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Stock price value: Using event study analysis on the effect of information security incidents to your advantage

Master's thesis in Information Security
Supervisor: Einar Arthur Snekkenes
December 2018

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Abstract

Understanding which elements affect a company's value is one of the main goals for the board of directors and senior management. By understanding these, they can make appropriate decisions to ensure a beneficial business for them and their shareholders. In recent time, the amount of reported security incidents has radically increased, and the affected companies are being held more accountable than ever. Justification for investing in information security controls has proven to be a challenging task. Still, in an age where new legislation, for instance the General Data Protection Regulation in Europe, an ever-evolving threat landscape, and the general increased availability of information, is demanding more transparency and commitment by companies to secure information, measuring the cost efficiency of an information security investment proves difficult.

Since there is no clear scientific method for assessing the actual financial impact of a security event, different approaches are used to estimate the loss.

The stock value of a company decides the monetary worth of a company. If a security event should lead to decline in stock value, the company needs to evaluate whether investing in information security can affect this change. In this thesis I therefore explores the possibility that there is a correlation between the monetary worth of a company and a public disclosure of information security incidents. Using event study methodology, I investigate this by analysing the fluctuation of the stock price in a predefined time window around the announcement of the incident. In order to answer this hypothesis, I have analysed 57 security events occurring over the span of 13 years from 52 companies. The results show that announcing a breach can have an effect on the value of the company in certain situations. In addition, I have elaborated on different ways for security professionals to use this research to communicate the need for investments in information security more efficiently to senior management.

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1 Introduction

1.1 Problem description

Information is one of the most valuable assets a company has today. A security incident that affects the information or the systems they use can prove costly for the company either directly by using resources to handle the incident, or indirectly by affecting production or corporate value. Connecting the cost of an investment in safeguards to profit or even reducing loss related to a security event, has been a challenging task for many years [1]. If the investment cannot be proven beneficial to the senior management, it will not get an approval. Recent announced security events show that the actual cost of a security incident varies from company to company, and from event to event. When there is a security event to assets that are physical in nature, it is easier to calculate what the losses would be should the asset be compromised. Loosing the transport of the goods could be translated into loss of revenue and goods, intrusion into the storage facility could be calculated the same way. However, when critical assets shifted more towards the intangible it proves challenging to put a reasonable value on the amount affected by a incident[2, 3, 4, 5].

A recent study conducted by the Ponemon Institute[5] set average cost of a data incident at $3,86 million, and the cost per lost or stolen record to $148. In cases where more than a million records are affected, the study shows the cost of incidents reduce as the amount of compromised records increase. This is one of many studies that attempts to specify the cost of an incident. As companies who experience security incidents still are reluctant to share this with the public, the empirical data on this matter remains insufficient in order to determine a sound number for the cost[6, 7, 8, 9].

Another way of looking at the cost of an incident is to determine whether it has affected the value of the company to the investors. The stock price of a company reflects the company's standing with its investors at a given time. If a company is prospering, the stock price would rise. If a company is experiencing a negative development, the stock price would fall. Investigating whether the stock price is at all affected by an announced security event could indicate that the company's value is directly affected by the security event.

Explaining the details of why an incident would cost a certain amount of money to senior management might prove challenging as the technical details of the incident might not be of interest. Senior management and the Board of directors have the responsibility to ensure that the investors are satisfied with their investment. Focusing on how security incidents might affect said investment's value might prove more beneficial in order to obtain funding for reducing the risk of it happening.

If a company can understand how security incidents affect the stock price, looking at the nature and scale of the incident, together with industry trends, they could use this information to explain what effect an incident can have for the company. Understanding this aspect of a incident could give security professionals new ways of communicating the need for investing in information security controls. Based on this, the question this thesis aims to answer is:

> *Can security professionals use financial models for calculating the effect of security incidents on stock value, to better communicate the need for information security investments?*

To answer this question, I will use event study methodology to analyse whether announcing a security incident leads to a change in the stock price of the affected company. The hypothesis this analysis will aim to prove or disprove is described as H1:

> *H1: There is a relationship between the value of a company and a publicly announced security incident.*

More specifically, the event study will measure the changes in the stock price in a specified time frame around the announcement of an incident. The thesis will also explore how security professionals can use this information as justification for investing in better security controls

1.2 Motivation

During the last couple of years, there has been an increase in both the amount of threat agents, the methods available to carry out attacks, and the exposure of critical systems. In 2017, The Shadow Brokers released advanced attack tools to the public, that almost eradicated the threshold for having the necessary skills to carrying out an advanced attack on computer systems. Supply chain attacks, where the attacker targets a more vulnerable company on their main targets supply chain, also saw a recent rise as experienced with the NotPetya campaign. DDoS attacks, and the threat of recurring DDoS attacks, are used increasingly as leverage to receive a payout. As the amount of online identities per person increases to 30 on average, keeping them all secure without connecting all of them with the same credentials is proving challenging. Even though the attacks methods have been around for many years, some of the largest companies in the world still experience devastating security events. Despite the increased publicity of cyber security and announcements of critical security incidents, companies still struggle with understanding how to better secure their critical assets [10].

There is no clean cut method for estimating loss related to a security incident. If you look at some of the largest security incidents in recent time, the amount of records affected range from 40 million to approximately 3 billion. Still, the cost for the different companies do not follow the same pattern. In 2013, the Target data incident led to approximately 110 million records compromised and a total loss of $300 million[11]. The same year Yahoo experienced a security incident that affected all 3 billion users, and costing the company approximately $400 million[12]. In 2017, a security incident at Equifax compromised record of 147,9 million individuals, resulting in a loss of approximately $600 million[13]. Another large security incident, the JP Morgan incident in 2014, has not publicly announced their total loss following the incident, as is the case for many incidents over the past years. They have however indicated that their yearly budget for countering security incidents is approximately $ 500 million[14]. In many of these cases, there were direct consequences to the value of the company following the incidents. At Target, when the CEO resigned just a few months after the incident, the stock dropped 3%[15]. When Yahoo were sold to Verizon in 2017, they had to agree to cutting $350 million off their valuation as a result of the incident[12]. In the aftermath of the Equifax incident, the CSO, CIO, and CEO retired from their posts, leading to fluctuations in the company's value [16].

The increased magnitude of incidents like these show that although the critical assets have moved from the physical plane to the digital, measures to ensure their safety is still not keeping up with the change in mission critical data[1]. Where in the past it was enough to safeguard the perimeter where the assets were located, the interconnectivity of the world today introduces new and hidden entry points. There are many measures available to ensure that anyone trying to breach the digital perimeter is caught, blocked or observed. The complexity of the attack methods however make it difficult to ensure a complete lock-down of the critical assets without also restricting the business. As long as a company is connected with the world outside their metaphorical four walls, they risk compromising their business. With such large amounts at stake, understanding how to take the right measures, both in terms of countering potential incidents, and in terms of obtaining cost-efficiency for the company, is what determines whether a company can survive the threat landscape they are facing today. Ensuring that the assets that can make or break a business are kept under safeguard is therefore proving to be a difficult task[2, 3, 4].

1.3 Summary of contributions to be made

The thesis aims to provide an overview of the correlation between announcing a security incident and an abnormal change in stock value. This will be determined through an event study analysis as further explained in chapter 2 and 3. The analysis will look at each incident separately as well as accumulate incidents to show trends for different industries. By using a financial model for determining the correlation, the thesis will also enable security professionals to explain the effect of incidents in a business context. The thesis will explore methods for doing so efficiently.

2 Background

2.1 Security incidents

There are many factors that decide what a security incident actually is, and many different definitions can be found[5, 17, 18, 19, 20]. For this thesis I have chosen to use the following definition:

> A security incident is an event that may indicate that an organization's systems or data have been compromised or that measures put in place to protect them have failed.[20].

For years, obtaining an overview of all identified security incidents has proven challenging. Companies still cannot with certainty say that they have a total overview of all incidents they have experienced, and many cases where incidents are identified, there is no guarantee that information regarding the incident is made publicly available. In the United States alone, a total of 1579 data incidents were registered according to a report by the Identity Theft Resources Center [17]. The actual total is still unknown. What the report does show is that the amount of incidents reported have increased with 46% compared to 2016. This development will probably continue and even if all of the incidents are not reported, the amount of incidents will most likely increase exponentially[21].

Since there are no standardized requirements for companies to disclose their security incidents, a realistic global total amount might not be obtainable. Finding reliable sources for information regarding incidents for a thesis such as this, is therefore difficult. With that said, the increased attention, and most likely the introduction of regulatory requirements to report incidents such as the California Security Breach Information Act[22] and the General Data Protection Regulation(GDPR)[23], has resulted in more incidents being announced either by the affected companies, or the media.

2.1.1 Financial impact of security incidents

As mentioned, one of the more difficult challenges in information security is deducting quantifiable data. The lack of historical data makes it even harder to estimate what economical effects a security related event might have. While estimating the loss of a security incident is hard in it self, it proves even more difficult when only about a quarter of the actual events that occur are reported. This leads to the an even bigger uncertainty as most of the historical data and research most likely is not a realistic representation. Many of the studies are often done in house, and therefore rely heavily on the knowledge base of their security personnel as well as statistics from their own security systems. Garg[24] proposed to look at a wider spectre comparing and analysing the economical impact of several security incident events. Their reason for choosing this approach is because many of the reports done in house were prone to being subjective as their target audience consists not only of researchers and other independent parties, but also essential stakeholders such as board members and investors. The numbers used for financial impact of the incidents could be adjusted to ensure that stakeholders would not pack up and leave. In addition, their findings show that many of the same reports focused heavily on the tangible losses following a incident, such as cost of replacing damaged systems or loss of income[24]. During their research they discovered that there were several court cases debating if loss of computer data was perceived as physical loss, in the same sense as for instance loss of computer chips for a PC production facility. Rulings went both ways only highlighting the issue at hand; it is not clear cut what actual effect information security incidents has on the value of a company.[24]. These findings were also the results of research done by Jackson[25].

2.1.2 Investing in information security

To ensure that companies can survive a incident, security personnel are continuously looking to new and effective measures for minimizing the risk of an incident occurring. To obtain sufficient funding for implementing these measures, security personnel need to understand what threats their company face and what risk these pose to them. There are several frameworks for risk management that can assist in uncovering this. Through ISO[26], NIST[27] and CIS[28] amongst others, frameworks exist that enable security personnel to structure and understand the risk landscape their company is facing.

Taking the step from understanding what measures need to be taken, to obtaining the needed funding to execute these is one of the key objectives of a Chief Information Security Officer (CISO). During the past years, CISO's have gained increased acknowledgement with senior management. The role of the CISO is steadily maturing and the growing attention to the escalating threat landscape provides CISO's with a stronger platform to advocate their council. Still, recent surveys show that in spite of receiving more recognition, the number one challenge CISO's face, is the allocation of funds to strengthen the information security[29]. As the internet facing systems are taking over as the critical infrastructure for companies, this challenge strengthens the dis-proportionality between what companies value as their critical assets, and to what extent they are willing to invest in securing these[30].

Thomas[31] further states that to make the assessment of security risk more usable in other disciplines, it is essential that methods are used that can quantify the security risk. It is after all easier to compare numbers with other numbers rather than numbers with a report. The main challenge of quantitative methods according to the research is that the lack of historical data makes it difficult to establish a reliable basis for the calculations[31, 32, 33].

One way to address this knowledge gap according to research is to adapt methods and models that are more known to the business world and use them to quantify the investments in information security. Daneva[32] and Su[33] discuss how different financial models can be adapted into security terms. The Real Options Analysis(ROA) was initially used for assessing the different financial options for tangible capital investments to ensure that all possibilities are considered. By using the same methodology, assessing the different approaches available can reduce the uncertainty of an security investment. The different approaches range from postponing investment until you have enough knowledge, to scaling up or down so that implementation can be tested before a full roll out, to outsourcing to a security vendor. Considering all of these aspects enables the parties to better understand what possibilities they have as well as increasing their agility if a given situation were to change[32].

Other models discussed are Return on Security Investment(ROSI), Annual Loss Expectency(ALE) and Net Present Value(NPV). ROSI is a cost benefit analysis in the simplest form where the costs of the investment are measured against the benefits reaped at a single point in time. Since calculating benefit from security events or systems is difficult, models such as ALE can be used to better quantify the investment. ALE looks at the rate of occurrence of a given event against the loss expected, should that event happen. By calculating the ALE before the security investment and comparing it to the ALE after the security investment, some sense of benefit can be extracted. To extend this reasoning from a single point investment to a longer perspective, NPV can be added to the ROSI. NPV explains the long term benefits of an investment by illustrating how an investment will be beneficial over time. Since there is no knowing when an event will occur, justifying the investment at the time of the investment can be difficult. By using NPV, the decision maker can more easily comprehend the long term benefits of an investment[33]. The struggle many are facing when using these models, is as mentioned earlier the historical database. All of the calculations require knowledge of what a single incident costs a company, how much loss control measures cover and what the initial value state of the assets are to name a few[31, 32, 33, 34].

Studies have been conducted in order to ascertain the cost aspect of security incidents. The Ponemon Institute[5] conduct yearly studies to highlight the cost of security incidents. Based on the data set used for the study, the average cost of an incident is $3.9 million. This number has grown approximately 10% each year since the first study in 2004. In their calculations, the cost of an incident consists of both direct(such as forensics, customer support, discounted products) and indirect costs(such as in-house investigation, calculated value of customer loss and customer acquisition rates). Although the calculations are quite extensive, knowing how much of the cost of these activities or calculating how much customer loss is affected by an incident is no easy task. If security personnel cannot factually state the relation between an incident, the cost it entails and the investments needed to reduce the risk of it occurring, presenting a sound foundation for funding requests might seem like an impossible task.

2.2 Beyond the security incident - Event Study Analysis

Instead of focusing on all the different aspects of an incident, many researchers have explored another field to obtain answers. I will go more into detail on these in section 2.3. At the end of the day, senior management has the responsibility to ensure that the company stake holders are satisfied. For publicly traded companies, this satisfaction can be related to the performance of a company's stock price. In finance, there are many models and simulations to look at how stock prices perform. When looking to understand how an event affects the company's value, an Event Study Analysis is conducted. Event studies are commonly used to understand what reactions the stock market has to a given event, and how a company' stock returns are behaving during this period[35]. Any types of events can be the catalyst, ranging from macroeconomic changes to more company specific events such as launch of new services or products, or even security incidents. The event study does this by measuring what effect the announcement of an event has on stock price behaviour. The goal is to ascertain whether the behaviour is abnormal for a given stock, depending on the stocks historical behaviour[36, 6, 37, 38, 39, 40, 41, 42]

2.2.1 Event Study Theory

Event study theory was first introduced in 1933 [43], but the theory we know today was not shaped until the 1960s. At its core, event study theory has three basic assumptions[44]. Firstly, the stock market is an efficient market. What that means is that the event study methodology assumes that capital markets accurately reflect the economic implications that the events in question has for the given company. Secondly, during the analysis period, the event, which is the key research point, should be the only event that has significant influence on the stock price changes. In an ideal world, that means that even if another event was occurring in the same analysis window, it would not affect the stock price. Finally, Event study theory assumes that the consequence of the event could be measured by the abnormal return rate on the stock.

Mackinlay[44] Explains the general event study methodology more in detail. Simplified, event studies are built on the following: It estimates the 'normal return' on the stock of the company in question on the trading days before, on and after the event, based on a predefined estimation window prior to the event. Next, it deducts this 'normal return' from the actual return for the company on the market, which shows that company's 'abnormal return' caused by the event.

Even though the basics of event study theory are the same across the board, the differentiating factor is the method used by the study to estimates the 'normal return'. The most common model for 'normal returns' is the 'market model' [45, 46]. The market model assumes that asset returns are jointly multivariate normal and identically and independently distributed through time. Based on this assumption, the market model is specified as; a linear relationship between R_{it} (return for security *i* at time *t*) and R_{mt} (return for the market *m* at time *t*) follows from joint normality where:

$$R_it = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \text{ with } E(\varepsilon_{it}) = 0 \text{ and } Var(\varepsilon_{it}) = \sigma_i^2$$

By employing this model, the analysis makes use of an estimation window prior to the event to derive the typical relationship between the company's stock and a given reference index by way of a regression analysis. Based on the regression coefficients ($\hat{\alpha}_i$ and $\hat{\beta}_i$) which are calculated during L_1 (the length of the estimation window), the 'normal returns' for the stock in question are estimated and used to calculate the 'abnormal returns' during L_2 (the length of the event window) and forward in time as $AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$ where AR_{it} is the abnormal return for security *i* at time *t*[45, 46]. The analysis window is illustrated in figure 1.

AR_{it} along with the error term of the market model is calculated on the forecast error, or in other words, the difference between the actual R_{it} and the forecast. For $H0$: the event has no effect when, conditional on the returns of the event window, the abnormal returns are jointly normally

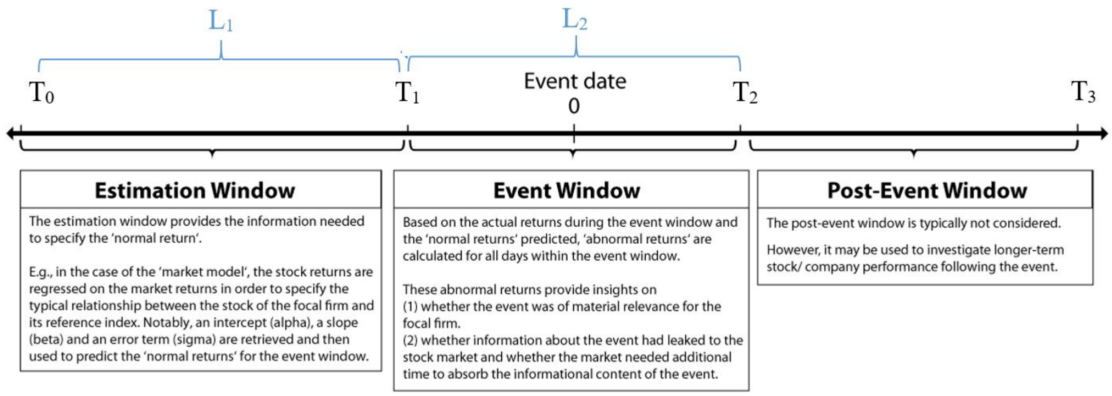

Figure 1: Analysis window Adapted from Benninga 2014

distributed with a 0 conditional mean and a conditional variance given by:

$$\sigma^2(AR_{it}) = \sigma_i^2\left[1+\frac{1}{L_1}+\frac{(R_{mt}-\hat{\mu_m})}{L_1\hat{\sigma}_m^2}\right] \text{ where } \hat{\mu_m}=\frac{1}{L_1}\sum_{L_1}R_{mt} \text{ and } \hat{\sigma}_m^2=\frac{1}{L_1}\sum_{L_1}(R_{mt}-\hat{\mu_m})^2$$

In reality, $\hat{\sigma_i^2}$ is used in stead of σ_i^2 , where $\hat{\sigma_i^2}=\frac{1}{L_1-2}\sum_{L_1}(R_{it}-\hat{\alpha}_i-\hat{\beta}_iR_{mt})^2$[47].

This is the de facto formula for computing the variance of a forecast error, when applied to the market model. As long as R_{mt} in the event window is similar to R_{mt} in the estimation window, $\frac{(R_{mt}-\hat{\mu_m})^2}{\hat{\sigma_m}^2}$ is small. Furthermore, as L_1 increases, $\sigma^2(AR_{it})\to\sigma_i^2$[45, 46].

When conducting an event study, the estimation window should usually be chosen to be large enough so that:

$$\sigma^2(AR_{it})\approx\sigma_i^2$$

For $H0$: the event has no impact when $AR_{it}\sim N(0,\sigma^2(AR_{it}))$

These abnormal returns must be aggregated in order to draw inferences:

- sum across periods in the event window
- sum across companies

Firstly, summing across time to obtain a cumulative abnormal return is defined as follows:

$CAR_i(t_1,t_2)=\sum_{t=t_1}^{t_2}AR_{it}$ sums the abnormal returns on security i from period t1 to period t2, where $T_1\le t_1\le t_2\le T_2$

Asymptotically, as $L_1\to\infty, Var\left[CAR_i(t_1,t_2)\right]=\sigma_i^2(t_1,t_2)=(t_2-t_1+1)\sigma_i^2$.

For $H0$, $CAR_i(t_1,t_2)\sim N(0,\sigma_i^2(t_1,t_2))$.

Next, aggregating across companies and assuming the CARs are independent across securities.

In order to aggregate across companies, simply sum the individual CAR_i terms:

$$\overline{CAR}(t_1, t_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(t_1, t_2) \text{ where N is the number of companies}$$

By further assuming that the CARs are independent across companies,

$$Var(\overline{CAR}(t_1, t_2)) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2(t_1, t_2), \text{ the covariance terms are 0.}$$

For $H0$, the event has no effect when $\overline{CAR}(t_1, t_2) \sim N(0, Var(\overline{CAR}(t_1, t_2)))$.

As per statistical validity theory, if individual abnormal returns differ from zero, test statistics need to be applied. A test statistic to test $H0$ is

$$\theta = \frac{\overline{CAR}(t_1, t_2)}{Var(\overline{CAR}(t_1, t_2))^{1/2}} \sim N(0, 1); \text{ asymptotic with N and} L_1$$

so use Standard Normal Distribution Tables[45, 46, 47].

2.3 Related work

2.3.1 Communicating information security

Fenz et al.[48] discussed the most critical challenges with information security risk management in their article. Along with unstructured asset management, poor practical implementation of effective risk management and knowledge sharing, they pointed out that understanding the actual cost of countermeasures was one of the key challenges. Grounding the cost in the perceived risk for the company's assets proved challenging as there was no direct link between the cost of an incident and the cost a countermeasure. The lack of viable security metrics were pointed to as a main contributor to this disconnect. A solution to this problem according to Fenz et al.[48] was to employ the knowledge and experience from others in the company, to aid in a decision support system. Relying on accounting for better evaluation techniques, operations for better understanding of the value chain and other schools of knowledge would enable security professionals to achieve a more holistic understanding of the landscape of the company. This in turn would enable you to establish a more viable security risk management system with security metrics rooted in actual understandable business context.

This notion was further by Soomro et al.[49]. They conducted a literature review on how information security management need to understand the different managerial roles in order to adopt these into their work with information security. As with Fenz et al.[48] the goal was to use other schools of knowledge to improve the standing of information security in the company. Soomro et al. also elaborated on several activities that would help in lifting information security to a organization wide level, such as training and awareness, risk management systems and policy enforcement. They also suggested several activities that would directly elevate information security issues to business security issues. The notion was that information is such an integral part of a company today, that any risk to information should be addressed as a risk to the business.

This also required an understanding of what drivers the different business areas have, and to connect information security to those drivers. If you are to successfully align the information security strategy and architecture with the business strategy and enterprise architecture, speaking the same language is crucial for ensuring anchoring at this level. Soomro et al.[49] made point out of looking at information security less as a technical field and more as a business field. Horne et al.[50] also emphasised the importance of ensuring that information security was less viewed as system and asset security domain, and more aligned with business drivers. This would ensure that any information security measure would be understandable and reasonable for the different business areas in a company.

This was further discussed by Ahmad and Maynard[51], who stated that the focus moving forward should be to only address information security as a business and managerial effort rather than a technical matter. Their study looked at how students in information security reacted to this approach to understanding the subject matter. Although more abstract and challenging to grasp, their study showed that the students responded well to a different approach to security, and highlighted the challenge of communicating with senior management. The notion was not that senior management did not have the knowledge or understanding of the importance of information security, but their focus was to ensure increased business value whereas information security came across as business dampening. This only strengthens the problem highlighted in my thesis. The problem does not seem to be the lack of knowledge about information security, but rather how it affects the business drivers and goals.

