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Abstract

This paper studies the cross-autocorrelation structure in the German and Turkish stock markets by using daily portfolio returns. We find the evidence that large cap portfolios lead small cap portfolios in both subperiods of German stock market but this structure is seen only in the first subperiod of Turkish stock market. Analysing the market-wide and portfolio-specific information effects on portfolio returns shows that above stated lead-lag relation is associated with the market-wide information content in lagged large cap portfolio returns. We also document a directional asymmetry in small (large) cap portfolio returns' reactions to lagged large (small) cap portfolio returns. The evidence is contradicting to the previous findings of McQueen, Pinegar and Thorley (1996) and Marshall and Walker (2002) whoose researches are conducted on US and Chile stock markets. Our findings show the lagged effects of bad news - not good news - on small cap portfolio returns. It is documented that the speed of adjustment of small cap portfolio prices to common market-wide information is slower than large cap portfolio prices and small cap portfolio prices are slower in reacting to bad news.

JEL Classification : G12; G14; G15

Keywords : German stock market ; Turkish stock market ; Cross-autocorrelation ; Market-wide and portfolio-specific information ; Asymmetric reaction

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1. Introduction

The cross-autocorrelation pattern among large and small market capitalization portfolios is documented by Lo and MacKinlay (1990a), tried to be explained by various hypotheses and tested by different researchers in finance literature[1]. The empirical evidence shows that large cap portfolio returns lead small cap portfolio returns. The examination of this phenomenon can lead to some implications regarding short-term predictability of portfolio returns and developing pricing models concerning cross-autocorrelation among portfolio returns. The significance of the lead-lag relation between high cap portfolios and low cap portfolios shows the importance of the size phenomenon, thus it should be taken into consideration in pricing and estimation problems in capital markets[2].

There are several explanations of the cross-autocorrelation structure in the stock markets. The most famous explanation of this lead-lag pattern is based on emphasizing the differences in the speeds of price adjustment processes of different assets. According to this hypothesis, small cap stock prices react to common information slower than large cap stock prices. The nonsynchronous trading, arising from the thinly traded small cap stocks, can partially explain this structure, but Atchison, Butler and Simonds (1987) and Lo and MacKinlay (1990a,1990b) show that nonsynchronous trading can not be the only reason. Lo and MacKinlay (1990a), and Brennen, Jagadeesh and Swaminathan (1993) provide explanations related with the transmission of information mechanism among stocks. According to this explanation, the different speed of reaction of large cap stocks and small cap stocks to market-wide information is the main reason of cross-autocorrelation. Lo and MacKinlay (1990a) show that the returns of small cap portfolios are correlated with lagged returns of large cap portfolios but not vice versa. According to the authors, this phenomenon is explained by the lagged adjustment of the small cap portfolio prices to the information shocks although these information shocks are reflected in large cap portfolio prices even earlier. Chan (1993) develops a model which explains

[1] See Conrad and Kaul (1988), Conrad, Kaul and Nimalendran (1991), Chan (1993), Brennen, Jagadeesh and Swaminathan (1993), Mench (1993), Boudoukh, Richardson and Whitelaw (1994), Badrinath, Kale and Noe (1995), Jagadeesh and Titman (1995) and Hameed (1997).

[2] Banz (1981), Reinganum (1981), Chan, Chen and Hsieh (1985), Chan and Chen (1988) and Fama and French (1992) among the others pointed out the role and importance of the size factor in asset pricing.

this phenomenon by the transmission of information framework under imperfect information. According to this model, market makers observe noisy signals about their stocks and correct pricing errors by observing the previous price changes in the other stocks. As the price changes in the other stocks reflect both firm-specific information and also market-wide information, the market-wide information reflected in the past price movements in the other stocks present additional information to market makers for correcting pricing errors in their stocks.

The second explanation of the lead-lag relation among stock returns is the presence of time-varying expected returns. Boudoukh, Richardson and Whitelaw (1994), Conrad and Kaul (1988), and Hameed (1997) claim that portfolio cross-autocorrelations arise because of the portfolio autocorrelations and contemporaneous correlations. According to the third explanation given by Badrinath, Kale and Noe (1995), cross-autocorrelation is related with the institutional ownership of the firms. The institutional ownership causes institutional investors to concentrate on specific groups of stocks and to produce more information about these kinds of stocks. As a result, price changes in these informationally favoured stocks produce additional signals for pricing the informationally unfavoured ones. On the other hand, McQueen, Pinegar and Thorley (1996) provide a new characteristic of the data in explaining the lead-lag relation between small and large cap portfolio returns. They employ a methodology of directional asymmetry in order to establish a deeper analysis of the cross-correlation structure. By analysing the asymmetric responses of small cap portfolios to common good and bad news, it is reported that small and large cap portfolios' reactions to bad news are fast but the reactions of small cap portfolios to good news are slower. Merton (1987) finds evidence that the information set-up cost is another factor which is highly correlated with the firm size. Mench (1993) argues that transaction costs, low transactions and market microstructure are the reasons of the cross-autocorrelation.

The above stated researches are all conducted on the US stock markets. There are also some researches in some other markets. Kanas and Kauretas (2001) find the evidence of cointegration among the size-sorted portfolio prices in the UK stock market. It is stated that large cap portfolio returns lead small cap portfolio returns but not vice versa. Marshall and Walker (2002) employ a sample of stocks traded in the

Santiago de Chile Stock Exchange in cross-autocorrelation structure. Their findings also support the evidence of a sooner effect of information on large cap stocks than on the small cap ones. They also report the lagged reaction of small cap portfolio returns to good news. Two other researches about cross-autocorrelation in the Chinese stock market are documented by Chui and Kwok (1998) and Li, Greco and Chavis (2002). Chui and Kwok (1998) show that B Shares in the Chinese stock market lead A Shares depending on the transmission of information mechanism. Li, Greco and Chavis (2002) document that H Shares lead A Shares. It is also documented that cross-autocorrelation between these stocks increases with the volatility of returns.

In this paper, we analyse the cross-autocorrelation puzzle in two European stock markets in order to analyse this phenomenon comparatively in different stock markets which have different development levels. One of these markets is the German stock market with its relatively old history and large number of assets and the other one is the younger Turkish stock market.

The evidence in the German stock market indicates that large cap portfolios lead small cap portfolios. This empirical result is consistent with the previous empirical researches. The same lead-lag structure is also seen in the Turkish stock market in one subperiod but not in the other one. The main reason of cross-autocorrelation structure is seen as the lagged effect of market-wide information reflected in the large cap portfolio returns on small cap portfolio returns. The analysis of asymmetric effects of lagged downward and upward movements of large cap portfolio returns on small cap portfolio returns show that the sensitivity of small cap portfolio returns to one-day lagged downward large cap portfolio returns as the sign of bad news is statistically significant, except for the second subperiod of the Turkish stock market which shows different characteristics than the other subperiod of the Turkish stock market and both subperiods of the German stock market. The reaction of small cap portfolio returns to one-day lagged good news is not statistically significant.

The organisation of the paper is as follows. The second section describes the data used in the analysis. In the third section, the methodology and the empirical results are presented. Section four concludes the paper.

2. Description of the Data

The data used in this analysis contain daily returns of sample stocks traded in the German and Turkish stock markets between January 1993 - November 2002 period. The total sample period is divided into two seperate five-year subperiods: January 1993 - December 1997 and January 1998 - November 2002. The stock returns are extracted by calculating the simple rate of returns from the "total return index" of each stock. The total return index data are obtained from Datastream[3] and include adjustments for dividends, stock splits and alike. We extract "the simple rate of returns" instead of "the continuously compounded rate of returns" of sample stocks because the continuous rate of return of a portfolio is not the weighted average of continuously compounded rate of stock returns found in that portfolio (see Campbell, Lo and MacKinlay (1997), pp. 11-12, 74).

