EVENT STUDY IN THE EVALUATION OF EFFECTS OF MERGERS AND ACQUISITIONS

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Abstract

The paper presents the essence of the methodology of event study used in developed markets to evaluate post-acquisition performance based on the market data. In particular, the paper discusses the issues of abnormal returns and expected return models, presenting also selected examples of post-acquisition performance in developed markets. At the end, the author has addressed the issue of contemporary tendencies in the event study methodology.

Keywords: event study, abnormal returns, mergers and acquisitions.

JEL classification: G14, G34.

Introduction

One of the popular methods employed in the methodology of financial effects of mergers and acquisitions based on the market data is **event study**¹, developed and used for the first time in 1969 by Fama². The methodology is frequently defined as the abnormal returns methodology and is used to measure the change of stock prices of listed companies related to certain events or event announcements. Basing on the market information, it can be shown that shareholders of merging companies benefit from the transaction as the value of their shares increases and the return rises, both of them in relation to the rise in the market price of those shares.

The aim of the event study is to define shareholders' additional profits or losses related to the event in which they are participating. The abnormal return is a direct measure of growth in post-acquisition shareholder value. The main aim of the paper is to present the nature and assumptions of the methodology used in developed markets to evaluate mergers and acquisitions using market data. Another objective is to overview the research into abnormal returns achieved by shareholders in relation to a bid announcement.

1. Observation period and reference day in the event study

Event analysis is carried out in certain time spans in relation to a reference day. To measure abnormal returns it is essential to define the day of the event as a reference for the evaluation of value growth. The reference day is defined as the date when public bid announcement is made or the bid is accepted.

The reference day is then used to define the observation period – the time span in days or months, defined in the literature as the event period or “event window”. Depending on how long the observation period is, we can distinguish between the analyses of short- and long-term abnormal returns. In the first approach, the analysis encompasses less than 100 days prior to and following the bid announcement; the most popular time span is not more than 60 days before and after bid announcement (-60, 60). The long-term approach refers to a much longer period of analysis of abnormal returns, even up to 2, 3 or 5 years after bid announcement or its execution.

2. Abnormal returns

Profits or losses are measured with abnormal returns. The essence of this measure is to relate the wealth of investors holding shares in the acquiring or target company over the observation window to the normal returns in an “ordinary” period when no effects related to the event were reported. As far as estimation is concerned, abnormal return for company i is actual less expected return on the share of company i over period t , as in the following formula³:

$$AR_{it} = R_{it} - E(R_{it}),$$

where:

AR_{it} – abnormal return for company i over period t ;

R_{it} – return for company i over period t ;

$E(R_{it})$ – expected normal return for company i over period t ;

t – day or month, depending on the data accepted for calculations and unit of the event window.

If abnormal return for stock i in the event window t is greater than zero, the acquisition generates wealth for investors holding shares in company i . If abnormal return equals to zero, the effect of acquisition is neutral in terms of shareholder wealth. Negative abnormal returns less than zero imply losses for shareholders. In the literature of the subject, two measures of abnormal returns are used⁴:

1. cumulative abnormal returns (CAR);
2. buy-and-hold-abnormal returns ($BHAR$).

Cumulative Abnormal Return (CAR) is calculated as a sum of daily or monthly returns over the analysed period. Cumulative abnormal returns for company i over time period T are calculated as shown in the following formula⁵:

$$CAR_{iT} = \sum_{t=1}^T AR_{it};$$

where:

CAR_{iT} – cumulative abnormal return for company i over time period T ;

T – observation period, time period measured in days or months;

AR_{it} – as above.

In the literature on the subject, two methods of estimating cumulative abnormal return for a population are used, the difference between them being the order of mathematical operations⁶. In the first approach, first the sum of cumulative abnormal returns (CAR_{iT}) is calculated for shares of all companies i which participated in the transaction over the period T . The sum is then averaged, according to the formula⁷:

$$ACAR = \frac{1}{N} \sum_{i=1}^N CAR_{iT} ;$$

where:

$ACAR$ – average cumulated abnormal returns;

N – number of companies;

CAR_{iT} – as above.