Narain Singh et al.[52] also studied how information security management should be positioned against the key business success factors. Their study showed that support from senior management was crucial for obtaining a level of anchoring across the company for this to work. The key challenge for increasing knowledge was identified as obtaining funds for resources to do so, and communicating efficiently with senior management would ensure their lasting support.

2.3.2 Event studies in information security

As mentioned, several studies have been conducted using event study methodology to ascertain whether there is a correlation between announcing security incidents and the behaviour of the stock value of a company. The results from these studies vary because the sample population and estimation factors vary.

In a event study by Campbell et al.[36], the goal of the study was to understand whether value of a publicly traded US company was affected by the publication of a security incident. The study aimed to understand whether the effect the announcement differed depending on whether confidential information was affected by the incident or not. They chose to work with a null hypothesis, where disproving it would indicate that announcing a security incident affects company value. In their study, they chose the standard 'market model' estimation method with Ordinary Least Squares(OLS) to estimate linear regression parameters, as well as Seemingly Unrelated Regression(SUR) to ensure that clustering of events would not affect the result. The total sample population for the study was 43 events, spanning 5 years from 1995 to 2000. The analysis window for the study was set to 123 days, where the first 120 were the estimation period, and the last three days were the event window $[-1, +1]$.

The results of the studies showed that there was a statistical significant negative market reaction to announcing a security incident where confidential information was compromised, but not for events where non-confidential information was affected. They concluded with there being a correlation between announcing a incident and negative change in stock price, but only for certain type of events.

The main limitations of their event study was that they only captured the market reaction to announcing the incident, not how the stock behaved after the event window. They also found it challenging to find a solid sample population, as not many incidents were publicly available at the time. The sample population is also outdated as all events used were pre 2000. They also could not eliminate sensitivity for confounding and clustering events, which is a common limitation of event study methodology.

A similar study was conducted by Alonso et al.[53]. They also aimed to investigate the effect announcing a security incident has on the stock value of the company, and had a particular focus on the financial industry. They used the market model with OLS linear regression to obtain the estimated normal return of the stock and the reference index. Their analysis window was a total of 221 days where 114 were used for estimation, 5 were used for the event window $[-1, +3]$ and 101 were used for a post-event window. The study included 20 events from various industries.

Their findings showed a statistical significance for most of the study and especially when credit card data was affected by the incident. The study also showed that even though the effect of the event could be seen for quite some time after the event, most of the companies in the study experiences that their stock stabilized around the end of the analysis window.

Although their study was sound, the small population makes the study a bit unreliable. Had they included more events, their study could have had a better foundation for their findings.

Another study by Hinz[37] focuses more on the impact of announcing a security incident on the victim company as well as similar companies. In addition, the study also looks at any change in the way investors look at the systematic risk on the security of that stock. The study uses the market model with OLS for estimating the expected return on the stock. Furthermore, this study only included 6 events within the consumer electronics industry. the analysis window lasted 221 days, where the first 170 were the estimation window, the next 30 were used as a buffer to ensure that the estimation window was not affected by an early leakage of the event, and the last 21 were the event window $[-10, +10]$.

The findings of their study indicated a statistical significance for both the victim company and other companies in the same industry. At the same time, there was no change is investors outlook on the systematic risk of the security of the companies in question.

The most obvious limitation of this study was the small sample population. With only 6 events studied, the results do not give a good representation of the question at hand. The fact that it is limited to one sector also makes it less relevant for any other situations than the one presented in this study. As with Campbell et al.[36], this study also did not include a post-event window to see whether the event had any effect after the initial event window.

Hovav and D'arcy[34] conducted a study where they examined how the announcement of virus attacks affected the stock value. Using the market model, they analysed 186 events spanning 14 years (1988-2002). For ensuring study validity, they used 199 days for the estimation window and variable event windows between $[0, 0]$ and $[0, 25]$.

Their study did not show any lower abnormal returns and therefore could not show a statistical significance for the stock price being affected by the events.

The study by Gatzlaff and McCullough[38] focused more specifically on what the effect of privacy related incidents had on the value of the company. In addition they also studied whether the company's response to the incident had any implications for the performance of their stock. This study also used the standard market model for estimating the normal stock return and included a total of 77 events between 2004-2006. The analysis window was 254 days, where 245 were the estimation window, 7 were used as a buffer to separate estimation and event window, and the last 2 were the event window $[0, +1]$. To broaden their study, they also looked at different intervals of event windows from the initial 2 days up to 181 days $[0, +180]$.

Their findings showed a statistically significant negative effect on stock value. The effect was stronger for companies that had higher growth opportunities as well as companies that refused to share details on the incident.

Although their study gives a solid indication of how privacy incidents affect company value, they do not elaborate further on the long term effect of an event. Even though they tested with an event window of 181 days, the premise was that this was a part of the actual event, and not trailing period. As with all event studies on this matter, their sample population could be larger as well.

Another study that looked at the effect of privacy incidents was conducted by Acquisti et al.[54]. They had the same outlook as Gatzlaff and McCullough[38] and also used the market model for estimation. They had a similar amount of samples (79), spanning 6 years between 2000-2006. They used a smaller analysis window where 92 days were used for estimation, 8 days were inserted as buffer, and tested with several event windows between $[-5, +10]$.

Their study showed a short lived significant effect on the stock value as the stock stabilized shortly after the announcement. Their study could have benefited from including a post-event window to see how the value performs over time. Their sample populations was also very diversified and they did not account for outlying events affecting the results.

Bose and Leung[41] on the other hand looked into how announcing an investment of ID theft countermeasures affected the company's stock value. They also used the standard market model for estimation with linear regression method (OLS) to estimate the normal return. Their study consisted of 87 events between 1995-2002, and the analysis window was 233 days, where 199 were the estimation window, 29 were used as a buffer to separate estimation and event window, and the last 5 were the event window $[-2, +2]$.

The event study showed that there was indeed a positive effect on the stock value after announcing a security investment to counter ID theft. Furthermore, their study also showed that smaller companies experienced more effect on the value than larger more established companies

The study was very limited to only include events where ID theft countermeasures were procured, and although it gives a good representation of how such an investment would affect the value of the company, it would be more interesting to see how other types of security investments affect the value as well. Their study also limited the analysis window to the days right after the announcement, missing the opportunity to evaluate a more long term effect on the stock.

Chai et al.[42]did in fact conduct a study where they looked more broader to the effect of announcing any IT security investment on the stock value. They used the market model and had a population of 104 events between 1997-2006. Their analysis window consisted of 255 days for estimation, 45 days were inserted as a buffer, and instead of using a fixed event window, they tested with multiple event windows intervals between $[-2, +2]$.

Their findings were particularly interesting, as the showed that there was indeed a positive effect on the stock, more so when the investment was for commercial exploitation rather than for improving the security of the company. This shows that the power of the announcement is stronger than the event itself, as it is not that common to announce a general improvement of the security without expecting some commercial benefit.

However, their study might fall short as they did not find reliable numbers for the actual cost of the investments. In addition, they did not include a post-event window, and therefore cannot analyse the long term effect of the announcement. It would be interesting to see how the events that were purely for commercial gain performed in the longer run.

A similar study was conducted by Szubartowicz and Schryen[55]. They focused their event study on the relationship between announcing the investment and the actual investment, as well as the relationship between announcing the investment and a significant security incident. They also used the market model for estimating the normal return and investigated 63 events between 2000-2017. They used an estimation window of 121 days, 1 day buffer and a 3 day event window $[-1, +1]$.

In all aspects of their study, they found that the stock value experienced a positive shift due to the events. The highest stock value change came when announcing to invest in information security after a significant security incident in the company's respective industry.

As with Chai et al.[42], they did not have reliable numbers on the cost of investing, nor could they officially verify all of the announcements. Even though they differentiated their study by timing the events both before and after an incident, they did not include a post-event window to investigate whether the change in stock price value normalized or continued to grow.

One thing all of the researched event studies have in common, is that they for the most part focus just on discovering the implications surround the event. None of the studies elaborate further on how these results can be of use to information security professionals. This is likely due to the fact that these studies for the most part are conducted from a financial standpoint, and although it gives a clear indication on where the focus for the financial domain lies, it does not contribute to other domains understanding how this information can be used.

3 Methodology

3.1 Event study

Event study methodology is by design adaptable to many structures, but they all seem to focus around the same seven steps[45]:

3.1.1 Event definition

The first objective when conducting an event study is to define the events of interest as well as establish the length of the period the stock prices of the involved companies in the event will be examined; the analysis window.

For this study, the analysis windows length is established to be a total of 220 trading days divided as follows:

- Event date is selected as the date where the security incident became public either directly by the company or by a reliable media outlet.
- Event window is selected as -1 and +3 trading days before and after the event date. Typically, event windows range in their length between 1 and 11 days and center symmetrically around the event day [56]. Note that in most incidents, returns before the event window starts do not seem significantly negative.
- Estimation window is selected as 114 trading days before the event window starts. Research reviewing 400 event studies shows that estimation window length varies between 30 and 750 days [56]. However, related studies that further investigate the sensitivity of results in an event study suggest that as long as the estimation window is longer than 100 days, results are not sensitive to varying estimation window lengths[57, 58].
- Post-event window is the remaining 101 trading days after the event windows closes.

3.1.2 Selection criteria

Once the events for the analysis are identified, the next step is to determine the selection criteria for including a given company in the study.

For my thesis, the inclusion criteria is whether there is data availability in terms of being listed in SP500 stock market index, as this is my selected reference market.

To obtain a better insight into the different aspects of a incident, a second analysis summarizes some characteristics of the data sample (e.g. sector and type of data affected).

3.1.3 Normal and abnormal returns

In order to appraise the impact an event has, it is vital to measure the abnormal return. The abnormal return is found by subtracting the estimated normal return from the actual return. The estimated normal return is defined as the return the stock was expected to achieve if the security incident did not occur.

I have chosen to use the most common model [56], the market model in order to estimate the normal return. Even though this model is widely accepted as the standard model for event study analysis, there is some criticism. Firstly, the model assumes that the risk-free interest rate included in the α factor is constant. This conflicts with the presumption that market returns vary over time.

The model builds on the actual returns of a given reference market and the correlation of the company's stock with the reference market. For my study, I have chosen the SP500 as a reference index. Equation (a) describes the model as:

$$AR_{it} = R_{it} - E(R_{it}) \text{ (a)}$$

The abnormal return on a given day within the event and post-event window (AR_{it}) represents the difference between the actual stock return (R_{it}) on that day and the estimated normal return $E(R_{it})$.

3.1.4 Estimation procedure

After selecting an estimation model, the parameters of the model must be estimated using a subset of the data. This data corresponds to the estimation window for the analysis $[-114, -2]$.

The estimated normal return is calculated based on two inputs; the historical relationship between the company's stock and its reference index (expressed by the alpha hat and beta hat parameters), and the actual reference market's return ($R_m t$). Equation (b) describes this as:

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i R_{mt} \text{ (b)}$$

3.1.5 Testing procedure

Once the abnormal returns can be calculated, the testing framework for the abnormal returns must be designed, so that it is possible to define the null hypothesis. Furthermore I must determine the techniques for aggregating the abnormal returns of individual companies.

Following general principles of inferential statistics[59], the null hypothesis ($H0$) maintains that there are no abnormal returns within the event window or, whereas my hypothesis ($H1$) suggests the presence of abnormal returns within the event window. For this event study, I will be focusing on disproving the null-hypothesis rather than proving that there is a presence of abnormal returns in the event window.

$$H1 : CAAR =!0$$

$$H0 : CAAR = 0$$

For each event (i), single day ARs within the event window will be aggregated to create 'cumulative abnormal returns (CARs).This is further described in equation (c):

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \text{ (c)}$$

Calculating CAR, meaning that I sum up across time, allow me to study how the stock price slowly reacts to the event, instead of just focusing in the event window $[-1, +3]$. Therefore the abnormal returns over several periods/days need to be accumulated to account for the impact of the event. Also looking at the CAR, I can further investigate for a possible overreaction and not only a possible initial under-reaction in the days surrounding the event.

However, by looking at a CAR that stretches over too many periods, the impact of the event will eventually become too small to detect, given the normal variability over the period of the CAR. In practice, this means that the confidence intervals increase with the size of periods of the CAR. Eventually even if there is significant impact to the stock value, a too long CAR will not statistically detect it.

Single day CARs will also be further aggregated across all the studied events to create 'cumulative average abnormal returns' (CAARs) as shown in equation (d):

$$\overline{CAR}(t_1, t_2) = \frac{1}{N} \sum_{i=1}^{N} CAR_i(t_1, t_2) \text{ (d)}$$

With N = number of studied events.

By obtaining this cross-sectional average, I am able to focus on the event under investigation without worrying that other events also occur during the analysis period. Nevertheless, it allows me to estimate the average size of the impact.

To test the Null hypothesis H0: $CAAR = 0$, I'll use a defined t-test as shown in equation (e):

$$t_{CAAR} = \frac{\overline{CAR}(t_1, t_2)}{Var(\overline{CAR}(t_1, t_2))^{1/2}} \text{ (e)}$$

Where $Var(\overline{CAR}(t_1, t_2))$ represents the variance of the cumulative abnormal returns across all the events in the study(S^2CAAR). This is further defined in equation (f):

$$Var(\overline{CAR}(t_1, t_2)) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_i^2(t_1, t_2) \text{ (f)}$$

With $\sigma_i^2(t_1, t_2)$ representing the variance of the cumulative abnormal returns in each event (S^2CAR). Equation (g) defines this further:

$$\sigma_i^2(t_1, t_2) = Var[CAR(t_1, t_2)] = (t_2 - t_1 + 1)\sigma_i^2 = (t_2 - t_1 + 1)\hat{\sigma}_i^2$$

In practice, I will be using the estimated variance (S^2AR_i) in place of the actual variance of each event.

If the null hypothesis is supported, $tCAAR$ follows a Student's t distribution.

The null hypothesis is rejected only if the p-value is less than the significance level. The significance level is described as the probability of rejecting the null hypothesis given that it is true (type I error) and is most often set at 0.05 (5%) [60]. In this case, if the significance level is 0.05, then the conditional probability of a type I error, given that the null hypothesis is true, is 5%. A statistically significant result is one in which the observed p-value is less than 5%, which is formally written as p-value < 0.05.

3.1.6 Empirical results

In addition to presenting the empirical results, the presentation of diagnostics can be fruitful. Often, especially in studies where the amount of events is limited, the empirical results can be heavily influenced by one or two outliers. In addition, to ensure a broader understanding of how significant the correlation is, different significance levels will be considered.

3.1.7 Interpretation and conclusions

Ideally, the empirical results will lead to insights into how the mechanism by which the information security event affects stock prices behaves over time.

Assumptions

1. Asset returns are jointly multivariate normal and independently and identically distributed through time.
2. During the event period, there are no other events with value implications.
3. The CARs are independent across firms. Although in 13 of the 58 studied events, their event windows overlap.
4. The length of the estimation window (L_1) is large enough so that $\sigma^2(AR_{it}) = \sigma_i^2$
5. $\hat{\sigma}_i^2$ is used instead of σ_i^2

3.2 Practical implementation

To perform this study in practice, the steps using MS Excel as a supporting tool, are summarized as follows [61]:

(a) For each event (i):

1. Obtain the returns of the company's stock R_{it}, as well as the returns of the reference index for the market R_{mt} per day (t) for the entire analysis window (estimation, event, and post-event). Use the Adjusted Close Stock price.
2. Identify the sequences of company and market returns to be included in the estimation window. Calculate the alpha hat, beta hat and sigma hat coefficients using the Excel formulas *intercept*, *slope* and *steyx* respectively.
3. Take the actual market returns on the event date (as well as other days in the event window) and use the alpha and beta value of the event to calculate expected returns throughout the event and post-event window. These returns represent the hypothetical returns a company would expect had the event not taken place.
4. By deducting these expected returns from the actual returns of the company's stock throughout the event window, calculate the abnormal returns, AR_it.
5. Calculate the $CARs$ within the event and post-event window
6. Calculate the S^2CAR within the event and post-event window

(b) Calculate the average of selected single cumulative abnormal return during the event window, $CAAR$.
(c) Calculate the standard deviation of the cumulative abnormal returns across the selected events, S^2CAAR
(d) Dividing the $CAAR$ through S_CAAR will yield the t-values needed for the CAAR t-test, $tCAAR$
(e) Using the $T.DIST.RT$, I calculate the right-tail p-value associated to the absolute value of $tCAAR$ with as many degrees of freedom as the sample size.
(f) If right-tail p-value < 0,025 (95% assurance)$\rightarrow$ Reject null hypothesis ($H0$: CAAR=0) $H1$: CAAR!=0
In other words, I have demonstrated that the information security incident event suggest the presence of Abnormal Returns within the event or post-event window.

In addition, for better graphical visualization, I will calculate the 95% confidence interval on either side of the CAAR using $T.INV.2T(0,05; N-1) * SQRT(S^2CAAR)$.

3.3 Data collection

In addition to having a sufficient number of events, it was also important that the events I collected were sufficiently diversified, both in terms different company industries and the type of data that was leaked in the security incident.

Initially, I decided to mainly focus on the finance, retail and technology industry. Later, I decided to collect information regarding the health sector as well as Ecommerce and Social Media. In terms of type of data that was leaked, I focused on Private Personal Information (PPI), credit card information, credentials and Intellectual Property (IP).

It was also important for me that the amount of records affected in the security incident was large enough for it to be a substantial event for the company.

In order for an event to qualify for my analysis, four criteria needed to be met.

1. Since I use the SP500 as my reference market, the company that falls victim to the event must be listed on the New York Stock Exchange (NYSE) or NASDAQ. To ensure validity of the statistical estimations, the company must also have been traded for at least 114 days prior to the announcement event.
2. The event must have been announced before August 2018, as I needed a sufficiently long post-event window to conduct my analysis.
3. The events needed to be within my self-defined scope, both with regards to sector and type of data leaked.
4. The events must have a reported effect on at least 30000 records. This number is chosen mainly because it is the number of reported record that has to affected in order for it to be included in the overview by McCandless[62].

To identify events that meet my criteria, I first started walking through McCandless[62], Armerding[63], and Green[64], before performing more general Internet searches. I also cross-checked events where PPI cas affected with the Chronology by Privacy Rights Clearinghouse[65]

To obtain information on other events of relevance that could have affected the stock price, I used general internet searches. All historical data, both reference index and company stock prices, have been collected from Yahoo Finance [66].

3.3.1 Events collected

In order to conduct the analysis and draw a conclusion based on statistical significant results, I initially identified 68 events. After researching the events and investigating for any other events of significance within the analysis window, I ended up disqualifying 11. Of these 11, 3 had other events of significance within the analysis window and 8 were de-listed from the stock exchange, making it difficult to find any historical stock data. The therefore ended up collecting data from 57 of these events.

4 Findings

4.1 Sample population

The event study analysis is based on the following sample population

Inc#	Event	Sector	Attack / Consequence	Published Date
Inc1	Adidas	Retail	PPI Credentials	28.06.2018
Inc2	Adobe	Technology	Credit card Credentials	13.10.2013
Inc3	Anthem	Health Care	PPI	02.02.2015
Inc4	AOL	Technology	PPI Credentials	28.04.2014
Inc5	Apple1	Technology	PPI (Device ID)	03.11.2012
Inc6	Apple2	Technology	PPI	22.07.2013
Inc7	AT&T1	Technology	PPI	13.06.2014
Inc8	AT&T2	Technology	PPI	10.06.2010
Inc9	Automatic Data Processing	Technology	PPI	06.07.2016
Inc10	Best Buy	Retail	PPI	05.05.2018
Inc11	Blizzard	Technology	Credentials	01.01.2012
Inc12	Centene	Health Care	PPI	25.01.2016
Inc13	CitiGroup	Finance	PPI	09.06.2011
Inc14	Community Health Services	Health Care	PPI	18.08.2014
Inc15	Dun & Bradstreet1	Ecomm & Social media	PPI	25.11.2013
Inc16	Dun & Bradstreet2	Ecomm & Social media	PPI(sensitive)	15.03.2017
Inc17	Ebay	Retail	PPI (email/home address) Credentials	21.05.2014

Table 1: Selection of Events

Inc#	Event	Sector	Attack / Consequence	Published Date
Inc18	Equifax	Finance	PPI	17.11.2017
Inc19	Experian	Finance	PPI	01.10.2015
Inc20	Facebook	Ecomm & Social media	PPI	17.03.2018
Inc21	Fidelity National Information Services (FNIS)	Finance	Credit card PPI	03.07.2007
Inc22	Gamestop	Retail	PPI Credit card	01.04.2017
Inc23	Gap Inc	Retail	PPI	29.11.2007
Inc24	Global Payments Inc	Finance	Credit card	30.03.2012
Inc25	Heartland Payment Systems	Finance	Credit card	20.01.2009
Inc26	Hewlett Packard	Technology	PPI	22.03.2006
Inc27	Home Depot	Retail	Credit card PPI (email)	02.09.2014
Inc28	HSBC	Finance	Credit card	14.04.2005
Inc29	JPMorgan	Finance	PPI (email/home address)	27.08.2014
Inc30	Macys	Retail	PPI Credit card	01.07.2018
Inc31	Merck	Health Care	IP	27.06.2017
Inc32	Monster1	Ecomm & Social media	PPI	21.08.2007
Inc33	Monster2	Ecomm & Social media	PPI	23.01.2009
Inc34	Morningstar	Finance	Credit card PPI Credentials	07.05.2013
Inc35	NASDAQ	Finance	Credentials	19.07.2013
Inc36	Pfizer	Health Care	PPI	04.11.2007
Inc37	Quest Diagnostics	Health Care	PPI	12.12.2016
Inc38	Royal Bank of Scotland	Finance	Credit card	29.12.2008
Inc39	RSA	Technology	IP	22.03.2011

Table 1: Selection of Events

Inc#	Event	Sector	Attack / Consequence	Published Date
Inc40	Sears	Retail	Credit card	04.04.2018
Inc41	Sonic	Retail	Credit card	26.11.2017
Inc42	Sony PSN1	Retail	Credentials Credit card	27.04.2011
Inc43	Sony PSN2	Retail	PPI	24.11.2014
Inc44	Starbucks	Retail	PPI	24.11.2008
Inc45	SuperValu	Retail	Credit card	15.08.2014
Inc46	Target	Retail	Credit card	13.12.2013
Inc47	TJX	Retail	Credit Card	17.01.2007
Inc48	T-Mobile	Technology	PPI	01.10.2015
Inc49	Twitter	Ecomm & Social media	Credentials	03.05.2018
Inc50	Under Armour	Retail	Credentials	29.03.2018
Inc51	UPS	Services	Credit card Personal data	20.08.2014
Inc52	Verisign	Technology	IP	02.02.2012
Inc53	Viacom	Technology	Credentials	29.11.2017
Inc54	Vodafone	Technology	PPI	12.11.2013
Inc55	Yahoo (Yahoo! Mail)	Technology	Credentials	30.01.2014
Inc56	Walmart	Retail	PPI	14.03.2018
Inc57	Walt Disney	Ecomm & Social media	Credentials	29.07.2016

Table 1: Selection of Events

For details on the analysis of each event, see "Appendix: Event Summary".