The sample population of the stocks for the analysis of the German and Turkish stock markets require the following criteria: (1) the stocks should be traded during the whole subperiod, (2) the stocks should not be very thinly traded.

After the initial sample selection according to the above criteria, in the second step stocks are divided into two groups, namely, large firm stocks and small firm stocks for both markets. According to the European Community Commission decision from 3rd April 1996, No.96/280/CE, the number of employees in a firm, apart from the criteria of sales, balance sheet value and functional independency, is considered as a criterion of defining medium and small cap firms. In this analysis we include the number-of-employee data besides the market value data which is commonly used in defining small and large cap stocks in the literature[4]. First, the firms which have less than 250 employees are ordered according to their market value levels for each stock market. Then, the stocks of the last 15 firms with the lowest market values are included into an equal-weighted portfolio of small cap stocks separately for the German and Turkish stock markets. Large cap portfolios for

[3] Datastream is provided as a part of the project "Finanzmarktinnovationen und –institutionen als Folge unvollkommener und unvollständiger Märkte".

[4] Perry (1985), Lo and MacKinlay (1990a), Mench (1993), Chan(1993), McQueen, Pinegar and Thorley (1996) and Marshall and Walker (2002) use market value data to define stocks as small or large cap stocks. Another grouping technique can be seen in Chordia and Swaminathan (2000). They use trading volume data as a criterion to group stocks into high volume portfolios and low volume portfolios in order to analyse the cross–autocorrelation structure.

both stock markets are formed by a similar method. At first, the firms which have more than 500 employees are ordered according to their market value levels. Then the stocks of the first 15 firms which have the highest market values are included into equal-weighted portfolios of large cap stocks for both stock markets. This process is separately implemented for two subperiods. The portfolio returns are calculated first from the simple returns and then they are converted to continuously compounded returns[5]. The descriptive statistics of small and large cap portfolios for two subperiods and both stock markets can be seen in Table 1.

Table 1 : Daily Portfolio Return Descriptive Statistics

$E(R_i)$ is the mean return of the portfolio i, $\sigma(R_i)$ is the standard deviation of portfolio i's return, n is the number of observation, ρ_j is the j^{th}-order autocorrelation coefficient, SCP is the small cap portfolio and LCP is the large cap portfolio.

	German Stock Market Data				**Turkish Stock Market Data**			
	1st Subperiod **Jan1993-Dec1997**		2nd Subperiod **Jan1998-Nov2002**		1st Subperiod **Jan1993-Dec1997**		2nd Subperiod **Jan1998-Nov2002**	
	SCP	**LCP**	**SCP**	**LCP**	**SCP**	**LCP**	**SCP**	**LCP**
$E(R_i)$	0.0005	0.0010	-0.0001	0.0003	0.0037	0.0045	0.0015	0.0017
$\sigma(R_i)$	0.0065	0.0101	0.0083	0.0150	0.0306	0.0279	0.0318	0.0343
n	1247	1247	1244	1244	1245	1245	1210	1210
Skewness	1.622	-0.591	0.143	-0.335	-0.312	-0.315	-0.445	-0.051
Kurtosis	18.583	8.312	5.479	4.912	4.220	4.492	7.732	6.010
ρ_1	0.136	-0.010	0.103	0.077	0.157	0.218	0.093	0.008
p-value	(0.000)	(0.716)	(0.000)	(0.007)	(0.000)	(0.000)	(0.001)	(0.790)
ρ_2	0.073	-0.032	0.025	-0.056	0.032	0.026	0.065	0.082
p-value	(0.011)	(0.257)	(0.382)	(0.048)	(0.263)	(0.356)	(0.023)	(0.004)
ρ_3	-0.031	0.041	0.018	-0.008	0.025	0.048	0.020	-0.033
p-value	(0.272)	(0.150)	(0.637)	(0.789)	(0.371)	(0.089)	(0.492)	(0.251)

The descriptive statistics given in Table 1 show that the small cap portfolios of both markets have lower average returns than large cap portfolios in all subperiods. This lower return structure of the small cap portfolios is followed by

[5] We first calculate the portfolio returns from the equal-weighted simple stock returns. Then the simple return time series of each portfolio are converted into index values with the starting value of 100 at the first day and increasing (decreasing) according to the simple daily return. We extract the continuously compounded returns of each portfolio by calculating the first logarithmic differences of these index values (see Campbell, Lo and MacKinlay (1997), p. 66).

their lower total risk levels except for the Turkish stock market in the January 1993 - December 1997 subperiod. We can see a sharp decrease in the average returns for both portfolios in both stock markets in the subperiod of January 1998 - December 2002, but this decrease is not seen in their risk level. The total risks of the German portfolios are increasing in the second subperiod although the average returns are decreasing. On the other hand, total risks of Turkish portfolios are almost at the same level and they are more stable over the periods.

In both stock markets, a tendency of first-order autocorrelation can be observed for both small and large cap portfolio returns. There are several explanations about the portfolio autocorrelations in finance theory: market efficiency, slow adjustment of stock prices to new information, autocorrelation in the underlying expected returns, nontrading, market microstructure and mispricing (see Mench (1993), pp. 307-308).

The autocorrelation statistics of the German stock market show that the first-order autocorrelations are statistically significant for all portfolios in both subperiods except for the large cap portfolio in the January 1993 - December 1997 subperiod. All the significant first-order autocorrelation coefficients are positive. For the small cap portfolio in the January 1993 - December 1997 subperiod and the large cap portfolio in the January 1998 - November 2002 subperiod, the second-order autocorrelations are also statistically significant. When asset prices adjust to new information slowly, increase (decrease) in stock prices are followed by new increases (decreases) and this can be seen as an explanation of the autocorrelations in portfolio returns. So, the insignificant first-order autocorrelation for the large cap portfolio may be explained by the possible fast adjustment of large cap portfolio prices to new information.

The daily portfolio return descriptive statistics of the Turkish stock market show that the first-order autocorrelations of the small cap portfolios are statistically different from zero even at 1% significance level. On the other hand, only the first-order autocorrelation of the large cap portfolio in January 1993 - December 1998 subperiod is statistically significant. The second-order autocorrelations are not statistically significant in the January 1993 - December 1998 subperiod but they become significant in the January 1998 - November 2002 subperiod for both

portfolios. The third-order autocorrelation is only significant for the large cap portfolio in the January 1993 - December 1997 subperiod. The summary statistics show that there is a general tendency of the positive first-order autocorrelation structure of portfolio returns in the Turkish stock market for both subperiods except for the large cap portfolio in the January 1998 - November 2002 subperiod. We can see that, the third-order autocorrelation is not significant for all portfolios in both stock markets except for the large cap portfolio in the January 1993 - December 1997 subperiod in the Turkish stock market. Thus, it is convenient to accept the importance of the first-order autocorrelation in both stock markets and both subperiods.

3. Methodology and Empirical Results

In order to analyse the cross-autocorrelations between small cap portfolios and large cap portfolios in both stock markets, we concentrate on several hypotheses thus, several models of the lead-lag relation are tested accordingly. The first analysis is the estimation of the general cross-autocorrelation structure between small and large cap portfolios in the Turkish and German stock markets. In the second stage, we analyse the effect of portfolio-specific and market-wide information of large (small) cap portfolios on small (large) cap portfolio returns for a deeper analysis of the source of lead-lag relation. Finally we analyse the asymmetric structure of the cross-autocorrelation in order to see the effect of lagged good and bad news from large (small) cap portfolio returns on small (large) cap portfolio returns.

