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The Value of Acquiring: An Event Study on Shareholder Value for Defense Sector M&A's

Masters' Thesis in Finance

Spring 2014

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Abstract

The purpose of this study is to examine whether an acquiring firm that operates as a contractor within the defence sector can expect to generate shareholder value from a merger and acquisition with a fellow defence sector competitor. Having selected thirty acquiring defence firms an event study utilizing the market model is performed to obtain the abnormal returns generated from a merger and acquisition. To account for estimation problems associated with financial data, and to provide accurate and robust results, the GARCH and EGARCH model are also utilized alongside a basic OLS estimation. The results indicate a positive shareholder value creation of 1.5 to 5 percent for acquiring defence sector firms.

KEYWORDS: Event Study, GARCH, EGARCH, the market model, defence

Acknowledgements

I would like to take this opportunity to express my much felt gratitude to those that made this paper possible. First and foremost I would like to thank my supervisor Hans Byström for his guidance and valuable insight while writing. I would also like to extend my appreciation to Stefan Svärd for his invaluable help in guiding me through the ins-and-outs of STATA. Furthermore, a heartfelt regards to Tim Johnson, Josh Kraindler and Phillip McGrath for their continued support and advice. Finally, I would like to thank my father whose dedication and enthusiasm as an aerospace engineer provided me with the inspiration to do this study.

Sincerely,

Jonathan

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1. Introduction

The focus of this paper is a look into the effect of mergers and acquisitions (M&A's) on shareholder value for acquiring firms within the defence sector. In this chapter an introduction into the problem at hand and the background history is presented. This is then followed by a look into previous research and the proposed purpose of this study. It concludes with a brief description of the structure of the paper.

1.1 Introduction to Topic

Pressure from federal governments to reduce military spending following the end of the Cold War can be seen as the cause of numerous mergers and acquisitions (M&A's) in the defence sector since the early 1990's. However, this consolidation of market position through M&A's just for the increased probability of winning contracts does not necessarily imply value creation for the acquiring firm. Corporate finance theory would warn us to take note that growth in firm size does not correlate to a growth in value creation. In fact several studies have shown that shareholder value for acquiring firms in other sector M&A's has often resulted in a reduction of value for the shareholders of the acquiring firm while increasing the value for the target firms shareholders (Jensen & Ruback, 1983; Bradley, Desai & Kim, 1988).

1.2 Background History

With the collapse of the Soviet Union effectively bringing the Cold War to an end there has been a noticeable increase in the number of merger and acquisitions (M&A's) among defence firms. In the face of reduced government spending on defence many major defence contractors looked to consolidate their position within this sector by seeking out M&A's with their fellow competitors. The past two and a half decades since the end of the Cold War witnessed the M&A of some of the world's largest defence contractors creating defence firms of unprecedented size and scale. Some of these M&A's include the combining of Lockheed and Martin Marietta to form Lockheed Martin; Northrop and

Grumman to form Northrop Grumman; and British Aerospace and Marconi Electronic Systems to form BAE Systems.

Fears of firms missing out on now limited defence contracts appear to have been exasperated by Bill Clinton's 1992 campaign pledge of reducing defence spending following the conclusion of both the Cold War and Desert Storm. Indeed, then-Secretary of Defense Les Aspin in the late summer of 1993 called together the executives of the United States' largest defence contractors to inform them that the Pentagon's budget would be drastically shrinking and that it was time to consolidate, streamline, and adapt to changing times.[1] This same notion of reduction in military spending was also prevalent in Europe. European defense firms were faced with a two-fold problem as they expected to face reductions in both their US contracts but also their contracts at home. Then-managing director of British Aerospace John Weston summed up the situation in Europe perfectly, "Europe... is supporting three times the number of contractors on less than half the budget of the U.S." (Rothman & Landberg, 1997). In fact at this time there was pressure from European governments for defense firms there to consolidate their positions into a single "European Aerospace and Defense Company".[2]

1.3 Previous Research

It has been shown in a number of studies that the strategic relatedness of the combining firms is not sufficient enough for the acquiring firm to generate positive abnormal returns (Lubatkin, 1987; Singh and Montgomery, 1987; Barney, 1988). Even in cases where the M&A has shown to result in a positive value creation due to an effective resource fit between the acquiring and target firm, the market response seems to allocate any potential "synergistic" gains to the target shareholders. Synergistic gains being the resulting increase in returns due to the combining firms' competitive strengths and resulting cash flows beyond, which the two companies are expected to accomplish separately (Seth, 1990; Sirower, 1997).

[1]Merger of Equals. <http://www.lockheedmartin.ca/us/100years/stories/merger.html>
[2]Defence merger on the radar <http://news.bbc.co.uk/2/hi/business/130305.stm>

As Capron and Pistre (2002) point out “value creation does not ensure value capture by the acquirer when the competition among potential bidders drives up the target price until the net present value (NPV) for the successful bidder is close to zero (i.e., the discounted synergies are equal to the premium paid)”.

As mentioned earlier, Jensen & Ruback (1983) and Bradley, Desai & Kim (1988) obtained findings that showed shareholder value for the acquiring firm in M&A’s for other sectors had resulted in a reduction of value for the shareholders of the acquiring firm while increasing the value for the target firms shareholders. In addition to this Ruback (1982) found that previous studies by Dodd & Ruback (1977), Kummer & Hoffmeister (1978), and Bradley (1980) had consistently found that on average announcements of tender offers for M&A’s from various sectors (not defence) had resulted in substantial increases of 16 to 21 percent in equity values for the target firms of the M&A. For the acquiring firm it was found that on average there were relatively small abnormal returns of 2 to 5 percent.