4.2 Data and calculations

All the calculations and source data for the analysis can be found in the attached excel file. For more information, see "Appendix B".

The event study findings focus on the Cumulative Abnormal Returns of the events in the sample population, which you will find under Results.

4.2.1 Comparing CARs

The following figure shows the Cummulative Abnormal returns of all the events in the study during the analysis window:

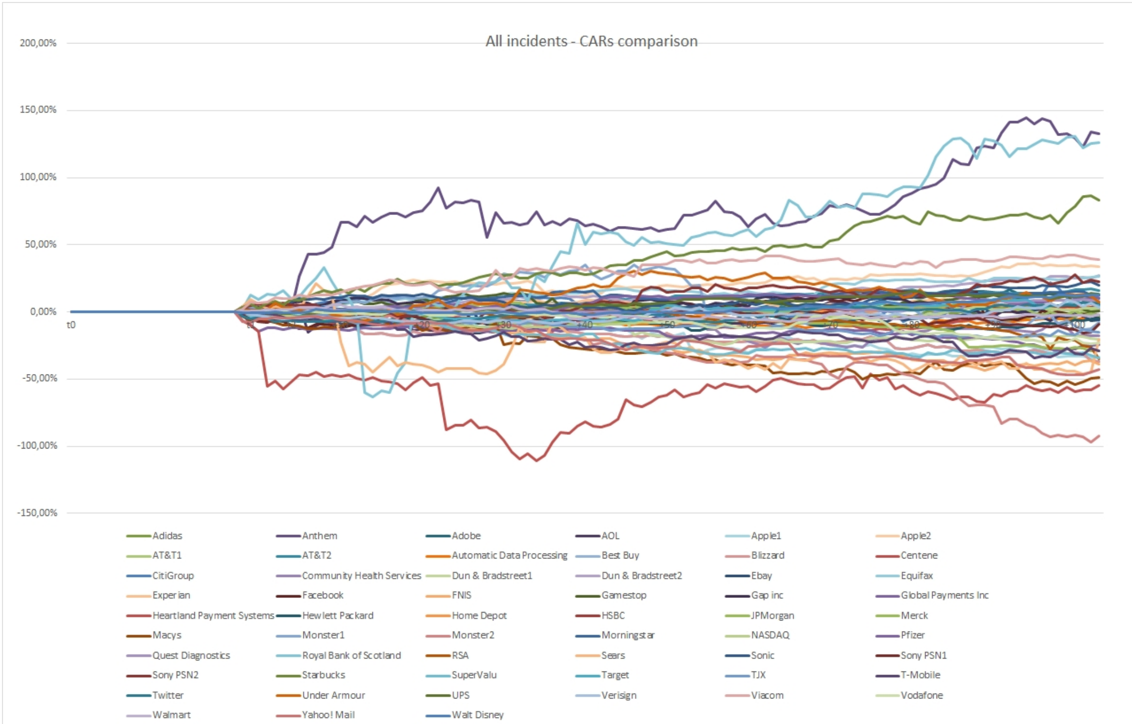

Figure 2: CARs for All Events

As you can see, there are several events that are radically different to the mass population in the study. These can be known as outliers[67]. As these can radically change the findings when accumulated with the other events, it is beneficial to interpret the results both with and without these outliers. The following analysis and interpretation will take this into consideration and present the findings.

Outliers

The specific events were chosen as outliers based on the drastically abnormal behaviour compared to the general sample population. Almost all of the experience fluctuations of 100% against the reference index during the analysis window, and some of them also spike at certain points during the window, To understand more about why these events behave different than the general sample population, I investigated each of them for other events during the analysis window that could affect the value of the stock.

Anthem

The stock price rose with over 20% on February 10th 2015(Event day+2) without the announcement of any new events, and kept rising until it reached a 132% increase t3.

Heartland Payment Systems

The stock declined with 55% on January 22nd 2009(Event day+2) and hit an all time low with a decline of 11& on Event day+35). Their CEO even publicly admitted that the stock performance was due to the incident and the following efforts to regain business[68]

Royal Bank of Scotland

The stock declined 11% on Event day+14, before stabilizing and starting is rise with 13% event day+36 and ending on 126% on t30. During the investigation, I discovered that an announcement on Event day+40 on the magnitude of losses in the previous year. This had been a part of a larger turbulent period for the bank, spanning several years[69]. As I cannot find any other event of interest during the analysis window, the macro event could be why the security event was not affecting the stock price during the analysis window.

Sears

The stock declined 34% on event day+11. After investigating further, Sears both announced that they received the ENERGY STAR® Partner of the Year Awards and that they will be auctioning off some of their stores around this time. Since it is not clear whether this affected the stock directly, I have chosen to flag it as an outlier, so that the accumulated results can be unbiased[70, 71]

4.3 Results

To present the results from the event study analysis, this section shows the main analysis of the entire sample population. In addition, a more drill down analysis of the different industries is presented, as well as analysis of type of data affected in the incident.

The results are presented using a graphical representation of the Cumulative Average Abnormal Return with a 95% confidence interval. The confidence interval provides a visual representation of the significance level towards 95% statistically assurance. This is done to show that if the interval includes the zero value, it is not statistically significant to the event study.

To see if there is a strong correlation in cases where I cannot prove 95% statistical significance, I have also chosen to present intervals for 85% and 90% confidence intervals.

The event studies presented are:

- All events in the sample population
- All events in the sample population without the outlier
- Events in the sample population belonging to companies in the financial industry
- Events in the sample population belonging to companies in the financial industry without the outliers
- Events in the sample population belonging to companies in the retail industry
- Events in the sample population belonging to companies in the retail industry without the outliers
- Events in the sample population belonging to companies in the ecommerce and social media industry
- Events in the sample population belonging to companies in the ecommerce and social media industry without the outliers
- Events in the sample population belonging to companies in the technology industry
- Events in the sample population where credit card data was affected
- Events in the sample population where credit card data was affected without the outliers
- Events in the sample population where private personal information was affected
- Events in the sample population where private personal information was affected without the outliers
- Events in the sample population where credentials were affected

4.3.1 CAAR All events

The Cumulative Average Abnormal Return of all the events in the sample population during the analysis window:

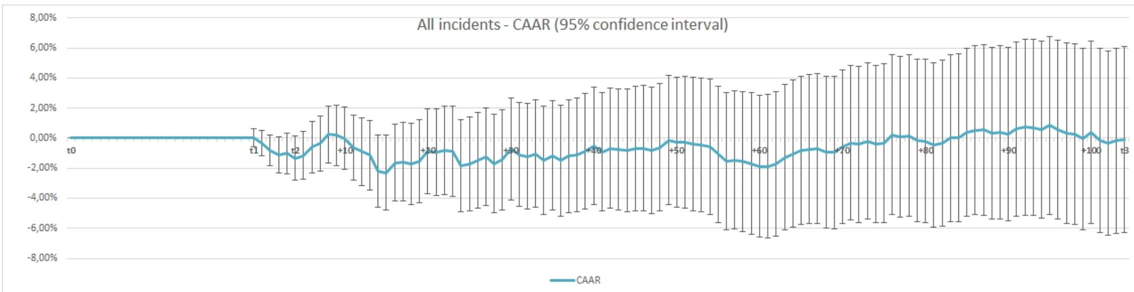

Figure 3: CAAR for All Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,005 %	9,020E-06	1,802E-02	FALSE	FALSE	FALSE
0	-0,354 %	1,804E-05	-8,338E-01	FALSE	FALSE	FALSE
+1	-0,817 %	2,706E-05	-1,571E+00	FALSE	FALSE	TRUE
+2	-1,102 %	3,608E-05	-1,834E+00	FALSE	TRUE	TRUE
+3	-1,008 %	4,510E-05	-1,501E+00	FALSE	FALSE	TRUE
t2	-1,357 %	5,412E-05	-1,845E+00	FALSE	TRUE	TRUE
+10	-0,025 %	1,082E-04	-2,415E-02	FALSE	FALSE	FALSE
+20	-0,877 %	1,984E-04	-6,226E-01	FALSE	FALSE	FALSE
+30	-0,721 %	2,887E-04	-4,246E-01	FALSE	FALSE	FALSE
+40	-0,504 %	3,789E-04	-2,587E-01	FALSE	FALSE	FALSE
+50	-0,276 %	4,691E-04	-1,272E-01	FALSE	FALSE	FALSE
+60	-1,877 %	5,593E-04	-7,936E-01	FALSE	FALSE	FALSE
+70	-0,599 %	6,495E-04	-2,351E-01	FALSE	FALSE	FALSE
+80	-0,198 %	7,397E-04	-7,296E-02	FALSE	FALSE	FALSE
+90	0,278 %	8,299E-04	9,667E-02	FALSE	FALSE	FALSE
+100	0,365 %	9,201E-04	1,203E-01	FALSE	FALSE	FALSE
t3	-0,080 %	9,562E-04	-2,582E-02	FALSE	FALSE	FALSE

Table 2: Summary of CAAR for All Events

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.2 CAAR All events without Outlier

The Cumulative Average Abnormal Return of all the events in the sample population, except for the outliers, during the analysis window:

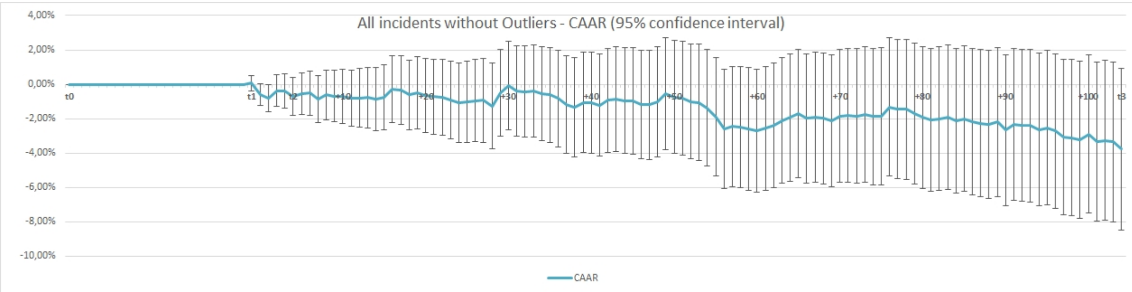

Figure 4: CAAR for All Events without Outliers

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,072 %	5,152E-06	3,157E-01	FALSE	FALSE	FALSE
0	-0,591 %	1,030E-05	-1,841E+00	FALSE	TRUE	TRUE
+1	-0,816 %	1,546E-05	-2,077E+00	TRUE	TRUE	TRUE
+2	-0,369 %	2,061E-05	-8,137E-01	FALSE	FALSE	FALSE
+3	-0,397 %	2,576E-05	-7,823E-01	FALSE	FALSE	FALSE
t2	-0,711 %	3,091E-05	-1,279E+00	FALSE	FALSE	FALSE
+10	-0,721 %	6,182E-05	-9,176E-01	FALSE	FALSE	FALSE
+20	-0,655 %	1,133E-04	-6,155E-01	FALSE	FALSE	FALSE
+30	-0,072 %	1,649E-04	-5,641E-02	FALSE	FALSE	FALSE
+40	-1,067 %	2,164E-04	-7,251E-01	FALSE	FALSE	FALSE
+50	-0,758 %	2,679E-04	-4,629E-01	FALSE	FALSE	FALSE
+60	-2,703 %	3,194E-04	-1,512E+00	FALSE	FALSE	TRUE
+70	-1,845 %	3,709E-04	-9,582E-01	FALSE	FALSE	FALSE
+80	-1,931 %	4,224E-04	-9,393E-01	FALSE	FALSE	FALSE
+90	-2,675 %	4,740E-04	-1,229E+00	FALSE	FALSE	FALSE
+100	-2,895 %	5,255E-04	-1,263E+00	FALSE	FALSE	FALSE
t3	-3,780 %	5,461E-04	-1,618E+00	FALSE	FALSE	TRUE

Table 3: Summary of CAAR for All Events without Outliers

The results show that $CAAR! = 0$ with 95% or more statistical significance only on the day after the event day, but not in the post-event window. The null hypothesis ($H0 : CAAR = 0$) can perhaps be rejected if the event window is $[0, +1]$ but not in the current event window or the post-event window.

4.3.3 CAAR Finance events

The Cumulative Average Abnormal Return of events connected to companies in the financial industry in the sample population during the analysis window:

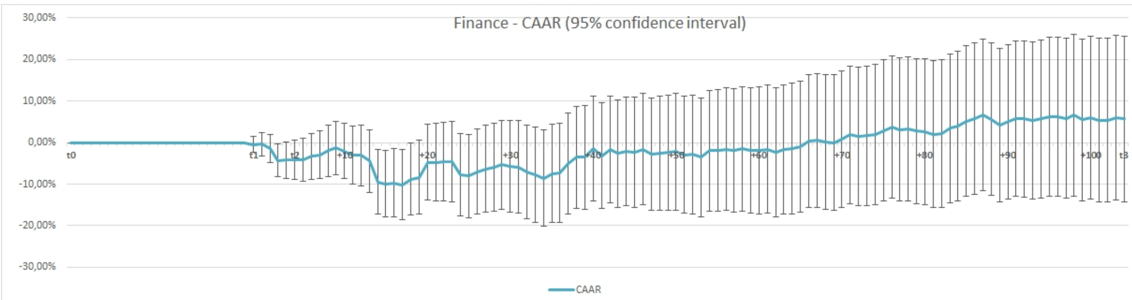

Figure 5: CAAR for Finance Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,496 %	7,576E-05	-5,695E-01	FALSE	FALSE	FALSE
0	-0,422 %	1,515E-04	-3,429E-01	FALSE	FALSE	FALSE
+1	-1,518 %	2,273E-04	-1,007E+00	FALSE	FALSE	FALSE
+2	-4,261 %	3,030E-04	-2,448E+00	TRUE	TRUE	TRUE
+3	-4,232 %	3,788E-04	-2,174E+00	FALSE	TRUE	TRUE
t2	-4,182 %	4,545E-04	-1,962E+00	FALSE	TRUE	TRUE
+10	-2,032 %	9,091E-04	-6,739E-01	FALSE	FALSE	FALSE
+20	-4,751 %	1,667E-03	-1,164E+00	FALSE	FALSE	FALSE
+30	-5,722 %	2,424E-03	-1,162E+00	FALSE	FALSE	FALSE
+40	-1,501 %	3,182E-03	-2,662E-01	FALSE	FALSE	FALSE
+50	-2,227 %	3,939E-03	-3,549E-01	FALSE	FALSE	FALSE
+60	-1,874 %	4,697E-03	-2,734E-01	FALSE	FALSE	FALSE
+70	0,738 %	5,454E-03	9,988E-02	FALSE	FALSE	FALSE
+80	2,642 %	6,212E-03	3,352E-01	FALSE	FALSE	FALSE
+90	5,004 %	6,970E-03	5,994E-01	FALSE	FALSE	FALSE
+100	5,933 %	7,727E-03	6,750E-01	FALSE	FALSE	FALSE
t3	5,693 %	8,030E-03	6,353E-01	FALSE	FALSE	FALSE

Table 4: Summary of CAAR for Finance Events

The results show that $CAAR! = 0$ with 95% or more statistical significance only on event day $+2$, but not in the post-event window. The null hypothesis ($H0 : CAAR = 0$) can perhaps be rejected if the event window is $[0, +2]$ but not in the current event window or the post-event window.

4.3.4 CAAR Finance events without Outlier

The Cumulative Average Abnormal Return of events connected to companies in the financial industry in the sample population, except for the outliers, during the analysis window:

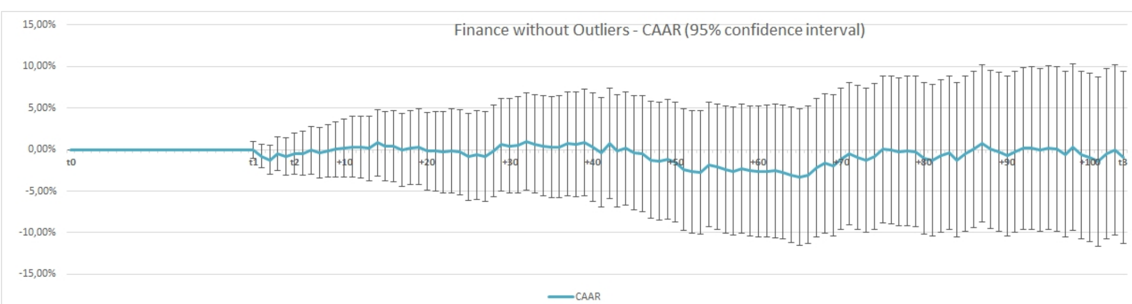

Figure 6: CAAR for Finance without Outliers

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,087 %	1,895E-05	-1,999E-01	FALSE	FALSE	FALSE
0	-0,782 %	3,789E-05	-1,270E+00	FALSE	FALSE	FALSE
+1	-1,258 %	5,684E-05	-1,668E+00	FALSE	FALSE	TRUE
+2	-0,501 %	7,578E-05	-5,756E-01	FALSE	FALSE	FALSE
+3	-0,815 %	9,473E-05	-8,375E-01	FALSE	FALSE	FALSE
t2	-0,522 %	1,137E-04	-4,893E-01	FALSE	FALSE	FALSE
+10	0,222 %	2,274E-04	1,471E-01	FALSE	FALSE	FALSE
+20	-0,200 %	4,168E-04	-9,787E-02	FALSE	FALSE	FALSE
+30	0,422 %	6,063E-04	1,713E-01	FALSE	FALSE	FALSE
+40	0,314 %	7,957E-04	1,112E-01	FALSE	FALSE	FALSE
+50	-1,492 %	9,852E-04	-4,755E-01	FALSE	FALSE	FALSE
+60	-2,670 %	1,175E-03	-7,790E-01	FALSE	FALSE	FALSE
+70	-1,143 %	1,364E-03	-3,094E-01	FALSE	FALSE	FALSE
+80	-1,045 %	1,554E-03	-2,651E-01	FALSE	FALSE	FALSE
+90	-0,759 %	1,743E-03	-1,819E-01	FALSE	FALSE	FALSE
+100	-0,952 %	1,932E-03	-2,166E-01	FALSE	FALSE	FALSE
t3	-0,937 %	2,008E-03	-2,091E-01	FALSE	FALSE	FALSE

Table 5: Summary of CAAR for Finance Events without Outliers

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.5 CAAR Retail events

The Cumulative Average Abnormal Return of events connected to companies in the retail industry in the sample population during the analysis window:

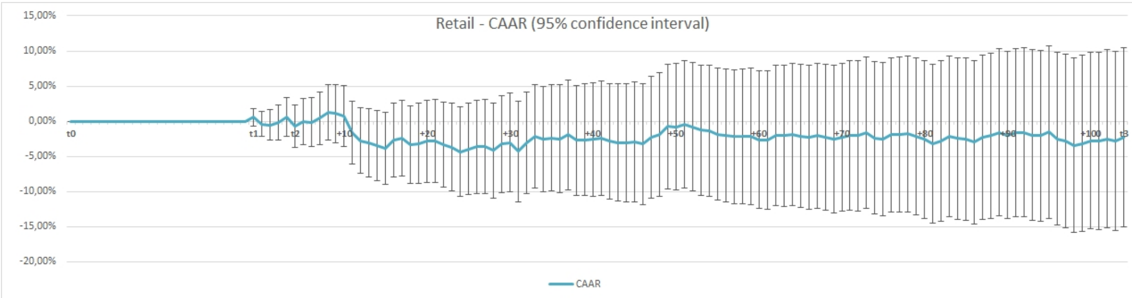

Figure 7: CAAR for Retail Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,558 %	3,439E-05	9,514E-01	FALSE	FALSE	FALSE
0	-0,415 %	6,877E-05	-4,999E-01	FALSE	FALSE	FALSE
+1	-0,561 %	1,032E-04	-5,521E-01	FALSE	FALSE	FALSE
+2	-0,178 %	1,375E-04	-1,516E-01	FALSE	FALSE	FALSE
+3	0,593 %	1,719E-04	4,521E-01	FALSE	FALSE	FALSE
t2	-0,727 %	2,063E-04	-5,063E-01	FALSE	FALSE	FALSE
+10	0,706 %	4,126E-04	3,478E-01	FALSE	FALSE	FALSE
+20	-2,857 %	7,565E-04	-1,039E+00	FALSE	FALSE	FALSE
+30	-3,052 %	1,100E-03	-9,200E-01	FALSE	FALSE	FALSE
+40	-2,589 %	1,444E-03	-6,812E-01	FALSE	FALSE	FALSE
+50	-0,784 %	1,788E-03	-1,853E-01	FALSE	FALSE	FALSE
+60	-2,645 %	2,132E-03	-5,729E-01	FALSE	FALSE	FALSE
+70	-2,315 %	2,476E-03	-4,652E-01	FALSE	FALSE	FALSE
+80	-2,590 %	2,820E-03	-4,878E-01	FALSE	FALSE	FALSE
+90	-1,985 %	3,163E-03	-3,530E-01	FALSE	FALSE	FALSE
+100	-2,751 %	3,507E-03	-4,645E-01	FALSE	FALSE	FALSE
t3	-2,275 %	3,645E-03	-3,768E-01	FALSE	FALSE	FALSE

Table 6: Summary of CAAR for Retail Events

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.6 CAAR Retail events without Outlier

The Cumulative Average Abnormal Return of events connected to companies in the retail industry in the sample population, except for the outliers, during the analysis window:

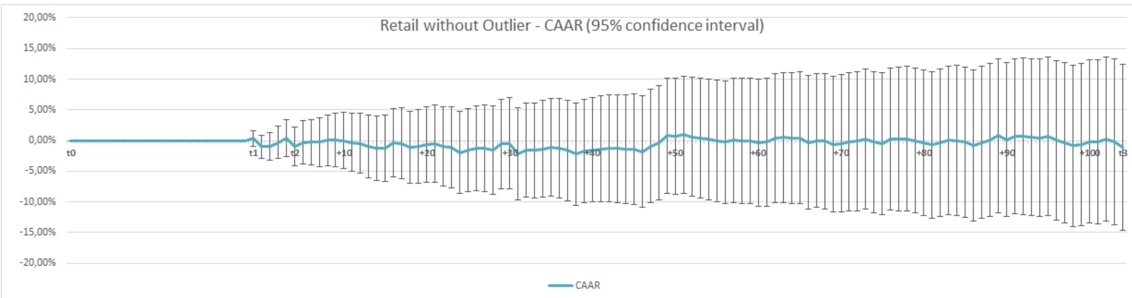

Figure 8: CAAR for Retail without Outliers

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,343 %	3,800E-05	5,568E-01	FALSE	FALSE	FALSE
0	-1,033 %	7,600E-05	-1,185E+00	FALSE	FALSE	FALSE
+1	-0,948 %	1,140E-04	-8,882E-01	FALSE	FALSE	FALSE
+2	-0,340 %	1,520E-04	-2,757E-01	FALSE	FALSE	FALSE
+3	0,388 %	1,900E-04	2,815E-01	FALSE	FALSE	FALSE
t2	-0,961 %	2,280E-04	-6,362E-01	FALSE	FALSE	FALSE
+10	-0,018 %	4,560E-04	-8,582E-03	FALSE	FALSE	FALSE
+20	-0,605 %	8,360E-04	-2,091E-01	FALSE	FALSE	FALSE
+30	-0,501 %	1,216E-03	-1,437E-01	FALSE	FALSE	FALSE
+40	-1,531 %	1,596E-03	-3,833E-01	FALSE	FALSE	FALSE
+50	0,661 %	1,976E-03	1,486E-01	FALSE	FALSE	FALSE
+60	-0,363 %	2,356E-03	-7,484E-02	FALSE	FALSE	FALSE
+70	-0,442 %	2,736E-03	-8,456E-02	FALSE	FALSE	FALSE
+80	-0,332 %	3,116E-03	-5,949E-02	FALSE	FALSE	FALSE
+90	0,163 %	3,496E-03	2,758E-02	FALSE	FALSE	FALSE
+100	-0,146 %	3,876E-03	-2,350E-02	FALSE	FALSE	FALSE
t3	-1,157 %	4,028E-03	-1,823E-01	FALSE	FALSE	FALSE

