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Pre-disclosure Information Asymmetry and Information Content as a Means of Explaining Trading Volume Responses to Interim Earnings Announcements in a Thinly Traded Stock Market

ABSTRACT

This study contains empirical findings regarding the effect of interim earnings announcements on investors' trading behavior. The aim of the paper is to empirically investigate the role of pre-disclosure information asymmetry and information content in explaining volume responses to interim earnings announcements. Pre-disclosure information asymmetry is proxied by the range in analysts' earnings forecasts. Information content is proxied by beta-adjusted returns and the divergence in reported EPS from analysts' mean EPS forecast. The data consist of 118 interim earnings announcements released by 21 firms traded on the Helsinki Stock Exchange (HSE) between 1992 and 1996. Evidence is pro-

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vided that the trading volume reaction is positively associated with information content and to some extent with the level of pre-disclosure information asymmetry. The results are in line with the theoretical trading volume proposition. However, the significance levels are lower than in similar US studies and the association between positive and negative news is slightly asymmetric.

JEL Classification code: *D82; G14; M41*

Keywords: *Volume, earnings announcements, information asymmetry, analysts' earnings forecasts, Helsinki Stock Exchange*

I INTRODUCTION

The market reaction to the public announcement of accounting earnings has been one of the primary fields of accounting research since Beaver (1968), and Ball and Brown (1968). Beaver (1968) made a clear distinction between volume and returns. In Beaver's view abnormal returns reflect the aggregate market reaction to new information, whereas abnormal trading volume reflects the degree to which individual investors change their beliefs upon the release of new information. In other words, the trading volume reaction reflects differences among individual investors that are 'cancelled out' in the averaging process that determines prices. Recently an increasing number of trading volume studies – both theoretical and empirical – have been published. As noted by Karpoff (1986:1069), trading occurs when market participants assign different values to an asset. Accordingly, when there is high trading volume in a market one has to accept that agents act in a heterogeneous pattern (see, for example, Holthausen, and Verrecchia 1990; Kim and Verrecchia 1991a,b, 1994; and Abarbanell, Lanen and Verrecchia 1995).

The aim of the present paper is to empirically investigate whether the trading volume reaction to an interim earnings announcement is associated with the information content of the announcement and the existence of pre-disclosure information asymmetry in the Finnish stock market. Compared with annual reports, interim earnings are more timely, less tax-oriented and thus more relevant. On the other hand, interim earnings are not audited; hence they are less reliable. The theoretical background to the trading volume reaction is based on Kim and Verrecchia (1991a), who show that volume is the product of the absolute value of price reaction (i.e. information content to the "average" investor) and the level of pre-disclosure infor-

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mation asymmetry among investors. Empirical studies have been conducted in the US stock market, e.g. by Beaver 1968, Morse 1980, 1981, Atiase 1985, Bamber 1986, 1987, Ziebart 1990, Atiase and Bamber 1994, and Lobo and Tung 1997. In these studies abnormal volume is found to be related to the information content of the announcement (proxied by cumulative abnormal returns and unexpected earnings) and the pre-disclosure information asymmetry (proxied by the dispersion and range of analysts' earnings forecasts).

This study aims to contribute to the existing body of literature in the following respects. Firstly, there are very few studies in which volume behavior around (interim) earnings announcements is analyzed based on Finnish data.[1] However, the Finnish stock market, with its thin and unequally distributed trading volumes, provides a suitable forum to study the robustness of previous findings produced in more developed stock markets (e.g. the US). In addition, the institutional setting in Finland has been reported to differ considerably from the setting in the US, for example, especially in respect of the earnings management aspects reported by Kasanen, Kinnunen, and Niskanen (1996) in Finland.

Secondly, financial analysts' earnings forecasts have barely been studied in Finland. In fact, up to now it has been difficult to obtain data on variations in analysts' earnings forecasts or even analysts' mean earnings forecast for research purposes. This lack has been felt especially in volume studies, where pre-disclosure information asymmetry is commonly proxied by the dispersion and/or range of analysts' earnings forecasts. Also, market earnings forecast is proxied in this study by the mean of analysts' earnings forecast, a practice not typically used in studies employing Finnish data. In previous studies earnings expectations have commonly been based on previous earnings announcements (see e.g. Martikainen, Rothovius, and Yli-Olli 1993, Kallunki 1996). In this study the analysts' earnings forecasts were provided by Startel/Taloussanomat – the largest Finnish provider of financial information services – to mitigate the lack of generally available analysts' forecast for research purposes.

Thirdly, volume studies have mainly been conducted in markets where short-selling is allowed. However, in Finland this was prohibited until May 1995, which possibly affected the volumes in the market. In particular, market participants' ability to react to announcements containing unfavourable news is restricted if short-selling is not permitted.

The remainder of the paper is organized as follows. In the next section the Kim and Verrecchia (1991a) model is described briefly. The abnormal volume and information content and information asymmetry metrics are presented in the third section. The empirical results and data are presented in the fourth section. Finally, the fifth section concludes the study.

1 Some volume studies have been conducted in Finland (e.g. Martikainen, Puttonen, Luoma, and Rothovius 1994; Rothovius 1992; and Berglund and Liljeblom 1990) but their scope differs from that of this study.

II THEORETICAL CONSIDERATIONS

The empirical analysis in this study is based on Kim and Verrecchia's (1991a) model. In their model[2], the volume reaction to a public announcement is the absolute value of the price change ($\left|\tilde{P}_2 - \tilde{P}_1\right|$) multiplied by a measure of information asymmetry among investors, Q. Thus,

(1) $$Volume = \left|\tilde{P}_2 - \tilde{P}_1\right| Q,$$

(2) $$\text{where } \left|\tilde{P}_2 - \tilde{P}_1\right| = \frac{n}{K_2}\left[\left|Surprise\right| + Noise\right],$$

(3) $$\text{and } Q = \lim_{N\to\infty}(1/N)\sum_{i=1}^{N}\left[r_i \frac{|s_i - s|}{2}\right],$$

where

N = number of investors,

r_i = investor i's risk tolerance based on a negative exponential utility function,

s_i = precision of investor i's private information,

s = average precision of investors' private pre-disclosure information,

n = precision of the public announcement signal,

K_2 = average precision of investors' aggregate information after the announcement (i.e. the average precision of investors' public and private pre-disclosure information, and n, the precision of the public announcement signal).