Ruback (1982) also points out several factors that need to be taken into account when employing an event study to calculate abnormal returns; these factors, he says, can affect the interpretation of your results. First, it can be hard sometimes to define a “major announcement” that the market may react to. Market speculation about a potential M&A can result in many minor market reactions based around speculative news reports and other such sources of information before the firms even announce their M&A intentions. Secondly, it is important to know that realized stock returns are adjusted for market-wide movements to focus on the components of returns that are due to the takeover. Thirdly, stock market prices incorporate the expected value of future uncertain opportunities. Hence, measured abnormal returns reflect the unanticipated percentage changes in expected value. This leads to abnormal returns only being unambiguously interpreted for unanticipated events. And finally, when two pieces of information are released, only their combined effect can be measured.

1.4 Purpose

The purpose of this paper is to try to see if an acquiring firm that operates as a contractor within the defence sector can expect any sort of immediate shareholder value creation from a merger and acquisition, as it is important that the decision to undertake an M&A takes into account value creation and not just firm size. To test for this an event study in which the abnormal returns of thirty acquiring defence firms will be calculated in an attempt to capture any value creation the firm may realize from the M&A. To provide robust and accurate results the abnormal returns will be calculated using an OLS, GARCH and EGARCH models; the latter allowing for conditional variances to be employed instead of the constant variance assumed in basic OLS.

It is expected that the results will show that though growth in firm size may increase the probability of winning a contract, it does not imply immediate value creation for the shareholders of the acquiring firm. It is hoped that this study will help provide an insight into the corporate strategy for firms operating within the defence sector. With firms operating in this sector so heavily reliant on government contracts for survival there is a possibility that management are more inclined to take a reduction in shareholder value if it increases the probability of winning contracts and thus firm survival.

1.5 Structure of Paper

In order to achieve the intended purpose of this study this paper will be laid out in the following structure. Chapter 2 will provide information into the theoretical background and method; providing the essential theoretical assumptions required for this study as well as providing the theoretical definitions and method of the event study process. This includes the estimation of normal returns, the calculation of abnormal returns and hypothesis testing. Next, Chapter 3 provides the event and data selection information. It is here that the event parameters, firm selection and data collection process is defined. In Chapter 4 the process of estimation and the observations from the event study are provided. Finally, in Chapter 5 the results of the study are discussed and the final conclusion of the paper is provided. The paper is rounded off with references and appendixes.

2. Theoretical Background and Method

In this chapter the background in the economic theory and theoretical method required for this study is provided. First, the efficient market hypothesis (EMH) is presented followed by a detailed look into the methodology of an event study including the theoretical framework into what an event study is as well as a step-by-step approach to estimating the normal returns, the calculation of abnormal returns and the application of hypothesis testing. Note: Sections 2.2 to 2.5 and 2.9 are drawn from Campbell, Lo and MacKinlay (1997).

2.1 Efficient Market Hypothesis

When doing an event study that concerns the movement of share prices around a certain event, in this case the announcement of an M&A, it is important to have a thorough understand of the Efficient Market Hypothesis (EMH) (Fama, 1969). At its core the efficient market hypothesis can be broken down into three different hypothesis; weak form, semi-strong form and strong form. Essentially, the weak form hypothesis of the EMH states that the current market price for traded assets, such as stocks, bonds and property, reflect all past publically available information. The semi-strong hypothesis assumes that current market prices reflect all publically available information and that prices will instantly change to reflect any new information that becomes available. The third, strong hypothesis goes onto add that even hidden and insider information is instantly reflected in the market price (Fama, 1969).

For the purposes of this study it is important to understand that the assumptions of the EMH play critical role in interpreting price changes that occur at and around the moment of announcement for the M&A. Those firms who's M&A announcement happened closer to the present might show results indicating a quicker response due advancements in information sharing technology. In regards to this study the assumption of the semi-strong hypothesis will be made. Given readily available communication and information technology of the past twenty-five years we can at least expect market prices and their variations around the announcement to reflect all past information. We can also expect instant changes to market prices to take place when the announcement is made.

2.2 What is an Event Study

The principle purpose of an event study is to measure the effect of an economic event on the value of a firm. These events can include such things as earning announcements, the issuing of new debt or equity, government/central bank announcements concerning macroeconomics variables, and of course mergers and acquisitions. It is assumed that the effects of an event would be in some way reflected in the price of the assets being used in the study. To capture the economic effect of the event on asset prices the behaviour of the asset prices around the event date need to be studied.

2.3 Steps of an Event Study

It is intended that a proposed theoretical prediction of the consequences of an event will be tested to ascertain whether the data is consistent with the theoretical prediction. The analysis of an event study can be broken down into several steps:

1. *Event Definition*: The event of interest is defined as well as the time period over which the asset prices will be analyzed. This time period is known as the *event window*.

2. *Selection Criteria*: The criteria for firm selection is defined and included in the analysis. This criterion for selection includes industry specific membership, specific stock market listing etc.

3. *Measuring Normal Returns*: The normal return is the return that would be expected if the event did not take place. It is defined as $E[R_{it}^{*}|\Omega_{it}]$, where R_{it}^{*} is the return for firm *i* (*i* = 1,…,N) at time *t* and Ω_{it} is the conditioning information for the normal performance model (Note: index i refers to a specific firm and specific event). The

estimation of the parameters for the normal performance model is done over an *estimation window*; this is often the period before the event window.

4. *Measuring and Testing Abnormal Returns*: The abnormal return is the difference between the actual return and the expected normal return. It is defined as:

$$\varepsilon_{it}^{*} = R_{it}^{*} - E[R_{it}^{*}|\Omega_{it}] \tag{1}$$

   Once the parameters of the normal performance model are estimated we calculate the abnormal returns and test to see if it is statistically significant.