Table 7: Summary of CAAR for Retail Events without Outliers

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.7 CAAR Ecomm and Social Media events

The Cumulative Average Abnormal Return of events connected to companies in the ecommercial and social media industry in the sample population during the analysis window:

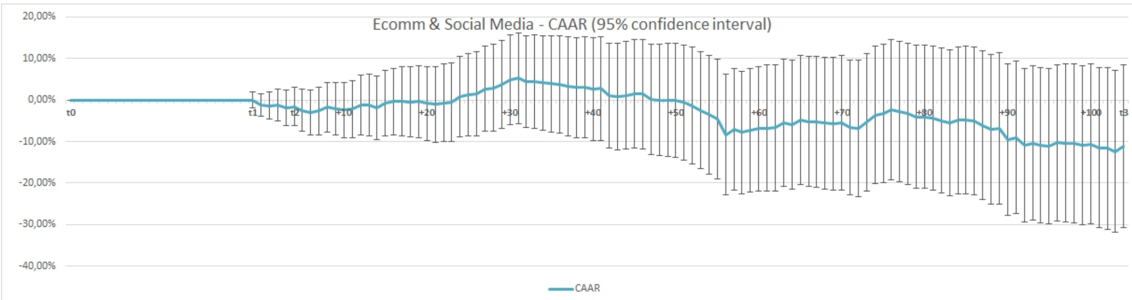

Figure 9: CAAR for Ecommerce and Social Media Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,033 %	6,065E-05	-4,226E-02	FALSE	FALSE	FALSE
0	-1,198 %	1,213E-04	-1,088E+00	FALSE	FALSE	FALSE
+1	-1,329 %	1,819E-04	-9,850E-01	FALSE	FALSE	FALSE
+2	-1,184 %	2,426E-04	-7,603E-01	FALSE	FALSE	FALSE
+3	-1,863 %	3,032E-04	-1,070E+00	FALSE	FALSE	FALSE
t2	-1,593 %	3,639E-04	-8,349E-01	FALSE	FALSE	FALSE
+10	-2,382 %	7,278E-04	-8,830E-01	FALSE	FALSE	FALSE
+20	-0,836 %	1,334E-03	-2,288E-01	FALSE	FALSE	FALSE
+30	4,813 %	1,941E-03	1,092E+00	FALSE	FALSE	FALSE
+40	2,651 %	2,547E-03	5,252E-01	FALSE	FALSE	FALSE
+50	-0,153 %	3,154E-03	-2,733E-02	FALSE	FALSE	FALSE
+60	-6,864 %	3,760E-03	-1,119E+00	FALSE	FALSE	FALSE
+70	-5,544 %	4,367E-03	-8,389E-01	FALSE	FALSE	FALSE
+80	-4,040 %	4,973E-03	-5,729E-01	FALSE	FALSE	FALSE
+90	-9,533 %	5,579E-03	-1,276E+00	FALSE	FALSE	FALSE
+100	-10,623 %	6,186E-03	-1,351E+00	FALSE	FALSE	FALSE
t3	-11,054 %	6,428E-03	-1,379E+00	FALSE	FALSE	FALSE

Table 8: Summary of CAAR for Ecomm and Social Media Events

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.8 CAAR Technology events

The Cumulative Average Abnormal Return of events connected to companies in the technology industry in the sample population during the analysis window:

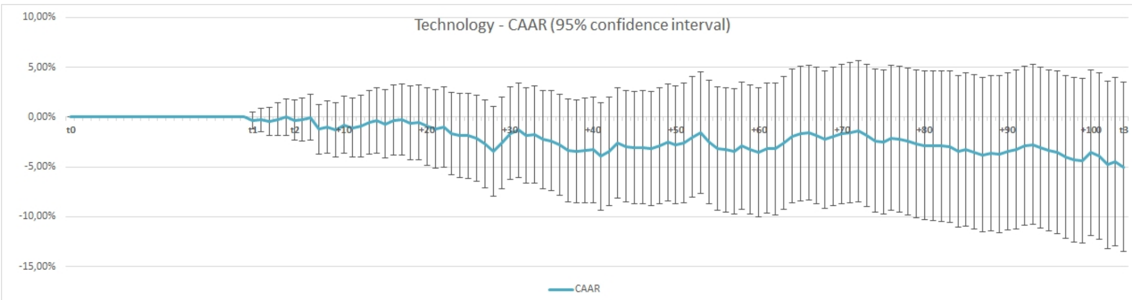

Figure 10: CAAR for Technology Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,347 %	1,475E-05	-9,043E-01	FALSE	FALSE	FALSE
0	-0,276 %	2,950E-05	-5,082E-01	FALSE	FALSE	FALSE
+1	-0,419 %	4,426E-05	-6,291E-01	FALSE	FALSE	FALSE
+2	-0,221 %	5,901E-05	-2,880E-01	FALSE	FALSE	FALSE
+3	-0,007 %	7,376E-05	-7,756E-03	FALSE	FALSE	FALSE
t2	-0,296 %	8,851E-05	-3,149E-01	FALSE	FALSE	FALSE
+10	-0,797 %	1,770E-04	-5,990E-01	FALSE	FALSE	FALSE
+20	-0,939 %	3,245E-04	-5,213E-01	FALSE	FALSE	FALSE
+30	-1,625 %	4,721E-04	-7,480E-01	FALSE	FALSE	FALSE
+40	-3,292 %	6,196E-04	-1,322E+00	FALSE	FALSE	FALSE
+50	-2,776 %	7,671E-04	-1,002E+00	FALSE	FALSE	FALSE
+60	-3,526 %	9,146E-04	-1,166E+00	FALSE	FALSE	FALSE
+70	-1,694 %	1,062E-03	-5,197E-01	FALSE	FALSE	FALSE
+80	-2,868 %	1,210E-03	-8,246E-01	FALSE	FALSE	FALSE
+90	-3,412 %	1,357E-03	-9,262E-01	FALSE	FALSE	FALSE
+100	-3,547 %	1,505E-03	-9,144E-01	FALSE	FALSE	FALSE
t3	-4,998 %	1,564E-03	-1,264E+00	FALSE	FALSE	FALSE

Table 9: Summary of CAAR for Technology Events

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.9 CAAR Credit card events

The Cumulative Average Abnormal Return of events where credit card data was affected in the sample population during the analysis window:

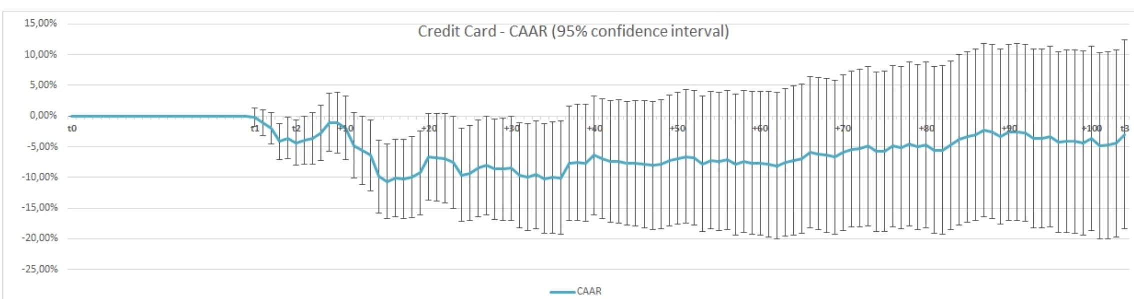

Figure 11: CAAR for Credit Card Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,248 %	4,956E-05	-3,527E-01	FALSE	FALSE	FALSE
0	-1,141 %	9,913E-05	-1,146E+00	FALSE	FALSE	FALSE
+1	-2,023 %	1,487E-04	-1,659E+00	FALSE	FALSE	TRUE
+2	-4,165 %	1,983E-04	-2,958E+00	TRUE	TRUE	TRUE
+3	-3,607 %	2,478E-04	-2,291E+00	TRUE	TRUE	TRUE
t2	-4,361 %	2,974E-04	-2,529E+00	TRUE	TRUE	TRUE
+10	-1,932 %	5,948E-04	-7,924E-01	FALSE	FALSE	FALSE
+20	-6,649 %	1,090E-03	-2,014E+00	FALSE	TRUE	TRUE
+30	-8,526 %	1,586E-03	-2,141E+00	TRUE	TRUE	TRUE
+40	-6,381 %	2,082E-03	-1,399E+00	FALSE	FALSE	FALSE
+50	-6,914 %	2,577E-03	-1,362E+00	FALSE	FALSE	FALSE
+60	-7,746 %	3,073E-03	-1,397E+00	FALSE	FALSE	FALSE
+70	-5,962 %	3,569E-03	-9,980E-01	FALSE	FALSE	FALSE
+80	-4,672 %	4,064E-03	-7,328E-01	FALSE	FALSE	FALSE
+90	-2,672 %	4,560E-03	-3,957E-01	FALSE	FALSE	FALSE
+100	-3,658 %	5,055E-03	-5,145E-01	FALSE	FALSE	FALSE
t3	-2,998 %	5,254E-03	-4,136E-01	FALSE	FALSE	FALSE

Table 10: Summary of CAAR for Credit Card Events

The results show that $CAAR! = 0$ with 95% or more statistical significance between event day $+2$ and the remaining event window, but not in the post-event window. The null hypothesis ($H0 : CAAR = 0$) can therefore be rejected if the event window is $[+2, +4]$ but not in the post-event window.

4.3.10 CAAR Credit card events without Outlier

The Cumulative Average Abnormal Return of events where credit card data was affected in the sample population, except for the outliers, during the analysis window:

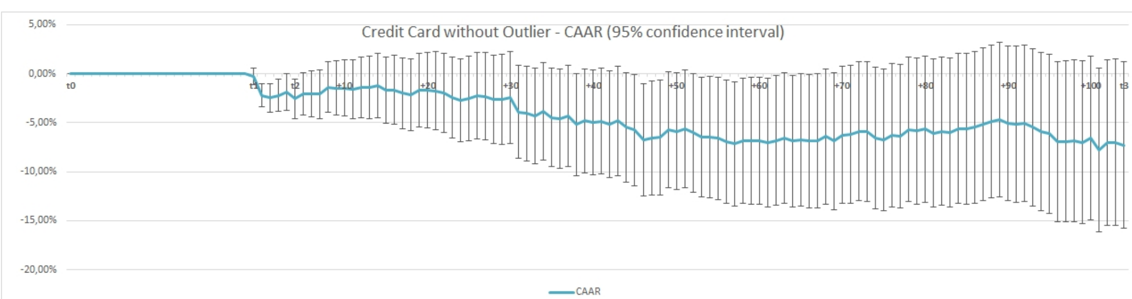

Figure 12: CAAR for Credit Card Events without Outliers

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-0,253 %	1,463E-05	-6,619E-01	FALSE	FALSE	FALSE
0	-2,234 %	2,925E-05	-4,130E+00	TRUE	TRUE	TRUE
+1	-2,475 %	4,388E-05	-3,737E+00	TRUE	TRUE	TRUE
+2	-2,205 %	5,850E-05	-2,882E+00	TRUE	TRUE	TRUE
+3	-1,855 %	7,313E-05	-2,169E+00	TRUE	TRUE	TRUE
t2	-2,560 %	8,776E-05	-2,733E+00	TRUE	TRUE	TRUE
+10	-1,486 %	1,755E-04	-1,122E+00	FALSE	FALSE	FALSE
+20	-1,691 %	3,218E-04	-9,429E-01	FALSE	FALSE	FALSE
+30	-2,453 %	4,680E-04	-1,134E+00	FALSE	FALSE	FALSE
+40	-4,973 %	6,143E-04	-2,007E+00	FALSE	TRUE	TRUE
+50	-5,898 %	7,606E-04	-2,139E+00	FALSE	TRUE	TRUE
+60	-6,853 %	9,068E-04	-2,276E+00	TRUE	TRUE	TRUE
+70	-6,248 %	1,053E-03	-1,925E+00	FALSE	TRUE	TRUE
+80	-5,654 %	1,199E-03	-1,633E+00	FALSE	FALSE	TRUE
+90	-5,068 %	1,346E-03	-1,382E+00	FALSE	FALSE	FALSE
+100	-6,543 %	1,492E-03	-1,694E+00	FALSE	FALSE	TRUE
t3	-7,276 %	1,550E-03	-1,848E+00	FALSE	TRUE	TRUE

Table 11: Summary of CAAR for Credit Card Events without Outliers

The results show that $CAAR! = 0$ with 95% or more statistical significance between the event day and the remaining event window, but not in the post-event window. The null hypothesis ($H0 : CAAR = 0$) can therefore be rejected if the event window is $[0, +4]$ but not in the post-event window.

4.3.11 CAAR Private Personal Information events

The Cumulative Average Abnormal Return of events where private personal information was affected in the sample population during the analysis window:

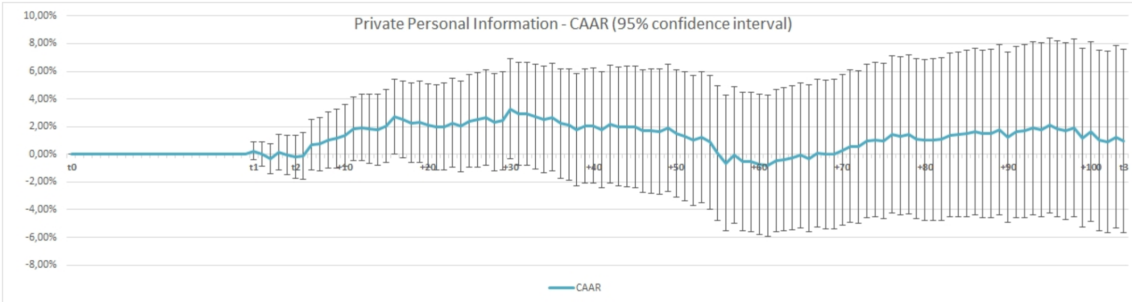

Figure 13: CAAR for for Private Personal Information Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,248 %	9,997E-06	7,841E-01	FALSE	FALSE	FALSE
0	0,018 %	1,999E-05	4,092E-02	FALSE	FALSE	FALSE
+1	-0,321 %	2,999E-05	-5,870E-01	FALSE	FALSE	FALSE
+2	0,159 %	3,999E-05	2,518E-01	FALSE	FALSE	FALSE
+3	-0,061 %	4,999E-05	-8,585E-02	FALSE	FALSE	FALSE
t2	-0,184 %	5,998E-05	-2,379E-01	FALSE	FALSE	FALSE
+10	1,355 %	1,200E-04	1,237E+00	FALSE	FALSE	FALSE
+20	2,110 %	2,199E-04	1,423E+00	FALSE	FALSE	FALSE
+30	3,280 %	3,199E-04	1,834E+00	FALSE	TRUE	TRUE
+40	2,057 %	4,199E-04	1,004E+00	FALSE	FALSE	FALSE
+50	1,506 %	5,199E-04	6,605E-01	FALSE	FALSE	FALSE
+60	-0,724 %	6,198E-04	-2,908E-01	FALSE	FALSE	FALSE
+70	0,316 %	7,198E-04	1,179E-01	FALSE	FALSE	FALSE
+80	1,045 %	8,198E-04	3,651E-01	FALSE	FALSE	FALSE
+90	1,211 %	9,198E-04	3,995E-01	FALSE	FALSE	FALSE
+100	1,633 %	1,020E-03	5,115E-01	FALSE	FALSE	FALSE
t3	0,980 %	1,060E-03	3,009E-01	FALSE	FALSE	FALSE

Table 12: Summary of CAAR for PPI Events

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.12 CAAR Private Personal Information events without Outlier

The Cumulative Average Abnormal Return of events where private personal information was affected in the sample population, except for the outliers, during the analysis window:

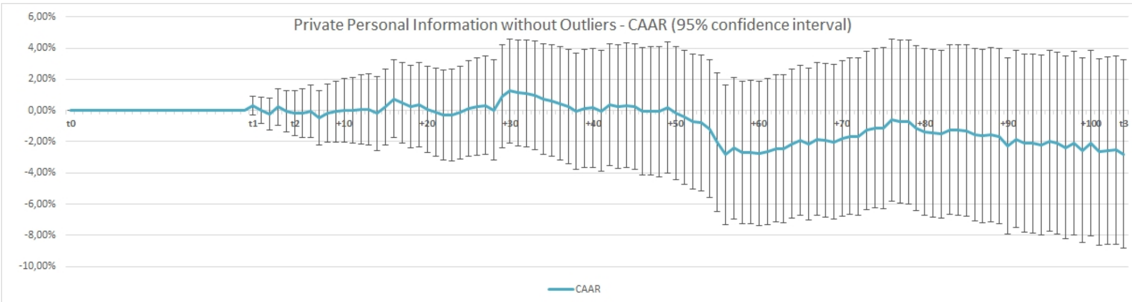

Figure 14: CAAR for Private Personal Information Events without Outliers

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	0,321 %	8,393E-06	1,107E+00	FALSE	FALSE	FALSE
0	0,024 %	1,679E-05	5,839E-02	FALSE	FALSE	FALSE
+1	-0,251 %	2,518E-05	-5,007E-01	FALSE	FALSE	FALSE
+2	0,237 %	3,357E-05	4,087E-01	FALSE	FALSE	FALSE
+3	-0,026 %	4,197E-05	-3,998E-02	FALSE	FALSE	FALSE
t2	-0,171 %	5,036E-05	-2,407E-01	FALSE	FALSE	FALSE
+10	0,015 %	1,007E-04	1,518E-02	FALSE	FALSE	FALSE
+20	0,058 %	1,847E-04	4,273E-02	FALSE	FALSE	FALSE
+30	1,265 %	2,686E-04	7,718E-01	FALSE	FALSE	FALSE
+40	0,179 %	3,525E-04	9,528E-02	FALSE	FALSE	FALSE
+50	-0,166 %	4,364E-04	-7,958E-02	FALSE	FALSE	FALSE
+60	-2,760 %	5,204E-04	-1,210E+00	FALSE	FALSE	FALSE
+70	-1,773 %	6,043E-04	-7,212E-01	FALSE	FALSE	FALSE
+80	-1,378 %	6,882E-04	-5,254E-01	FALSE	FALSE	FALSE
+90	-2,285 %	7,722E-04	-8,223E-01	FALSE	FALSE	FALSE
+100	-2,105 %	8,561E-04	-7,194E-01	FALSE	FALSE	FALSE
t3	-2,782 %	8,897E-04	-9,327E-01	FALSE	FALSE	FALSE

Table 13: Summary of CAAR for PPI Events without Outliers

The results do not show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) therefore cannot be rejected in the event or post-event window.

4.3.13 CAAR Credentials events

The Cumulative Average Abnormal Return of events where credentials were affected in the sample population during the analysis window:

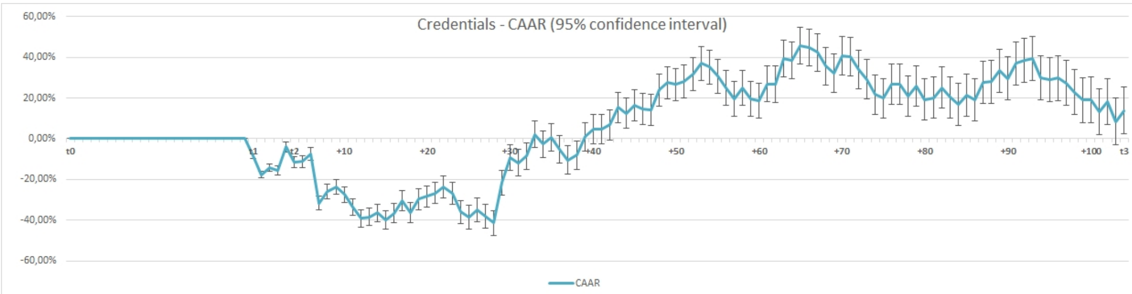

Figure 15: CAAR for Credential Loss Events

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

	CAAR	S2 CAAR	CAAR t-test	95% conf	90% conf	85% conf
t1	-8,578 %	2,594E-05	-1,684E+01	TRUE	TRUE	TRUE
0	-17,688 %	5,188E-05	-2,456E+01	TRUE	TRUE	TRUE
+1	-14,257 %	7,782E-05	-1,616E+01	TRUE	TRUE	TRUE
+2	-15,677 %	1,038E-04	-1,539E+01	TRUE	TRUE	TRUE
+3	-4,042 %	1,297E-04	-3,549E+00	TRUE	TRUE	TRUE
t2	-11,351 %	1,556E-04	-9,099E+00	TRUE	TRUE	TRUE
+10	-27,351 %	3,113E-04	-1,550E+01	TRUE	TRUE	TRUE
+20	-28,226 %	5,707E-04	-1,182E+01	TRUE	TRUE	TRUE
+30	-9,274 %	8,301E-04	-3,219E+00	TRUE	TRUE	TRUE
+40	4,762 %	1,089E-03	1,443E+00	FALSE	FALSE	FALSE
+50	26,594 %	1,349E-03	7,241E+00	TRUE	TRUE	TRUE
+60	18,699 %	1,608E-03	4,663E+00	TRUE	TRUE	TRUE
+70	40,801 %	1,868E-03	9,441E+00	TRUE	TRUE	TRUE
+80	19,331 %	2,127E-03	4,192E+00	TRUE	TRUE	TRUE
+90	29,686 %	2,386E-03	6,077E+00	TRUE	TRUE	TRUE
+100	19,122 %	2,646E-03	3,717E+00	TRUE	TRUE	TRUE
t3	13,841 %	2,750E-03	2,640E+00	TRUE	TRUE	TRUE

Table 14: Summary of CAAR for Credential Events

The results show that $CAAR! = 0$ with 95% or more statistical significance in the event or post-event window. The null hypothesis ($H0 : CAAR = 0$) can therefore be rejected in the event or post-event window.

5 Discussion

5.1 Interpretation

For the majority of the event study, I cannot reject the null hypothesis. Furthermore, this means that my study shows that for the most part, announcing security incidents do not affect the stock value of the company with statistical significance. During the partial analysis, we do see that the outliers have an impact on the results, and by excluding them from the sample population for the different analyses we do see a noticeable change in the results. Still, these changes do not affect the interval for the statistical significance to a degree where any of the analyses fall into 95% confidence.

The only events that show a solid statistical significance are those where credentials are affected by the incident. In those events, there is a 100% statistical significance for the entire event window and the majority of the post-event window. The analysis shows that the stock value decreases 30-40% in the first period of the post-event window $[t2, +30]$, while at the same time fluctuating and increasing the same amount. Eventually, it stabilizes towards the end of the analysis window, as is the case with several of the analyses in the study.

In addition, events where credit cards are affected show a statistical significance of at least 85% in the days after the event in the event window, as well as atleast 90% statistical significance for almost the whole first period of the post-event window $[t2, +37]$. This is improved dramatically by excluding the outliers for these events as the majority of the event window shows 95% statistical significance $[0, +3]$, extending into the first four days of the post-event window with 90% statistical significance. In addition, instead of showing 90% statistical significance in the first part of the post-event window, the analysis showed a 90% statistical significance for the majority of the latter part of the post-event window$[+31, t3]$.