In the second approach, first the average abnormal return for all the analysed shares i in period t is calculated as in the following formula⁸:

$$AAR_t = \frac{1}{N_t} \sum_{i=1}^{N_t} AR_{it} ;$$

where:

AAR_t – average abnormal returns for all the analysed shares in period t ;

N_t – number of shares in period t ;

AR_{it} – as above.

Next, the averages are summed up for a given observation window (t_1, t_2) , as in the equation⁹:

$$CAAR_{t_1}^{t_2} = \sum_{t=t_1}^{t_2} AAR_t ;$$

where:

$CAAR_{t_1}^{t_2}$ – cumulative average abnormal returns;

t_1 – starting day of observation window;

t_2 – ending day of the window;

AAR_t – as above.

Buy-and-Hold-Abnormal Return ($BHAR$) is calculated as the return on a buy-and-hold investment in company i , i.e. from the starting day of the window (the moment of purchase)

till the ending day of the window less the expected return on a buy-and-hold investment in a reference portfolio or control firm as in the equation below ¹⁰:

$$BHAR_{iT} = \prod_{t=1}^T (1 + R_{it}) - \prod_{t=1}^T [1 + E(R_{it})];$$

where:

$BHAR_{iT}$ – Buy-and-Hold Abnormal Returns for shares i over time T ;

R_{it} , $E(R_{it})$, t , T – as above.

Like in the case of the CAR measure, general evaluation of the merger or acquisition is not based on individual results, i.e. for individual company i , but on the cumulative results for the entire population. To achieve this, average buy-and-hold abnormal return is calculated with the following formula¹¹:

$$ABHAR_T = \frac{1}{N} \sum_{i=1}^N BHAR_{iT} ;$$

where:

$ABHAR_T$ – average buy-and-hold abnormal return on shares i over observation period T ;

N – number of companies;

$BHAR_{iT}$, T – as above.

In the literature of the subject, there are many controversies over the above-mentioned measures of abnormal returns. Most of them concern the application of both measures in long-term analyses. Barber and Lyon¹² argue that $BHAR$ is a better measure than CAR for long-term investments. Fama¹³, on the other hand, considers CAR to be the best measure, since only in this case the test of abnormal return is statistically consistent with the expected return models. Kothari and Warner¹⁴, as a result of their simulations, have observed that both measures, CAR and $BHAR$, are a source of errors in statistical tests but calculating abnormal return based on $BHAR$ is more error-prone than CAR .

The most recent publications presenting results of mergers and acquisitions based on the market data reveal the following regularity: short-term analysis of abnormal returns is based usually on daily returns and the CAR measure. Long-term analysis, on the other hand, is based mainly on monthly returns and the CAR or $BHAR$ measures.

3. Expected return models in event study

With regards to the essence of abnormal return, in order to measure its value, first the actual return should be calculated, and next – the expected return. And while the preceding is relatively easy to estimate, the latter can present more problems.

Estimation of expected return means arriving at a return for shareholders over an ordinary period. In other words, the return estimated at this stage is the “simple” return provided that the event did not occur. At this stage, several solutions can be applied. Sudarsanam has identified seven models¹⁵ where expected returns are calculated. The first two models are simple, the so-called single-index or constant-average return models¹⁶. The next three are market models and the last two – portfolio models.

Mean-adjusted model

The expected return is an ex ante return on shares i in period t . It is usually calculated as an average daily or monthly return over an independent period, as in the equation below¹⁷:

$$E(R_{it}) = K_i,$$

where:

K_i – daily return on shares i over an independent period;

$E(R_{it})$ – expected return on shares i over period t .

An independent period is understood as a time period when no bid announcements involving the analysed companies were made. It does not overlap the event period. It is a pre-announcement period.