2.4 Measuring Normal Performance

In order to measure the normal performance the time horizon for the event study is divided into several windows. These windows include the estimation window (pre-event), the event window and the post-event window. The event date itself is defined as *t* = 0. Calculating the abnormal return over the event window provides us with a measure of the events impact on the asset price and hence the value of the firm. The estimation window is used to define the expected normal return and it is usually assumed that the event is exogenous to the price changes. Also, it is typical that the estimation and event windows do not overlap; estimation window contains L_1 returns and the event window contains L_2 return observations.

Figure 1.

(Estimation Window) (Event Window) (Post-event Window)

|_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|_ _ _ _ _ _ _ _ . _ _ _ _ _ _ _ _|_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _|

T_0 T_1 0 T_2 T_3

2.5 Estimating Expected Normal Return

The following models are those most commonly used in the estimation of the expected normal return. For these models it is assumed that the returns for the assets are jointly multivariate normal, and identically and independently distributed over time.

1. *Constant-mean-return model*: In this model the mean return of a given asset is assumed to be constant over time. The model is defined as:

$$R_{it} = \alpha_i + \varepsilon_{it} \quad (2)$$

$$E[\varepsilon_{it}] = 0 \quad Var[\varepsilon_{it}] = \sigma_{\varepsilon i}^2$$

With the expected normal return being defined as:

$$E[R_{it}^* | \Omega_{it}] = \hat{\alpha}_i \quad (3)$$

$$\hat{\alpha}_i = \frac{1}{L_1} \sum_{t=T_{0+1}}^{T_1} R_{it}$$

2. *Market model*: If a stable relationship is assumed to exist between the market return and the asset return then the following model is applied for expected normal return:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (4)$$

$$E[\varepsilon_{it}] = 0 \quad Var[\varepsilon_{it}] = \sigma_{\varepsilon i}^2$$

A reduction in the variance of the abnormal return can be achieved by removing the part of the return that is related to the variation in the market return; allowing for the possibility of detecting the event's effect on return. If the R^2 of the market model regression is higher, then there is a distinct advantage over the constant-mean-model.

For the market model the expected normal return is defined as;

$$E[R_{it}^{*}|\Omega_{it}] = \hat{\alpha}_i + \hat{\beta}_i R_{mt}^{*} \quad (5)$$

where ordinary least squares (OLS) is used on the observations from the estimation window to estimate $\hat{\alpha}_i$ and $\hat{\beta}_i$. In addition, if the assumptions that $\alpha_i = 0$ and $\beta_i = 1$ a simplified version of the market model, known as the adjusted market model is formed. With these assumptions the expected normal returns become equal to the market returns in the event window.

3. *Multifactor model*: The multifactor model, also known as the multivariate model, allows for the inclusion of additional factors to the market portfolio. Additional factors might include such things as sized based firm portfolios or industry indexes. Use of a multifactor model allows for the further reduction in the variance of abnormal returns. An example of K-factor multifactor model is;

$$R_{it} = \alpha_i + \sum_{k=1}^{K} \beta_{ik} R_{kt} + \varepsilon_{it} \quad (6)$$

$$E[\varepsilon_{it}] = 0 \quad Var[\varepsilon_{it}] = \sigma_{\varepsilon i}^2$$

Where R_{kt} is equal to the return on an additional factor. The expected normal return for this K-factor model is defined as:

$$E[R_{it}^{*}|\Omega_{it}] = \hat{\alpha}_i + \sum_{k=1}^{K} \hat{\beta}_{ik} R_{kt} \quad (7)$$

Like the normal market model the parameters are estimated by applying OLS on the multifactor model. Once again observations from the estimation window are used as the data source.

2.6 Modeling with ARCH/GARCH

For a linear regression performed via OLS to be considered the Best Linear Unbiased Estimator (BLUE) it assumes the error terms have a constant variance ($Var[\varepsilon_i|X] = \sigma^2 \ \forall i$) and are uncorrelated with each other ($Cov[\varepsilon_i, \varepsilon_j|X] = 0$). However, when doing empirical studies that utilize returns it is often found that the variance of returns is not constant over time. Over a sample of returns one can expect to find periods of high volatility and other periods of little movement at all. This phenomenon in volatility movement is known as *volatility clustering* and can lead to estimation problems known as heteroskedasticity. To account for this clustering effect in the volatility the Auto-Regressive Heteroskedasticity (ARCH) model first proposed by Engle (1982) can be used. If we let the return of some asset between times *t*-1 and *t* be equal to a conditional expectation plus a stochastic error (η_t) we get the following equation:

$$r_t = \sum_{i=1}^{k} b_i \, x_{t,i} + \eta_t \tag{8}$$

$$\eta_t | \Omega_{t-1} \sim N(0, \sigma_t^2)$$

From the above we see that the error terms are assumed to follow a normal distribution that is conditional on the information (Ω) due at t-1. However, due to the variances varying over time we can expect the unconditional distribution of η_t to have fatter tails than that of a normal distribution:

$$\eta_t = \sigma_t \varepsilon_t \tag{9}$$

$$\varepsilon_t \sim IID \ \& \ N(0,1)$$

With ε_t displaying unit variance the conditional variance will depend upon the past values of squared errors and results in the following equation for the conditional variance:

$$\sigma_t^2 = \omega + \alpha_1 \eta_{t-1}^2 + \alpha_2 \eta_{t-2}^2 + \ldots + \alpha_q \eta_{t-q}^2 \tag{10}$$

This is the equation for the ARCH(q) model where ω and α are required to be non-negative values to produce positive values for variances at any time.