In the above relation, Q characterizes investors' information asymmetry. It is derived by averaging, among all investors, the absolute difference between the precision of each investor's private information, s_i, and the average precision s, weighted by each investor's risk tolerance, r_i. When public disclosure occurs, investors revise their beliefs. The price reaction reflects the average change in investors' beliefs. Those investors who are relatively better informed (investors with more precise private pre-disclosure information) experience a smaller revision of their beliefs because the new information is relatively less important to them than to those who are less well informed (investors with less precise (or no) private pre-disclosure information). The presence of differential precision thus causes differential belief revisions among investors, which in turn creates volume. When there are no differences in precision between investors there is no volume (i.e. when s_i=s for all i).

This formalizes Beaver's (1968) intuition that abnormal returns reflect the reaction of the aggregate market to new information, whereas abnormal trading volume reflects the degree to

2 See also Atiase and Bamber (1994:324–329)

which individual investors change their beliefs upon the release of new information. In other words, the trading volume reaction reflects differences among individual investors that are 'cancelled out' in the averaging process that determines prices. Accordingly, volume is the product of the absolute value of price reaction and the level of information asymmetry among investors.

The relation in Eq. 2 captures the spirit of event studies. In the case of earnings announcements in interim earnings, the change in prices ($|\tilde{P}_2 - \tilde{P}_1|$) and the surprise in the model correspond to abnormal returns and unexpected earnings, respectively. The earnings-price response coefficient (the sensitivity of price change to an earnings surprise), is an increasing function of the precision of the interim earnings announcement signal, n, which can be interpreted as the information content of the announced information for pricing purposes. A higher value of n/K_2 implies a more sensitive price reaction to an announcement. However, price reaction is a decreasing function of the precision of other information available prior to the announcement. The greater the amount of pre-announcement information the less sensitive is the price reaction to the surprise in the announcement.

III METHODOLOGY

3.1 The dependent variable – abnormal trading volume

Abnormal trading volume can be specified by means of various trading inducement models employed in the literature. These models include mean-adjusted trading models based on the mean trading volume for the stock during non-event periods, and market models for trading volume analogous to the market model for returns frequently used in estimating abnormal returns. Frequently, the volume metric used is the number of shares traded for firm i on day t divided by the number of outstanding shares for firm i on day t. The percentage of outstanding shares takes into account firm size differences.

The daily trading figures are based on the HSE's trading history file consisting of trades settled on the HSE.[3] In this research the number of outstanding shares for a stock series is based on the Helsinki Stock Exchange's *Annual Report* covering the years 1992–1996. The figures represent the number of outstanding shares at the end of the announcement year. These figures are adjusted for stock splits, stock issues, conversions of debt to shares (based on firms' own declarations to the HSE) and exercised warrants (based on firms' own declarations to the HSE). Adjustments for stock splits were made as of the date when the split came into a effect.

3 Many of the firms in the sample are also traded on other exchanges. In markets without arbitrage opportunities price changes between exchanges should be about the same, although the trading volume might vary. For a more complete analysis, trades on other exchanges should also be taken into account.

Adjustments for large stock issues[4] without any difference in dividend entitlement over "old" shares were made as of the date when the stock issue was launched. Adjustments for large stock issues with a different dividend entitlement over "old" shares were made as of the date when the dividend difference ended.[5] Restrictions on the rights of foreigners to hold shares in Finnish companies were lifted as of January 1, 1993, when restricted shares became non-restricted. A corresponding adjustment was made to the number of outstanding shares. Any other factors affecting the number of outstanding shares were adjusted for at the end of the each calendar year.[6] The turn of the year was chosen because firms typically do not release their interim earnings at that time.

The underlying volume metric has frequently been observed to be non-normal. A common practice is to take a natural logarithmic transformation of the percentage of shares traded (e.g. Morse 1980; Pincus 1983; Ajinkya, Atiase, and Gift 1991; Ajinkya and Jain 1989, and Campbell, Grossman, and Wang 1993). A log transformation stands up rather well to a standard normality test. In this procedure a small constant term C is included to preclude taking the log(0) and to yield approximate normality[7] (see Richardson, Sefcik, and Thomson 1986).

Abnormal trading volume is specified using a market model for trading volume[8] with a multiplicative trading inducement procedure as suggested by Cready and Ramanan (1991). Accordingly, trading volume generation is posited in the following form

$$(4) \qquad log(\frac{n_{it}}{S_{it}} + C) = a_i + b_i \, log(\frac{\Sigma n_{it}}{\Sigma S_{it}} + C) + e_{it}$$

where

n_{it} = number of shares traded in stock i on day t,

S_{it} = number of outstanding shares in stock i on day t

Σn_{it} = total number of shares traded on the HSE on day t,

ΣS_{it} = total number of outstanding shares on the HSE on day t

4 A stock issue is considered large if the number of shares increases by more than 10% from the number of shares before the stock issue.

5 This is because stock issues with a dividend difference over "old" shares are listed separately until the dividend difference disappears.

6 The lagged adjustment in small issues will cause a small upward bias to the percentage of shares traded for firms that have stock issues before their interim earnings announcements within a year. However, this effect is assumed to be marginal.

7 Richardson, Sefcik, and Thomson (1986) chose 0.001275 as the constant term to maximize the fit of the weekly data to a normal distribution. Cready and Mynatt (1991) used daily data and divided the weekly constant by 5. Some researchers have added 1.0 to all volume measures before applying the log transformation (e.g. Ajinkya and Jain 1989) and some researchers have added 0.001 (e.g. Ajinkya, Atiase, and Gift (1991).

8 A mean-adjusted trading model (where expected trading is based on mean trading in stock i (t = –281, ...,–31)) and a recursive market model for trading volume were also specified. The results (not reported here), however, do not seem to be especially sensitive to the choice of trading inducement model.

C = 0.0001[9]

a_i = intercept term for share i,

b_i = slope coefficient for share i,

e_{it} = error term for stock i on day t.

The model was estimated using OLS regression with 250 volume observations (t = –281, ..., –31) prior to each announcement date. Thus, the normal volume for day t (t = –30, ...,+30) and stock i is based on a model those parameters are determined by the pre-announcement volume behavior.