3.1. General Cross-autocorrelation Structure

Li, Greco and Chavis (2002) implement the Iterated Seemingly Unrelated Regressions (ITSUR) method to estimate the lead-lag relation between A Shares and H Shares in the Chinese stock market. Another research by Chui and Kwok (1998) also implement the ITSUR method in order to analyse cross-autocorrelation between A shares and B Shares in the Chinese stock market. The simultaneous estimation of a system by the ITSUR method is shown to be more efficient than the ordinary least squares method. In our analysis, the following system is simultaneously estimated by

the ITSUR method in order to analyse the general cross-autocorrelation structure in the German and Turkish stock markets.

$$R_{S,t} = a_S + b_{SS} R_{S,t-1} + b_{SL} R_{L,t-1} + \varepsilon_{S,t} \quad (1)$$

$$R_{L,t} = a_L + b_{LL} R_{L,t-1} + b_{LS} R_{S,t-1} + \varepsilon_{L,t} \quad (2)$$

where, $R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, a_S and a_L are the regression coefficients of the small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation coefficient of small cap portfolio return, b_{SL} is the sensitivity of small cap portfolio return to one-day lagged return of large cap portfolio, b_{LL} is the first-order autocorrelation coefficient of large cap portfolio return, b_{LS} is the sensitivity of large cap portfolio return to one-day lagged return of the small cap portfolio, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms of the small and large cap portfolios respectively.

The addition of the one-day lagged own return term to the system estimation enables the control of the autocorrelation effect. The summary of the empirical results are reported in Table 2 for the German and Turkish stock markets.

Panel A of Table 2 presents system estimation results for the German stock market in the January 1993 - December 1997 subperiod. In this subperiod, we get the evidence of the statistically significant one-day lagged effect of large cap portfolio returns on small cap portfolio returns. There is also an effect of one-day lagged small cap portfolio returns on large cap portfolio returns at a lower significance level. But in this subperiod, it is seen that although the effect of one-day lagged large cap portfolio return on the small cap portfolio return is positive (b_{SL}= 0.059), the effect of one-day lagged small cap portfolio returns on the large cap portfolio returns is significant only at 10 % level and it is negative (b_{LS} = -0.081). This negative coefficient can be interpreted as a contrarian effect of the small cap portfolio on large cap portfolio. For the small cap portfolio, one-day lagged autocorrelation is found significant even at 1% level, indicating the effect of the previous days' returns on today's portfolio returns. This is the evidence of the slow reaction of portfolio returns to the information in January 1993 - December 1997 subperiod. In this subperiod, an increase (decrease) in small cap portfolio price is followed by another increase (decrease) in the following day and an increase (decrease) in the previous

price of large cap portfolio also causes increase (decrease) in contemporaneous small cap portfolio price.

Table 2 : General Lead-lag Relation between Small and Large cap portfolios

$R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, a_S and a_L are the regression coefficients of the small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation coefficient of small cap portfolio return, b_{SL} is the sensitivity of small cap portfolio return to one-day lagged return of large cap portfolio, b_{LL} is the first-order autocorrelation coefficient of large cap portfolio return, b_{LS} is the sensitivity of large cap portfolio return to one-day lagged return of the small cap portfolio, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms of the small and large cap portfolios respectively.

	$R_{S,t} = a_S + b_{SS}R_{S,t-1} + b_{SB}R_{L,t-1} + \varepsilon_{S,t}$			$R_{L,t} = a_L + b_{LL}R_{B,t-1} + b_{LS}R_{S,t-1} + \varepsilon_{L,t}$		
	a_S	b_{SS}	b_{SL}	a_L	b_{LL}	b_{LS}
	Panel A : German stock market : Jan 1993- Dec 1997 Subperiod					
Coefficient	0.000†	0.110**	0.059**	0.001*	-0.008	-0.081†
t-statistic	(1.912)	(3.836)	(3.196)	(3.680)	(-0.285)	(-1.799)
R-Squared		0.025			0.003	
	Panel B : German stock market : Jan 1998- Nov 2002 Subperiod					
Coefficient	-0.000	0.069*	0.071**	0.000	0.066*	0.068
t-statistic	(-0.395)	(2.369)	(4.415)	(0.672)	(2.253)	(1.284)
R-Squared		0.026			0.007	
	Panel C : Turkish stock market : Jan 1993- Dec 1997 Subperiod					
Coefficient	0.003**	0.031	0.151**	0.004**	0.235**	-0.042
t-statistic	(3.394)	(0.620)	(2.793)	(4.610)	(4.809)	(-0.950)
R-Squared		0.027			0.040	
	Panel D : Turkish stock market : Jan 1998- Nov 2002 Subperiod					
Coefficient	0.001	0.157**	-0.072	0.002	-0.001	0.008
t-statistic	(1.468)	(2.890)	(-1.429)	(1.623)	(-0.018)	(0.138)
R-Squared		0.010			0.000	

** Significant at 1 % level, * Significant at 5 % level, † Weekly significant at 10 % level.

The empirical results of January 1998 - November 2002 subperiod for the German stock market are presented in Panel B of Table 2. In this subperiod, similarly to the previous subperiod, we get the evidence of the positive and highly significant relation between small cap portfolio returns and lagged large cap portfolio returns

(b_{SL} = 0.071). The sensitivity coefficient of small cap portfolio return to its own one-day lagged return is also found positive and significant (b_{SS} = 0.069), which indicates a slow reaction of small cap portfolio prices to new information. In this subperiod, we see that small cap portfolio returns' sensitivity to one-day lagged large cap portfolio returns is greater than its one-day lagged own return ($b_{SL} > b_{SS}$). This result can be interpreted as an evidence of the importance of the information got from the lagged large cap portfolio returns in the price adjustment process of small cap portfolios. On the other hand, we could not get the evidence of any significant effect of lagged small cap portfolio returns on large cap portfolio returns.

An overall analysis of two subperiods in the German stock market shows a significant lead-lag relation between the small and large cap portfolios. We find an especially significant and positive effect of lagged large cap portfolio return on small cap stock return but not vice versa. The empirical evidence of large cap portfolios lead small cap portfolios in German stock market is consistent with the previous evidence of the cross-autocorrelation structure in the other stock markets.

The cross-autocorrelation estimation results of the January 1993 - December 1997 subperiod of the Turkish stock market (Panel C of Table 2) also present a significant and positive relation between small cap portfolio returns and one-day lagged large cap portfolio returns, but not vice versa. In this subperiod, the autocorrelation coefficient of small cap portfolio return (b_{SS}) is not statistically significant. This indicates that only the effect of the past large cap stock price movements, but not its own one-day lagged price changes, is significant on small cap stock returns. On the other hand, the one-day lagged small cap portfolio return does not have a significant effect on the return of the large cap portfolio, but the autocorrelation coefficient (b_{LL}) is significant at 1% level. The evidence from the first subperiod of Turkish stock market also shows the leading role of the large cap portfolio.

The empirical results of January 1998 - November 2002 subperiod of the Turkish stock market (Panel D) present completely different characteristics than both subperiods of the German stock market and the first subperiod of the Turkish stock market. In this subperiod, it is seen that there is a highly significant and positive autocorrelation (b_{SS}) in small cap portfolio but the effect of one-day lagged large cap

portfolio return on small cap portfolio return is not significant. It can be said that, in this period, on the contrary to the first subperiod, small cap portfolio returns are affected by the past price movements of their own rather than large cap portfolio's past price movements. The case of large cap portfolio also presents different characteristics. In this subperiod, none of the coefficients are found to be statistically significant on large cap portfolio returns.