The alternative approach to utilizing an ARCH(q) model is to implement Bollerslev's (1986) Generalized Auto-Regressive Heteroskedasticity (GARCH) model. The GARCH model is often viewed as an infinite ARCH(q) model. Though, it is still a conditional variance model that relies on the past values of squared errors like the ARCH(q) it also takes into account the past conditional variances. The following is the equation for the GARCH(1,1) model:

$$\sigma_t^2 = \omega + \alpha_1 \eta_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (11)$$

where $\alpha_1 \eta_{t-1}^2$ is derived from the ARCH model and defined as the ARCH term while $\beta \sigma_{t-1}^2$ is the GARCH term. The first term (ARCH) is the number of lags of the residual squared, and the second one is the number of lags of the variance (GARCH). The model can be generalized by naming the number of ARCH terms with p and the number of GARCH terms with q, GARCH(p, q).

2.7 Estimating Expected Normal Return with GARCH(1, 1) Model

In calculating the expected normal return with a GARCH(1, 1) model the following conditional variance is applied to the mean model to help capture the effect of any heteroskedasticity that might exist within the data sample:

$$\varepsilon_{it} | \Omega_{t-1} \sim N(0, \sigma_t^2) = \omega + \alpha_1 \eta_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (12)$$

A number of event studies have utilized GARCH(1, 1) models including Batchelor and Orakcioglu (2003); McKenzie et al. (2004); and Wang et al. (2002)

2.8 Estimating Expected Normal Return with EGARCH Model

The GARCH(1, 1) model does not account for any asymmetry that may arise from the positive and negative shocks in the market or as it is known the *leverage effect*. Bandi and Reno (2012) explain that the asymmetry that arises from information affecting a company's revenue negatively increases its risk which causes the assets to decline in value as a result of lower revenues while increasing the debt ratio, which makes the shares more volatile because of the increased leverage; hence the leverage effect. To account for this Nelson (1991) created so-called EGARCH model (Exponential GARCH model). The EGARCH model applies a logarithmic conditional variance; the variance remains positive even if the parameters are negative. He also introduced a leverage term into GARCH model which takes account of the asymmetric effect by increasing or reducing the effect of the error term. The following is the conditional variance of the EGARCH (1, 1) model;

$$ln(\sigma_t^2) = \omega + \beta ln(\sigma_{t-1}^2) + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \qquad (13)$$

where ω corresponds to a constant , β is the now logarithmic GARCH term, and α is the ARCH term that no longer has to be positive. The γ term is the so-called leverage term; if γ is significant and different from zero there will exist asymmetry in estimation period. The σ is the standard deviation. The residual ε_{t-1} corresponds to $(R_t - \hat{R}_t)$ where $\hat{R}_t$ is previously estimated using one of the normal estimation models. In contrast to the ARCH/GARCH model the EGARCH model allows for volatility clustering and leverage effect to be taken into account.

2.9 Measuring and Testing Abnormal Returns

The abnormal returns of firm *i* for day *t* (AR_{it}) are estimated using the following equation;

$$AR_{it} = R_{it} - [\hat{\alpha}_i + \hat{\beta}_i R_{mt}^*] \qquad (14)$$

where R_{it} is the observed return for firm *i* at time *t*, and R_{mt} is the return on a market index for the same period. In the above equation, α_i and β_i are estimated using ordinary least squares (OLS) over the estimation period.

To calculate average excess returns for each relative day the following formula is used:

$$AR_t = \left(\frac{1}{N}\right) \sum_{i=1}^{N} AR_{it} \qquad (15)$$

where N is the number of securities with excess returns during day t. The cumulative abnormal return (CAR) for each asset *i* (CAR_i) is formed by summing individual excess returns over time as follows:

$$CAR_{i,k,l} = \sum_{t=k}^{N} AR_{it} \quad (16)$$

where $CAR_{i,k,l}$, is for the period from t = k days until t = l days. Finally the cumulative average abnormal return ($\overline{CAR}$) over the event time from *k* days until *l* days is calculated by:

$$\overline{CAR}_{k,l} = \left(\frac{1}{N}\right) \sum_{i=1}^{N} CAR_{i,k,l} \quad (17)$$

With the abnormal returns calculated, it is possible to determine if the deviation from the normal return is a coincidence or not. A standard t-test can be applied to test the significance of the data. As an example a significance level of 5% can be used to test the accuracy of the results and with the hypothesis test defined as:

The abnormal returns cannot be distinguished from zero

$$H_0: \overline{CAR}_{k,l} = 0$$

The abnormal returns can be distinguished from zero

$$H_1: \overline{CAR}_{k,l} \neq 0$$

The decision rule is to reject H_0 if $|t_{ratio}| > t_{critical}$ or p-value < 0.05. This means that the value is statistically significantly different from zero with a significance level of 5%, only 5% chance of deviation from the normal return is a coincidence. The formula for calculating the t_{ratio} value is:

$$t_{ratio} = \frac{\overline{CAR}_{k,l}}{SE(\overline{CAR}_{k,l})} \quad (18)$$

Where $\overline{CAR}_{k,l}$ comes from expression (18) and SE($\overline{CAR}_{k,l}$) is the standard deviation. The importance of estimating the correct variance becomes apparent for the calculation of the t-value. With an incorrectly calculated the variance, the t- value can become erroneous and leads to biased observations. The critical t-value ($t_{critical}$) is 1.96 at the 5% significance level. This means that if the t_{ratio} is greater than 1.96 we reject H_0. If we do not reject H_0 because the t_{ratio} is less than 1.96 indicates the results are not statistically different from zero.