Even though the study does not show a statistically significant relationship between the announcement of the event and an effect on the stock price, the analysis on the entire sample population without the outliers shows that there is a 90% significance level on the day of the event and the day after $[0, +1]$. This strongly indicates a presence of negative Abnormal Returns on the day of the announcement of the incident and the following day. In other words, announcing a security incident will most likely affect the value of the company the day of the announcement as well as the following day.

Furthermore, there is no need for the CAAR to be statistically significant throughout the analysis window to demonstrate that the event in question is significant. This is however only a valid argument as long as the CAAR stabilizes at some point. As the results show, the CAAR stabilizes around the start of the post-event window for the main analysis as well as most of the partial analyses.

5.2 Compared to other studies

All event studies are dependent on their assumptions, sample population and analysis windows. This also makes it difficult to draw direct similarities between the different studies. As mentioned in 2.3, although the end result mostly shows either statistical significance, strong significance or no significance, they are all different in their interpretations. Some use longer estimation periods to build a better foundation, such as Bose and Leung[41], Hinz[37] and Chai et al.[42], while others use a shorter period such as Gatzlaff and McCullough[38]. Compared to the related studies, my estimation window within range, although it could have been increased to improve the estimation. Still, I did not experience any abnormalities in my studies compared to the others that indicate that my estimation window was not sufficient.

The biggest difference, which is also the biggest challenge for event studies on this matter, is the size and quality of the sample population. As these initially depend on the selection criteria set for each study, when investigating information security incidents, the main challenge faced is finding reliable sources for the announcements. Due to the continuing reluctance to announce a incident, studies are almost dependent on using events that might not be the most reliable just to obtain a large enough sample population. If the studies set more limiting criteria, such as in my thesis where the incident must have at least 30000 record affected by the incident, the amount of events are limited. I chose this criteria mainly because I did not see any of the other studies make this limitation. While most of the studies excluded events that experienced overlapping analysis windows or were affected by other significant events, I wanted to focus on events that should have been experienced as significant. This lead to more specific although limited sample population, whereas others used almost 200 events[34], many of the other studies had a much lower sample population, going even as lows as 6 events[37, 53]. Several of the studies actually had around the same amount of events as me, indicating that even though my population was within range of such event studies, I as well would like to have had a larger sample population[38, 54].

Many of the studies showed statistical significance within 95% confidence level for large parts of their analysis[53, 36, 37, 38, 42, 55]. A few of them found a strong albeit not statistical significance in their results, while others saw no significance[41, 34]. This only shows that there is no way to easily compare results within event studies. For the most part I found no statistical significance for my main or partial studies. Where I did find 95% significance was when credit card or credentials were affected. This could be compared to the findings in Campbell et al.[36] where they also found statistical significance where confidential information was affected but not when non-confidential information was affected.

Only one of the event studies reviewed used a specific post-window in their event study[53]. Although they did not discuss the implications of the log term effect in their study, their results show that after the post-event window, almost all of the CAARs for both the entire sample population as well as the partial sector and attack type stabilized by the end of the analysis window. This indicates that even though some fluctuations might occur, in the long run, the stock value flattens out. This was also the basis for my inclusion of a post event window. In my study however, a majority of the analyses saw a clear diminished CAAR at the end of the event window. Especially when removing outliers from the population did I experience a substantial decline in stock value. This further strengthens the dissimilarities event studies have when sample populations vary (57 in my study vs. 20 in Alonso et al.).

5.3 Real world application

Although I cannot prove my hypothesis($H1$) with statistical significance, the results of the event study still gives security professionals some insights into how an incident can affect the value of a company. As mentioned, the goal of the thesis is not just to prove a link between security incidents and company value, but also provide security professionals with new input for strengthening their justifications for investing in security measures. Since more and more companies are subjected to regulations that require notification of an incident, knowing how the value of the company MIGHT be affected by such an announcement can aid security professionals in gaining support from senior management.

5.3.1 Under-performing stock

In most of the partial analyses, the CAAR shows that events in the study, for some reason perform worse than expected at the end of the analysis window. This indicates that even though it cannot be statistically proven, the findings show in this thesis that the value of the stock in many cases perform worse than the expected performance around the time the security incident is announced. Even though this is the case for the CAARs for the entire sample population, security professionals working in the technology, ecommerce and social media industries in particular can show to this stock value behaviour. Implement measures that potentially could counter a 4% stock value decline over approximately 100 days is something that senior management and investors could appreciate. This is also relevant for security professionals in companies that handle credit card data, as the CAARs for those events showed a 7% decrease at the end of the event window. It is important to emphasise that my thesis does not prove the statistical significance of this correlation, but the findings presented give some indication to this behaviour nonetheless.

5.3.2 Risk management

Since almost all of the analyses show that even though the CAARs decline in the event window, it quickly stabilizes around the start of the post-event window, security personnel can use this information as input to their risk management frameworks. By including this factor in the threshold analysis for a risk acceptance criteria for instance, the level of acceptance can be described using relevant variables for senior management. Showing that we can accept a risk as long as we see the stock value stabilizing within a week of the announcement could aid in gaining support from senior management. This could be beneficial when requesting funding for other more crucial security investments, as you can show the senior management that you understand what matters the most in the long run.

5.3.3 Securing Credentials

Although the sample size might be to small to factually prove this, the one analysis where the study showed statistical significance across the board was when credentials were compromised in an event. Still, this can be used to support investments for properly securing credentials, as the findings show that regardless of how the stock performs after announcing that credentials have been compromised, there is statistic significance that the performance will be affected by announcing the incident. So many companies rely on internet facing systems that require credentials to access. This analysis further solidifies the need to have stronger authentication and more factors for identification, so that even if such an event would occur, the credentials cannot be misused to gain unauthorised access and escalating the event even more.

5.3.4 Preparation for the announcement

An interesting finding in the analysis was that even if the stock is immediately affected by announcing an incident, in the majority of my analysis, it stabilizes around the end of the event window. Firstly, communicating this expected dip in value to the senior management can assist in giving an assurance of a short term value impact. Secondly, since many of my partial analyses, and especially those where outliers were excluded, show a steady decrease in stock value over time, preparing for the aftermath of an announcement could prove beneficial. If the announcement strategy also ensures to inform the public of any and all remediations as a result of the incident, the expected loss of value over time could be affected. This is also confirmed by Szubartowicz and Schryen[55]. In their study it was clear that announcing investments in information security right after a significant incident lead to the strongest positive reaction to the stock value.

5.3.5 Show understanding of business context

The largest takeaway from my study, is that there are many different aspects of the business that can provide security professionals with valuable information. By using financial modelling to justify your funding requests, you speak in the same terms as the senior management[72]. This enables them to see your understanding of what is the most important aspects to the business; ensuring that investors are satisfied with the value of their investment. By focusing on the business context of your security efforts instead of highlighting the information security threat landscape and why it should be a priority, you convey your understanding of the role of information security as a business enabler[49].

5.4 Suggested future work

As with all event studies, my study would benefit from a larger sample population. Finding relevant incidents from reliable sources is a challenge, but hopefully, the introduction of regulations that require notification of incidents will help in building reliable databases of incidents. More specification of attack method could also improve the findings as it will give a better overview of which type of attacks a company need to pay extra attention to.

For my study, I mostly used US companies in order to employ the SP500 as a reference index.

Using another index or even looking at at a global perspective and working with the SP Global 100 index could provide interesting insight.

Event study methodology allows for use of different estimation models for calculating expected returns on a stock. In stead of using the market model, employing another model such as Comparison Period Mean Adjusted Model, Market model with Scholes-Williams beta estimation or GARCH and EGARCH error estimation, or even the Fama and Frehch 3 or 4 factor estimation models could provide more independently calculated results[73, 74, 75].

Finally, employing a longer estimation window could also improve the basis for the analysis. The regression model only improves its accuracy as the data for estimation grows.

6 Conclusion

Event studies have been used for many decades in finance. The method provides a sufficient overview of how a given event affects stock value of a company. Using this method for increasing knowledge in the information security domain can be fruitful, even if the study results in my thesis did not show statistical significance for the most part. The biggest challenge for this thesis was to establish a large enough sample population with reliable events. This has shown to be the decisive factor for many event studies on this matter and should be taken into consideration when utilizing the results.

However, the goal of the thesis was to understand in what capacity this methodology could be used information security professionals. There is a strong correlation between announcing an incident and the value the affected company has on the stock market. An interesting takeaway is that rather than focusing on how an industry experiences the effect of an event, it is the type of information affected that shows the strongest effect of announcing an incident. Companies that handle credit card data should ensure the security of their critical data in all aspects of their service. In addition, all companies should invest heavily in protection of credentials. Being able to justify information security investments on this basis rather than traditional information security threat and risk modelling gives information security professionals a new approach to effectively communicate with senior management. Its not that they do not care about information security, they just need someone to explain the effect in terms of what is important to them.

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A Acronyms

Acronyms	Description
ALE	Annual Loss Expectency
AR	Abnormal Return
CAAR	Cumulated Average Abnormal Return
CAR	Cumulated Abnormal Return
CEO	Chief Executive Officer
CIO	Chief Information Officer
CIS	Center for Internet Security
CISO	Chief Information Security Officer
CSO	Chief Security Officer
DDoS	Distributed Denial of Service
GDPR	General Data Protection Regulation
IP	Intellectual Property
ISO	International Organization for Standardization
NASDAQ	National Association of Securities Dealers Automated Quotations
NIST	National Institute of Standards and Technology
NPV	Net Present Value
NYSE	New York Stock Exchange
OLS	Ordinary Least Squares
PPI	Private Personal Information
ROA	Real Options Analysis
ROSI	Return On Security Investment
SP500	Standard & Poor's 500 stock index
SUR	Seemingly Unrelated Regression

Table 15: List of acronyms

B Event summaries

Inc1

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

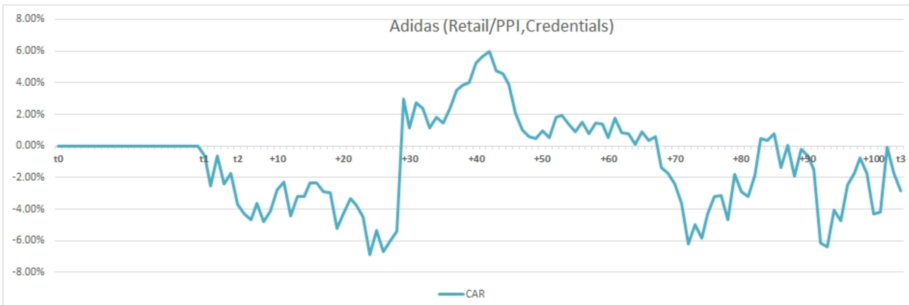

Figure 16: Inc1 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc1	CAR	S2 CAR	CAR t-test
t1	-0,602 %	3,017E-04	-3,466E-01
	-2,506 %	6,034E-04	-1,020E+00
	-0,639 %	9,051E-04	-2,122E-01
	-2,408 %	1,207E-03	-6,932E-01
	-1,710 %	1,508E-03	-4,402E-01
t2	-3,703 %	1,810E-03	-8,703E-01
+10	-2,778 %	3,620E-03	-4,617E-01
+20	-4,220 %	6,637E-03	-5,180E-01
+30	1,151 %	9,654E-03	1,172E-01
+40	5,231 %	1,267E-02	4,647E-01
+50	0,974 %	1,569E-02	7,776E-02
+60	0,559 %	1,871E-02	4,087E-02
+70	-2,419 %	2,172E-02	-1,641E-01
+80	-2,883 %	2,474E-02	-1,833E-01
+90	-0,658 %	2,776E-02	-3,950E-02
+100	-4,291 %	3,077E-02	-2,446E-01
t3	-2,828 %	3,198E-02	-1,582E-01

Table 16: Inc1 Summary data

Inc2

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

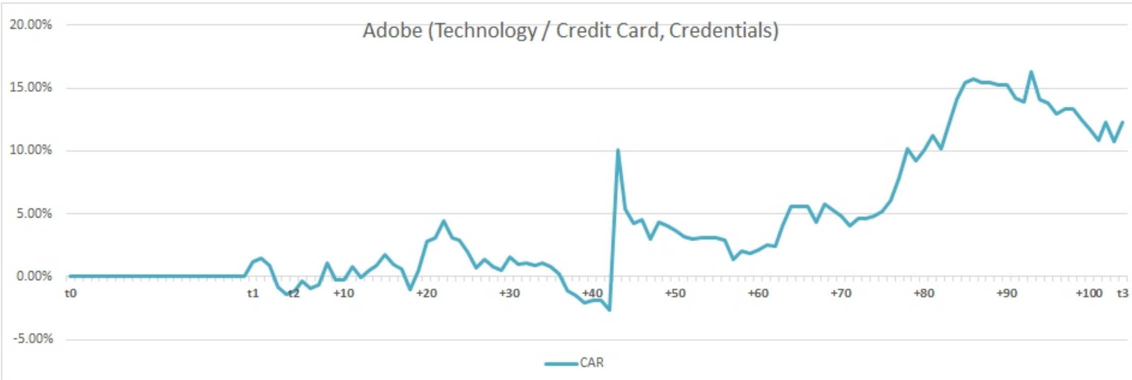

Figure 17: Inc2 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc2	CAR	S2 CAR	CAR t-test
t1	1,183 %	1,715E-04	9,037E-01
0	1,481 %	3,430E-04	7,999E-01
+1	0,940 %	5,145E-04	4,145E-01
+2	-0,811 %	6,860E-04	-3,098E-01
+3	-1,368 %	8,575E-04	-4,671E-01
t2	-1,134 %	1,029E-03	-3,534E-01
+10	-0,214 %	2,058E-03	-4,723E-02
+20	2,781 %	3,773E-03	4,528E-01
+30	1,563 %	5,488E-03	2,110E-01
+40	-1,905 %	7,203E-03	-2,244E-01
+50	3,721 %	8,917E-03	3,940E-01
+60	2,118 %	1,063E-02	2,054E-01
+70	4,806 %	1,235E-02	4,325E-01
+80	10,073 %	1,406E-02	8,494E-01
+90	15,213 %	1,578E-02	1,211E+00
+100	11,693 %	1,749E-02	8,841E-01
t3	12,254 %	1,818E-02	9,089E-01

Table 17: Inc2 Summary data

Inc3

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

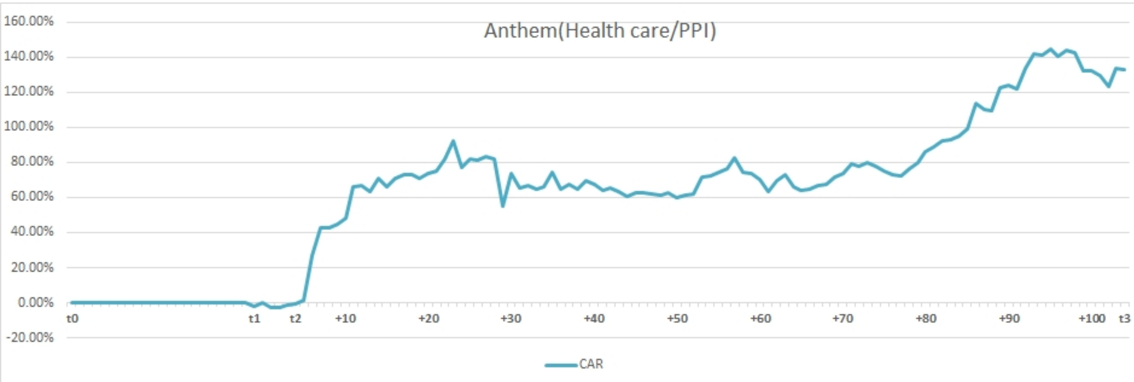

Figure 18: Inc3 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc3	CAR	S2 CAR	CAR t-test
t1	-2,299 %	2,675E-03	-4,444E-01
	-0,179 %	5,350E-03	-2,441E-02
	-2,778 %	8,025E-03	-3,101E-01
	-2,556 %	1,070E-02	-2,471E-01
	-1,279 %	1,337E-02	-1,106E-01
t2	-0,654 %	1,605E-02	-5,162E-02
+10	48,241 %	3,210E-02	2,693E+00
+20	73,936 %	5,885E-02	3,048E+00
+30	73,792 %	8,560E-02	2,522E+00
+40	67,779 %	1,123E-01	2,022E+00
+50	60,031 %	1,391E-01	1,610E+00
+60	70,525 %	1,658E-01	1,732E+00
+70	73,443 %	1,926E-01	1,673E+00
+80	85,879 %	2,193E-01	1,834E+00
+90	123,586 %	2,461E-01	2,491E+00
+100	132,481 %	2,728E-01	2,536E+00
t3	132,642 %	2,835E-01	2,491E+00

Table 18: Inc3 Summary data

Inc4

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

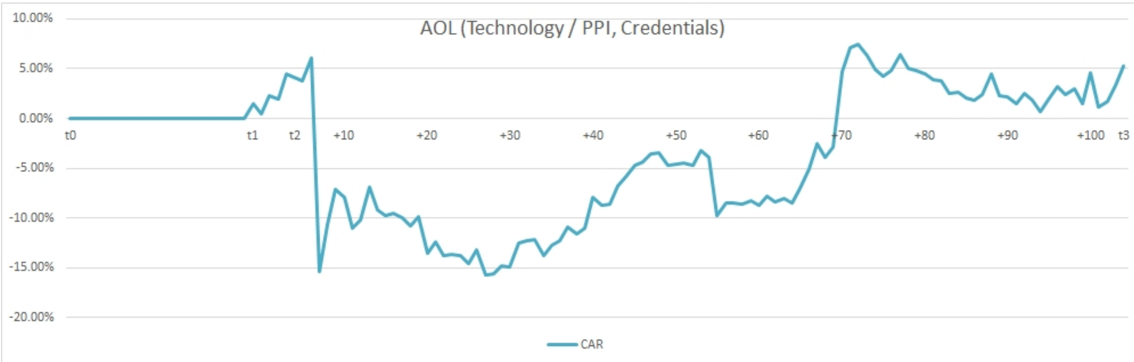

Figure 19: Inc4 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc4	CAR	S2 CAR	CAR t-test
t1	-1,3023 %	0,0151691016	1,517 %
0	0,4304 %	-0,0109676553	0,420 %
+1	0,6636 %	0,0187598016	2,296 %
+2	0,3931 %	-0,0036974497	1,926 %
+3	-0,0863 %	0,0258568664	4,512 %
t2	-0,2705 %	-0,0036757711	4,144 %
+10	1,4146 %	-0,0080512760	-7,929 %
+20	0,8512 %	-0,0373369577	-13,580 %
+30	-0,1020 %	-0,0011702846	-14,875 %
+40	-1,0483 %	0,0307513987	-7,947 %
+50	0,6457 %	0,0017536788	-4,564 %
+60	0,2039 %	-0,0045970967	-8,705 %
+70	-0,0620 %	0,0754914894	4,693 %
+80	0,3145 %	-0,0033733342	4,488 %
+90	-0,2990 %	-0,0011953832	2,184 %
+100	0,1337 %	0,0317908228	4,631 %
t3	-0,9476 %	0,0195340833	5,264 %

Table 19: Inc4 Summary data

Inc5

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

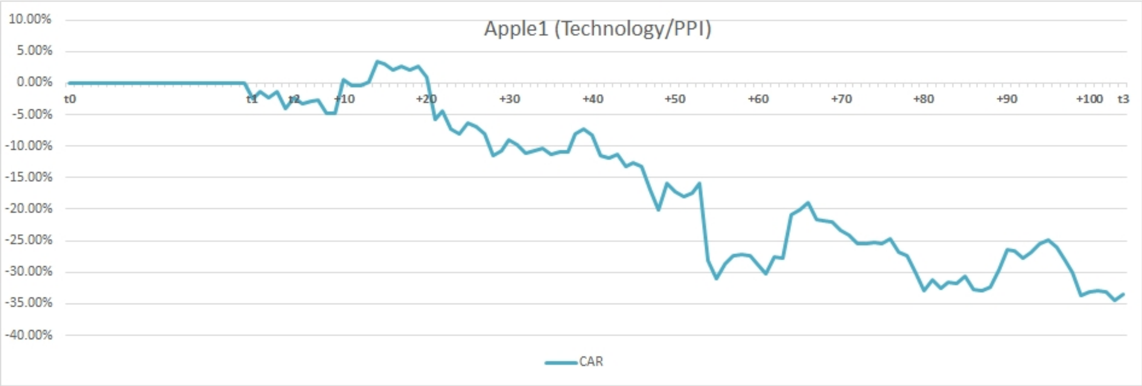

Figure 20: Inc5 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc5	CAR	S2 CAR	CAR t-test
t1	-2,493 %	1,643E-04	-1,945E+00
	-1,355 %	3,285E-04	-7,474E-01
	-2,385 %	4,928E-04	-1,074E+00
	-1,401 %	6,571E-04	-5,467E-01
	-3,961 %	8,213E-04	-1,382E+00
t2	-2,405 %	9,856E-04	-7,662E-01
+10	0,603 %	1,971E-03	1,357E-01
+20	0,924 %	3,614E-03	1,537E-01
+30	-8,961 %	5,257E-03	-1,236E+00
+40	-8,325 %	6,899E-03	-1,002E+00
+50	-17,171 %	8,542E-03	-1,858E+00
+60	-28,692 %	1,018E-02	-2,843E+00
+70	-23,399 %	1,183E-02	-2,152E+00
+80	-32,986 %	1,347E-02	-2,842E+00
+90	-26,495 %	1,511E-02	-2,155E+00
+100	-33,017 %	1,676E-02	-2,551E+00
t3	-33,432 %	1,741E-02	-2,534E+00

Table 20: Inc5 Summary data

Inc6

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

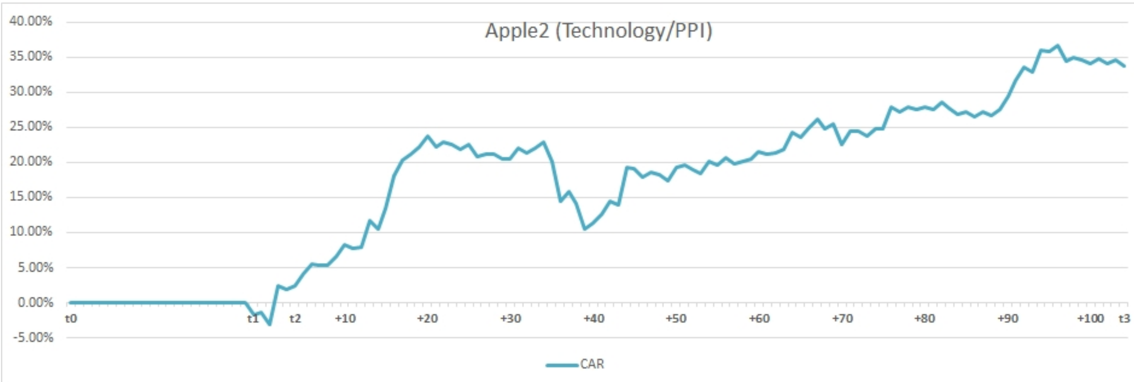

Figure 21: Inc6 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc6	CAR	S2 CAR	CAR t-test
t1	-1,659 %	2,604E-04	-1,028E+00
	-1,450 %	5,208E-04	-6,352E-01
	-3,009 %	7,812E-04	-1,077E+00
	2,419 %	1,042E-03	7,495E-01
	1,816 %	1,302E-03	5,033E-01
t2	2,356 %	1,562E-03	5,961E-01
+10	8,195 %	3,125E-03	1,466E+00
+20	23,795 %	5,729E-03	3,144E+00
+30	20,550 %	8,332E-03	2,251E+00
+40	11,399 %	1,094E-02	1,090E+00
+50	19,214 %	1,354E-02	1,651E+00
+60	21,563 %	1,614E-02	1,697E+00
+70	22,543 %	1,875E-02	1,646E+00
+80	27,883 %	2,135E-02	1,908E+00
+90	29,408 %	2,396E-02	1,900E+00
+100	34,141 %	2,656E-02	2,095E+00
t3	33,738 %	2,760E-02	2,031E+00