As an overall summary of findings, we can say that the empirical findings from the German stock market support the evidence of lead-lag relation between small and large cap portfolios. Although small cap portfolio also leads large cap portfolio, the direction of the relation is negative which indicates a contrarian effect and its significance is weak (significant at 10% level). So we can say that the large cap portfolio leads small cap portfolio in the German stock market. On the other hand, the empirical results in Turkish stock market are similar to those of the German stock market only in the first subperiod.

3.2. Market-wide and Portfolio-specific Information in the Cross-autocorrelation Structure

At the first stage of the analysis we examined the general lead-lag relation of small and large cap portfolios and we got the evidence of the large cap portfolio returns lead small cap portfolio returns but not vice versa. At this second stage of the analysis, we concentrate on the decomposition of portfolio returns into systematic and portfolio-specific parts and examine the effects of lagged market-wide and portfolio-specific information of lagged large (small) cap portfolio returns on the returns of small (large) cap portfolios. According to the transformation of information hypothesis, the market-wide information included in the large cap portfolio prices may be used as a signal for a further adjustment of the prices of small cap portfolios. By decomposing total returns of the small (large) cap portfolios into the systematic and portfolio-specific parts and estimating the effects of each of these returns on the large (small) cap portfolio returns we can get some valuable information which can help to understand the source of the significant effect of the one-day lagged large cap portfolio returns on small cap portfolio returns.

3.2.1. Decomposition of Total Returns into Systematic and Portfolio-specific Returns

We implement the market model in order to decompose the total portfolio returns into systematic and portfolio-specific parts. The systematic part of the total return reflects market-wide information and the rest, portfolio-specific return part, reflects portfolio-specific information in small and large cap portfolio returns.

The market model is estimated by the ordinary least squares method for both portfolios in both stock markets and subperiods.

$$R_{S,t} = \alpha_S + \beta_{SM} R_{M,t} + e_{S,t} \quad (3)$$

$$R_{L,t} = \alpha_L + \beta_{LM} R_{M,t} + e_{L,t} \quad (4)$$

where, $R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $R_{M,t}$ is the return of the market portfolio proxy at time t, β_{SM} is the market beta coefficient of small cap portfolio, β_{LM} is the market beta coefficient of large cap portfolio, α_S is the regression coefficient of small cap portfolio, α_L is the regression coefficient of large cap portfolio, $e_{S,t}$ and $e_{L,t}$ are the error terms or portfolio-specific returns of the small and large cap portfolios respectively. In this model, DAX 100 and Istanbul Stock Exchange National 100 indexes are used as market portfolio proxies for German and Turkish stock markets respectively.

According to the summary results of the above model reported in Table 3, in both markets and in both subperiods, market beta coefficients are highly significant. Another point that should be indicated is the high explanation power of the model for all large cap portfolios in both markets. The coefficients of determination are also high for small cap portfolios in the Turkish stock market but not in the German stock market. The coefficients of determination for small cap portfolios in German stock market are only 5.6% and 5.9% whereas they are 94.6% and 80.4% for large cap portfolios in the January 1993 - December 1997 and January 1998 - November 2002 subperiods respectively. This characteristic is not the same in the Turkish stock market. Although the coefficients of determination of small cap portfolios are less than those of large cap portfolios in each subperiod, the explanation power of the market proxy is high in both kinds of portfolios and it is changing between 69.4%-94.1%.

Table 3 : Parameter Estimation of Market Model

$R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $R_{M,t}$ is the return of the market portfolio proxy at time t, β_{SM} is the market beta coefficient of small cap portfolio, β_{LM} is the market beta coefficient of large cap portfolio, α_S is the regression coefficient of small cap portfolio, α_L is the regression coefficient of large cap portfolio, $e_{S,t}$ and $e_{L,t}$ are the error terms or portfolio-specific returns of the small and large cap portfolios respectively. In this model, DAX 100 and Istanbul Stock Exchange National 100 indexes are used as market portfolio proxies.

	$R_{S,t} = \alpha_S + \beta_{SM} R_{M,t} + e_{S,t}$		$R_{L,t} = \alpha_L + \beta_{LM} R_{M,t} + e_{L,t}$	
	α_S	β_{SM}	α_L	β_{LM}
	Panel A : German stock market : Jan 1993 - Dec 1997 Subperiod			
Coefficient	0.000	0.160**	0.000**	1.019**
t-statistic	(1.863)	(8.627)	(3.026)	(147.661)
R-Squared	0.056		0.946	
	Panel B : German stock market : Jan 1998 - Nov 2002 Subperiod			
Coefficient	-0.000	0.116**	0.000*	0.779**
t-statistic	(-0.221)	(8.786)	(2.530)	(71.442)
R-Squared	0.059		0.804	
	Panel C : Turkish stock market : Jan 1993 - Dec 1997 Subperiod			
Coefficient	0.001	0.919**	0.001**	0.943**
t-statistic	(1.141)	(58.351)	(5.777)	(127.431)
R-Squared	0.733		0.929	
	Panel D : Turkish stock market : Jan 1998 - Nov 2002 Subperiod			
Coefficient	0.001	0.735**	0.001**	0.923**
t-statistic	(1.501)	(52.349)	(3.031)	(138.249)
R-Squared	0.694		0.941	

** Significant at 1 % level, * Significant at 5 % level.

The estimation of parameters and extraction of error terms enables to generate the time series of portfolio-specific and systematic returns for small and large cap portfolios in both markets.

3.2.2. Significance of Market-wide and Portfolio-specific Information in the Cross-autocorrelation Structure

The error terms of small and large cap portfolios estimated by the above stated market model can be used as portfolio-specific returns in testing the effect of the lagged small (large) cap portfolio-specific information on large (small) cap portfolio returns. Similarly, the systematic return ($R_{S,t} - e_{S,t}$) for the small cap portfolio and ($R_{L,t} - e_{L,t}$) for the large cap portfolio reflect the market effect on portfolio returns and for this reason they can be used as indicators of the market-wide information in the cross-autocorrelation structure.

The following system is estimated simultaneously by the ITSUR process to test the portfolio-specific and the market-wide information effects on portfolio returns:

$$R_{S,t} = a_S + b_{SS} R_{S,t-1} + b_{SL}^{e} e_{L,t-1} + b_{SL}^{ML} R_{ML,t-1} + \varepsilon_{S,t} \qquad (5)$$

$$R_{L,t} = a_L + b_{LL} R_{L,t-1} + b_{LS}^{e} e_{S,t-1} + b_{LS}^{MS} R_{MS,t-1} + \varepsilon_{L,t} \qquad (6)$$

where, $R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $e_{L,t-1}$ and $e_{S,t-1}$ are the one-day lagged error terms of the market model or one-day lagged portfolio-specific returns of the small and large cap portfolios respectively, $R_{ML,t-1}$ is the one-day lagged systematic return of large cap portfolio, $R_{MS,t-1}$ is the one-day lagged systematic return of small cap portfolio, a_S and a_L are the regression coefficients of small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation coefficient of small cap portfolio, b_{SL}^{e} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio-specific return, b_{SL}^{ML} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio systematic return, b_{LL} is the first-order autocorrelation coefficient of large cap portfolio return, b_{LS}^{e} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio-specific return, b_{LS}^{MS} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio systematic return, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for small and large cap portfolios respectively.

The summary statistics of the system estimation are reported in Table 4. The decomposition of stock returns and employing portfolio-specific and systematic

returns as separate explanatory variables enables us to examine the reason of the cross-autocorrelation structure deeper.