3. Event and Data Selection

In this chapter the event and data selection information is presented. It is here that the event parameters, firm selection and data collection process is defined. First the event date is defined followed by the criteria for firm selection and then the process of data collection.

3.1 Event Choice

For the purposes of this paper the event date of importance is the announcement of the M&A; not the date the M&A is finalized. Assuming the semi-strong efficient market hypothesis holds we can expect the market to react immediately to the announcement of an impending M&A. Also, rarely does the announcement of an M&A come after the transaction has happened, nor the M&A transaction happening in one day. Most M&A's are drawn out undertakings with chunks of a firms shares being bought up a piece at a time. For these reasons the event date is the announcement of the M&A. Note: An M&A can be described as being either one of two definitions; a merger where two firms combine into one surviving firm or an acquisition where there is the purchase, in whole or in part, by another firm (Cherian and Jarrow, 1995).

The length of the event window and the estimation periods were chosen based upon the methodology of those used by Capron & Pistre (2002), Ruback (1982), and Yoo, Lee & Choi (2013). Initially the event window employed by Capron & Pistre, and Ruback was days -20 to +1 around the event date 0; a large time frame before the event date being used to capture any insider/leaked information and market speculation. However, Yoo, Lee & Choi employed the technique of multiple event windows to provide a more reliable description of the abnormal returns generated. In trying to keep with the methodology of Capron & Pistre and Ruback while providing the robust results of Yoo, Lee & Choi multiple event windows of varying lengths will be used. The following table displays the nine different event windows that will be employed in this study:

Table 1. Event Dates

[-20;+10]	[-20;+5]	[-20;+1]
[-15;+10]	[-15;+5]	[-15;+1]
[-10;+10]	[-10;+5]	[-10;+1]

a. [;] represent days around event date [0;0]

The estimation period for this study will be the same as that employed by Capron & Pistre (2002) and Ruback (1982) which is -180 to -50 days before the event date 0. It is important to set the estimation period date back far enough so as to avoid any biases from the market already knowing (inside information) or speculating about an impending M&A.

3.2 Firm Selection

As mentioned earlier in this paper the event study will involve the use of thirty firms that can be described as a defence contractor who has been the acquirer in a major M&A within the past 25 years. For the purposes of this paper a defence contractor is defined as a firm who provides goods and/or services to government and private contractors that are mandated to uphold public defence (military defence departments, international and national investigation agencies, local law enforcement departments, security agencies etc.) with the majority of the firms' revenues coming from these sources. It should be noted that the majority of spending on defence is done by national departments of defence (military). However, this author is of the opinion that it is important to acknowledge alternative sources of defence revenue. Furthermore, the use of the term "acquirer" in some cases is quite ambiguous; for example the merger of Lockheed and Martin Marietta. Originally, their merger was coined the "merger of equals". However, the merger involved the purchasing and de-issuing of Martin Marietta shares so Lockheed shares could become the primary shares of the new company.

3.3 Data Collection

There is an abundance of sources online that provide lists of the world's largest defence contractors; both for companies that still exist or for those that have now become defunct either through M&A's and break-ups, or bankruptcy and liquidation. Using several online financial sources (Wall Street Journal, Bloomberg, The Economist Online, Google Finance, Yahoo Finance, etc.) thirty firms were chosen that fit the profile of an acquiring defense contractor who has had a major M&A in the past twenty-five years.

In order to find an accurate and credible date for the M&A announcements a number of sources were used. Initially, credible online sources such as the Wall Street Journal, Bloomberg and the New York Times were used, but to confirm the accuracy of these dates the Thomson Reuters Eikon system was employed to further confirm their accuracy. A list of the firms and their respective announcement dates can be found in appendix 1.

To provide an adequate sample size for the event study, stock prices, as well as the respective index prices, were taken for each firm obtaining data up to a year before and after the announcement date. All firm stock returns as well as market index returns were found using the Wall Street Journal utilizing their extensive source of historical prices for both assets and indexes. The use of Wall Street Journal data for event studies has often been done with a number of notable studies including those by Ruback (1982) and Capron & Pistre (2002). Thankfully the Wall Street Journal has an easy download to spreadsheet function making the data collection a relatively simple task.

4. Estimation and Empirical Results

This chapter contains five sections; the first four sections contain the process of estimation for the abnormal returns utilizing basic OLS, GARCH and EGARCH models. The final section showcases the observations from the event study including a brief description of the results.

4.1 Calculating Log-Returns and Uploading to STATA

Having downloaded the appropriate prices from the Wall Street Journal the data was uploading into Microsoft Excel where it was organized into the appropriate format for use in STATA for the estimation of the abnormal returns. Before being the uploaded it was necessary to convert the prices into the returns over the previous day. To convert the returns the often-used and simple *log-return* approach was applied. The following formula is for calculating log-return:

$$r_t = ln\frac{P_t}{P_{t-1}} = ln(P_t) - ln(P_{t-1}) \tag{20}$$

Where P_t is the observed price and r_t is the exponential return. This formula allows for today's closing price to be expressed as a percentage return over previous day's closing price.

With the prices converted into the appropriate returns the data was separated and formatted into two different excel files. The following tables provide an example of the excel file formats required for upload into STATA for estimation of the abnormal returns:

Table 2. Excel format for STATA

firm	company_id	event_date
NOC	1001	1994-04-04
Boeing	1002	1996-12-16
Lockheed	1003	1994-08-30
BAE	1004	1999-01-19
.	.	.
.	.	.
.	.	.

