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FIRM-SPECIFIC BIASES IN THE CAPITAL MARKETS' RESPONSE: AN EMPIRICAL EVIDENCE FOR THE NYSE AND THE LSE

Summary: Firms announcing splits or acquiring other companies usually have some common characteristics that can be expressed by a market or book value or are explained by financial ratios. We conduct an event study over the trading period between 1985 and 2008 for the New York Stock Exchange and the London Stock Exchange. For randomly selected event dates, securities are randomly chosen from sub-samples of firms that have similar characteristics. Mean abnormal returns that are significantly different from zero are observed for some characteristic-based subsamples. As significant mean forecast biases exist, it is suggested that results of event studies for samples when firms share some common characteristics should be concluded very cautiously.

Key words: event study, capital market.

1. Introduction

A vast number of empirical studies try to examine the influence of an economic event on the value of a firm. Assuming the rationality of market participants, economists frequently use event-study methodology and observe asset prices over a relatively short period of time to answer that question [Campbell, MacKinlay 1997]. Aggregating results over many firms experiencing a similar event to evaluate the wealth effects of an event has been widely used in many research fields such as finance, law, macroeconomics or accounting. Although the discussion over measuring and analyzing abnormal returns and the application of event studies have quite a long history, it is still an open question when, which and how different procedures should be applied.

One of the most frequently cited papers by event-study practitioners are the studies by Brown and Warner [1980; 1985]. Brown and Warner [1985] conduct simulated event studies with randomly selected securities and event dates with equal probability on trading days from 1962 to 1979. Brown and Warner simulate 250 samples with 50 securities each by random selection from a subset of securities

from the files of the Center for Research in Security Prices at the University of Chicago (CRSP).

The results of Brown and Warner's study [1985] show that abnormal returns measured with simple estimation procedures such as market-adjusted and mean adjusted returns are well-specified. A comparison of market-adjusted and mean adjusted performance measures display no significant mean bias.

Ahern [2008; 2009] compares alternative prediction models (i.e. market model returns, market adjusted returns and mean adjusted returns) and applies alternative parametric and non-parametric tests in order to check the forecast error bias. He retrieves data from the CRSP Daily Stock dataset between January 1965 and December 2003.

Ahern reports that for randomly drawn securities and dates the models appear to show no mean bias. This finding is consistent with Brown and Warner's results [1985]. At the very beginning, the study suggests that what is true for random samples may not hold when samples are grouped by some characteristics. Then, for non-randomly selected securities, standard event study procedures may produce statistically significant biases as the prediction models can be statistically misspecified.

Ahern points out that there are research studies where event study samples may not be representative of the overall market. This can be true, for example, for mergers and acquisitions, splits or firms that initiate dividends. In such cases, companies are likely to have some common characteristics only because they are grouped respective to the fact that some kind of event was experienced. As a consequence, samples are supposed to be non-randomly chosen.

Ahern simulates event studies similar to those of Brown and Warner, but the samples are not random. The samples are grouped by common characteristics and are drawn from the lowest and highest deciles of market capitalization, prior returns, book-to-market ratio and earnings-to-price ratio. The break-even points for deciles in the four groups mentioned above are computed for all firms as in Fama and French [1992] and on Kenneth French's website. Ahern reports that some prediction models generate abnormal returns with significant differences from zero as a consequence of non-randomly selected samples.

This article also seeks to examine the problem of the forecast error bias in non-randomly selected samples. The evidence comes from the USA (New York Stock Exchange) and UK (London Stock Exchange) and covers the period of 1985-2008.

The paper develops some of the ideas produced by previous event studies. First, we update the random sample from Ahern's paper up to the end of 2008 for the New York Stock Exchange. We also apply an additional company characteristic to check whether standard event study methods produce statistical biases in the grouped samples. We apply the event study approach to two datasets – one is comprised of NYSE-listed securities, and the other refers to LSE-quoted firms. This is because it is supposed to check for false abnormal returns also for another exchange.