Table 4 : The Effects of Market-wide and Portfolio-specific Information in the Lead-lag Relation

$R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $e_{L,t-1}$ and $e_{S,t-1}$ are the one-day lagged error terms of the market model or one-day lagged portfolio-specific returns of the small and large cap portfolios respectively, $R_{ML,t-1}$ is the one-day lagged systematic return of large cap portfolio, $R_{MS,t-1}$ is the one-day lagged systematic return of small cap portfolio, a_S and a_L are the regression coefficients of small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation coefficient of small cap portfolio, b^e_{SL} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio-specific return, b^{ML}_{SL} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio systematic return, b_{LL} is the first-order autocorrelation coefficient of large cap portfolio return, b^e_{LS} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio-specific return, b^{MS}_{LS} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio systematic return, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for small and large cap portfolios respectively.

	$R_{S,t} = a_S + b_{SS}R_{S,t-1} + b^e_{SL}e_{L,t-1} + b^{ML}_{SL}R_{ML,t-1} + \varepsilon_{S,t}$				$R_{L,t} = a_L + b_{LL}R_{L,t-1} + b^e_{LS}e_{S,t-1} + b^{MS}_{LS}R_{MS,t-1} + \varepsilon_{L,t}$			
	a_S	b_{SS}	b^e_{SL}	b^{ML}_{SL}	a_B	b_{BB}	b^e_{LS}	b^{MS}_{LS}
	Panel A : German stock market : January 1993-December 1997 Subperiod							
Coefficient	0.000†	0.107**	-0.092	0.068**	0.001**	0.022	-0.081†	-0.288
t-statistic	(1.874)	(3.703)	(-1.187)	(3.592)	(2.959)	(0.185)	(-1.778)	(-0.362)
R-Squared	0.028				0.003			
	Panel B : German stock market : January 1998- November 2002 Subperiod							
Coefficient	-0.000	0.069*	0.069†	0.072**	0.000	-0.044	0.067	0.981*
t-statistic	(-0.395)	(2.369)	(1.943)	(4.019)	(0.909)	(-0.681)	(1.277)	(2.052)
R-Squared	0.026				0.010			
	Panel C : Turkish stock market : January 1993- December 1997 Subperiod							
Coefficient	0.003**	0.033	0.162	0.148*	0.004**	0.191†	-0.052	0.006
t-statistic	(3.394)	(0.611)	(1.410)	(2.399)	(4.628)	(1.837)	(-1.063)	(0.057)
R-Squared	0.027				0.040			
	Panel D : Turkish stock market : January 1998- November 2002 Subperiod							
Coefficient	0.001	0.160**	0.026	-0.081	0.002	0.021	0.009	-0.020
t-statistic	(1.480)	(2.947)	(0.227)	(-1.580)	(1.630)	(0.165)	(0.150)	(-0.129)
R-Squared	0.011				0.000			

** Significant at 1 % level, * Significant at 5 % level, † Weekly significant at 10 % level.

As presented in Panel A of Table 4, although one-day lagged market-wide information from large cap portfolio (b_{SL}^{ML}) has a highly significant effect on small cap portfolio returns, large cap portfolio-specific information (b_{SL}^{e}) does not have any statistically significant effect on small cap portfolio returns. On the other hand, one-day lagged market-wide information reflected in small cap portfolio returns has no significant effect on large cap portfolio returns, although the small cap portfolio-specific information has a negative and weakly significant effect on large cap portfolio returns (b_{LS}^{e} is significant at 10% level). These results can be seen as supporting the outcomes of the transmission of information hypothesis. The market-wide signals reflected in large cap portfolio returns of the previous day is positively related with small cap stock returns, indicating that, small cap stock investors' trading strategies are affected by the large cap stock price changes due to the non-synchronous trading, higher level of the market-wide information content or higher speed of adjusting to the market-wide information of large cap portfolios.

The January 1998 - November 2002 subperiod of the German stock market also documents similar results with the highly significant large cap portfolio systematic return effect on small cap portfolio returns. But in this subperiod, one-day lagged large cap portfolio-specific information effect (b_{SL}^{e}) is also found significant at 10% level. Although the small cap portfolio-specific information (b_{LS}^{e}) is not significant on large cap portfolio returns, one-day lagged market-wide information is found significant.

Panel C and Panel D report the cross-autocorrelation structure in the Turkish stock market in two subperiods. In the first five-year period of January 1993 - December 1997, the only significant factor for small cap portfolio return is the one-day lagged systematic return of large cap portfolio. Both one-day lagged small cap portfolio-specific and systematic returns (b_{LS}^{e} and b_{LS}^{MS}) do not have statistically significant effects on large cap portfolio returns. In the second subperiod, one-day lagged large cap portfolio-specific and systematic returns are found insignificant on small cap portfolio returns.

As an overall summary, significance test results support a general significant lagged relation between small cap portfolios and large cap portfolios basically because of the market-wide information content of large cap portfolio returns.

3.2.3. Significance of Market Portfolio Proxy Return and Portfolio-specific Information in the Cross-autocorrelation Structure

In the above analysis we employed systematic returns of small and large cap portfolios as the market-wide information signs. In this section, we directly employ one-day lagged market portfolio proxy returns and portfolio-specific returns in the model in order to test the effects of the market-wide and portfolio-specific information on small and large cap portfolio returns. For this purpose, the following system is estimated by the ITSUR process:

$$R_{S,t} = a_S + b_{SS} R_{S,t-1} + b^e_{SL} e_{L,t-1} + b^M_{SM} R_{M,t-1} + \varepsilon_{S,t} \qquad (7)$$

$$R_{L,t} = a_L + b_{LL} R_{L,t-1} + b^e_{LS} e_{S,t-1} + b^M_{LM} R_{M,t-1} + \varepsilon_{L,t} \qquad (8)$$

where, $R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $e_{L,t-1}$ and $e_{S,t-1}$ are the one-day lagged error terms of market model or one-day lagged portfolio-specific returns of the small and large cap portfolios respectively, $R_{M,t-1}$ is the one-day lagged market portfolio proxy return representing the market-wide information, a_S and a_L are the regression coefficients of the small and large cap portfolios respectively, b_{SS} is the first-order autoregression coefficient of small cap portfolio return, b^e_{SL} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio-specific return, b^M_{SM} is the sensitivity of small cap portfolio return to one-day lagged return of market portfolio proxy, b_{LL} is the first-order autoregression coefficient of large cap portfolio return, b^e_{LS} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio-specific return, b^M_{LM} is the sensitivity of large cap portfolio return to one-day lagged return of market portfolio proxy, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for small and large cap portfolios respectively.

The summary statistics of the above estimated system is reported in Table 5. The empirical results that are presented in Table 5 are consistent with the results presented in Table 4 in both stock markets and subperiods. In the first subperiod of German stock market (Panel A), one-day lagged market-wide information effect on small cap portfolio return (b_{SM}^{M}) is significant at 1% level. In this subperiod, one-day lagged autocorrelation coefficient (b_{SS}) is also statistically significant. This indicates the dependence of today's price changes on its own past price movements. On the other hand, this structure is not seen in the case of large cap portfolio. Although we have the evidence of a highly significant relation between large cap portfolio return and the market proxy return from the parameter estimations of the market model (Table 3), one-day lagged price movement of market proxy, or the market-wide information, has no significant effect on large cap portfolio returns in this subperiod. Similarly, one-day lagged autocorrelation parameter (b_{LL}) of large cap portfolio is also insignificant. The second subperiod, presented in Panel B of Table 5, shows similar characteristics for small cap portfolio returns, but in this subperiod, large cap portfolio-specific information also has a weakly significant effect on small cap portfolio returns. Another empirical result for the German stock market for this subperiod is the significant effect of one-day lagged market-wide information on large cap portfolios.