Table 3. Excel format for STATA

date	market_ret	company_id	firm	ret
1995-03-31	-0.002912813	1001	NOC	-0.01826
1995-03-30	-3.4791E-05	1001	NOC	0.031098
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
1997-12-01	0.017143089	1002	Boeing	0.015146
1997-11-28	0.003593476	1002	Boeing	0.02382
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

4.2 Estimation of the Abnormal Returns with OLS

With the appropriate files uploaded into STATA the first series for estimations for the parameters of the expected normal returns was done. Utilizing the market model mentioned in section 2.5, formula (4) the log returns of each individual defence firm were regressed against their respective logged market index for the estimation period defined in section 3.1 (-180 days to -50 days prior to the event date). As mentioned previously the estimation of the parameters under the market model is achieved through OLS to provide an estimation of the expected normal return formula (5). This follows the same methodology employed by Capron & Pistre (2002) and Ruback (1982).

With the parameters estimated for each individual firm their expected normal return for individual days within their respective pre-defined event windows were calculated.

These expected normal returns were then subtracted from the actual returns to obtain the abnormal returns (14). The average of these was then calculated to obtain the average abnormal return (15) for each individual firm. By summing the average abnormal return of every firm the cumulative abnormal return (16) was found. This was then averaged to find the cumulative average abnormal return (17). Finally, a standard t-test is performed to check the significance of the result; the standard t-test being explained in the latter part of section 2.9, formula (18).

The above process was repeated for the nine the different event windows (refer to table 1). With each event window requiring thirty regressions to be run (one for each firm) it has resulted in 270 individual regressions being performed to obtain the cumulative average abnormal returns where the market model with basic OLS was applied.

4.3 Estimation of Abnormal Returns using GARCH Model

The second round of estimation of the abnormal returns involved the use of the GARCH(1, 1) model much like the methodology employed by Yoo, Lee & Choi (2013). They employed both a basic OLS market model plus a GARCH model in their study; the GARCH being used to account for any heteroskedasticity that may exist in the data. Likewise the use of the GARCH model here is being employed to account for any heteroskedasticity within the data.

The calculation of the abnormal returns using the GARCH model is essentially the same process as mentioned above. Again the market model is employed as the mean equation to calculate the parameters of the expected normal return. However, now a conditional variance utilizing the GARCH(1, 1) model from section 2.7, formula (12) is applied. With the new parameters estimated with the GARCH(1, 1) the process for calculating the abnormal returns, average abnormal returns, cumulative returns, cumulative average abnormal returns and the standard t-test is same as those performed before. Also, like the basic OLS market model this process was repeated for the nine different event windows resulting in a further 270 regressions being performed to obtain the GARCH model results.

4.4 Estimation of Abnormal Return using EGARCH Model

Third, and finally, an estimation of the parameters was done using an EGARCH model. Though, the use of the EGARCH model has been employed in a number of event studies, there is a limited number studies concerning M&A's that have employed its use and certainly not when discussing the M&A's for the defence sector. It seems appropriate that the EGARCH be utilized in this study as several of the M&A announcement dates take place around periods of long, pronounced volatility where the leverage effect most certainly is taking place; most notably these periods include the Asian market crash of 1997, the IT bubble-burst of the early 2000's and the recent financial crash of 2008.

As before with the GARCH model, the process of calculating the abnormal returns utilizes the same market model as the mean equation for estimating the parameters. However, the EGARCH(1, 1) model from section 2.8, formula (14) was now employed as the conditional variance of the error terms; accounting for any leverage effect that may exist within the data. The process after obtaining the expected normal return parameters is same as that performed for basic OLS and the GARCH(1, 1) model. Also, as before a further 270 regressions were run to obtain the cumulative average abnormal returns for the nine event windows.

Note: STATA is a code-based statistical program. Different codes for each model were run to obtain the empirical results. These codes can be found in appendix 2.

4.5 Empirical Results

In this section the results of the event study are presented to see if M&A's for defence firms achieve any sort of the shareholder creation. The following table presents the data separated by a) the model used to find the abnormal returns and b) the size of the event window. It should be noted that this table has the cumulative average return presented in percentage.

Table 4. Cumulative Average Abnormal Returns

Event Window	OLS	GARCH(1, 1)	EGARCH (1, 1)
[-20;+10]	*4.124*** *(2.67)*	*4.831**** *(3.10)*	*4.324*** *(2.49)*
[-15;+10]	*3.141*** *(2.19)*	*3.821*** *(2.68)*	*3.373*** *(2.14)*
[-10;+10]	*2.491* *(1.67)*	*3.128*** *(2.11)*	*2.767** *(1.71)*
[-20;+5]	*3.121*** *(2.29)*	*3.692**** *(2.72)*	*3.214*** *(2.20)*
[-15;+5]	*2.137** *(2.19)*	*2.682*** *(2.27)*	*2.263** *(1.79)*
[-10;+5]	*1.487* *(1.18)*	*1.988* *(1.61)*	*1.656* *(1.26)*
[-20;+1]	*3.478*** *(2.58)*	*3.915**** *(2.90)*	*3.554*** *(2.56)*
[-15;+1]	*2.495*** *(2.10)*	*2.905*** *(2.49)*	*2.603*** *(2.19)*
[-10;+1]	*1.844* *(1.52)*	*2.212** *(1.86)*	*2.803*** *(2.05)*

a. *, ** and *** represent rejection of the null hypothesis at the 10%, 5% and 1% level, respectively.
b. ( ) represents t-statistics.