There is no unanimity on the length of event period that should be used due to the lack of a well developed theory on the length of time that trading takes to respond to information events. If the market is efficient then new information should be discounted into prices instantaneously. Market friction caused by delayed information dissemination causes inertia in price and volume responses to information. For example, in Kross, Ha, and Heflin's research (1994) the event period runs from day –1 through day +7 (where day 0 is the announcement date of the report) and in Atiase and Bamber (1994) the short (long) event period runs from day –1 (–1) through day 0 (+5). In these studies the results seem to be robust in respect of the length of the event period.

As stated by Foster (1986:378), various other reasons for trading exist, e.g. tax considerations, liquidity reasons, and portfolio adjustments. To the extent that these are cross-sectionally correlated, however, the trading inducement model used mitigates such effects by abstracting them to the extent that they affect total trading in the market. In addition, tax reasons are virtually avoided if they result in trading predominantly around the year end because no interim earnings were announced from December to April in the sample firms.

3.2 Independent variables

3.2.1 Information content metrics – abnormal returns and unexpected earnings

Several types of statistical models have been employed to measure the information content of an information event. In principle the information content can be measured by observing the price reactions in the market and/or observing the change in unexpected earnings. Examples of price reaction models include beta-adjusted returns, mean-adjusted returns, and market-adjusted returns. However, according to Brown and Warner (1980, 1985) these models do not cause any large differences in the results obtained (see also Kallunki 1996).

9 Some other arbitrary constants were also applied. The results, however, do not seem to be especially sensitive to the choice of the value of C.

Daily returns were used for stocks listed on the HSE, a small Scandinavian stock market. The returns, covering the years 1991 – 1996, were calculated as differences in logarithmic price indices, including splits, stock dividends, and new issues, as based on Hernesniemi (1990) and computed by the HSE. Due to the thin trading volume a number of missing prices could cause misspecification in abnormal returns (see e.g. Maynes and Rumsey 1993 and Kallunki 1996:38). A uniform return procedure was used. Where there are non-trading days, the procedure allocates multiperiod returns equally over the days in the multiperiod interval.

The information content of the announcement was measured by cumulating beta-adjusted returns over the same response period used for trading volume, as discussed above. Using daily data, the model parameters were estimated using OLS regression with 250 return observations (t=–281,...,–31) prior to each announcement date. Thus,

$$(5) \qquad R_{it} = a_i + b_i R_{mt} + e_{it}$$

where R_{it} is the return on asset i at time t, a_i is the intercept term of asset i, b_i is the beta coefficient of asset i, R_{mt} is the return on stock market value-weighted portfolio m at time t and e_{it} is an error term. Thus the beta-adjusted return on day t (t = –30,+30) for stock i, e_{it}, is $R_{it} - (a_i + b_i R_{mt})$. Consistent with Kim and Verrecchia (1991a), the sign of the cumulative beta-adjusted returns was abstracted using an absolute value transformation. The same kind of information content measure is used for example by Kross, Ha, and Heflin (1994) and Atiase and Bamber (1994). Some other measures have also been used (see e.g. Ziebart 1990). However, as pointed out by Verrecchia (1993):*"While there may exist a variety of alternative possible candidates to measure information content, only price change and volume require no proxies, and in this sense are truly "operational"."*

Other information content metrics are typically based on reported earnings as studied intensively in the literature since Ball and Brown (1968). Frequently the previous year's earnings are used as a proxy for expected earnings. Estimating unexpected earnings as the change relative to the previous year assumes that annual earnings follow a random walk time-series process, i.e. shocks to annual earnings are permanent and there are no competing information sources available to the market. However, in the presence of transitory components in earnings, the previous year's earnings are a poor proxy for the current year's expected earnings and thus changes in earnings are also poor proxy for unexpected earnings (e.g. Easton and Harris 1991; Hayn 1995; Martikainen, Kallunki, Perttunen 1997). The presence of a transitory component in earnings implies a lower slope coefficient between returns and unexpected earnings compared to a situation where earnings are purely permanent. This is also widely documented in the literature. The finding that earnings appear to explain only a small frac-

tion of the total variation in returns has led to much discussion (evidence summarized by Lev 1989).

When the (seasonal) random walk model for earnings is sensitive to the above-mentioned shortcomings more timely proxies for (un)expected earnings are called for. An example of a more timely proxy for expected earnings is mean (or consensus) analysts' earnings forecast. By comparing reported earnings to mean analysts' earnings forecast one can obtain a proxy for the (average) information content of an announcement. The information content metric used here is the absolute difference between the mean analysts' earning forecast and reported earnings scaled by the number of outstanding shares.[10] Thus,

$$(6) \qquad \left|UE\right| = \frac{\left| \textit{mean analysts' earnings forecast} - \textit{reported earnings} \right|}{\text{number of outstanding shares}}$$

Reported earnings were estimated using "earnings before extraordinary items" in the interim reports.

3.2.2 Pre-disclosure information asymmetry proxy

In the literature the range and dispersion of analysts' earnings forecasts are frequently employed as a proxy for pre-disclosure information asymmetry (see e.g. Ziebart 1990, Atiase and Bamber 1994, Lobo and Tung 1997). At least two theories have been put forward as the reason for the existence of dispersion in analysts' earnings forecasts. These originate from considerations of the effect of uncertainty on a firm's value, with particular emphasis on the uncertainty surrounding a firm's future cash flows, which underpin the firm's value. Among others, Verrecchia (1980), Epstein and Turnbull (1980) and Holthausen and Verrecchia (1988) have considered the theoretical impact of uncertainty on firms' value.

These studies suggest that the greater fundamental uncertainty surrounding a firm's future cash flow the greater the stock price responses are to value-relevant information. Where accrual accounting earnings are used as a proxy for a firm's future cash flows, greater uncertainty in earnings may also indicate greater uncertainty surrounding the firm's future cash flows (for empirical evidence see for example Dalay, Senkow, and Vigeland 1988). Alternatively, earnings uncertainty may represent noise, defined as that portion of the signal with no information content, in the process of generating earnings signals. The subjective nature of accrual accounting permits a firm's managers to influence reported earnings without necessarily alter-

10 Net sales and the market value of the equity were also applied. However, the tenor of the results was unaltered.

ing the firm's fundamental economic cash flows, now or in the future. Hence, if earnings uncertainty is a manifestation of noise, greater uncertainty in earnings ought to result in smaller stock price responses (see, for example, Imhoff and Lobo 1992). Thus, earnings uncertainty may have a different effect on the value of the firm, depending on whether it reflects fundamental uncertainty or noise or both.

