.682)	(0.214)
ARCH-LM (10)	8.091	6.493	9.815	11.824
	(0.620)	(0.772)	(0.456)	(0.297)
ARCH-LM (20)	16.959	14.562	21.395	12.919
	(0.655)	(0.800)	(0.374)	(0.880)
ARCH-LM (60)	50.939	54.250	67.909	48.638
	(0.791)	(0.684)	(0.225)	(0.852)

p-values are reported under the corresponding coefficints or statistics.

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APPENDİX

Table 1A: Return and Volatility Statistics with GARCH Specification with 4 Lags.

	FULL SAMPLE	BETWEEN 90-94	BETWEEN 95-2000:11	BETWEEN 2002-2003:8
Mean				
Constant	0.001	0.001	0.001	0.000
	(0.063)	(0.012)	(0.096)	(0.906)
α_M	-0.002	-0.002	-0.002	-0.003
	(0.017)	(0.001)	(0.014)	(0.066)
α_T	-0.002	-0.001	-0.001	-0.003
	(0.053)	(0.071)	(0.137)	(0.070)
α_H	-0.001	0.000	0.001	0.002
	(0.911)	(0.527)	(0.080)	(0.163)
α_Φ	0.001	0.000	0.000	0.000
	(0.349)	(0.477)	(0.502)	(0.784)
R_{t-1}	0.118	0.095	0.040	-0.040
	(0.000)	(0.001)	(0.072)	(0.444)
R_{t-2}	0.001	0.000	0.034	-0.056
	(0.992)	(0.980)	(0.119)	(0.276)
R_{t-3}	0.026	0.021	0.023	-0.007
	(0.088)	(0.205)	(0.283)	(0.892)
R_{t-4}	0.036	0.024	0.029	-0.082
	(0.010)	(0.129)	(0.153)	(0.076)
Variance				
Constant	-0.801	0.000	0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.320)
V_M	0.473	0.533	0.358	0.715
	(0.001)	(0.001)	(0.042)	(0.085)
V_T	-0.447	-0.626	-0.702	-0.170
	(0.001)	(0.001)	(0.001)	(0.749)
V_H	-0.141	-0.122	-0.203	0.109
	(0.236)	(0.402)	(0.358)	(0.813)

V_F	-0.321	-0.334	-0.501	-0.235
	(0.002)	(0.002)	(0.002)	(0.508)
V_{1a}	0.453	0.207	0.200	0.150
	(0.000)	(0.000)	(0.000)	(0.049)
V_{1b}	0.876	0.689	(0.671)	0.474
	(0.000)	(0.000)	(0.000)	(0.068)
D	1.372	1.438	1.369	1.247
	(0.000)	(0.000)	(0.000)	(0.000)
Skewness	-0.16327	-0.064	-0.123	-0.120
Kurtosis	610754	4.339	4.686	5.002
Function value	8941.531	1055.347	6596.311	1144.825
Sign Bias Test	0.224	-1.191	-0.475	-0.827
	(0.822)	(0.233)	(0.634)	(0.408)
Negative Size Bias Test	0.295	-1.082	-0.841	-0.501
	(0.767)	(0.279)	(0.400)	(0.617)
Positive Size Bias Test	-0.357	-1.026	-0.454	-0.663
	(0.721)	(0.304)	(0.649)	(0.507)
Joint Test	0.116	0.750	0.326	0.269
	(0.950)	(0.522)	(0.806)	(0.847)
Q-statistics				
Q(5)	10.626	8.161	7.468	4.589
	(0.059)	(0.147)	(0.188)	(0.468)
Q(10)	17.780	18.279	18.301	7.399
	(0.058)	(0.050)	(0.050)	(0.687)
Q(20)	26.247	28.419	31.754	16.343
	(0.157)	(0.099)	(0.045)	(0.695)
Q(60)	66.154	64.468	64.312	63.830
	(0.272)	(0.323)	(0.328)	(0.343)
ARCH-LM (5)	4.220	5.899	3.371	1.651
	(0.518)	(0.316)	(0.643)	(0.895)
ARCH-LM (10)	7.097	98.454	10.088	11.326
	(0.716)	(0.454)	(0.432)	(0.332)
ARCH-LM (20)	16.531	25.830	21.074	17.411
	(0.683)	(0.171)	(0.392)	(0.626)
ARCH-LM (60)	50.581	87.754	67.851	51.342
	(0.801)	(0.011)	(0.227)	(0.779)