The cross-autocorrelation structure of the Turkish stock market is presented in Panel C and Panel D of Table 5. In the first subperiod, the market-wide information (b_{SM}^{M}) is statistically significant on small cap portfolio returns but the large cap portfolio-specific information (b_{SL}^{e}) is insignificant. But the significant effect of market-wide information is not seen in the second period. On the other hand, in both subperiods, the small cap portfolio-specific (b_{LS}^{e}) and market-wide (b_{LM}^{M}) information are not statistically significant on large cap portfolio returns.

Table 5 : The Effects of Market Portfolio Proxy as Market-wide Information and Portfolio-specific Information in the Lead-lag Relation

$R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $e_{L,t-1}$ and $e_{S,t-1}$ are the one-day lagged error terms of market model or one-day lagged portfolio-specific returns of the small and large cap portfolios respectively, $R_{M,t-1}$ is the one-day lagged market portfolio proxy return representing the market-wide information, a_S and a_L are the regression coefficients of the small and large cap portfolios respectively, b_{SS} is the first-order autoregression coefficient of small cap portfolio return, b^e_{SL} is the sensitivity of small cap portfolio return to one-day lagged large cap portfolio-specific return, b^M_{SM} is the sensitivity of small cap portfolio return to one-day lagged return of market portfolio proxy, b_{LL} is the first-order autoregression coefficient of large cap portfolio return, b^e_{LS} is the sensitivity of large cap portfolio return to one-day lagged small cap portfolio-specific return, b^M_{LM} is the sensitivity of large cap portfolio return to one-day lagged return of market portfolio proxy, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for small and large cap portfolios respectively.

	$R_{S,t} = a_S + b_{SS}R_{S,t-1} + b^e_{SL}e_{L,t-1} + b^M_{SM}R_{M,t-1} + \varepsilon_{S,t}$				$R_{L,t} = a_L + b_{LL}R_{L,t-1} + b^e_{LS}e_{S,t-1} + b^M_{LM}R_{M,t-1} + \varepsilon_{L,t}$			
	a_S	b_{SS}	b^e_{SL}	b^M_{SM}	a_L	b_{LL}	b^e_{LS}	b^M_{LM}
	Panel A : German stock market : January 1993-Decemeber 1997 Subperiod							
Coefficient	0.000†	0.107**	-0.092	0.070**	0.001**	0.022	-0.081†	-0.046
t-statistic	(1.953)	(3.703)	(-1.187)	(3.592)	(3.565)	(0.185)	(-1.778)	(-0.362)
R-Squared	0.028				0.003			
	Panel B : German stock market : January 1998-November 2002 Subperiod							
Coefficient	-0.000	0.069*	0.069†	0.056**	0.000	-0.044	0.067	0.114*
t-statistic	(-0.249)	(2.369)	(1.943)	(4.019)	(0.797)	(-0.681)	(1.277)	(2.052)
R-Squared	0.026				0.010			
	Panel C : Turkish stock market : January 1993-December 1997 Subperiod							
Coefficient	0.003**	0.033	0.162	0.139*	0.004**	0.191†	-0.052	0.006
t-statistic	(3.628)	(0.611)	(1.410)	(2.399)	(4.603)	(1.837)	(-1.063)	(0.057)
R-Squared	0.027				0.040			
	Panel D : Turkish stock market : January 1998-November 2002 Subperiod							
Coefficient	0.001	0.160**	0.026	-0.075	0.002	0.021	0.009	-0.015
t-statistic	(1.414)	(2.947)	(0.227)	(-1.580)	(1.610)	(0.165)	(0.150)	(-0.129)
R-Squared	0.011				0.000			

** Significant at 1 % level, * Significant at 5 % level, † Weekly significant at 10 % level.

As a general overview of the summarized empirical evidence of the lagged market-wide and portfolio-specific information effects on portfolio returns, we can see that in both markets small cap stock prices are positively affected by the one-day

lagged market-wide information except for the subperiod of January 1998 - November 2002 in the Turkish stock market. The portfolio-specific information of large cap portfolios do not have statistically significant effects on small cap portfolio returns except for the second subperiod of the German stock market. In this subperiod b_{SL}^{e} has a greater effect on small cap portfolio returns than the market-wide information (b_{SM}^{M}=0.056<b_{SL}^{e}=0.069), but its significance is weak (significant at 10% level). These results can be considered as the evidence of the significant effect of the lagged market-wide information on small cap portfolio prices. One-day lagged market-wide information effect does not have strong influences on large cap portfolio returns except in the second subperiod of the German stock market. The one-day lagged small cap portfolio-specific information also does not have a strong statistically significant effect on large cap portfolio returns in both stock markets.

3.3. Directional Asymmetry in Cross-autocorrelation Structure

McQueen, Pinegar and Thorley (1996) illustrated a directional asymmetry in the cross-autocorrelation of the size-sorted portfolios in New York Stock Exchange. In their research, it is reported that both large and small cap portfolios' reactions to bad news are quick but there is a lag in adjusting the prices to good news in the case of small cap portfolios. The ARCH regression method is used in order to estimate the symmetric and asymmetric cross-autocorrelation structures. Another research about the asymmetric reaction of size-sorted portfolio returns to good and bad news is done by Marshall and Walker (2002). In their article it is documented that large cap portfolios react to both good and bad news sooner than the small cap portfolios do and the good news has more pronounced lagged effect than bad news has.

Like McQueen, Pinegar and Thorley (1996) and Marshall and Walker (2002), we also employ binary variables in order to analyse the reactions of small (large) cap portfolio returns to increasing and decreasing lagged large (small) cap portfolio returns seperately. These binary variables allow original portfolio returns to decompose into two different new time series. First series, upward returns, equal to the original returns when they take positive values and zero otherwise. The second series, downward returns, equal to the original returns when they take negative values and zero otherwise. But we do not employ concurrent portfolio returns and

lagged portfolio returns together as exogenous variables in the model specification because of the multicollinearity problem arising from the significant first-order autocorrelations. We estimate the following system by using the ITSUR method.

$$R_{S,t} = a_S + b_{SS} R_{S,t-1} + b_{SL}^{up} R_{L,t-1}^{up} + b_{SL}^{dw} R_{L,t-1}^{dw} + \varepsilon_{S,t} \quad (9)$$

$$R_{L,t} = a_L + b_{LL} R_{L,t-1} + b_{LS}^{up} R_{S,t-1}^{up} + b_{LS}^{dw} R_{S,t-1}^{dw} + \varepsilon_{L,t} \quad (10)$$

where, $R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $R_{L,t-1}^{up}$ is the one-day lagged upward returns of large cap portfolio, $R_{L,t-1}^{dw}$ is the one-day lagged downward returns of large cap portfolio, a_S and a_L are the regression coefficients of small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation of small cap portfolio return, b_{SL}^{up} is the sensitivity of small cap portfolio returns to one-day lagged upward returns of large cap portfolio, b_{SL}^{dw} is the sensitivity of small cap portfolio returns to one-day lagged downward returns of large cap portfolio, b_{LL} is the first-order autocorrelation of large cap portfolio return, b_{LS}^{up} is the sensitivity of large cap portfolio returns to one-day lagged upward returns of small cap portfolio, b_{LS}^{dw} is the sensitivity of large cap portfolio returns to one-day lagged downward returns of small cap portfolio, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for the small and large cap portfolios respectively.