In previous studies the magnitude of pre-disclosure information asymmetry is proxied for example by the variation and range of analysts' earnings forecasts. These measures can be defended by arguing that investors form divergent pre-disclosure expectations on the basis of financial advisors' recommendations. However, as pointed out by Atiase and Bamber (1994:316), financial analysts form only a subset of market participants. This proxy might underestimate the true variation in the expectations of a broader, more heterogeneously informed set of investors. This is because financial analysts are, on average, well-informed. In addition, these proxies reflect divergent expectations, whereas the theoretical definition is the differential precision of pre-disclosure information (see Eq. 3). Hence, divergent expectations might also be the result of differences in the average precision.

In Finland, there has been a distinct lack of datadases covering analysts' earnings forecasts for research purposes. However, Startel/Taloussanomat, the leading Finnish provider of financial information services, agreed to make its database available to mitigate this lack. The institutional setting for analysts' earnings forecasts is relatively new in Finland as the earliest available forecast was from June 1992. Brokerage houses and banks typically publish their earnings forecasts to Startel a couple of weeks prior to the (interim) earnings announcement date. As the announcement date approaches Startel releases the analysts' earnings forecasts to the market several days in advance (during the sample periods it varies from six days to one day, average two trading days[11]) and in the following manner: i) highest and lowest earnings forecast, ii) mean forecast, and iii) names of the forecasters. The number of earnings forecasters in Startel's file varies from four to 12. If the number of earnings forecasters is lower than four it is not considered by Startel to be representative.

The metric for the magnitude of pre-disclosure information asymmetry proxied by the range of analysts' earnings per share forecasts, *RANGE*, takes the following form:

$$(7) \qquad RANGE = \frac{\left| highest\ EPS\ forecast - lowest\ EPS\ forecast \right|}{\left| mean\ EPS\ forecast \right|}$$

11 The average time span from the forecast release to the actual earnings announcement date have systematically increased. The yearly means are the following: year 1992, 1 trading day; 1993 (1.5); 1994 (2.0); 1995 (2.6); 1996 (3.2)

Observations with mean forecasts from FIM –20 000 to FIM 20 000 were omitted (two observations) due to the metric's sensitivity to small denominators (similar cut-off rules have also been used for example in Atiase and Bamber 1994, Pincus 1983). The file containing the variation (or dispersion) of analysts' earnings forecasts was not available.

3.5 Regression model for hypothesis testing

The hypothesized relationships were investigated by estimating the following regressions:

$$(8) \quad ABVOL = \alpha + b_1|UE| + b_2|CAR| + b_3 RANGE + b_4 SIZE + e$$

[*information content*] [*information asymmetry*] [*control variable*]

where

ABVOL = estimated abnormal volume around the time of the interim earnings announcement, measured as the sum of the prediction errors specified by the market model for volume (see Eq. 4);

$|UE|$ = information content of the announcement measured as the absolute difference between the mean analysts' earnings forecast and the reported earnings scaled by the number of outstanding shares (see Eq. 6);

$|CAR|$ = information content of the announcement measured as the absolute cumulative beta-adjusted return (see Eq. 5);

RANGE = absolute difference of maximum and minimum analysts' earnings forecasts scaled by the absolute mean of analysts' earnings forecast (see Eq. 7);

SIZE = natural log of the market value of the equity measured at the end of the pre-announcement year;

α and *b*s = OLS regression coefficients; and

e = error term.

The reason for using firm size as a control variable is based on Kim and Verrecchia's (1991a) model and arguments put forward by Atiase and Bamber (1994). The need for a control variable originates from the use of the range or variation of analysts' earnings forecasts as a proxy for pre-disclosure information asymmetry. The variation of analysts' earnings forecasts may reflect differences in the average precision of investors' pre-disclosure information in addition to differential precision in pre-disclosure information. The magnitude of the price reaction reflects the average precision of the pre-disclosure information. However, the price response also reflects the magnitude of the earnings surprise, for example. To control for the effect of differences in the average precision of investors' private pre-disclosure information

the price reaction and firm size were included as dependent variables in the regression model, as in Atiase and Bamber (1994) and Lobo and Tung (1997).

The regression was run over four periods relative to the announcement: the pre-announcement period (days –5 to –1), the announcement date (day 0), a short post-announcement period (days 1 to 5), and a long post-announcement period (days 1 to 10). In all periods *|UE|, SIZE* and *RANGE* were the same, whereas *|CAR|* was cumulated over identical days as the dependent variable *ABVOL*. It was assumed that investors obtain information regarding the content of interim reports at the time of the announcement. In other (non-announcement) periods the information flow ought to be much weaker. If this is true, the reaction between abnormal volume and the independent variables ought to be stronger around the time of the earnings announcement than in other periods. The statistical significance was tested for by a t-statistic adjusted for an unknown type of heteroscedasticity using White's (1980) estimate of parameter standard error.

IV SAMPLE AND RESULTS

4.1 Sample selection

The sample consisted of interim earnings announcements made between 1992 and 1996 by HSE-listed firms. The sample observations met the following additional sampling criteria:

1. Analysts' earnings forecasts available in the Startel/Taloussanomat file.
2. Daily trading volume (price indices) available in the HSE's trade history file (price history file) from 281 days preceding, to 30 days following, the date of each interim earnings announcement.

The sampling criteria resulted in a total of 118 firm-year announcements released by the 21 firms presented in Appendix 1. The firms for whose interim earnings analysts' earnings forecasts were available can be characterized as large and their stocks are actively traded on the HSE. However, despite the banks being large, they attract very little explicit analysis. One possible explanation for this is that analysts frequently operate in or close to banks and thus they avoid judging their competitors or themselves.