The rest of this paper consists of four sections. Section 2 describes a dataset for samples from subsets of securities listed on the New York Stock Exchange and the London Stock Exchange. Section 3 focuses on alternative abnormal performance measures applied in the present study. In Section 4.1 we present a sample description for the NYSE and the LSE. Section 4.2 presents and discusses our empirical results. Section 5 concludes with a summary of the major results.

2. The dataset and experimental design

We analyze a sample of companies listed on the New York Stock Exchange (NYSE) and the London Stock Exchange (LSE) during the period 1985-2008 to check if there are biases in non-randomly selected firms in an event study procedure. The Thomson One Banker database is used as a data source in the present study. It is used to extract daily index values, daily market security prices, and market equity values for companies. Financial statement information on the NYSE and LSE firms was collected on a yearly basis. The sample consists of firms that were active at the beginning of 2009. We exclude firms with missing market and financial data.

Event dates are chosen on a random basis from among all trading days covering the period 1985-2008. For a randomly selected event date a security is chosen from a sample or a subsample.

To be included in a general sample, a security must have no missing returns during the event and estimation period. Once the event date is chosen, a company is randomly selected from a sample of all NYSE firms (and LSE firms, respectively). As a result, a date-company combination appears to be applied in event-study methodology for the random sample (R).

To be included in a subsample, a security must additionally have accounting and market data that are essential to put it into the right decile. Subsamples are formed using the characteristics of: (1) market value of equity that is calculated as the mean market capitalization for the last 200 trading days before the randomly selected event date (ME); (2) prior returns that are defined as the arithmetic mean of prior returns for 200 trading days before the randomly selected event date (PR); (3) book-to-market ratio, which is measured as the ratio of book equity value at the end of the calendar year preceding the year of the event date to the mean market capitalization for the last 200 trading days before the randomly selected event date (BM); (4) earnings-to--price ratio, which is the ratio of net income at the end of the calendar year preceding the year of the event date to the mean market price for the last 200 trading days before the randomly selected event date (EP); (5) value of assets, which is expressed as the book value of assets at the end of the calendar year preceding the year of the event date (A). Depending on the ME, PR, BM, EP and A results for each company in relation to the general NYSE (LSE, respectively) sample, each security is then classified into the proper decile. This means that each security is assigned to a decile for each of the five characteristics mentioned above. If the financial statement or

market data does not allow one or more of the characteristics to be computed and assigned to the proper NYSE (LSE, respectively) decile, the security is still eligible for inclusion in a subsample grouped by other assignments.

We then define the groups of securities classified to the lowest (L) and the highest (H) decile for a particular characteristic. Once the random event date is chosen, a company is then randomly selected from among companies that meet the decile requirement for a particular characteristic. As a result, a date-company combination appears to be applied in event-study methodology for ten subsamples (so we define subsamples as ME-L, ME-H, PR-L, PR-H, BM-L, BM-H, EP-L, EP-H, A-L, A-H).

The research procedure simulates 100 groups of 12,500 events (with *event* defined as a combination of a random event date and a random security selected from among all the firms in a sample or subsample) for the random sample and for each of the ten security-characteristic based subsamples. In consequence, the forecast error biases are examined in eleven samples, each consisting of 1,250,000 events.

3. Performance measures

The prediction models tested in the present study for random and non-random samples include three models to detect abnormal performance. In the first research step, for each security-event date combination, the daily returns are calculated over a period of 201 days, so for an event day (day *t*0) and for 200 days of the preceding period that is designated to be the estimation period. We use 200 daily return observations in the estimation window, starting on day *t*-200 and ending on day *t*-1, relative to the event day *t*0. The daily return for security *i* on day *t* is defined as:

$$R_{i,t} = \frac{P_{i,t}}{P_{i,t\text{-}1}} - 1,$$

where $P_{i,t}$ is the price of stock *i* for day *t*, i$\in$ [1 ... N^S], where N^S is the number of companies in the sample or subsample.

The market portfolio returns were calculated with the use of the NYSE Composite Index (for the New York Stock Exchange) and the FTSE All Share Index (for the London Stock Exchange). The benchmark portfolio returns for event *i* were calculated in a similar way to the daily return for security *i* on day *t* (so we get here $R^m_{i,t}$).