Table 21: Inc6 Summary data

Inc7

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

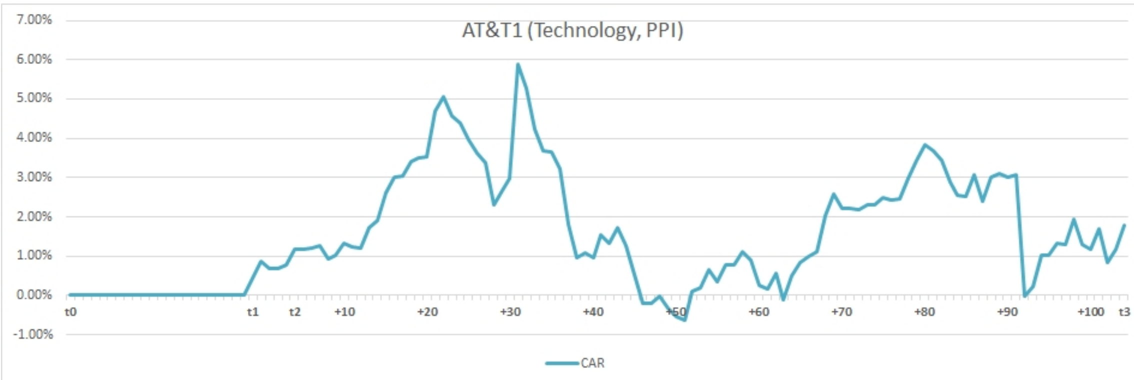

Figure 22: Inc7 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc7	CAR	S2 CAR	CAR t-test
t1	0,454 %	8,330E-05	4,977E-01
0	0,866 %	1,666E-04	6,707E-01
+1	0,686 %	2,499E-04	4,339E-01
+2	0,690 %	3,332E-04	3,781E-01
+3	0,791 %	4,165E-04	3,874E-01
t2	1,184 %	4,998E-04	5,296E-01
+10	1,336 %	9,996E-04	4,226E-01
+20	3,524 %	1,833E-03	8,231E-01
+30	2,988 %	2,666E-03	5,787E-01
+40	0,950 %	3,499E-03	1,607E-01
+50	-0,541 %	4,332E-03	-8,218E-02
+60	0,252 %	5,165E-03	3,509E-02
+70	2,224 %	5,998E-03	2,872E-01
+80	3,834 %	6,831E-03	4,639E-01
+90	3,023 %	7,664E-03	3,453E-01
+100	1,171 %	8,497E-03	1,270E-01
t3	1,773 %	8,830E-03	1,887E-01

Table 22: Inc7 Summary data

Inc8

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

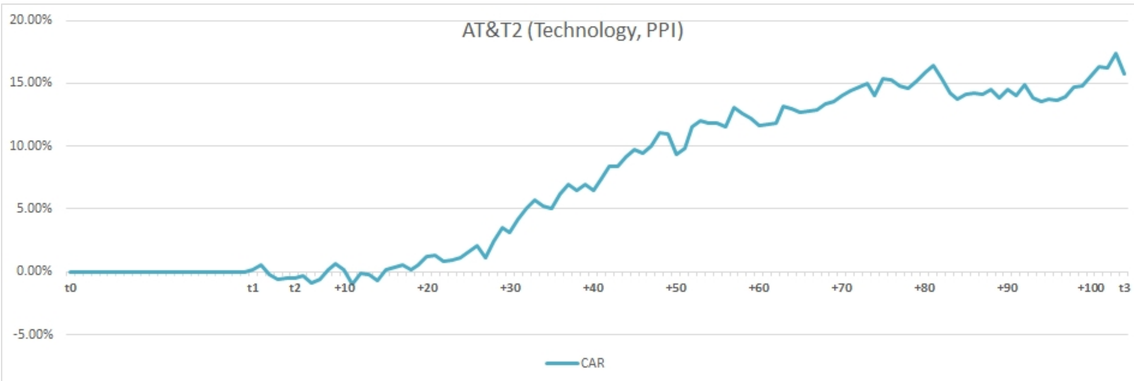

Figure 23: Inc8 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc8	CAR	S2 CAR	CAR t-test
t1	0,124 %	5,154E-05	1,725E-01
0	0,559 %	1,031E-04	5,506E-01
+1	-0,249 %	1,546E-04	-2,001E-01
+2	-0,569 %	2,061E-04	-3,960E-01
+3	-0,469 %	2,577E-04	-2,924E-01
t2	-0,468 %	3,092E-04	-2,664E-01
+10	0,201 %	6,184E-04	8,067E-02
+20	1,262 %	1,134E-03	3,748E-01
+30	3,156 %	1,649E-03	7,771E-01
+40	6,458 %	2,165E-03	1,388E+00
+50	9,346 %	2,680E-03	1,805E+00
+60	11,641 %	3,195E-03	2,059E+00
+70	13,987 %	3,711E-03	2,296E+00
+80	15,852 %	4,226E-03	2,439E+00
+90	14,459 %	4,741E-03	2,100E+00
+100	15,521 %	5,257E-03	2,141E+00
t3	15,705 %	5,463E-03	2,125E+00

Table 23: Inc8 Summary data

Inc9

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

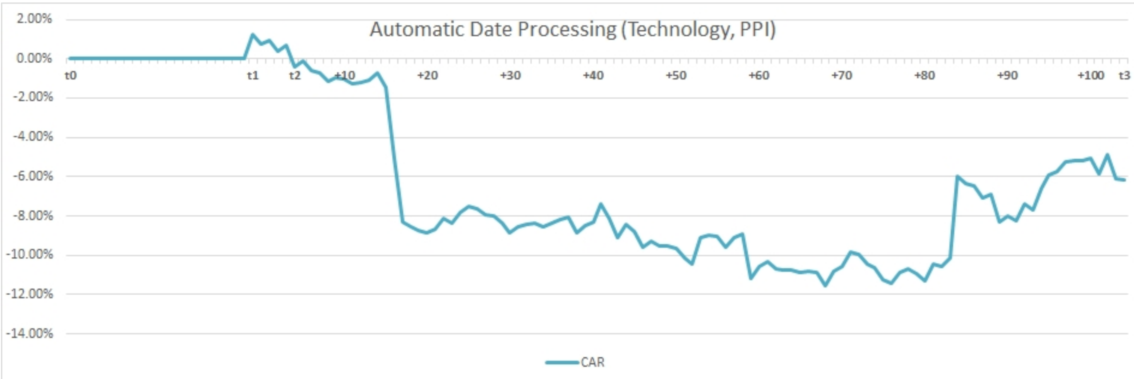

Figure 24: Inc9 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc9	CAR	S2 CAR	CAR t-test
t1	1,242 %	3,315E-05	2,158E+00
0	0,777 %	6,630E-05	9,540E-01
+1	0,903 %	9,945E-05	9,050E-01
+2	0,365 %	1,326E-04	3,169E-01
+3	0,685 %	1,657E-04	5,324E-01
t2	-0,411 %	1,989E-04	-2,912E-01
+10	-1,052 %	3,978E-04	-5,277E-01
+20	-8,835 %	7,293E-04	-3,272E+00
+30	-8,862 %	1,061E-03	-2,721E+00
+40	-8,281 %	1,392E-03	-2,219E+00
+50	-9,653 %	1,724E-03	-2,325E+00
+60	-10,588 %	2,055E-03	-2,336E+00
+70	-10,541 %	2,387E-03	-2,158E+00
+80	-11,292 %	2,718E-03	-2,166E+00
+90	-8,008 %	3,050E-03	-1,450E+00
+100	-5,037 %	3,381E-03	-8,662E-01
t3	-6,145 %	3,514E-03	-1,037E+00

Table 24: Inc9 Summary data

Inc10

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

Figure 25: Inc10 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc10	CAR	S2 CAR	CAR t-test
t1	-0,056 %	2,315E-04	-3,650E-02
0	-1,644 %	4,631E-04	-7,641E-01
+1	-1,708 %	6,946E-04	-6,481E-01
+2	-2,254 %	9,261E-04	-7,406E-01
+3	-2,745 %	1,158E-03	-8,069E-01
t2	-1,961 %	1,389E-03	-5,262E-01
+10	-3,099 %	2,778E-03	-5,880E-01
+20	-14,679 %	5,094E-03	-2,057E+00
+30	-10,906 %	7,409E-03	-1,267E+00
+40	-15,189 %	9,724E-03	-1,540E+00
+50	-18,236 %	1,204E-02	-1,662E+00
+60	-22,670 %	1,435E-02	-1,892E+00
+70	-23,435 %	1,667E-02	-1,815E+00
+80	-27,915 %	1,899E-02	-2,026E+00
+90	-28,939 %	2,130E-02	-1,983E+00
+100	-30,970 %	2,362E-02	-2,015E+00
t3	-36,799 %	2,454E-02	-2,349E+00

Table 25: Inc10 Summary data

Inc11

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

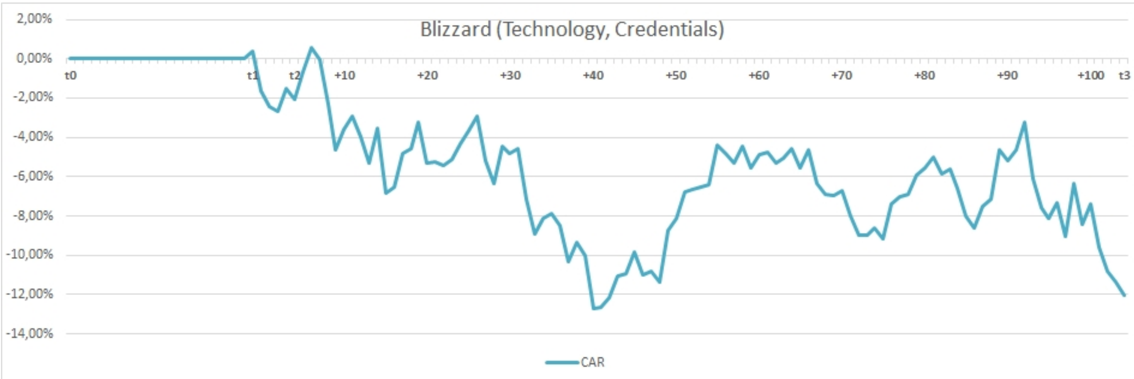

Figure 26: Inc11 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc11	CAR	S2 CAR	CAR t-test
t1	0,377 %	1,623E-04	2,958E-01
0	-1,647 %	3,246E-04	-9,142E-01
+1	-2,457 %	4,868E-04	-1,114E+00
+2	-2,705 %	6,491E-04	-1,062E+00
+3	-1,530 %	8,114E-04	-5,371E-01
t2	-2,062 %	9,737E-04	-6,607E-01
+10	-3,599 %	1,947E-03	-8,156E-01
+20	-5,295 %	3,570E-03	-8,861E-01
+30	-4,799 %	5,193E-03	-6,659E-01
+40	-12,738 %	6,816E-03	-1,543E+00
+50	-8,152 %	8,439E-03	-8,874E-01
+60	-4,865 %	1,006E-02	-4,850E-01
+70	-6,706 %	1,168E-02	-6,204E-01
+80	-5,568 %	1,331E-02	-4,827E-01
+90	-5,193 %	1,493E-02	-4,250E-01
+100	-7,397 %	1,655E-02	-5,750E-01
t3	-12,045 %	1,720E-02	-9,184E-01

Table 26: Inc11 Summary data

Inc12

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

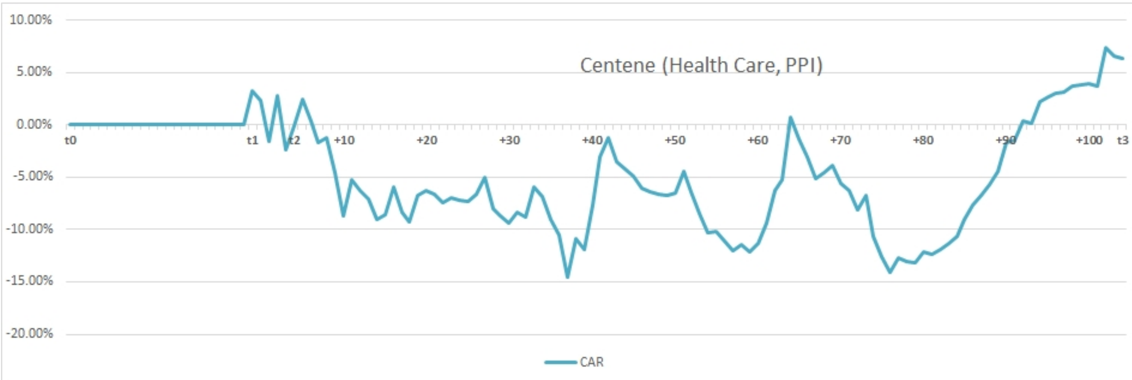

Figure 27: Inc12 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc12	CAR	S2 CAR	CAR t-test
t1	3,245 %	4,998E-04	1,451E+00
0	2,365 %	9,996E-04	7,480E-01
+1	-1,531 %	1,499E-03	-3,955E-01
+2	2,828 %	1,999E-03	6,325E-01
+3	-2,346 %	2,499E-03	-4,693E-01
t2	-0,079 %	2,999E-03	-1,442E-02
+10	-8,698 %	5,998E-03	-1,123E+00
+20	-6,315 %	1,100E-02	-6,022E-01
+30	-9,365 %	1,599E-02	-7,405E-01
+40	-7,638 %	2,099E-02	-5,272E-01
+50	-6,574 %	2,599E-02	-4,078E-01
+60	-11,291 %	3,099E-02	-6,414E-01
+70	-5,572 %	3,599E-02	-2,937E-01
+80	-12,120 %	4,098E-02	-5,987E-01
+90	-1,736 %	4,598E-02	-8,097E-02
+100	3,961 %	5,098E-02	1,754E-01
t3	6,381 %	5,298E-02	2,772E-01

Table 27: Inc12 Summary data

Inc13

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

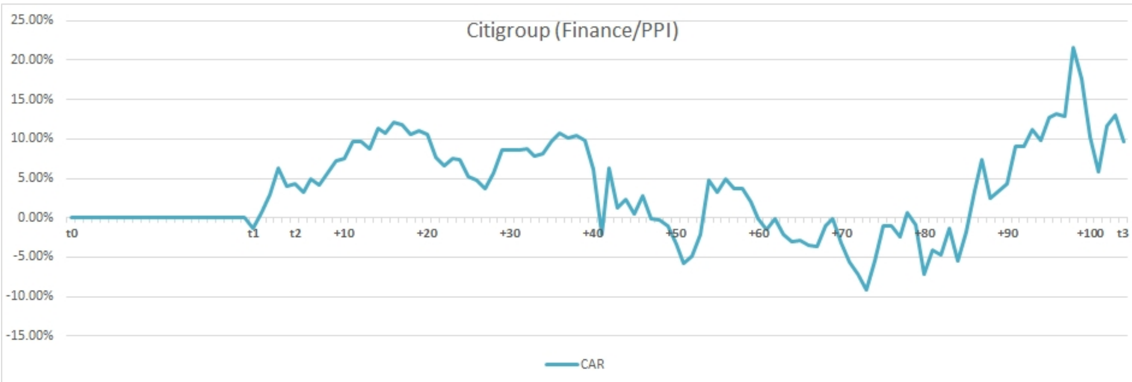

Figure 28: Inc13 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc13	CAR	S2 CAR	CAR t-test
t1	-1,345 %	1,542E-04	-1,083E+00
0	0,596 %	3,084E-04	3,393E-01
+1	2,882 %	4,627E-04	1,340E+00
+2	6,293 %	6,169E-04	2,534E+00
+3	4,013 %	7,711E-04	1,445E+00
t2	4,297 %	9,253E-04	1,412E+00
+10	7,528 %	1,851E-03	1,750E+00
+20	10,624 %	3,393E-03	1,824E+00
+30	8,564 %	4,935E-03	1,219E+00
+40	6,106 %	6,477E-03	7,586E-01
+50	-3,321 %	8,020E-03	-3,708E-01
+60	-0,141 %	9,562E-03	-1,438E-02
+70	-3,196 %	1,110E-02	-3,033E-01
+80	-7,095 %	1,265E-02	-6,309E-01
+90	4,277 %	1,419E-02	3,591E-01
+100	10,253 %	1,573E-02	8,175E-01
t3	9,633 %	1,635E-02	7,534E-01

Table 28: Inc13 Summary data

Inc14

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

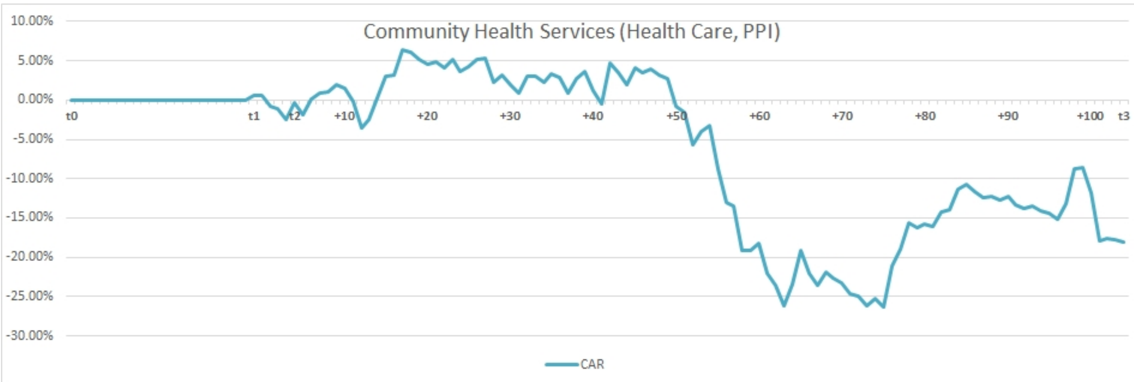

Figure 29: Inc14 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc14	CAR	S2 CAR	CAR t-test
t1	0,520 %	4,927E-04	2,343E-01
0	0,532 %	9,853E-04	1,694E-01
+1	-0,789 %	1,478E-03	-2,053E-01
+2	-1,119 %	1,971E-03	-2,521E-01
+3	-2,444 %	2,463E-03	-4,924E-01
t2	-0,265 %	2,956E-03	-4,879E-02
+10	1,541 %	5,912E-03	2,005E-01
+20	4,516 %	1,084E-02	4,337E-01
+30	1,937 %	1,576E-02	1,543E-01
+40	1,263 %	2,069E-02	8,777E-02
+50	-0,814 %	2,562E-02	-5,088E-02
+60	-18,240 %	3,054E-02	-1,044E+00
+70	-23,207 %	3,547E-02	-1,232E+00
+80	-15,748 %	4,040E-02	-7,835E-01
+90	-12,225 %	4,532E-02	-5,742E-01
+100	-11,810 %	5,025E-02	-5,268E-01
t3	-18,116 %	5,222E-02	-7,927E-01

Table 29: Inc14 Summary data

Inc15

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

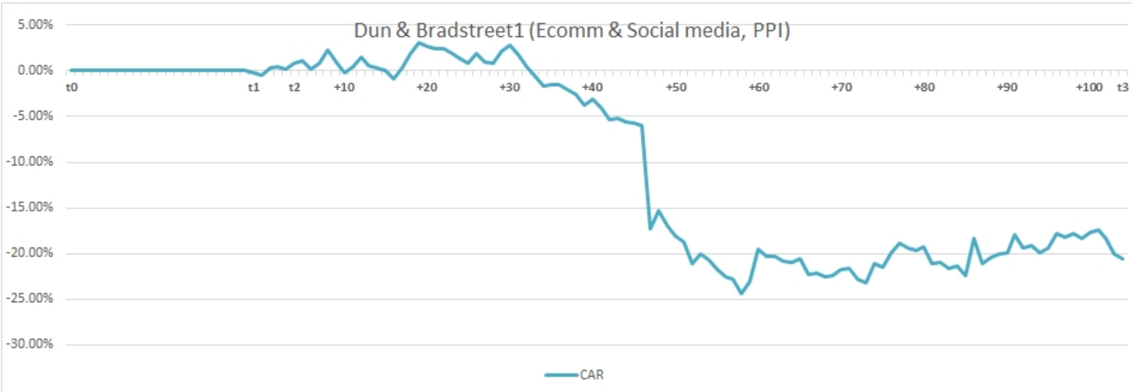

Figure 30: Inc15 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc15	CAR	S2 CAR	CAR t-test
t1	-0,221 %	7,471E-05	-2,562E-01
0	-0,409 %	1,494E-04	-3,347E-01
+1	0,380 %	2,241E-04	2,537E-01
+2	0,470 %	2,988E-04	2,722E-01
+3	0,148 %	3,735E-04	7,679E-02
t2	0,824 %	4,482E-04	3,892E-01
+10	-0,204 %	8,965E-04	-6,803E-02
+20	2,707 %	1,644E-03	6,678E-01
+30	2,792 %	2,391E-03	5,710E-01
+40	-3,100 %	3,138E-03	-5,534E-01
+50	-18,133 %	3,885E-03	-2,909E+00
+60	-19,496 %	4,632E-03	-2,865E+00
+70	-21,769 %	5,379E-03	-2,968E+00
+80	-19,239 %	6,126E-03	-2,458E+00
+90	-19,895 %	6,873E-03	-2,400E+00
+100	-17,742 %	7,620E-03	-2,032E+00
t3	-20,564 %	7,919E-03	-2,311E+00