4.2 Primary analysis

Table 1 presents descriptive statistics on the independent and dependent variables. The mean abnormal trading volume at the event date (*VOL0*), 0.768, is almost twice as high as that of the five-day period prior to the announcement (*VOLPRE5*), 0.438. In fact it is about the same as that of the five-day period after the announcement (*VOLPOST5*), 0.772. The event date mean

TABLE 1. Descriptive statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum
independent variables, *ABVOL*				
VOLPRE5	0.438	2.804	–7.006	7.519
VOL0	0.768	0.973	–2.105	3.479
VOLPOST5	0.772	2.820	–5.363	9.771
VOLPOST10	1.437	5.543	–13.54	23.97
dependent variables, |*CAR*|				
CARPRE5	0.049	0.049	0.0003	0.277
CAR0	0.027	0.025	0.0003	0.115
CARPOST5	0.033	0.031	0.0009	0.225
CARPOST10	0.052	0.054	0.0006	0.287
|*UE*|	0.003	0.003	0.0000	0.015
SIZE	22.27	0.837	20.82	25.10
RANGE	0.680	0.828	0.053	6.000

ABVOL = estimated abnormal volume around the time of the interim earnings announcement, measured as the sum of the prediction errors specified by the market model for volume using four periods: pre-announcement period, VOLPRE5 (days –5 to –1); VOL0, (day 0); VOLPOST5, (days +1,+5); VOLPOST10, (days +1 to +10);

\|*UE*\| = information content of the announcement measured as the absolute difference of mean analysts' earnings forecast and reported earnings scaled by the number of outstanding shares;

\|*CAR*\| = information content of the announcement measured as the absolute cumulative beta-adjusted return using four periods: pre-announcement period, CARPRE5 (days –5 to –1); CAR0, (day 0); CARPOST5, (days +1,+5); CARPOST10, (days +1 to +10);

SIZE = natural log of the market value of the equity measured at the end of the pre-announcement year;

RANGE = absolute difference of maximum and minimum analysts' EPS forecasts scaled by absolute mean analysts' EPS forecast.

abnormal trading volume indicates an increase of about 116 per cent over the normal trading volume[12].

The mean abnormal trading behavior around the interim earnings announcements is illustrated in Figure 1. It suggests that abnormally high trading is concentrated on the announcement date itself and for a number of days after the announcement event. Positive abnormal

12 Figure is achieved by $e^{0.77} - 1$ (= 1.16).

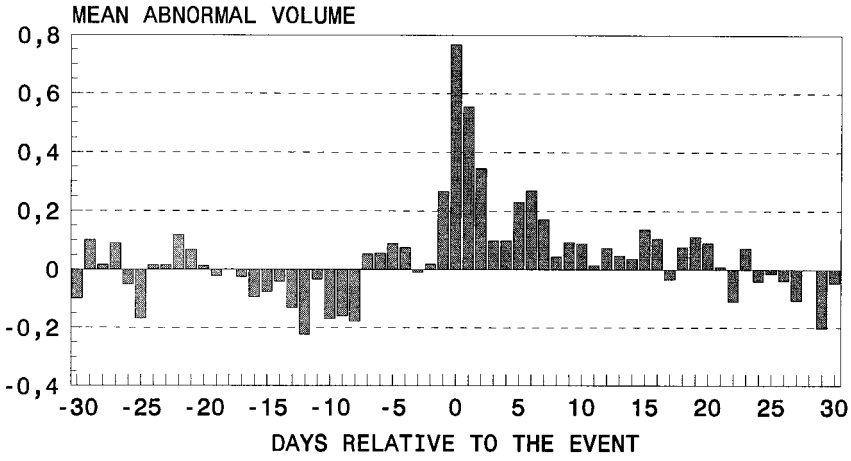

FIGURE 1. Mean abnormal trading around the interim earnings announcements.

volume seems to persist for quite a long period. It is also worth mentioning the negative mean abnormal volumes existing a couple of weeks before the announcement date, which is consistent for example with Lobo and Tung's (1997) findings in the US.

Table 2 reports the correlations between the variables employed in the analysis. The correlation between the four volume measures and the corresponding absolute price reaction ranges from 0.119 to 0.276. Each of the correlations is significantly greater than zero at $p<0.1$. The highest correlation is found at the announcement date and is significantly greater than zero at $p<0.001$. The results in Table 2 also show that there is a slight ($p<0.1$) positive relation between trading volume and the range of analysts' earnings forecasts on the announcement date. This is consistent with the hypothesis that trading volume at the time of interim earnings announcements increases with the degree of predisclosure information asymmetry. Correlation is lower in other periods. Prior research in the US has shown that trading volume (Atiase 1985, 1987, Lobo and Tung 1997, see however Atiase and Bamber 1994) and price reaction (Bamber 1986, 1987, Lobo and Tung 1997) to earnings announcements is a decreasing function of firm size. Firm size is included in the regression analysis as an independent variable to control for the effects of firm size and factors that may be correlated with it. The magnitude of unexpected earnings, $|UE|$, is also included in the analysis. In Kim and Verrecchia's (1991a) model, unexpected news (surprise) is discounted in the price reaction. Since it can take traders some time digest the information content of an announcement, causing drift especially in post-announcement returns, unexpected earnings are included. In order to clarify these relationships the results of the regression analysis are presented in the next section.

TABLE 2. Correlations between variables employed in the regression analysis.

	RANGE	*SIZE*	*|UE|*	*VOLPRE5*	*VOL0*	*VOLPOST5*	*VOLPOST10*
RANGE	1.000	–0.086	–0.082	0.080	0.133	0.029	0.012
	(0.0)	(0.177)	(0.378)	(0.194)	(0.075)	(0.376)	(0.449)
SIZE	–0.086	1.000	–0.062	0.109	0.126	–0.017	–0.059
	(0.177)	(0.0)	(0.504)	(0.119)	(0.087)	(0.426)	(0.263)
|UE|	–0.082	–0.062	1.000	–0.040	0.181	0.040	0.135
	(0.190)	(0.252)	(0.0)	(0.336)	(0.025)	(0.332)	(0.073)
CARPRE5	0.137	–0.168	–0.058	0.119	0.132	0.066	0.041
	(0.070)	(0.034)	(0.535)	(0.100)	(0.077)	(0.238)	(0.329)
CAR0	–0.050	–0.044	0.089	0.113	0.276	0.205	0.185
	(0.296)	(0.316)	(0.339)	(0.111)	(0.001)	(0.013)	(0.023)
CARPOST5	–0.024	–0.074	–0.110	–0.074	–0.085	0.174	0.267
	(0.398)	(0.213)	(0.235)	(0.213)	(0.181)	(0.030)	(0.001)
CARPOST10	–0.030	–0.265	–0.124	–0.079	–0.055	0.123	0.240
	(0.375)	(0.002)	(0.181)	(0.198)	(0.277)	(0.092)	(0.005)