The abnormal returns for security *i* for day *t* are obtained by subtracting benchmark return ($R^B_{i,t}$) from stock return for company *i*, which is described as:

$$AR_{i,t} = R_{i,t} - R^B_{i,t}.$$

Three prediction models are employed to calculate the benchmark return ($R^B_{i,t}$): the market model (denoted here as MM), the mean adjusted return (MAR) and the index adjusted return (IAR).

The market model is the most commonly used prediction procedure. It relates the return of a security to the return of the market portfolio, so that abnormal return is measured as:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R^m_{i,t}),$$

where $R^m_{i,t}$ is the return on the market portfolio (which is here represented by a relevant index). The parameters of the market model (α_i, β_i) are calculated using the ordinary least squares (OLS) procedure.

In the second estimation procedure, mean adjusted abnormal returns are defined as:

$$AR_{i,t} = R_{i,t} - \overline{R}_i,$$

where the mean return for company *i* for the estimation period is expressed as:

$$\overline{R}_i = \frac{1}{200}\sum_{t-1}^{t-200} R_{i,t}.$$

We also use the third method to estimate abnormal returns, and the index-adjusted daily abnormal return will be given by:

$$AR_{i,t} = R_{i,t} - R^m_{i,t},$$

where $R^m_{i,t}$ is the daily market return (which is also represented here by the NYSE Composite Index for the New York Stock Exchange and the FTSE All Share Index for the London Stock Exchange) for the event date selected for security *i*.

Given the results of the three models to estimate daily excess returns for firm *i*, the mean abnormal performance for *t*0 is measured as follows:

$$\overline{\overline{AR_{t0}}} = \frac{1}{N^S_t}\sum_{i=1}^{N^S_t} AR_{i,t0},$$

where N^S_t is the number of events (so the number of combinations date-company) for day *t* in each of the samples (R, ME-L, ME-H, PR-L, PR-H, BM-L, BM-H, EP-L, EP-H, A-L, A-H) for the NYSE or the LSE. The mean abnormal return for *t*0 is calculated in two steps. It is based on 100 values of sample mean abnormal returns, where each is a mean adjusted return for 12,500 events.

Next, the statistical significance of event day abnormal returns is assessed for each of the eleven samples. The null hypothesis to be tested in the study is that the mean abnormal return for day *t*0 is equal to zero, with the alternative hypothesis that the mean abnormal return for day *t*0 differs from zero. The test statistic is defined as the ratio of the day *t*0 mean excess return to its estimated standard deviation, so it equals:

$$t-statistic=\frac{\overline{AR_0}}{\hat{S}(\overline{AR_t})},$$

where:

$$\hat{S}(AR_t)=\sqrt{\frac{1}{199}\sum_{t-1}^{t-200}\left(AR_t-\overline{\overline{AR}}\right)^2},\ \text{and}$$

$$\overline{\overline{AR}}=\frac{1}{200}\sum_{t-1}^{t-200}\overline{AR_t}.$$

The test statistic is assumed to be Student-t distributed.

4. Empirical results

4.1. Sample description

The following are some descriptive statistics of the dataset. The general samples for the research consist of companies listed on the New York Stock Exchange (NYSE) and the London Stock Exchange (LSE) during the period 1985-2008.

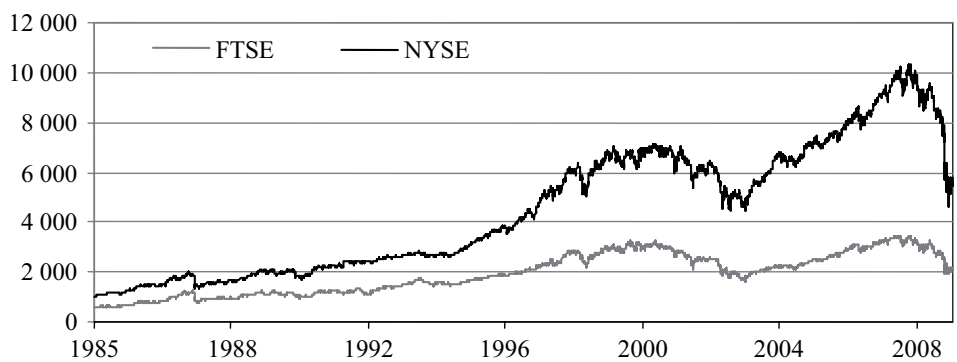

Fig. 1. Daily values of the NYSE Composite Index and FTSE All Share Index during the period 1985-2008

Source: own work.