Market-adjusted model

Expected return on shares of company i in time t equals to the return on the market index in the event window¹⁸:

$$E(R_{it}) = R_{Mt},$$

where:

R_{Mt} – return on the market index over period t .

The model allows avoiding the estimation of α and β market parameters, including at the same time returns on the market indices R_{Mt} as normal returns. It is consistent with the CAPM model provided that the coefficient β equals to 1 for all the shares.

Market model

Expected return on the shares of company i over period t based on the market model is estimated with the following equation¹⁹:

$$E(R_{it}) = \alpha_i + \beta_i R_{Mt}.$$

where:

α_i – intersection coefficient for the market model;

β_i – risk coefficient for share i ;

R_{Mt} – as above.

Market model is the Sharpe's single-index model where returns are assumed to be related to the stock index. It is assumed that expected value of the long-run random factor equals to zero. The model breaks down the return on company i into the system component, related to the market index, and a non-system component (statistical error), which is independent of the market behaviour. Post-acquisition effects for company i are depicted by the random factor of the equation, ε_{it} . In other words, statistical error in the market model is the abnormal return for company i in period t .

Capital Asset Pricing Model

Expected return on shares of company i in over the period t , is calculated in the CAPM model as follows²⁰:

$$E(R_{it}) - R_{Ft} = \beta_i (R_{Mt} - R_{Ft}),$$

where:

$E(R_{it})$, R_{it} , R_{Mt} , β_i – as above;

R_{Ft} – risk-free return over period t .

The assumptions of the CAPM model are similar to those in the Sharpe market model, except for the fact that it accounts for the market risk of a given share only. The risk-free return used in this model is usually substituted for by the return on treasury bills.

Fama and French Three Factor Model

Expected return on the shares of company i over period t according to the Fama and French Three Factor Model is calculated with the following equation²¹:

$$E(R_{it}) = R_{Ft} + \beta_{1i}(R_{Mt} - R_{Ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t.$$

where:

β_{1i} – coefficient of sensitivity to market changes;

β_{2i} – coefficient of sensitivity to company size (capitalisation);

β_{3i} – coefficient of sensitivity to BTMV ratio;

SMB_t – return on a portfolio comprising small companies less return on a portfolio comprising big companies over period t ;

HML_t – return on a portfolio comprising companies of high BTMVs less return on a portfolio comprising companies of low BTMVs over period t ;

$E(R_{it}), R_{it}, R_{Mt}, R_{Ft}$ – as above.

Since 1997, the Fama and French model has become more popular to evaluate post-acquisition performances based on the market data. The advantage of the model is the fact that it includes the factors which determine financial performance, such as company size or BTMV. If a company lacks this information, it is not eliminated from the sample as the SMB and HML factors are results for portfolios of listed companies and not just participants of the event. The Fama and French model seems to refer to the portfolio analysis, except that the model parameters are constant over the whole period of estimation, whereas in portfolio analysis in relation to company size and BTMV ratio the parameters can change annually along with the changes in the portfolio²².

In the three above-presented models of capital market, the α and β parameters are estimated on the basis of the regression function for data in subsequent periods, usually using the least squares method. The reference period is an interval in days or months preceding the event, usually ranging from 120 to 210 before the bid announcement²³. It is not a rule, however, as in some empirical cases, the estimation period overlaps the observation window.

Reference portfolio model

The reference portfolio model involves comparative analysis based on a group. In this approach, the companies are organised into portfolios according to their characteristics, e.g. size, BTMV ratio, profile of activity. Next, the expected return for company i over period t is estimated as the return over period t for a group of similar companies, to which given company has been assigned²⁴. The mathematical depiction of this approach is similar to that of the market-adjusted model where return on the market index is substituted for by the return on portfolio²⁵:

$$AR_{it} = R_{it} - R_{st} ;$$

where:

R_{st} – return on portfolio of similar capitalisation over period t .