Table 30: Inc15 Summary data

Inc16

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

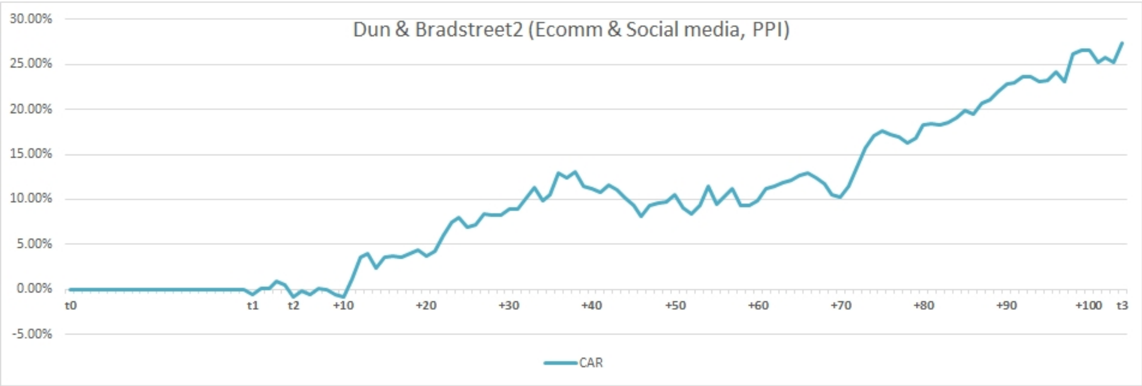

Figure 31: Inc16 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc16	CAR	S2 CAR	CAR t-test
t1	-0,539 %	3,580E-04	-2,848E-01
0	0,076 %	7,160E-04	2,835E-02
+1	0,033 %	1,074E-03	1,009E-02
+2	0,908 %	1,432E-03	2,398E-01
+3	0,492 %	1,790E-03	1,163E-01
t2	-0,823 %	2,148E-03	-1,776E-01
+10	-0,902 %	4,296E-03	-1,376E-01
+20	3,681 %	7,876E-03	4,148E-01
+30	8,968 %	1,146E-02	8,379E-01
+40	11,186 %	1,504E-02	9,123E-01
+50	10,524 %	1,862E-02	7,713E-01
+60	9,842 %	2,220E-02	6,606E-01
+70	10,267 %	2,578E-02	6,395E-01
+80	18,348 %	2,936E-02	1,071E+00
+90	22,842 %	3,294E-02	1,259E+00
+100	26,614 %	3,652E-02	1,393E+00
t3	27,384 %	3,795E-02	1,406E+00

Table 31: Inc16 Summary data

Inc17

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

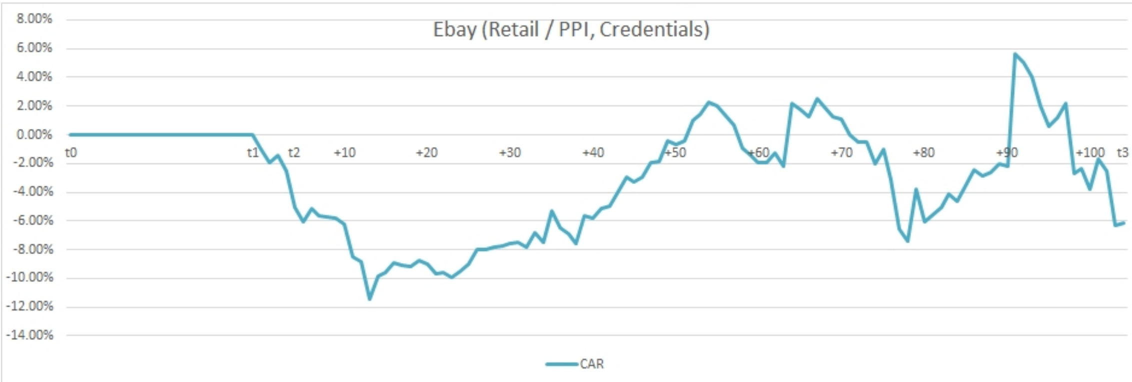

Figure 32: Inc17 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc17	CAR	S2 CAR	CAR t-test
t1	0,021 %	1,235E-04	1,870E-02
0	-0,995 %	2,470E-04	-6,334E-01
+1	-1,964 %	3,705E-04	-1,020E+00
+2	-1,396 %	4,940E-04	-6,281E-01
+3	-2,507 %	6,175E-04	-1,009E+00
t2	-5,031 %	7,410E-04	-1,848E+00
+10	-6,259 %	1,482E-03	-1,626E+00
+20	-9,004 %	2,717E-03	-1,727E+00
+30	-7,544 %	3,952E-03	-1,200E+00
+40	-5,845 %	5,187E-03	-8,116E-01
+50	-0,660 %	6,422E-03	-8,235E-02
+60	-1,920 %	7,657E-03	-2,194E-01
+70	1,050 %	8,892E-03	1,114E-01
+80	-6,055 %	1,013E-02	-6,017E-01
+90	-2,202 %	1,136E-02	-2,066E-01
+100	-3,759 %	1,260E-02	-3,349E-01
t3	-6,175 %	1,309E-02	-5,397E-01

Table 32: Inc17 Summary data

Inc18

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

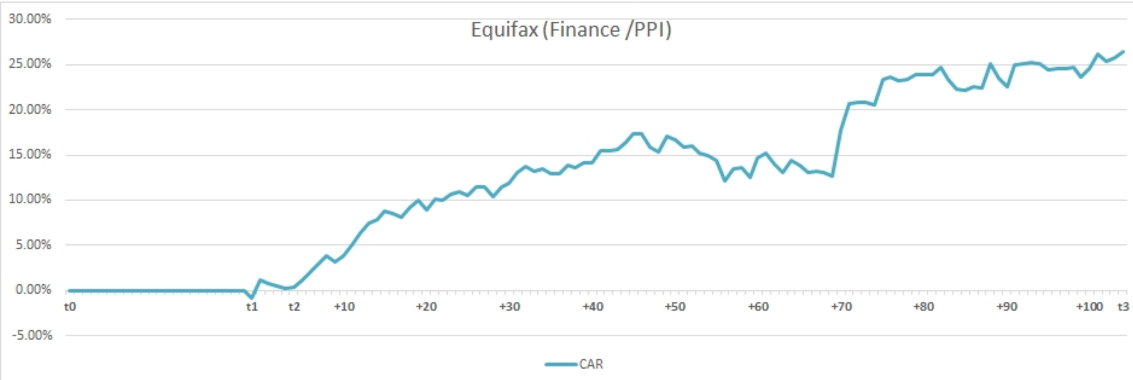

Figure 33: Inc18 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc18	CAR	S2 CAR	CAR t-test
t1	-0,870 %	5,721E-04	-3,637E-01
0	1,110 %	1,144E-03	3,283E-01
+1	0,812 %	1,716E-03	1,959E-01
+2	0,432 %	2,289E-03	9,024E-02
+3	0,205 %	2,861E-03	3,824E-02
t2	0,354 %	3,433E-03	6,046E-02
+10	3,812 %	6,866E-03	4,600E-01
+20	8,867 %	1,259E-02	7,904E-01
+30	11,829 %	1,831E-02	8,742E-01
+40	14,123 %	2,403E-02	9,110E-01
+50	16,629 %	2,975E-02	9,641E-01
+60	14,732 %	3,547E-02	7,822E-01
+70	17,715 %	4,119E-02	8,728E-01
+80	23,903 %	4,692E-02	1,104E+00
+90	22,538 %	5,264E-02	9,823E-01
+100	24,591 %	5,836E-02	1,018E+00
t3	26,430 %	6,065E-02	1,073E+00

Table 33: Inc18 Summary data

Inc19

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

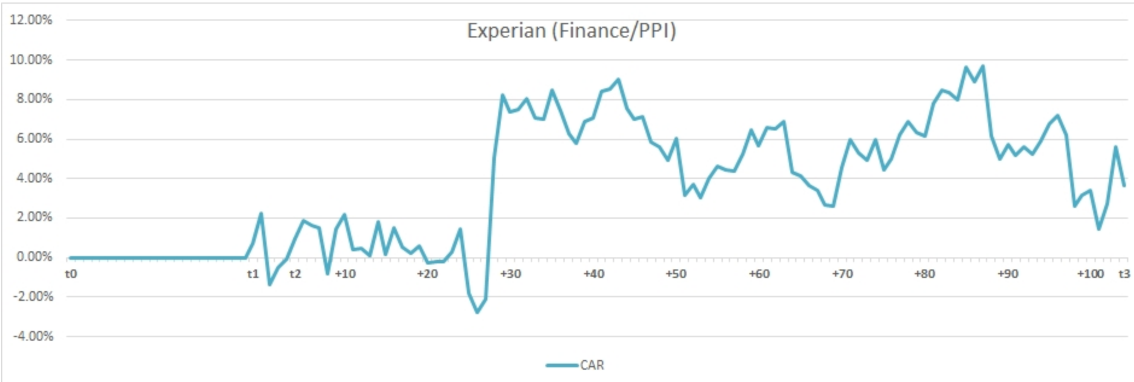

Figure 34: Inc19 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc19	CAR	S2 CAR	CAR t-test
t1	0,739 %	1,377E-04	6,295E-01
0	2,233 %	2,754E-04	1,346E+00
+1	-1,394 %	4,131E-04	-6,860E-01
+2	-0,502 %	5,508E-04	-2,140E-01
+3	-0,054 %	6,885E-04	-2,056E-02
t2	0,977 %	8,261E-04	3,398E-01
+10	2,200 %	1,652E-03	5,413E-01
+20	-0,271 %	3,029E-03	-4,927E-02
+30	7,379 %	4,406E-03	1,112E+00
+40	7,096 %	5,783E-03	9,331E-01
+50	6,022 %	7,160E-03	7,116E-01
+60	5,638 %	8,537E-03	6,102E-01
+70	4,570 %	9,914E-03	4,590E-01
+80	6,153 %	1,129E-02	5,790E-01
+90	5,736 %	1,267E-02	5,096E-01
+100	3,387 %	1,404E-02	2,858E-01
t3	3,634 %	1,460E-02	3,008E-01

Table 34: Inc19 Summary data

Inc20

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

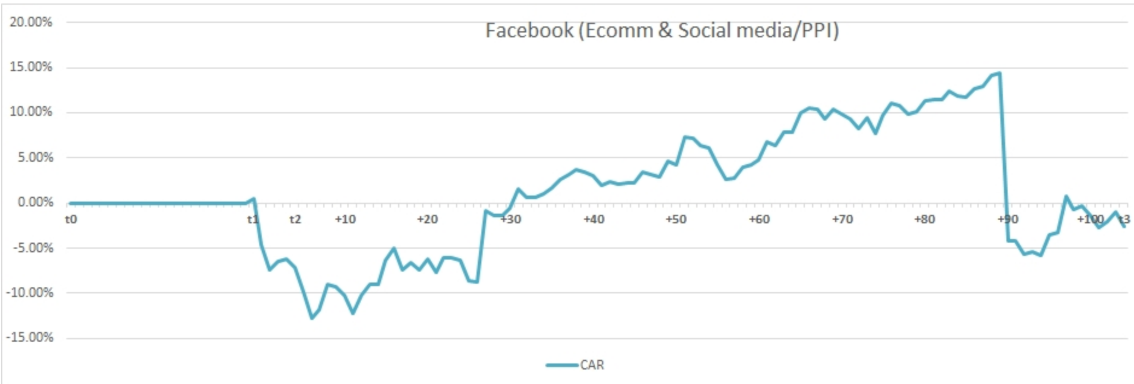

Figure 35: Inc20 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc20	CAR	S2 CAR	CAR t-test
t1	0,478 %	1,531E-04	3,862E-01
	-4,666 %	3,063E-04	-2,666E+00
	-7,388 %	4,594E-04	-3,447E+00
	-6,436 %	6,125E-04	-2,601E+00
	-6,216 %	7,657E-04	-2,247E+00
t2	-7,154 %	9,188E-04	-2,360E+00
+10	-10,210 %	1,838E-03	-2,382E+00
+20	-6,271 %	3,369E-03	-1,080E+00
+30	-0,541 %	4,900E-03	-7,722E-02
+40	2,974 %	6,432E-03	3,708E-01
+50	4,291 %	7,963E-03	4,809E-01
+60	4,718 %	9,494E-03	4,842E-01
+70	9,790 %	1,103E-02	9,323E-01
+80	11,350 %	1,256E-02	1,013E+00
+90	-4,145 %	1,409E-02	-3,492E-01
+100	-1,351 %	1,562E-02	-1,081E-01
t3	-2,579 %	1,623E-02	-2,024E-01

Table 35: Inc20 Summary data

Inc21

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

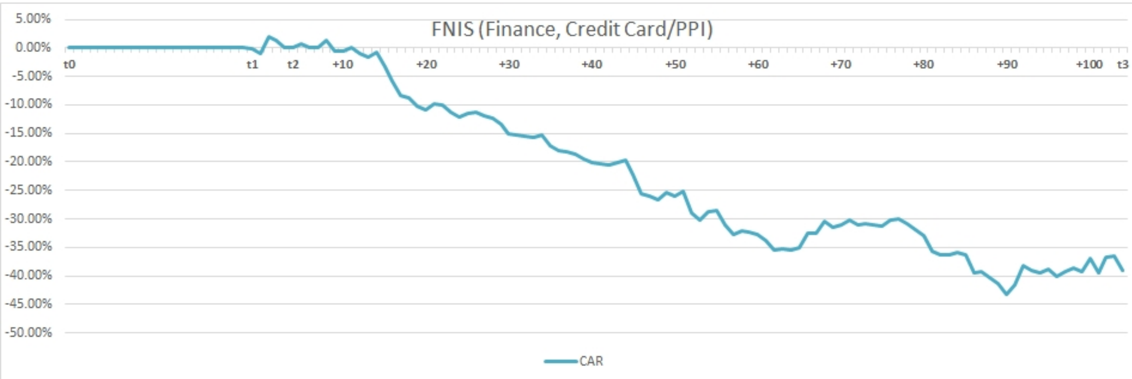

Figure 36: Inc21 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc21	CAR	S2 CAR	CAR t-test
t1	-0,230 %	1,373E-04	-1,962E-01
0	-0,892 %	2,746E-04	-5,384E-01
+1	1,942 %	4,118E-04	9,569E-01
+2	1,308 %	5,491E-04	5,582E-01
+3	0,075 %	6,864E-04	2,859E-02
t2	0,046 %	8,237E-04	1,609E-02
+10	-0,503 %	1,647E-03	-1,239E-01
+20	-10,850 %	3,020E-03	-1,974E+00
+30	-14,964 %	4,393E-03	-2,258E+00
+40	-20,031 %	5,766E-03	-2,638E+00
+50	-26,093 %	7,139E-03	-3,088E+00
+60	-32,824 %	8,512E-03	-3,558E+00
+70	-31,098 %	9,884E-03	-3,128E+00
+80	-32,862 %	1,126E-02	-3,097E+00
+90	-43,282 %	1,263E-02	-3,851E+00
+100	-37,000 %	1,400E-02	-3,127E+00
t3	-39,127 %	1,455E-02	-3,244E+00

Table 36: Inc21 Summary data

Inc22

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

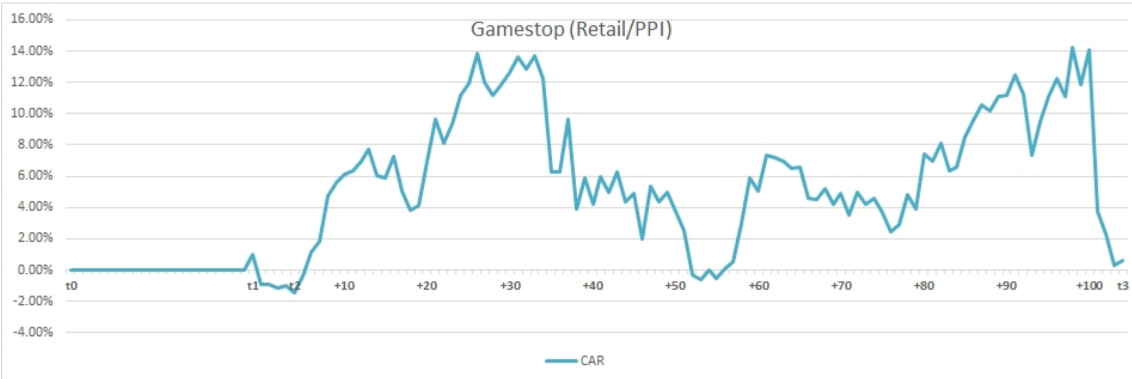

Figure 37: Inc22 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc22	CAR	S2 CAR	CAR t-test
t1	1,011 %	6,566E-04	3,947E-01
0	-0,930 %	1,313E-03	-2,565E-01
+1	-0,926 %	1,970E-03	-2,087E-01
+2	-1,170 %	2,626E-03	-2,283E-01
+3	-0,960 %	3,283E-03	-1,675E-01
t2	-1,435 %	3,940E-03	-2,286E-01
+10	6,126 %	7,879E-03	6,901E-01
+20	6,978 %	1,445E-02	5,806E-01
+30	12,649 %	2,101E-02	8,727E-01
+40	4,240 %	2,758E-02	2,553E-01
+50	3,784 %	3,414E-02	2,048E-01
+60	5,076 %	4,071E-02	2,516E-01
+70	4,870 %	4,728E-02	2,240E-01
+80	7,413 %	5,384E-02	3,195E-01
+90	11,161 %	6,041E-02	4,541E-01
+100	14,072 %	6,697E-02	5,437E-01
t3	0,597 %	6,960E-02	2,263E-02

Table 37: Inc22 Summary data

Inc23

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

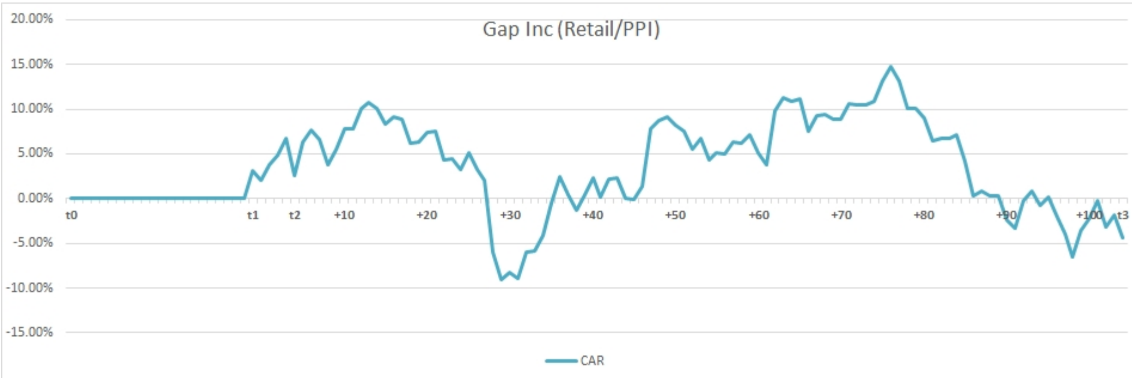

Figure 38: Inc23 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc23	CAR	S2 CAR	CAR t-test
t1	3,180 %	3,821E-04	1,627E+00
0	2,012 %	7,642E-04	7,278E-01
+1	3,778 %	1,146E-03	1,116E+00
+2	4,831 %	1,528E-03	1,236E+00
+3	6,672 %	1,910E-03	1,527E+00
t2	2,639 %	2,292E-03	5,511E-01
+10	7,751 %	4,585E-03	1,145E+00
+20	7,400 %	8,406E-03	8,071E-01
+30	-8,220 %	1,223E-02	-7,434E-01
+40	2,280 %	1,605E-02	1,800E-01
+50	8,238 %	1,987E-02	5,844E-01
+60	5,113 %	2,369E-02	3,322E-01
+70	8,855 %	2,751E-02	5,339E-01
+80	9,072 %	3,133E-02	5,126E-01
+90	-2,353 %	3,515E-02	-1,255E-01
+100	-2,195 %	3,897E-02	-1,112E-01
t3	-4,315 %	4,050E-02	-2,144E-01

Table 38: Inc23 Summary data

Inc24

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

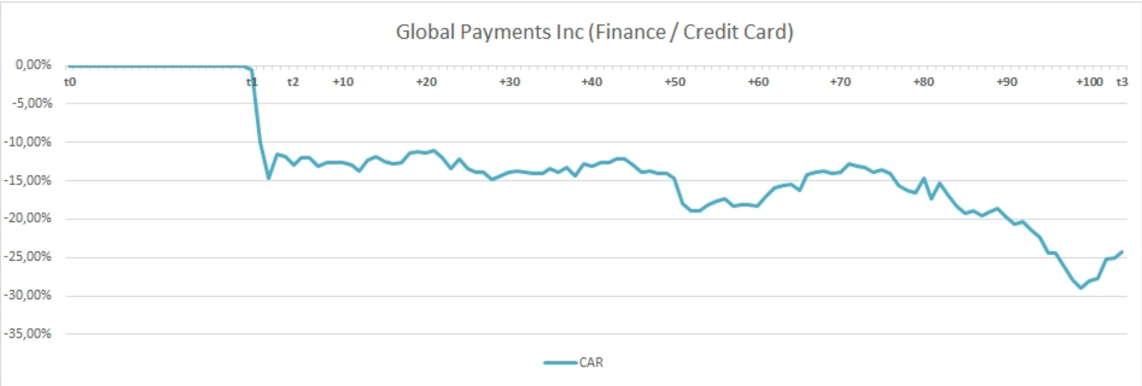

Figure 39: Inc24 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc24	CAR	S2 CAR	CAR t-test
t1	-0,467 %	9,623E-05	-4,756E-01
0	-9,984 %	1,925E-04	-7,197E+00
+1	-14,605 %	2,887E-04	-8,596E+00
+2	-11,586 %	3,849E-04	-5,906E+00
+3	-11,883 %	4,811E-04	-5,417E+00
t2	-12,971 %	5,774E-04	-5,398E+00
+10	-12,627 %	1,155E-03	-3,716E+00
+20	-11,415 %	2,117E-03	-2,481E+00
+30	-13,820 %	3,079E-03	-2,491E+00
+40	-13,056 %	4,042E-03	-2,054E+00
+50	-14,686 %	5,004E-03	-2,076E+00
+60	-18,297 %	5,966E-03	-2,369E+00
+70	-13,844 %	6,928E-03	-1,663E+00
+80	-14,744 %	7,891E-03	-1,660E+00
+90	-19,733 %	8,853E-03	-2,097E+00
+100	-27,954 %	9,815E-03	-2,822E+00
t3	-24,240 %	1,020E-02	-2,400E+00

Table 39: Inc24 Summary data

Inc25

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

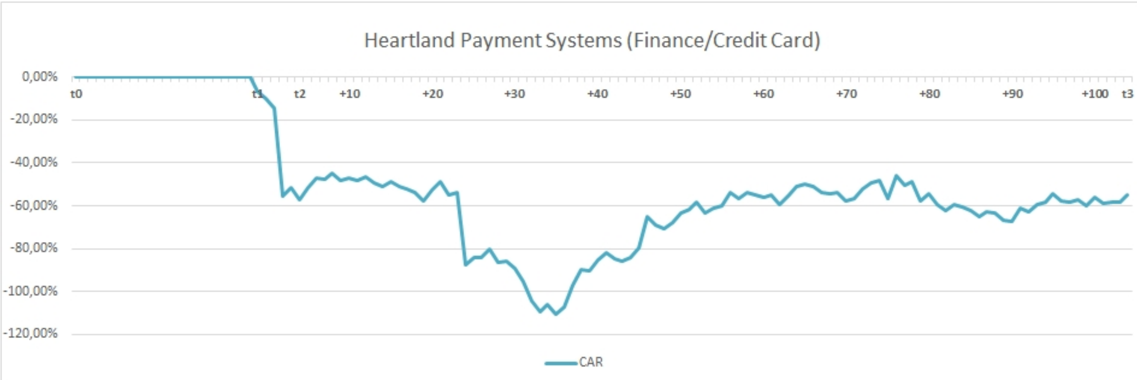

Figure 40: Inc25 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc25	CAR	S2 CAR	CAR t-test
t1	-6,571 %	1,166E-03	-1,924E+00
0	-10,070 %	2,333E-03	-2,085E+00
+1	-14,625 %	3,499E-03	-2,472E+00
+2	-55,449 %	4,666E-03	-8,118E+00
+3	-51,600 %	5,832E-03	-6,757E+00
t2	-57,262 %	6,998E-03	-6,845E+00
+10	-46,931 %	1,400E-02	-3,967E+00
+20	-52,507 %	2,566E-02	-3,278E+00
+30	-89,313 %	3,732E-02	-4,623E+00
+40	-85,203 %	4,899E-02	-3,850E+00
+50	-63,299 %	6,065E-02	-2,570E+00
+60	-56,259 %	7,232E-02	-2,092E+00
+70	-57,559 %	8,398E-02	-1,986E+00
+80	-54,634 %	9,564E-02	-1,767E+00
+90	-67,154 %	1,073E-01	-2,050E+00
+100	-56,003 %	1,190E-01	-1,624E+00
t3	-54,998 %	1,236E-01	-1,564E+00