Figure 1 presents the changes of the indexes we use in the event study (the NYSE Composite Index and the FTSE All Share Index) during the period of 1985-2008.

Table 1. Return properties on the New York Stock Exchange

	1985-1990	1991-1996	1997-2002	2003-2008	1985-2008			
	Mean	Mean	Mean	Mean	Mean	Median	Kurtosis	Skewness
ME-L	0.06%	0.11%	0.27%	0.12%	0.14%	0.13%	4.91	1.41
ME-H	0.04%	0.04%	0.06%	0.06%	0.05%	0.05%	2.03	–0.88
PR-L	–0.20%	–0.25%	–0.13%	–0.17%	–0.19%	–0.15%	6.14	–1.88
PR-H	0.33%	0.42%	0.49%	0.35%	0.40%	0.38%	4.44	1.64
BM-L	0.08%	0.11%	0.12%	0.10%	0.10%	0.11%	3.40	–1.16
BM-H	0.00%	0.03%	0.09%	0.02%	0.04%	0.05%	1.44	–0.65
EP-L	0.04%	0.09%	0.10%	0.05%	0.07%	0.08%	2.71	–0.67
EP-H	0.02%	0.04%	0.08%	0.03%	0.04%	0.05%	2.09	–0.87
TA-L	0.08%	0.13%	0.14%	0.09%	0.11%	0.12%	2.26	–1.02
TA-H	0.02%	0.03%	0.06%	0.05%	0.04%	0.05%	2.22	–1.09
Random	0.04%	0.05%	0.09%	0.06%	0.06%	0.08%	3.24	–1.19

Source: own work.

Table 2. Return properties on the London Stock Exchange

	1985-1990	1991-1996	1997-2002	2003-2008	1985-2008			
	Mean	Mean	Mean	Mean	Mean	Median	Kurtosis	Skewness
ME-L	0.00%	–0.02%	0.04%	0.06%	0.02%	0.01%	0.09	0.40
ME-H	0.04%	0.03%	0.05%	0.06%	0.05%	0.06%	1.11	–0.86
PR-L	–0.38%	–0.42%	–0.25%	–0.22%	–0.31%	–0.30%	0.76	–0.74
PR-H	0.44%	0.45%	0.37%	0.31%	0.39%	0.36%	3.70	1.65
BM-L	0.04%	0.08%	0.11%	0.04%	0.07%	0.05%	2.26	1.16
BM-H	–0.02%	–0.03%	0.02%	0.03%	0.00%	0.01%	0.90	–0.41
EP-L	–0.05%	–0.05%	0.05%	0.03%	–0.01%	–0.02%	–0.12	0.24
EP-H	0.01%	–0.01%	0.01%	0.04%	0.01%	0.02%	1.38	–0.58
TA-L	0.03%	0.03%	0.06%	0.05%	0.04%	0.02%	1.49	0.98
TA-H	0.03%	0.02%	0.05%	0.05%	0.04%	0.05%	1.68	–0.90
Random	0.02%	0.01%	0.05%	0.05%	0.03%	0.04%	0.29	–0.17

Source: own work.

Table 1 records the major features of the NYSE sample (Table 2 presents information for the LSE). We show the properties of returns for listed firms during the period 1985-2008 and in four periods of six years each. The distribution and

characteristics of returns for securities are illustrated for all firms that can potentially be randomly selected into the proper decile. We show the results of mean returns for securities both for the random sample and for subsamples. The data are created on a monthly basis. The subsamples were created taking into account the values for the lowest (L) and the highest (H) deciles in groups for equity market value (ME), prior returns (PR), book-to-market ratio (BM), earnings-to-price ratio (EP) and assets (A).