The results of parameter estimation of the above system are reported in Table 6. When the large cap portfolio price movements are divided into upward and downward movements sections as the signs of good and bad news, we get very significant one-day lagged reactions of small cap portfolio returns to bad news in the German stock market. Panel A and Panel B of Table 6 show that b_{SL}^{dw} coefficients for both subperiods are positive and statistically significant at 1% level. But one-day lagged reactions to good news (b_{SL}^{up}) are insignificant in small cap portfolios. On the other hand, in the subperiod January 1993 - December 1997, large cap portfolio returns are negatively related with one-day lagged bad news in small cap portfolio returns. This negative and significant coefficient shows the contrarian effect. When

small cap portfolio returns increase, large cap portfolio investors switch to small cap portfolios in order to get the further advantage of the following increase in small cap stock returns. In this sense, the high significance of small cap portfolio autocorrelation is also reasonable. This feature of large cap portfolio is different in January 1998 -November 2002 subperiod with insignificant reaction to good and bad news in small cap portfolio returns. As an overall summary, empirical evidence got from the German stock market shows that small cap portfolio returns are sensitive to one-day lagged bad news but not to good news.

The asymmetric cross-autocorrelation structure in the Turkish stock market are reported in Panel C and Panel D of Table 6. Small cap portfolio returns in the January 1993 - December 1997 subperiod are positively related with one-day lagged downward returns of large cap portfolio but there is no significant relation with one-day lagged upward returns of large cap portfolio. In this subperiod one-day lagged upward and downward returns of small cap portfolios are not statistically significant on large cap portfolio returns. These findings also support the evidence of the significant effect of one-day lagged bad news reflected in large cap portfolio returns on small cap portfolio returns. This structure is different in January 1998 - November 2002 subperiod. In this subperiod, small cap portfolio returns are negatively and significantly related with one-day lagged upward returns of large cap portfolios but not with one-day lagged downward returns of large cap portfolio. The significance level of this relation is only 10%. The one-day lagged upward and downward small cap portfolio returns do not have any significant effects on large cap portfolio returns. These results show that in the second subperiod, one-day lagged good and bad news do not affect small and large cap portfolio returns. This different characteristic of January 1998- November 2002 subperiod is consistent with the previous results that are got from the other models tested in this research.

Table 6 : Asymmetric Cross-autocorrelation Structure in the German and Turkish Stock Markets

$R_{S,t}$ is the return of small cap portfolio at time t, $R_{L,t}$ is the return of large cap portfolio at time t, $R^{up}_{L,t-1}$ is the one-day lagged upward returns of large cap portfolio, $R^{dw}_{L,t-1}$ is the one-day lagged downward returns of large cap portfolio, a_S and a_L are the regression coefficients of small and large cap portfolios respectively, b_{SS} is the first-order autocorrelation of small cap portfolio return, b^{up}_{SL} is the sensitivity of small cap portfolio returns to one-day lagged upward returns of large cap portfolio, b^{dw}_{SL} is the sensitivity of small cap portfolio returns to one-day lagged downward returns of large cap portfolio, b_{LL} is the first-order autocorrelation of large cap portfolio return, b^{up}_{LS} is the sensitivity of large cap portfolio returns to one-day lagged upward returns of small cap portfolio, b^{dw}_{LS} is the sensitivity of large cap portfolio returns to one-day lagged downward returns of small cap portfolio, $\varepsilon_{S,t}$ and $\varepsilon_{L,t}$ are the error terms for the small and large cap portfolios respectively.

	$R_{S,t} = a_S + b_{SS}R_{S,t-1} + b^{up}_{SL}R^{up}_{L,t-1} + b^{dw}_{SL}R^{dw}_{L,t-1} + \varepsilon_{S,t}$				$R_{L,t} = a_L + b_{LL}R_{L,t-1} + b^{up}_{LS}R^{up}_{S,t-1} + b^{dw}_{LS}R^{dw}_{S,t-1} + \varepsilon_{L,t}$			
	a_S	b_{SS}	b^{up}_{SL}	b^{dw}_{SL}	a_B	b_{LL}	b^{up}_{LS}	b^{dw}_{LS}
	Panel A : German stock market : January 1993 - December 1997 Subperiod							
Coefficient	0.001**	0.110**	0.008	0.106**	0.001	-0.002	0.004	-0.221*
t-statistic	(2.695)	(3.811)	(0.252)	(3.436)	(1.389)	(-0.069)	(0.063)	(-2.466)
R-Squared	0.027				0.005			
	Panel B : German stock market : January 1998 - November 2002 Subperiod							
Coefficient	0.000	0.067*	0.041	0.099**	0.001	0.064*	0.027	0.112
t-statistic	(0.667)	(2.293)	(1.443)	(3.672)	(0.881)	(2.168)	(0.298)	(1.211)
R-Squared	0.028				0.007			
	Panel C : Turkish stock market : January 1993 – December 1997 Subperiod							
Coefficient	0.005**	0.023	0.089	0.235**	0.003**	0.237**	-0.030	-0.058
t-statistic	(3.999)	(0.466)	(1.451)	(3.536)	(3.224)	(4.831)	(-0.578)	(-1.076)
R-Squared	0.030				0.039			
	Panel D : Turkish stock market : January 1998 – November 2002 Subperiod							
Coefficient	0.002*	0.148**	-0.101†	-0.025	0.002	-0.001	0.005	0.010
t-statistic	(1.995)	(2.693)	(-1.845)	(-0.418)	(1.383)	(-0.016)	(0.078)	(0.161)
R-Squared	0.007				0.000			

** Significant at 1 % level, * Significant at 5 % level, † Weekly significant at 10 % level.

4. Conclusion

This paper presents an empirical research of the cross-autocorrelation puzzle in two different European stock markets. The purpose of this research is to find out whether the lead-lag structure, observed in the US stock markets, is also seen in some other European stock markets or not. The evidence from our first test indicates that there are significant lead-lag relations between small cap portfolios and large cap portfolios in the German stock market in two different subperiods. The findings of this research are consistent with the previous findings of Lo and MacKinlay (1990a) for the US stock market in which the large cap portfolio returns lead small cap portfolio returns, but not vice versa.

As a result of our second test, we got the evidence that the market-wide information is the basic source of cross-autocorrelation structure in the German stock market. Both one-day lagged systematic return of large cap portfolios and the market proxy returns have statistically significant effects on small cap portfolio returns. These results support the evidence of the transmission of information hypothesis as an explanation of cross-autocorrelation structure.

The last test is implemented in order to analyse the asymmetric effects of one-day lagged upward and downward price movements of large (small) cap portfolios on small (large) cap portfolio returns. It is seen that one-day lagged downward price movements of large cap portfolios have statistically significant effects on small cap portfolio returns in German stock market. This result indicates the lagged reaction of small cap portfolios to bad news but not to good news. We also get some contrarian effects of the downward price movements of small cap portfolio on large cap portfolio returns. These findings are just the opposite of the results documented by McQueen, Pinegar and Thorley (1993). They show that small cap stocks respond to good, but not to bad common news slowly. Our findings are also contradicting with the results of Marshall and Walker (2002). They analysed the asymmetric reactions of size-sorted portfolios to common information and found the evidence of sooner effect of bad news on portfolio returns. On the other hand, evidence from another research area presents contradictory results to above stated findings of McQueen, Pinegar and Thorley (1993) and Marshall and Walker (2002). Some event-study analyses show that the bad news in the form of rating downgrades have lagged

effects on stock prices but the good news in the form of rating upgrades reflect in stock prices sooner (Griffin and Sanvicente (1982), Hand, Robert and Richard (1992), Matolcsy and Lianto (1995), Barron, Clare and Thomas (1997) and Liu, Seyyed and Smith (1999)) and small cap stocks have stronger reactions to rank changes (Stickel (1985)). In this sense our findings are consistent with the lagged effects of bad news on asset prices. Another supporting approach to our findings can be seen as the overconfidence hypothesis of behavioral finance. According to this hypothesis, behavioral investors are more reluctant to their losses. The overconfidence with the reluctance to react bad news and to relaize the looses cause lagged effects of bad news on asset returns.