We can see from the table that there appears to exist a positive relationship between M&A's and shareholder value creation for defence firms. This is a rather interesting find as previous studies concerning other market sectors have found that M&A's often result near zero or negative abnormal returns, Jensen & Ruback (1983) and Bradley, Desai & Kim (1988). Though, as mentioned earlier in this paper Dodd & Ruback (1977), Kummer & Hoffmeister (1978), and Bradley (1980) had found results that indicated acquiring firms within the M&A process received positive abnormal returns in the 2-5% range which would be consistent with the findings here.

There is a general pattern that the larger the event window the larger the abnormal return. This is also the same pattern for level of significance with larger event windows witnessing higher levels of significance. This could be perceived in one of two ways;

either the results are larger and more significant owing to a larger sample data or there exists substantial leaks/speculation about the M&A's before the announcement dates pushing the price up. It is most likely the case that the significance can be attributed to the increased sample size; though, I would not be surprised to find that information leaks and speculation were widespread before each M&A.

Concerning the use of the different models we can see that the returns between the three models is fairly close with OLS obtaining the lowest, GARCH the highest and the EGARCH to split the difference though leaning slightly towards the OLS results. As for the statistical significances it would appear that the GARCH provided the most statistically significant results. However this combined with the high abnormal returns generated by the model compared to the EGARCH results could indicate that there may have been some asymmetry in the data indicating the leverage effect taking place.

5. Discussion and Conclusions

In this chapter a brief discussion of the results is presented concerning the possibilities for the outcome of the results as compared to the expected results. Also, this chapter contains the conclusion where the final thoughts of this paper will be presented.

5.1 Discussion & Conclusions

With the empirical results indicating a positive abnormal return we can infer that the M&A's taking place among these acquiring defence firms is in fact generating some shareholder value. Initially, it was proposed that the expectation of this paper was to see negative abnormal returns. The original thought behind this is that with the defence firms experiencing a contraction in their market due to government cut backs following the end of the cold war, management of the these firms would be willing to take initial hits in shareholder value from an M&A if it resulted in the survival of the firm and an increase in the probability of the winning future contracts.

It would now appear that there might be a market reaction to these M&A's. Earlier in the paper the efficient market hypothesis from Fama (1969) was mentioned. For good measure it was indicated to make the assumption that the semi-strong hypothesis holds for the purposes of this paper. The results of the empirical study could be interpreted as the efficient market acknowledging the precarious position that defence firms have found themselves in. The contraction of the defence market is essentially open information for anyone who does a fraction of research. It is a possibility that shareholders know this and agree with executive management that M&A's are the best option for defence firms given the market. Though, this is contrary to other sectors where M&A's are received with a negative impact, an M&A's among defence contractors may be perceived by this efficient market as a necessity. Thus, an announcement of an impending M&A may boost investor confidence and result in an increase in shareholder value.

In conclusion we can infer from this study that the market responses to defence sector mergers and acquisitions appear to differ from those of other sectors. And that, contrary to the original position taken by this author at the start of this study, mergers and acquisitions among firms operating as contractors within the defence sector actually results in shareholder value creation for the acquiring firm.

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Appendix 1.

Table. Firms

Firm	Market	Quote Symbol	Event Date
Northrop Grumman	*NYSE*	NOC	1994-04-04
Boeing	*NYSE*	BA	1996-12-16
Lockheed Martin	*NYSE*	LMT	1994-08-30
General Electric	*NYSE*	GE	2007-01-16
General Dynamics	*NYSE*	GD	1999-05-17
Rockwell-Collins	*NYSE*	COL	2013-08-12
United Technologies	*NYSE*	UTX	2011-09-21
L-3 Communications	*NYSE*	LLL	2002-01-14
URS Corporation	*NYSE*	URS	2007-05-29
Alliant Techsystems	*NYSE*	ATK	2001-01-31
Jacobs Engineering Group	*NYSE*	JEC	2011-11-01
Honeywell	*NYSE*	HON	1999-06-07
Oshkosh	*NYSE*	OSK	2006-10-16
CACI	*NYSE*	CACI	2010-10-18
3M Company	*NYSE*	MMM	2012-10-01
Computer Sciences Corporation (CSC)	*NYSE*	CSC	2002-12-16
Curtiss Wright	*NYSE*	CW	2010-05-27
Exelis Inc.	*NYSE*	XLS	2012-12-10
Precision Castparts Corporation	*NYSE*	PCP	2012-11-09
Raytheon	*NYSE*	RTN	2009-09-01
ManTech International	*NASDAQ*	MANT	2012-02-29
Texas Instruments	*NASDAQ*	TXN	2011-04-04
Elbit Systems	*NASDAQ*	ESLT	1999-12-23
FLIR Systems	*NASDAQ*	FLIR	2007-10-25
iRobot	*NASDAQ*	IRBT	2012-09-17
Finmeccanica	*BIT*	FNC	2008-05-13
Rheinmetall	*FWB*	RHM	2008-03-17
BAE Systems plc	*LSE*	BA	1999-01-19
Rolls Royce plc	*LSE*	RR	1994-11-21
Saab AB	*OMX*	SAAB B	2008-04-28

Appendix 2.