Tables 1 and 2 show the differences in sample return properties between securities meeting the decile requirements. The panels report results of mean return, median, kurtosis and skewness for securities listed on the New York Stock Exchange and the London Stock Exchange.

4.2. Results for mean excess returns

The aim of the study is to investigate the forecast error bias in non-randomly selected samples. The evidence, taken from the New York Stock Exchange and the London Stock Exchange, covers the period of 1985-2008. We conduct an event study for randomly selected event dates and for securities selected from the groups of firms meeting the relevant decile requirements. The random sample (R) is compared to the subsamples that are formed from securities in the lowest (L) and the highest (H) decile, according to the market value (ME), prior returns (PR), book-to-market ratio (BM), earnings-to-price ratio (EP) and assets (A). Then, date-company combinations are applied in the event-study procedure. We investigate mean abnormal returns for event day $t0$ for three alternative prediction procedures: market model (MM), mean adjusted returns (MAR) and index adjusted returns (IAR). We apply the same experimental design for two datasets: securities listed on the NYSE and the LSE. The research procedure simulates 100 groups of 12,500 events in each sample so each of the reported mean abnormal returns in the next two tables is calculated in two steps, as it is based on 100 values of sample mean abnormal returns, where each is a mean adjusted return for 12,500 events.

Table 3 shows the results of average abnormal returns on day 0 for eleven samples drawn from NYSE-listed companies and Table 4 from LSE-quoted firms.

As it is seen from Table 3 and Table 4, the models correctly predict almost zero excess returns for a random sample. This confirms the results of Brown and Warner's research that for randomly drawn samples the prediction models produce no forecast bias.

There appears to be no major difference between the results of an event-study for abnormal returns calculated with the market model and mean adjusted returns. The index adjusted returns seem to be quite different both in terms of mean values and in terms of statistical significance. For the NYSE dataset, the index model produces statistical forecast biases in nine of ten cases. Although the index model produces excess returns that are significantly different form zero in almost all subsamples, the average index adjusted returns are in many cases of minor economic importance.

Table 3. Performance measures on day *t*0 for the New York Stock Exchange

Model	MM		MAR		IAR	
Equity market value (ME)						
ME-L	0.0145%		0.0069%		0.1236%	***
ME-H	–0.0089%		–0.0215%	*	0.0085%	
Prior market returns (PR)						
PR-L	0.3117%	***	0.3056%	***	0.0984%	***
PR-H	–0.2966%	***	–0.3118%	***	0.0639%	***
Book-to-market (BM)						
BM-L	–0.0335%	*	–0.0447%	*	0.0382%	**
BM-H	0.0543%	*	0.0434%		0.0595%	*
Earnings-to-price (EP)						
EP-L	0.0223%		0.0097%		0.0608%	***
EP-H	0.0372%	***	0.0273%	**	0.0486%	***
Assets						
A-L	0.0016%		–0.0074%		0.0812%	***
A-H	0.0032%		–0.0084%		0.0112%	***
Random Sample (R)	0.0011%		–0.0098%		0.0325%	***

Statistical significance at the 1% (***), 5% (**), and 10% (*) level.

Source: own work.

Table 4. Performance measures on day *t*0 for the London Stock Exchange

Model	MM		MAR		IAR	
Equity market value (ME)						
ME-L	0.0620%		0.0624%		0.0579%	
ME-H	–0.0181%	**	–0.0212%		0.0030%	
Prior market returns (PR)						
PR-L	0.3362%	***	0.3388%	***	–0.0222%	
PR-H	–0.3447%	***	–0.3480%	***	0.0636%	***
Book-to-market (BM)						
BM-L	–0.0480%	**	–0.0488%	*	0.0145%	
BM-H	0.0551%		0.0548%	*	0.0334%	
Earnings-to-price (EP)						
EP-L	0.0579%		0.0576%		0.0297%	
EP-H	0.0256%	*	0.0260%	*	0.0210%	
Assets						
A-L	–0.0040%		–0.0035%		0.0264%	**
A-H	–0.0083%	**	–0.0119%		0.0082%	**
Random Sample (R)	–0.0099%	**	–0.0104%	*	0.0015%	

Statistical significance at the 1% (***), 5% (**), and 10% (*) level.