ABVOL = estimated abnormal volume around the time of the interim earnings announcement, measured as the sum of the prediction errors specified by the market model for volume using four periods: pre-announcement period, VOLPRE5 (days –5 to –1); VOL0, (day 0); VOLPOST5, (days +1,+5); VOLPOST10, (days +1 to +10);

|UE| = information content of the announcement measured as the absolute difference of mean analysts' earnings forecast and reported earnings scaled by the number of outstanding shares;

|CAR| = information content of the announcement measured as the absolute cumulative beta-adjusted return using four periods: pre-announcement period, CARPRE5 (days –5 to –1); CAR0, (day 0); CARPOST5, (days +1,+5); CARPOST10, (days +1 to +10);

SIZE = natural log of the market value of the equity measured at the end of the pre-announcement year;

RANGE = absolute difference of maximum and minimum analysts' EPS forecasts scaled by absolute mean analysts' EPS forecast;

***p*-values in paranteheses**

4.3 Regression results

Table 3 shows the estimated coefficients, R_2, the F-values with their significance levels and the mean square errors (MSE). The figures in parentheses represent adjusted *p*-values for the estimated coefficients based on White's (1980) heteroscedasticity-consistent covariance estimates. Two sets of regressions were employed: i) a full model including all the independent variables, and ii) a model omitting the control variable, firm size (*SIZE)* and unexpected earnings ($|UE|$). In the full model, the regression coefficients of information content (b_1 and b_2) are

TABLE 3. Abnormal trading activity metrics regressed on the information content of the announcements and level of pre-disclosure information asymmetry

$$ABVOL = \alpha + b_1|UE| + b_2|CAR| + b_3 RANGE + b_4 SIZE + e$$

Dependent variable, *ABVOL*	|*UE*|	|*CAR*|	*RANGE*	*SIZE*	R^2	*F*	*MSE*
VOLPRE5	–15.02	13.03	0.246	0.457	0.04	1.1	7.387
	(0.417)	(0.022)	(0.202)	(0.092)		(0.367)	
		10.94	0.221		0.02	1.1	
		(0.045)	(0.221)			(0.347)	
VOL0	54.22	10.77	0.207	0.191	0.15	5.1	0.796
	(0.015)	(0.000)	(0.025)	(0.014)		(0.001)	
		11.06	0.17		0.10	6.2	
		(0.000)	(0.057)			(0.003)	
VOLPOST5	55.15	16.64	0.133	0.012	0.04	1.0	6.807
	(0.282)	(0.003)	(0.326)	(0.965)		(0.395)	
		15.96	0.11		0.03	1.9	
		(0.003)	(0.347)			(0.161)	
VOLPOST10	294.1	27.71	0.243	0.173	0.09	2.7	25.480
	(0.045)	(0.000)	(0.327)	(0.688)		(0.035)	
		24.73	0.128		0.06	3.5	
		(0.001)	(0.407)			(0.033)	

ABVOL = estimated abnormal volume around the time of the interim earnings announcement, measured as the sum of the prediction errors specified by the market model for volume;

\|*UE*\| = information content of the announcement measured as the absolute difference of mean analysts' earnings forecast and reported earnings scaled by the number of outstanding shares;

\|*CAR*\| = information content of the announcement measured as the absolute cumulative beta-adjusted return;

RANGE = absolute difference of maximum and minimum analysts' EPS forecasts scaled by absolute mean analysts' EPS forecast;

SIZE = natural log of the market value of the equity measured at the end of the pre-announcement year;

α and *b*s = OLS regression coefficients; and

e = error term.

The p-values in parentheses refer to the significance levels based on one-tail t-statistics adjusted for an unknown type of heteroscedasticity using White (1980). MSE refers to the mean square error of the regression. The one-tailed significance levels are for the coefficients of \|UE\|, \|CAR\|, and RANGE, and the two-tailed significance levels are for the coefficients of SIZE (see e.g. Atiase and Bamber 1994:321).

significant at p <0.05, and the coefficient of pre-disclosure information asymmetry (b_3) is significant at p <0.05 on the announcement date (day 0). In particular, absolute abnormal return reactions ($|CAR|$) seem to perform well as an independent variable, p <0.001. In the periods succeeding the announcement date (*VOLPOST5, VOLPOST10*) the association is much weaker than on the announcement date itself, especially in respect of the information asymmetry proxy (*RANGE*), p >0.10. Instead, induced trading is still associated with $|CAR|$, p <0.005. In the pre-announcement period (days –5 to –1) the association seems to be much weaker. Using the Shapiro-Wilk test of normality, it was found that the null hypothesis that the residuals are normally distributed could not be rejected for any of the regressions.

The regression results provided support for the hypotheses. Trading volume on the date of interim earnings announcements (day 0) was clearly significantly positive related to associated price reaction after controlling for firm size, unexpected earnings and the range of analysts' earnings forecasts. On the date of interim earnings announcements (day 0) trading volume was also significantly positive related to the range of analysts' earnings forecasts, after controlling for firm size, unexpected earnings, and associated price reactions. Comparing the results to corresponding studies based on the US markets (Atiase and Bamber 1994, Lobo and Tung 1997), the *p*-values for the price reaction are about the same, whereas they are much lower for the range of analysts' earnings forecasts. Bearing in mind 1) the size differences between the markets (NYSE vs. HSE) and between the samples (over 5,000 observations in Atiase and Bamber's (1994) study and over 9,000 observations in Lobo and Tung's study) and 2) the relative newness of the analysts' earnings forecasting institution in Finland it is understandable that the range of analysts' earnings forecasts is a noisier proxy for predisclosure information asymmetry in Finland than in the US.

4.4 Additional tests

This section summarizes a series of additional tests that examine whether the results in the previous section are robust in respect of i) return procedure, 2) functional form, 3) sensitivity to outliers, 4) the sign of the news, and 5) the potential effect of instititional changes. As a result of thin trading a number of missing prices could cause misspesification in abnormal returns. The uniform return procedure was primarily used as described above. Two additional return procedures were applied to approximate prices for days without trading. The first procedure is based on Hernesniemi (1990) and is used by the HSE to compute the HEX index series. The second procedure is based on 'lumped' returns, where all of the multiperiod return is assigned to the days on which the stock actually trades and returns for no-trade days are set to zero (see e.g. Maynes and Rumsey 1993). However, virtually no differences were observed in the results whatever return procedure was used.