The advantage of the reference portfolio model estimating the expected return is its simplicity, yet the model is not flawless. One of its weaknesses is that since the portfolio is balanced at the beginning of each observation year, the sample size can decrease. Regular balancing of the portfolio is not a rule in portfolio analysis, which can be carried out without following this procedure.

Control firm model

Control firm model, on the other hand, is similar to portfolio analysis, except for the fact that it refers not to a portfolio but to one of the companies. This approach involves assigning each company its peer which is not involved in a takeover. The control firm is a model selected according to one or more features that both companies have in common, e.g. size, BTMV ratio, profile of activity, etc. The expected return on share of company i over period t is estimated as the return on the control firm over the same period.

While compared and contrasted to portfolio analysis, the control firm model has its strengths. In contrast to portfolio analysis, it eliminates the shares which have only recently entered the stock market, as only the returns on the analysed and control firms are considered in the event period. It is also related to the fact that no annual balancing is required here. Moreover, the companies which are compared are usually of similar sizes, which also implies that their returns are similar, and that eliminates any errors in the distribution of returns²⁶.

4. Application of event analysis in the evaluation of post-acquisition performance

The rich evidence in the literature indicates that abnormal return as a direct measure of higher shareholder wealth is the most popular tool to evaluate the post-acquisition performance. The most developed M&A markets are the USA and the UK, and for that reason, most of the cases of post-acquisition financial performance investigated in the literature refer to those markets. Much less empirical studies describe the cases in the Continental Europe. Several attempts to evaluate post-acquisition performance based on the market data have been made also in Poland.

Depending on the accepted observation period (the so-called event window), the research carried out in the USA and the UK was of either short- or long-term character. In the case of the Continental Europe and Poland, due to various limitations, mainly short-term approach was adopted in the research. The development of capital market affected also the methodology of the research, and in particular – the selection of expected return models and measures of abnormal return. While analysing individual cases of measuring post-acquisition profits and losses achieved by shareholders, the following rule can be observed for expected return models in the event study – the more mature market, the more they are sophisticated (e.g. the Fama-French market model). In the developing markets, on the other hand, the models are much simpler, e.g. mean-adjusted model, market-adjusted model, or the Sharpe market model. With regard to the calculation of abnormal return, in the developed markets a new measure, BHAR, has been developed. It has not been transferred to the developing markets yet, which is also related directly to the observation period.

Furthermore, while analysing the results of estimating abnormal returns in the research projects presented below, it can be noted that shareholders react to a bid announcement in a similar way in all the capital markets. Shareholders of the target companies benefit more, whereas the shareholders of acquirers insignificantly lose. The reasons for inconsistency among the results presented below should be traced back to the methodological aspects, mainly the market size and number of analysed M&A events.

Table 1. Examples of measuring post-acquisition abnormal returns in UK and USA in the 1990s

Authors, Year, Country, Time span	Sample size (Type of take-over)	Event window	Measure Model employed	Results	Explanation of results
Sudarsanam, Holl and Salami (1996, UK) 1980-90	429 (mergers and acquisition bids)	(-20, +40)	Market model, Market-adjusted model (CAR)	29.18% -4.04%	targets bidders