The same lead-lag structure of German stock market is only seen in the Turkish stock market in the first subperiod. In the first subperiod of January 1993 - December 1997, large cap portfolios lead small cap portfolios and the main source of this cross-autocorrelation structure is seen as the market-wide information reflected in the large cap portfolio return. We could not find any evidence of lagged small cap portfolio effect on large cap portfolio returns. Similarly to the findings in the German stock market, in this subperiod, only the lagged downward price movements in large cap portfolio have statistically significant effects on small cap portfolio returns, indicating the lagged reaction of small cap portfolio returns to bad news but not to good news.

In the second subperiod, January 1998 - November 2002, the empirical results of the Turkish stock market show a completely different structure than the evidence in the first subperiod. In this subperiod we cannot observe a cross-autocorrelation between small and large cap portfolio returns. The first-order autocorrelation of the small cap portfolio is highly significant but those of the large cap portfolio is not. This subperiod covers the years in which the Asian crisis had strong negative effects on the emerging markets as well as on the Turkish stock market. Another extraordinary and strong effect arises from the big financial crisis in Turkey, which occurred through the end of 2001 and its effects are seen in the year 2002 as well. These fundamental events may disturb the above stated cross-autocorrelation phenomenon in the Turkish stock market in the second subperiod.

References :

Atchison, M., K. Butler and R. Simonds (1987) "Nonsynchronous Security Trading and Market Index Autocorrelation", *Journal of Finance*, Vol. 42, pp. 111-118.

Badrinath, S., J. Kale and T. Noer (1995), "Of Shephards, Sheeps and the Cross-Autocorrelations in Equity Returns", *Review of Financial Studies*, Vol. 8, pp. 401-430.

Banz, Rolf (1981), "The Relationship Between Return and Market Value of Common Stocks", *Journal of Financial Economics*, Vol. 9, pp. 3-18.

Barron, M.J., A.D. Clare and S.H. Thomas (1997), "The Effect of Bond Rating Changes and New Ratings on UK Stock Returns", *Journal of Business Finance and Accounting*, Vol. 24, pp. 497-509.

Boudoukh, Jacob, Matthew P. Richardson and Robert F. Whitelaw (1994), "A Tale of Three Schools: Insights on Autocorrelations of Short-horizon Stock Returns", *Review of Financial Studies*, Vol. 7, pp. 539-573.

Brennan, Michael J., Narasimhan Jagadeesh and Bhakaran Swaminathan (1993), "Investment Analysis and The Adjustment of Stock Prices to Common Information", *Review of Financial Studies*, Vol. 6, pp. 799-824.

Campbell, John J., Andrew W. Lo and A. Craig MacKinlay (1997), *The Econometrics of Financial Markets*, Princeton University Press, Princeton, New Jersey.

Chan, Kalok (1993), "Imperfect Information and Cross-Autocorrelation Among Stock Prices", *Journal of Finance*, Vol. 48, pp. 1211-1230.

Chan, K. C. and Nai-fu Chen (1988), "An Unconditional Asset-Pricing Test and the Role of Firm Size as an Instrumental Variable for Risk", *Journal of Finance*, Vol. 43, pp. 309-325.

Chan, K. C., Nai-fu Chen and David A. Hsieh (1985), "An Exploratory Investigation of the Firm Size Effect", *Journal of Financial Economics*, Vol. 14, pp. 451-471.

Chordia, Tarun and Bhaskaran Swaminathan (2000), "Trading Volume and Cross-Autocorrelations in Stock Retuns", *Journal of Finance*, Vol. 55, pp. 913-935.

Chui, Andy C. W. and Chuck C. Y. Kwok (1998), "Cross-Autocorrelation Between A Shares and B Shares in the Chinese Stock Market", *Journal of Financial Research*, Vol. 21, pp. 333-354.

Conrad, Jennifer and Gautam Kaul (1988), "Time Varying Expected Returns", *Journal of Business*, Vol. 61, pp. 409-425.

Conrad, Jennifer, Gautam Kaul and M.Nimalendram (1991), "Components of Short-Horizon Individual Security Return", *Journal of Financial Economics*, Vol. 29, pp. 365-394.

Fama, E. F. and K. R. French (1992), "The Cross-section of Expected Stock Returns", *Journal of Finance*, Vol. 47, pp. 427-466.

Griffin, P. A., Sanvicente, A. Z. (1982), "Common Stock Returns and Rating Changes: A Methodological Comparison", *Journal of Finance*, Vol. 37, pp. 103-119.

Hameed, Allaudeen (1997), "Time Varying Factors and Cross-Autocorrelations in Short-Horizon Stock Returns", *Journal of Financial Research*, Vol. 20, pp. 435-458.

Hand, J. R. M., R. W. Holthausen and R. W. Leftwich (1992), "The Effect of Bond Rating Agency Announcements on Bond and Stock Prices", *Journal of Finance*, Vol. 47, pp. 733-752.

Kanas, Angelos and Georgios P. Kouretas (2001), "A Cointegration Approach to the Lead-lag Effect Among Size-Sorted Equity Portfolios", working paper.

Jegadeesh, N. and S. Titman (1995), "Overreaction, Delayed Reaction and Contrarian Profits", *Review of Financial Studies*, Vol. 8, pp. 973-993.

Li, Yuming, Joseph F. Greco and Betty Chavis (2002), "Lead-lag Relations Between A Shares and H Shares in the Chinese Stock Markets", working paper.

Liu, Pu, Fazal J. Seyyed and Stanley D. Smith (1999), "The Independent Impact of Credit Rating Changes – The Case of Moody's Rating Refinement on Yield Premiums", *Journal of Business Finance and Accounting*, Vol. 26, pp. 337-363.

Lo, Andrew and Craig MacKinlay (1990a), "When are Contrarian Profits Due to Stock Market Overreaction?", *Review of Financial Studies*, Vol. 3, pp. 175-205.

Lo, Andrew and Craig MacKinlay (1990b), "An Econometric Analysis of Nonsyncronous Trading", *Journal of Econometrics*, Vol. 45, pp. 181-211.

Marshall, Pablo and Eduardo Walker (2002), "Asymmetric Reaction to Information and Serial Dependence of Short-run Returns", *Journal of Applied Economics*, Vol. 5, pp. 273-292.

Matolcsy, Z. P. and T. Lianto (1995), "The Incremental Information Content of Bond Rating Revisions : The Australian Evidence", *Journal of Banking and Finance*, Vol. 19, pp. 891-902.

McQueen, Grant, Michael Pinegar and Steven Thorley (1996), "Delayed Reaction to Good News and Cross-Autocorrelation of Portfolio Returns", *Journal of Finance*, Vol. 51, pp. 889-920.

Mench, Timothy S. (1993), "Portfolio Return Autocorrelation", *Journal of Financial Economics*, Vo. 34, pp. 307-344.

Merton, R. C. (1987), "A Simple Model of Capital Market Equilibrium with Incomplete Information", *Journal of Finance*, Vol. 42, pp. 483-510.

Perry, Philip R. (1985), "Portfolio Serial Correlation and Nonsynchronous Trading", *Journal of Financial and Quantitative Analysis*, Vol. 20, pp. 517-523.

Reinganum, M. (1981), "Misspecification of Capital Asset Pricing Model: Empirical Anomalies Based on Earnings' Yields and Market Values", *Journal of Financial Economics*, Vol. 9, pp. 19-46.

Stickel, S. E. (1985), "The Effect of Value Line Investment Survey Rank Changes on Common Stock Prices", *Journal of Financial Economics*, Vol. 14, pp. 121-143.