The results' sensitivity to alternative specifications of the functional form of the relation can be assessed by transforming variables into a log form (see Atiase and Bamber 1994). If the log-transformed relation results in lower mean square errors (*MSEs*) than in the original model then the original model's error term is heteroscedastic. Log transformation requires the data to have positive values only. An arbitrary constant[13] ,15, was added to the *ABVOL* to meet this requirement. The results seem to be somewhat weaker in a multiplicative form.[14] The tenor of the results was also the same in the pre-and post announcement periods. The computed *MSE*-values[15] were also somewhat higher in the log transformed form, *VOLPRE5* (*MSE*=7.244), *VOL0* (0.812), *VOLPOST5* (6.884), and *VOLPOST10* (25.480), than in the original form (see Table 3). The functional form was also diagnosed by adding a squared form of the original variables to the independent variables. Since the estimated *p*-values (not given here) were rather high the results do not support the existence of this kind of nonlinearity.

The sensitivity of the results to extreme values was studied by winsorizing the data. Since we are especially interested in the robustness of the association on the announcement date, regression analysis was carried out using *VOL0* only as the dependent variable. When six outliers (5.1 % of the observations) were deleted to include those observations for which the standardized values of the dependent variable *VOL0* were within |2.0|, the regression coefficients of the independent variables were all significantly positive at $p<0.05$ (based on White-adjusted t-values).

The symmetry of the volume reaction to positive vs. negative news was studied i) by regressing abnormal volume separately on positive and negative news and ii) by using a sign dummy. Karpoff's (1987) argued that short-selling restrictions resulted in asymmetric volume response to news with the opposite sign. The regression results for the separate models are presented in Table 4. There are some differences in the regression coefficients and *p*-values depending on the sign of the news. For example *RANGE* seems to be significantly related ($p<0.05$) to abnormal volume in the pre-announcement period (*VOLPRE5*) but with the opposite sign. Accordingly, if positive news (*UE*>0) is released with a large *RANGE* it generates more pre-announcement trading, whereas negative news associated with a large *RANGE* generates less pre-announcement trading. In addition, on the announcement date (*VOL0*), a positive information release with a large *RANGE* generates more volume. The volume reaction to negative news also seems to be lower than that with positive news. The largest difference in

13 Some other constants were also applied. The results, however, do not seem to be especially sensitive to the value of the constant.

14 The corresponding *p*-values (based on White-adjusted t-values) for the independent variables on the announcement date *(VOL0)* were as follows: for $|UE|$, p=0.01; $|CAR|$, p=0.01; *RANGE*, p=0.08; and *SIZE*, p=0.02.

15 The square errors were made comparable to the original form by means of the following adjustment: $\varepsilon = ABVOL - (e^{AB\hat{V}OL} e^{0.5\sigma^2} - 15)$

TABLE 4. Abnormal trading activity metric regressed separately on positive and negative news.

$$ABVOL = \alpha + b_1|UE| + b_2|CAR| + b_3 RANGE + b_4 SIZE + e$$

positive news (N=61)	|UE|	|CAR|	RANGE	SIZE	R^2	F
VOLPRE5	11.47	22.28	0.486	0.887	0.08	1.3
	(0.453)	(0.139)	(0.017)	(0.040)		(0.289)
VOL0	64.82	8.558	0.228	0.112	0.14	2.3
	(0.007)	(0.046)	(0.002)	(0.337)		(0.069)
VOLPOST5	132.2	14.78	0.039	0.435	0.05	0.7
	(0.142)	(0.017)	(0.452)	(0.294)		(0.570)
VOLPOST10	602.8	31.23	–0.003	0.364	0.17	2.9
	(0.005)	(0.004)	(0.498)	(0.658)		(0.030)
negative news (N=57)						
VOLPRE5	–21.56	15.01	–0.809	0.165	0.06	0.9
	(0.416)	(0.006)	(0.050)	(0.525)		(0.488)
VOL0	35.45	12.98	0.088	0.249	0.18	2.9
	(0.211)	(0.001)	(0.408)	(0.012)		(0.032)
VOLPOST5	0.369	16.28	0.261	–0.315	0.06	0.8
	(0.499)	(0.075)	(0.361)	(0.338)		(0.527)
VOLPOST10	9.543	23.01	0.235	–0.093	0.07	1.0
	(0.484)	(0.010)	(0.411)	(0.843)		(0.437)

ABVOL = estimated abnormal volume around the time of the interim earnings announcement, measured as the sum of the prediction errors specified by the market model for volume;

$|UE|$ = information content of the announcement measured as the absolute difference of mean analysts' earnings forecast and reported earnings scaled by the number of outstanding shares;

$|CAR|$ = information content of the announcement measured as the absolute cumulative beta-adjusted return;

RANGE = absolute difference of maximum and minimum analysts' EPS forecasts scaled by absolute mean analysts' EPS forecast;

SIZE = natural log of the market value of the equity measured at the end of the pre-announcement year;

α and *b*s = OLS regression coefficients; and

e = error term.

The figures in parentheses refer to the *p*-values based on the t-statistic adjusted for an unknown type of heteroscedasticity using White (1980). The one-tailed significance levels are for the coefficients of |UE|, |CAR|, and RANGE, and the two-tailed significance levels are for the coefficients of SIZE.