Gregory (1997, UK) 1984-92	403 (mergers and acquisitions)	1 month	Six models (CAR)	from -0.71% to -0.3%	bidders
Rau and Vermaelen (1998, USA) 1980-91	3.169 (mergers) 348 (acquisition bids)	(+1, +36)	Size- and BTMV-adjusted model (CAR)	-4.04% +8.85%	bidders in mergers bidders in acquisitions
Mitchell and Stafford (1998, USA) 1961-93	2.767 (mergers and acquisition bids)	3 years	Size- and BTMV-adjusted (BHAR) Fama and French model (CAR)	from -7.9% to -0.08%	bidders
Higson i Elliot (1998, UK) 1975-90	830 (mergers and acquisition bids)	3 years	Value-adjusted model (CAR)	1%	bidders
Baker and Limmack (2002, UK) 1977-90	595 (mergers and acquisition bids)	(0, +60)	Eight models: Market model, two-factor model, Fama and French model, size-, industry- and BTMV-adjusted models (CAR)	-26.15%	bidders
Goergen and Renneboog (2003, UK) 1993-2000	70 (target companies) 66 (bidders)	(-60, +60)	CAPM model (CAR)	29.32% -1.65%	targets bidders
Sudarsanam and Mahate (2003, UK) 1983-95	519 (acquisition bids)	(+41, +750) i.e. approx. 3 years	Four models: mean-, market-, size- and MTBV-adjusted models (BHAR measure)	from -21.89% to -8.74%	bidders
Moeller, Schlingemann and Stulz (2003, USA) 1980-2001	12.023 (acquisition bids)	36 months	Calendar-oriented approach (CAR) Event-oriented approach (BHAR)	-0.41% -16.02%	bidders in the two approaches, respectively

Source: own study based on literature study.

Table 2. Examples of measuring post-acquisition abnormal returns in other European Countries in the 1990s

Authors, Year, Country, Time span	Sample size (Type of take-over)	Event window	Measure Model employed	Results	Explanation of results
Bergstrom, Hogfeldt and Hogholm (1993, Sweden) 1980-92	94 targets, 149 bidders (acquisition bids)	11 days	Market model (CAR)	17% 0%	targets bidders
Doukas and Holmen (2000, Sweden) 1980-95	93 (acquisition bids)	11 days	Market model (CAR)	1%	bidders
Goergen and Renneboog (2003, several European countries) 1993-2000	66 target companies 75 bidders	-60 up to +60 days	CAPM market model (CAR)	15% 1%	targets bidders
M. Lewandowski (2001, Poland) 1998 – 1 st half year 2000	63 open market share repurchases	(-30, +30)	Sharpe's market model (CAR)	+2.62%	Targets
A. Szyszka (2002, Poland) 1997-2000	75 open market share repurchases	(-30, +10)	Sharpe's market model (CAR)	+10.4%	targets
R. Machała (2005, Poland) 1996-2001	12 mergers and acquisitions	(-40, +40)	CAR and three models: 1) mean-adjusted model 2) market-adjusted model 3) market model	+3.18% -8.59% +35.56	mergers acquirers targets

A. Perepeczo (2006, Poland) 1998-2005	144 open market share repurchases	(-60,+60)	CAR and three models: 1) mean-adjusted model 2) market-adjusted model 3) Sharpe's market model		targets
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Source: own study based on literature study.

Conclusions

Event study has been used for more than 36 years now, since its first application in 1969. For years, the research projects based on the methodology point to one important issue, however – despite the fact that the companies' environment was changing over the time, the method itself is still based on the classical event study applied by Fama, Fisher, Jensen and Roll²⁷. The key objective of event study remains unchanged. It measures the Cumulative Average Abnormal Returns around the event day for a given sample of shares.

Nonetheless, although the main objective and framework of the methodology remain unchanged, it does not imply that no other changes have taken place. On the contrary, we can identify two major changes which have contributed to a new trend. The first one involves market prices of shares under investigation. According to the latest tendencies, the data is used rather on a daily than monthly basis as it enables a more accurate calculation of abnormal returns and a more thorough investigation of the post- announcement performance. The second change concerns the methods of estimating abnormal return, and more precisely – the expected return models, which become more and more complex and sophisticated every year. The same applies to statistical verification of the results, as the statistical calibration methods of the significance level are equally sophisticated²⁸.

The first change is significant to the measuring of short-term abnormal returns whereas the second – to the long-term event studies as it led to new findings of observations made in the 1990s. At the same time, similar changes were recorded in the literature on the CAPM model, they involved mainly the Fama and French Three Factor model. Recently it has been observed, for instance, that company sizes, measured with its capitalisation and the BTMV ratio, determine the financial effects of merging companies. For this reason, according to the recent observations, the expected return models control the impact of those factors on the results.