Source: own work.

The most significant errors in three alternative models are false positive abnormal returns in samples characterized by securities with low prior returns. We also find false negative mean excess returns for NYSE and LSE subsamples of firms with high prior returns.

Additionally, Table 3 and Table 4 reveal that also in other non-random samples abnormal returns are biased, which can be observed, for example, in the case of firms with high earnings-to-price (NYSE) or a high book-to-market ratio (NYSE) or low market capitalization (LSE).

Summing up, the results clearly show that the prediction models are in some cases statistically misspecified for non-random samples grouped by firm characteristics.

5. Conclusion

This study examines the problem of the forecast error bias in non-randomly selected samples, for a sample of securities listed on the New York Stock Exchange and the London Stock Exchange.

The random sample is compared to the subsamples that are formed from securities in the lowest and the highest decile, according to the value of market value, prior returns, book-to-market ratio, earnings-to-price ratio and assets. The dates are randomly selected from the period 1985-2008. The results are for market model, mean adjusted returns and index adjusted returns. We can observe mean abnormal returns for the random sample and for the subsamples.

Contrary to the findings of Brown and Warner's research for a random sample, we confirm Ahern's results that abnormal returns measured with simple estimation procedures are not always well-specified for non-random sample groupings. In such cases, the prediction procedure may produce significant forecast biases as the hypothesis zero is rejected. The most significant errors are observed for samples characterized by securities with low and high prior returns.

Here, we observe mean bias and over-rejection errors for some extreme deciles. But in actual event samples firms often share some common characteristics. This usually happens in event studies of firms announcing new exchange listings, and firms making equity offerings, small or large acquirers or distressed firms. Non-random sample groupings may produce forecast error bias, as proven in the present research. The research results should encourage event study practitioners to be especially cautious in drawing conclusions about event-induced wealth changes in cases where firms share some common characteristics.

Literature

Ahern K.R., *Sample selection and event study estimation*, 22 February 2008, http://ahern.bol.ucla.edu/, pp. 1-41.

Ahern K.R., *Sample selection and event study estimation,* "Journal of Empirical Finance" 2009, vol. 16, p. 466-482.

Brown S.J., Warner J.B., *Measuring security price performance*, "Journal of Financial Economics" 1980, vol. 8, p. 205-258.

Brown S.J., Warner J.B., *Using daily stock returns – the case of event studies*, "Journal of Financial Economics" 1985, vol. 14, p. 3-31.

Campbell J.Y., Lo A.W., MacKinlay A.C., *The Econometrics of Financial Markets*, Princeton University Press, Princeton, New Jersey 1997.

Fama E.F., French K.R., *The cross-section of expected stock returns*, "Journal of Finance" 1992, vol. 47, p. 427-465.

ZNIEKSZTAŁCENIA POMIARU REAKCJI RYNKU KAPITAŁOWEGO – STUDIUM EMPIRYCZNE DLA NOWOJORSKIEJ I LONDYŃSKIEJ GIEŁDY PAPIERÓW WARTOŚCIOWYCH

Streszczenie: Spółki dokonujące splitów czy nabywające inne przedsiębiorstwa posiadają zazwyczaj pewne cechy wspólne, które mogą być widoczne w wartości rynkowej lub księgowej albo są wyjaśniane przez wskaźniki finansowe. W artykule dokonujemy analizy zdarzeń dla okresu 1985-2008 dla giełdy nowojorskiej NYSE oraz londyńskiej LSE. Dla losowo wybranych dat, również losowo dobraliśmy spółki spośród podgrup posiadających podobne charakterystyki (wartość rynkowa, wartość aktywów, historyczne stopy zwrotu, wskaźnik B/M, E/P). W rezultacie zaobserwowaliśmy średnie ponadnormalne stopy zwrotu istotnie różne od zera. Odnotowane zakłócenia w pomiarze oczekiwanych stóp zwrotu skłaniają do tego, aby – szczególnie w badaniach z wykorzystaniem analizy zdarzeń dla grup przedsiębiorstw posiadających określone cechy wspólne − formułować wnioski z ogromną ostrożnością.