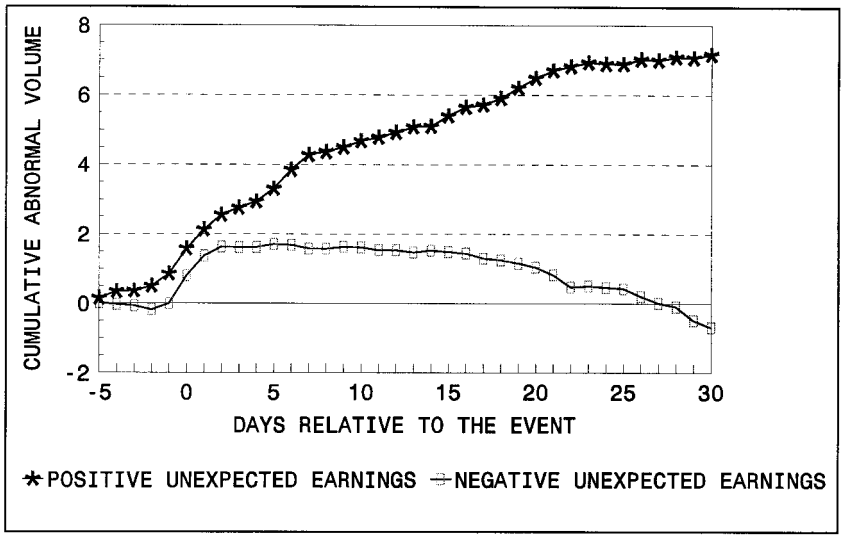

FIGURE 2. Cumulative abnormal volume behavior around interim earnings announcements for positive and negative news.

the F-values seems to be in the long post-announcement period (*VOLPOST10*).[16] In particular, the asymmetry in respect of unexpected earnings suggests that the induced trading is significant and higher for positive earnings news, whereas it is insignificant for negative earnings news, as illustrated in the cumulative abnormal volume graphs in Figure 2. The results for the sign dummy confirm the above[17]. The regression coefficient of the differential slope for negative news was negative and significant (p<0.05, one-tail test) only in the long post-announcement period.

Since the data consist of observations pooled across the sample firms and years, institutional changes might affect the results. The most significant institutional changes obviously include the lifting of foreign ownership restrictions at the beginning of 1993 and the right to short-sell (using stock-lending contracts) stocks at the beginning of May 1995. The abolition of restrictions on foreign ownership rapidly increased foreign investment in Finnish companies, integrating the Finnish markets more closely with the global capital markets. The stock-lending facility – among other things – benefits investors with negative earnings expectations. Since

16 The need for two separate models for positive and negative news was also tested by a Chow test. The computed *F*-value (2, 111) was 5.46, p<0.01 indicating that two regressions are required in the long post-announcement period. In the other periods the *F*-values were insignificant at the 5% level.

17 The employed sign dummy model took the following form:
$ABVOL = \alpha_1+\alpha_2 D+b_1|UE|+b_2 D|UE|+b_3|CAR|+b_4 RANGE+b_5 SIZE+e$, where D =1 if UE < 0, 0 otherwise.

this provided bearish investors with a new tool, it possibly increased the volume reaction, especially to negative unexpected news. However, even before May 1995, it was possible to take a bearish view using options and forwards. In addition, stock-lending volumes have been quite low, partly caused by its novelty and tax considerations[18].

Since institutional changes possibly cause cross-correlations affecting volume responses, dummy variables (denoting the announcement year) were included in the original model (8). This assumes that each announcement year's volume response is constant for each of the dependent variables but for different intercepts. However, the dummy variables were statistically insignificant for the conventional levels, indicating that the announcement year may not have a systematic impact on the abnormal volume. The introduction of stock-lending may have affected trading volumes if the borrower sold stocks and bought them back later on. However, if the borrower kept the borrowed stocks to maturity the trading volume in the stocks concerned would have been unaffected. Again, the dummy variable technique was employed to test the possibility that abolition of the short-selling restriction affected volume responses. A dummy variable (denoting the period with the short-selling facility) was added to the separate models on positive and negative news. The results (not given here) with a statistically insignificant (p>0.05) coefficient for the dummy variable indicate that the abolition of the short-selling restriction may not have affected the volume response to positive and negative news. The Chow test also rejected the hypothesis that a separate regression model is needed for each period for the conventional significance levels.

V CONCLUSIONS

This study contains empirical findings on the effect of interim earnings announcements on investors' trading behavior on the Helsinki Stock Exchange. The reason for using Finnish data is to establish whether findings from the US in respect of explaining volume inducement around an information event also hold in thin security markets. It was found that the trading volume reaction is positively associated with the information content of an announcement and also to some extent with the level of pre-disclosure information asymmetry. These results are in line with Kim and Verrecchia's (1991a) theoretical trading volume proposition and with empirical findings in the US markets. Thus, previous findings produced in more developed stock markets in respect of volume generation around earnings announcements also seem to be applicable to thin markets. However, the significance levels are lower and the association between posi-

18 In taxation, short-term stock-lending has been considered to represent a sale of the stock with the realization of possible capital gains and losses.

tive and negative news is somewhat asymmetric. The finding is puzzling but nonetheless consistent with findings of post-announcement drift in returns reported in Finland (e.g. Kallunki 1996). In fact, the finding of persistent abnormally high volumes for weeks after a positive news announcement is consistent with the sequential information arrival hypothesis proposed by Copeland (1976). This study can be extended in various directions. For example, the distribution of trade size around and on the announcement date might result in valuable insights into the trading strategies of large (informed) versus small (uninformed) investors. ■

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APPENDIX 1.

Interim earnings included in the sample.

	Number of interim earnings in the sample during 1992–1996					
Firm	**1992**	**1993**	**1994**	**1995**	**1996**	**Total**
Amer Group Ltd	1	.	2	2	2	7
Cultor Ltd (since 1989)	1	2	2	2	2	9
Enso-Gutzeit Corp.	1	2	2	2	.	7
Finnlines Ltd.	.	.	.	1	1	2
Huhtamäki Corp.	1	2	2	2	2	9
Instrumentarium Corp.	.	.	1	1	.	2
Kesko Corp.	1	1	2	2	2	8
Kone Corp.	1	2	2	2	1	8
Kymmene Corp.	1	2	2	2	.	7
Metra Corp.	.	.	2	2	2	6
Metsä-Serla Corp.	.	2	2	2	2	8
Nokia Corp.	1	1	1	1	3	7
Outokumpu Corp.	1	2	1	2	2	8
Partek Corp.	1	1	.	1	1	4
Pohjola Ins. Comp. Ltd	.	.	.	1	.	1
Repola Corp.	1	1	2	2	.	6
Rautaruukki Corp.	1	1	2	2	2	8
Sampo Ins. Comp. Ltd	.	.	.	1	.	1
Oy Stockmann Ab	.	1	1	1	1	4
Unitas (since 1991)	1	.	.	.	.	1
Valmet	1	.	1	1	2	5
Total	14	20	27	32	25	118