Even though the changes in the methodology of event study have contributed to better quality of methods mainly in a long run, several limitation problems have been highlighted

only recently, and they still remain unsolved, e.g. the argument about CAR and BHAR measures. The experience shows, however, that a long-term event study requires “extreme caution”²⁹ and even the application of the best methods does not alter the fact that “analysis of long-run abnormal returns is treacherous”³⁰. Analysis of short-term abnormal returns is free of the problems inherent to long-term abnormal returns. The methods are simple and the results are reliable – their interpretation is also clear and unambiguous.

The methodology of event study has wide application not only to evaluation of post-acquisition performance but also to test market efficiency, as well as in the theory of corporate finance to analyse the impact of dividend policy, changes in capital structure or changes in control over the company on shareholder wealth. Numerous cases discussed in the literature prove that the methodology can also be found in the evaluation of response of share prices to events and decisions made by companies, which include for instance: repurchase tender offers (Lakonishok, Vermaelen, 1990); spinoffs (Cusatis, Miles, Woolridge, 1993, Hite, Owers, 1983), dividend initiations and omissions (Michaely, Thaler, Womack, 1995), open market repurchases (Ikenberry, Lakonishok, Vermaelen, 1995), stock splits (Desai, Jain, 1995, Ikenberry, Rankine, Stice, 1996), initial public offering (Ritter, 1991), proxy contests (Ikenberry, Lakonishok, 1993), seasoned equity offerings (Speiss, Affleck-Graves, 1995); publication of financial data of the companies (Bernard, Thomas, 1989) and mergers and acquisitions (Jensen, Ruback, 1983; Agrawal, Jaffe, Mandelker, 1992)³¹.

Notes

¹ For more on the event study methodology see Fama, Fisher, Jensen, Roll (1969), pp.1-21.

² Diacogiannis (1994), p.677.

³ Sudarsanam (1998), p.219.

⁴ Sudarsanam (2003), p.92.

⁵ Barber & Lyon (1997), p.344.

⁶ Limmack (2003), p.346, distinguishes two measures: Cumulative Abnormal returns (CARs) and (Cumulative Average Excess Returns – CEARs) pointing out that results do not affect the interpretation.

⁷ Loderer, Martin (1990), p.23.

⁸ Agrawal, Jaffe, Mandelker (1992), p.1609.

⁹ *Ibidem*.

¹⁰ Barber, Lyon (1997), p.344.

¹¹ Sudarsanam, Mahate (2003), p.312.

- ¹² In their study, the authors have analysed the strengths and weaknesses of both measures used in the exploration of long-term abnormal returns in the event period from 1 up to 5 years. Barber, Lyon (1997), pp.341-372.
- ¹³ Fama (1998), pp.283-306.
- ¹⁴ Kothari, Warner (1997), pp.301-339.
- ¹⁵ Sudarsanam (2003), pp.90-91.
- ¹⁶ Dasgupta, Laplantte, Mamingi (1998).
- ¹⁷ Sudarsanam (2003), pp.90-91.
- ¹⁸ *Ibidem*.
- ¹⁹ Sudarsanam (2003), p.91.
- ²⁰ *Ibidem*.
- ²¹ Baker, Limmack (2001), p.12.
- ²² Barber, Lyon (1997), p.356.
- ²³ Dasgupta, Laplantte, Mamingi (1998).
- ²⁴ Sudarsanam (2003), p.91.
- ²⁵ Gregory (1997), p.978.
- ²⁶ *Ibidem*, p.354.
- ²⁷ Fama, Fisher, Jensen, Roll (1969), pp.1-21.
- ²⁸ Kothari, Warner (2004), pp.8-9.
- ²⁹ Kothari, Warner (1997), p.301.
- ³⁰ Lyon, Barber, Tsai (1999), p.165.
- ³¹ Kothari, Warner (1997), p.352.

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