STATA Codes

OLS Market Model

```
use eventdates, clear
sort company_id
by company_id: gen eventcount=_N
by company_id: keep if _n==1
sort company_id
keep company_id eventcount
save eventcount
use stockdata, clear
sort company_id
merge company_id using eventcount
tab _merge
keep if _merge==3
drop _merge
expand eventcount
drop eventcount
sort company_id date
by company_id date: gen set=_n
sort company_id set
save stockdata2
use eventdates, clear
sort company_id
by company_id: gen set=_n
sort company_id set
save eventdates2
use stockdata2, clear
merge company_id set using eventdates2
tab _merge
keep if _merge==3
drop _merge
egen group_id = group(company_id set)

sort group_id date
by group_id: gen datenum=_n
by group_id: gen target=datenum if date==event_date
egen td=min(target), by(group_id)
drop target
gen dif=datenum-td
by group_id: gen event_window=1 if dif>=-20 & dif<=1
egen count_event_obs=count(event_window), by(group_id)
by group_id: gen estimation_window=1 if dif<-50 & dif>=-180
egen count_est_obs=count(estimation_window), by(group_id)
replace event_window=0 if event_window==.
replace estimation_window=0 if estimation_window==.
drop if count_event_obs < 21
drop if count_est_obs < 130
```

```
set more off
gen predicted_return=.
egen id=group(group_id)

xtset id date

forvalues i=1(1)30 {
l id group_id if id==`i' & dif==0
reg ret market_ret if id==`i' & estimation_window==1
predict p if id==`i'
replace predicted_return = p if id==`i' & event_window==1
drop p
}

sort id date
gen abnormal_return=ret-predicted_return if event_window==1
by id: egen cumulative_abnormal_return = sum(abnormal_return)
sort id date
by id: egen ar_sd = sd(abnormal_return)
gen test =(1/sqrt(2)) * ( cumulative_abnormal_return /ar_sd)
reg cumulative_abnormal_return if dif==0, robust
sum cumulative_abnormal_return if dif==0
translate @Results resultat3.txt
```

GARCH Model

```
use eventdates, clear
sort company_id
by company_id: gen eventcount=_N
by company_id: keep if _n==1
sort company_id
keep company_id eventcount
save eventcount
use stockdata, clear
sort company_id
merge company_id using eventcount
tab _merge
keep if _merge==3
drop _merge
expand eventcount
drop eventcount
sort company_id date
by company_id date: gen set=_n
sort company_id set
save stockdata2
use eventdates, clear
sort company_id
by company_id: gen set=_n
```

```
sort company_id set
save eventdates2
use stockdata2, clear
merge company_id set using eventdates2
tab _merge
keep if _merge==3
drop _merge
egen group_id = group(company_id set)

sort group_id date
by group_id: gen datenum=_n
by group_id: gen target=datenum if date==event_date
egen td=min(target), by(group_id)
drop target
gen dif=datenum-td
by group_id: gen event_window=1 if dif>=-20 & dif<=1
egen count_event_obs=count(event_window), by(group_id)
by group_id: gen estimation_window=1 if dif<-50 & dif>=-180
egen count_est_obs=count(estimation_window), by(group_id)
replace event_window=0 if event_window==.
replace estimation_window=0 if estimation_window==.
drop if count_event_obs < 21
drop if count_est_obs < 130


set more off
gen predicted_return=.
egen id=group(group_id)

xtset id date

forvalues i=1(1)30 {
l id group_id if id==`i' & dif==0
arch ret market_ret if id==`i' & estimation_window==1, arch(1)
garch(1) gtolerance(999) difficult iterate(100)
predict p if id==`i'
replace predicted_return = p if id==`i' & event_window==1
drop p
}

sort id date
gen abnormal_return=ret-predicted_return if event_window==1
by id: egen cumulative_abnormal_return = sum(abnormal_return)
sort id date
by id: egen ar_sd = sd(abnormal_return)
gen test =(1/sqrt(2)) * ( cumulative_abnormal_return /ar_sd)
reg cumulative_abnormal_return if dif==0, robust
sum cumulative_abnormal_return if dif==0
translate @Results resultat3.txt
```

EGARCH Model

```
use eventdates, clear
sort company_id
by company_id: gen eventcount=_N
by company_id: keep if _n==1
sort company_id
keep company_id eventcount
save eventcount
use stockdata, clear
sort company_id
merge company_id using eventcount
tab _merge
keep if _merge==3
drop _merge
expand eventcount
drop eventcount
sort company_id date
by company_id date: gen set=_n
sort company_id set
save stockdata2
use eventdates, clear
sort company_id
by company_id: gen set=_n
sort company_id set
save eventdates2
use stockdata2, clear
merge company_id set using eventdates2
tab _merge
keep if _merge==3
drop _merge
egen group_id = group(company_id set)

sort group_id date
by group_id: gen datenum=_n
by group_id: gen target=datenum if date==event_date
egen td=min(target), by(group_id)
drop target
gen dif=datenum-td
by group_id: gen event_window=1 if dif>=-20 & dif<=1
egen count_event_obs=count(event_window), by(group_id)
by group_id: gen estimation_window=1 if dif<-50 & dif>=-180
egen count_est_obs=count(estimation_window), by(group_id)
replace event_window=0 if event_window==.
replace estimation_window=0 if estimation_window==.
drop if count_event_obs < 20
drop if count_est_obs < 130
```

```
set more off
gen predicted_return=.
egen id=group(group_id)

xtset id date

forvalues i=1(1)30 {
l id group_id if id==`i' & dif==0
arch ret market_ret if id==`i' & estimation_window==1, earch(1)
egarch(1) gtolerance(999) difficult iterate(100)
predict p if id==`i'
replace predicted_return = p if id==`i' & event_window==1
drop p
}

sort id date
gen abnormal_return=ret-predicted_return if event_window==1
by id: egen cumulative_abnormal_return = sum(abnormal_return)
sort id date
by id: egen ar_sd = sd(abnormal_return)
gen test =(1/sqrt(2)) * ( cumulative_abnormal_return /ar_sd)
reg cumulative_abnormal_return if dif==0, robust
sum cumulative_abnormal_return if dif==0
translate @Results resultat3.txt
```