Table 40: Inc25 Summary data

Inc26

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

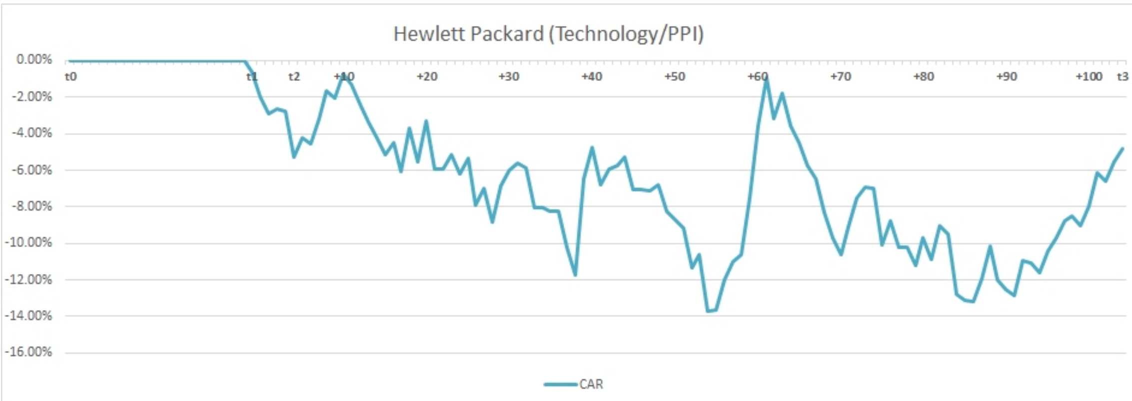

Figure 41: Inc26 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc26	CAR	S2 CAR	CAR t-test
t1	-0,624 %	2,363E-04	-4,062E-01
0	-2,007 %	4,726E-04	-9,233E-01
+1	-2,890 %	7,089E-04	-1,085E+00
+2	-2,610 %	9,451E-04	-8,490E-01
+3	-2,783 %	1,181E-03	-8,097E-01
t2	-5,260 %	1,418E-03	-1,397E+00
+10	-0,711 %	2,835E-03	-1,335E-01
+20	-3,302 %	5,198E-03	-4,580E-01
+30	-5,996 %	7,561E-03	-6,895E-01
+40	-4,776 %	9,924E-03	-4,795E-01
+50	-8,692 %	1,229E-02	-7,841E-01
+60	-3,549 %	1,465E-02	-2,932E-01
+70	-10,620 %	1,701E-02	-8,142E-01
+80	-9,716 %	1,938E-02	-6,980E-01
+90	-12,536 %	2,174E-02	-8,503E-01
+100	-7,955 %	2,410E-02	-5,124E-01
t3	-4,801 %	2,505E-02	-3,033E-01

Table 41: Inc26 Summary data

Inc27

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

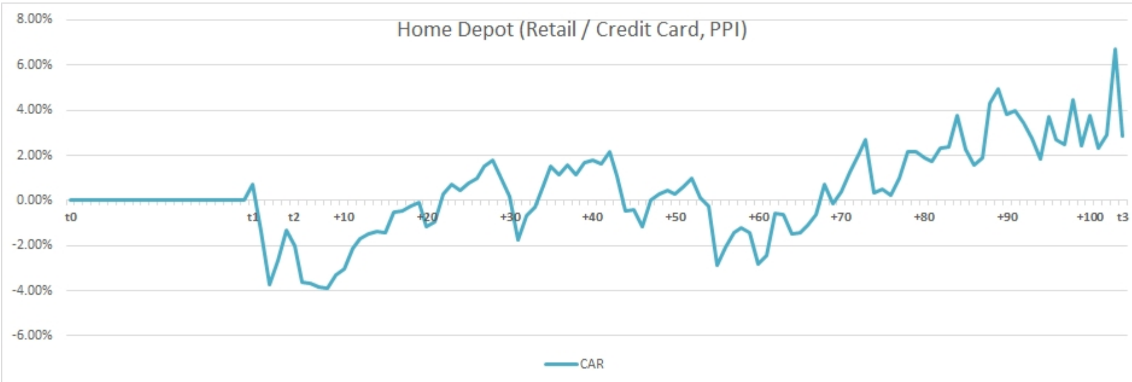

Figure 42: Inc27 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc27	CAR	S2 CAR	CAR t-test
t1	0,709 %	7,644E-05	8,105E-01
0	-1,355 %	1,529E-04	-1,096E+00
+1	-3,739 %	2,293E-04	-2,469E+00
+2	-2,664 %	3,057E-04	-1,523E+00
+3	-1,300 %	3,822E-04	-6,648E-01
t2	-1,992 %	4,586E-04	-9,302E-01
+10	-3,007 %	9,172E-04	-9,928E-01
+20	-1,157 %	1,682E-03	-2,822E-01
+30	0,185 %	2,446E-03	3,744E-02
+40	1,772 %	3,210E-03	3,128E-01
+50	0,269 %	3,975E-03	4,266E-02
+60	-2,822 %	4,739E-03	-4,099E-01
+70	0,386 %	5,503E-03	5,209E-02
+80	1,888 %	6,268E-03	2,385E-01
+90	3,839 %	7,032E-03	4,578E-01
+100	3,754 %	7,797E-03	4,252E-01
t3	2,859 %	8,102E-03	3,176E-01

Table 42: Inc27 Summary data

Inc28

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

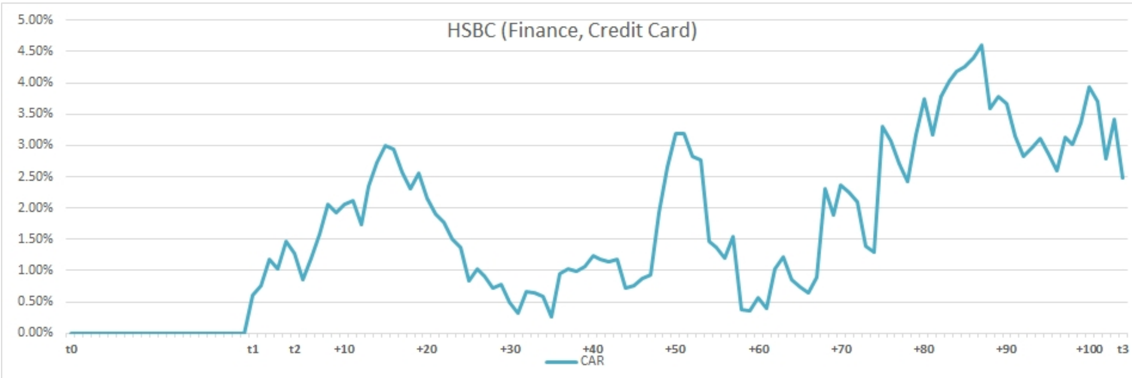

Figure 43: Inc28 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc28	CAR	S2 CAR	CAR t-test
t1	0,599 %	3,597E-05	9,993E-01
0	0,751 %	7,193E-05	8,854E-01
+1	1,183 %	1,079E-04	1,139E+00
+2	1,037 %	1,439E-04	8,644E-01
+3	1,465 %	1,798E-04	1,092E+00
t2	1,282 %	2,158E-04	8,726E-01
+10	2,066 %	4,316E-04	9,944E-01
+20	2,150 %	7,913E-04	7,644E-01
+30	0,490 %	1,151E-03	1,445E-01
+40	1,244 %	1,511E-03	3,200E-01
+50	3,194 %	1,870E-03	7,385E-01
+60	0,562 %	2,230E-03	1,189E-01
+70	2,374 %	2,590E-03	4,666E-01
+80	3,743 %	2,949E-03	6,892E-01
+90	3,664 %	3,309E-03	6,370E-01
+100	3,928 %	3,669E-03	6,485E-01
t3	2,481 %	3,812E-03	4,018E-01

Table 43: Inc28 Summary data

Inc29

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

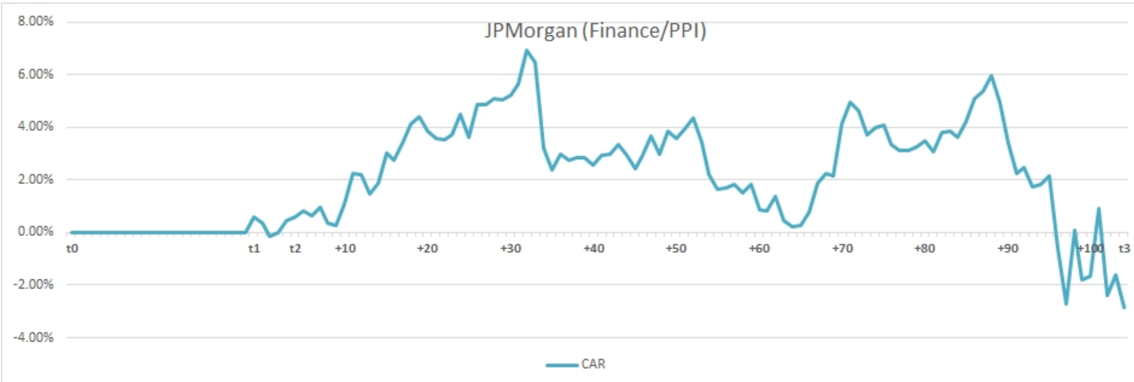

Figure 44: Inc29 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc29	CAR	S2 CAR	CAR t-test
t1	0,574 %	6,476E-05	7,139E-01
	0,343 %	1,295E-04	3,013E-01
	-0,150 %	1,943E-04	-1,075E-01
	-0,021 %	2,590E-04	-1,284E-02
	0,445 %	3,238E-04	2,473E-01
t2	0,613 %	3,885E-04	3,112E-01
+10	1,083 %	7,771E-04	3,884E-01
+20	3,862 %	1,425E-03	1,023E+00
+30	5,245 %	2,072E-03	1,152E+00
+40	2,550 %	2,720E-03	4,891E-01
+50	3,577 %	3,367E-03	6,164E-01
+60	0,853 %	4,015E-03	1,346E-01
+70	4,128 %	4,662E-03	6,046E-01
+80	3,480 %	5,310E-03	4,776E-01
+90	3,410 %	5,958E-03	4,417E-01
+100	-1,640 %	6,605E-03	-2,017E-01
t3	-2,858 %	6,864E-03	-3,450E-01

Table 44: Inc29 Summary data

Inc30

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

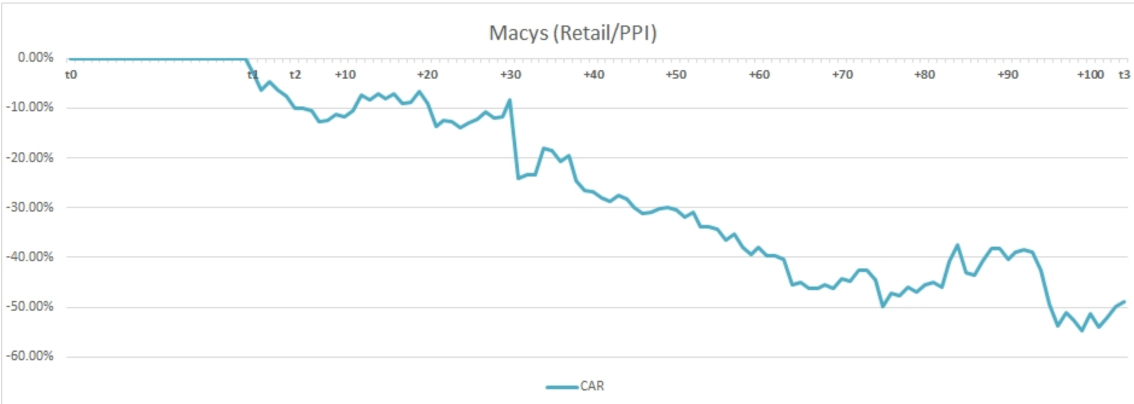

Figure 45: Inc30 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc30	CAR	S2 CAR	CAR t-test
t1	-3,209 %	5,137E-04	-1,416E+00
	-6,282 %	1,027E-03	-1,960E+00
	-4,617 %	1,541E-03	-1,176E+00
	-6,476 %	2,055E-03	-1,429E+00
	-7,676 %	2,569E-03	-1,514E+00
t2	-10,073 %	3,082E-03	-1,814E+00
+10	-11,699 %	6,165E-03	-1,490E+00
+20	-8,945 %	1,130E-02	-8,414E-01
+30	-8,438 %	1,644E-02	-6,581E-01
+40	-26,717 %	2,158E-02	-1,819E+00
+50	-30,351 %	2,671E-02	-1,857E+00
+60	-38,037 %	3,185E-02	-2,131E+00
+70	-44,397 %	3,699E-02	-2,308E+00
+80	-45,567 %	4,213E-02	-2,220E+00
+90	-40,286 %	4,726E-02	-1,853E+00
+100	-51,441 %	5,240E-02	-2,247E+00
t3	-48,917 %	5,446E-02	-2,096E+00

Table 45: Inc30 Summary data

Inc31

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

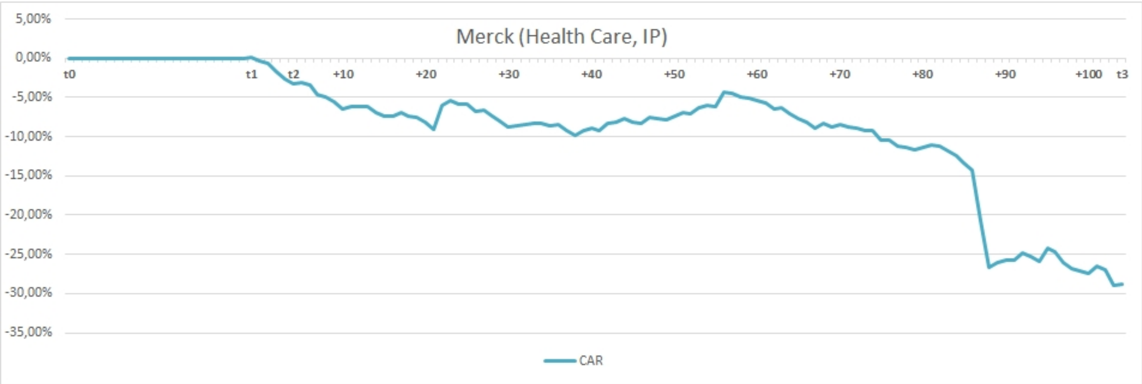

Figure 46: Inc31 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc31	CAR	S2 CAR	CAR t-test
t1	0,068 %	7,517E-05	7,805E-02
0	-0,383 %	1,503E-04	-3,126E-01
+1	-0,670 %	2,255E-04	-4,461E-01
+2	-1,721 %	3,007E-04	-9,924E-01
+3	-2,665 %	3,758E-04	-1,375E+00
t2	-3,197 %	4,510E-04	-1,505E+00
+10	-6,433 %	9,020E-04	-2,142E+00
+20	-8,083 %	1,654E-03	-1,988E+00
+30	-8,786 %	2,405E-03	-1,791E+00
+40	-8,950 %	3,157E-03	-1,593E+00
+50	-7,415 %	3,909E-03	-1,186E+00
+60	-5,426 %	4,660E-03	-7,948E-01
+70	-8,508 %	5,412E-03	-1,157E+00
+80	-11,357 %	6,164E-03	-1,447E+00
+90	-25,790 %	6,916E-03	-3,101E+00
+100	-27,423 %	7,667E-03	-3,132E+00
t3	-28,727 %	7,968E-03	-3,218E+00

Table 46: Inc31 Summary data

Inc32

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

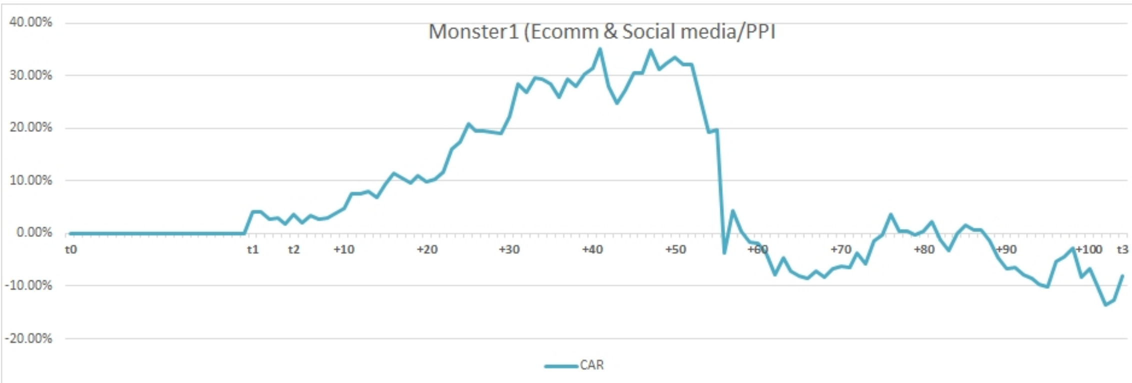

Figure 47: Inc32 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc32	CAR	S2 CAR	CAR t-test
t1	4,216 %	5,369E-04	1,819E+00
	4,133 %	1,074E-03	1,261E+00
	2,663 %	1,611E-03	6,635E-01
	2,887 %	2,148E-03	6,231E-01
	1,730 %	2,685E-03	3,339E-01
t2	3,718 %	3,221E-03	6,551E-01
+10	4,853 %	6,443E-03	6,046E-01
+20	9,804 %	1,181E-02	9,021E-01
+30	22,266 %	1,718E-02	1,699E+00
+40	31,298 %	2,255E-02	2,084E+00
+50	33,567 %	2,792E-02	2,009E+00
+60	-1,825 %	3,329E-02	-1,000E-01
+70	-6,285 %	3,866E-02	-3,197E-01
+80	0,527 %	4,403E-02	2,512E-02
+90	-6,614 %	4,940E-02	-2,976E-01
+100	-6,693 %	5,476E-02	-2,860E-01
t3	-7,945 %	5,691E-02	-3,330E-01

Table 47: Inc32 Summary data

Inc33

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

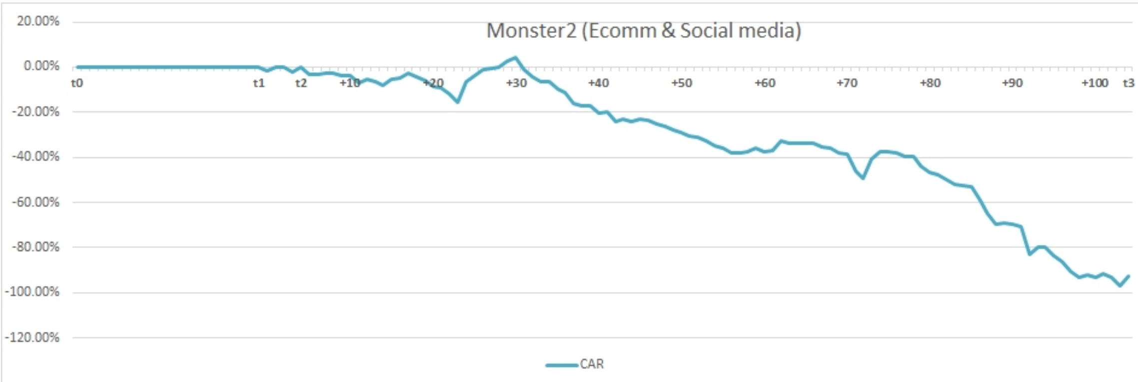

Figure 48: Inc33 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc33	CAR	S2 CAR	CAR t-test
t1	-0,066 %	1,596E-03	-1,658E-02
	-1,696 %	3,191E-03	-3,002E-01
	-0,249 %	4,787E-03	-3,599E-02
	0,113 %	6,383E-03	1,415E-02
	-2,182 %	7,979E-03	-2,443E-01
t2	-0,305 %	9,574E-03	-3,117E-02
+10	-3,965 %	1,915E-02	-2,865E-01
+20	-8,728 %	3,511E-02	-4,659E-01
+30	4,060 %	5,106E-02	1,797E-01
+40	-20,426 %	6,702E-02	-7,890E-01
+50	-28,993 %	8,298E-02	-1,007E+00
+60	-37,726 %	9,894E-02	-1,199E+00
+70	-38,836 %	1,149E-01	-1,146E+00
+80	-46,386 %	1,309E-01	-1,282E+00
+90	-69,376 %	1,468E-01	-1,811E+00
+100	-92,954 %	1,628E-01	-2,304E+00
t3	-92,599 %	1,691E-01	-2,252E+00

Table 48: Inc33 Summary data

Inc34

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

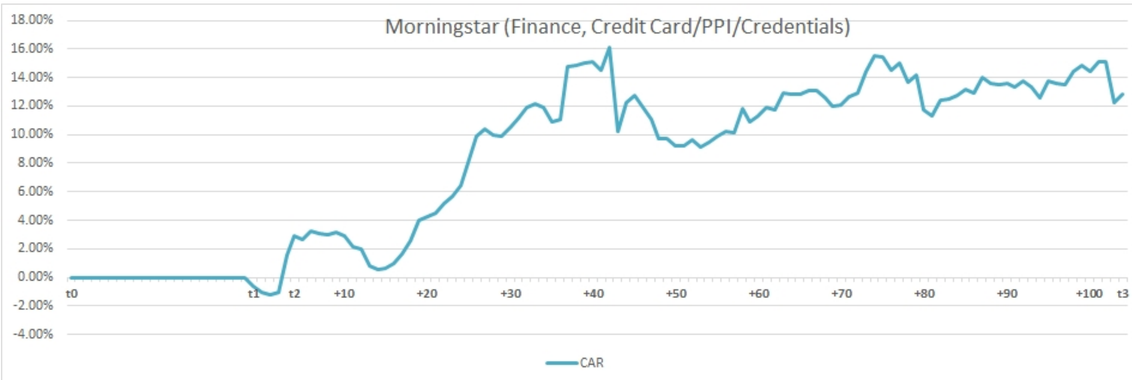

Figure 49: Inc34 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc34	CAR	S2 CAR	CAR t-test
t1	-0,626 %	6,865E-05	-7,552E-01
0	-1,073 %	1,373E-04	-9,154E-01
+1	-1,217 %	2,060E-04	-8,481E-01
+2	-1,039 %	2,746E-04	-6,269E-01
+3	1,584 %	3,433E-04	8,547E-01
t2	2,930 %	4,119E-04	1,444E+00
+10	2,909 %	8,238E-04	1,013E+00
+20	4,224 %	1,510E-03	1,087E+00
+30	10,451 %	2,197E-03	2,230E+00
+40	15,091 %	2,883E-03	2,810E+00
+50	9,197 %	3,570E-03	1,539E+00
+60	11,361 %	4,257E-03	1,741E+00
+70	12,081 %	4,943E-03	1,718E+00
+80	11,752 %	5,630E-03	1,566E+00
+90	13,559 %	6,316E-03	1,706E+00
+100	14,472 %	7,003E-03	1,729E+00
t3	12,867 %	7,277E-03	1,508E+00

Table 49: Inc34 Summary data

Inc35

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

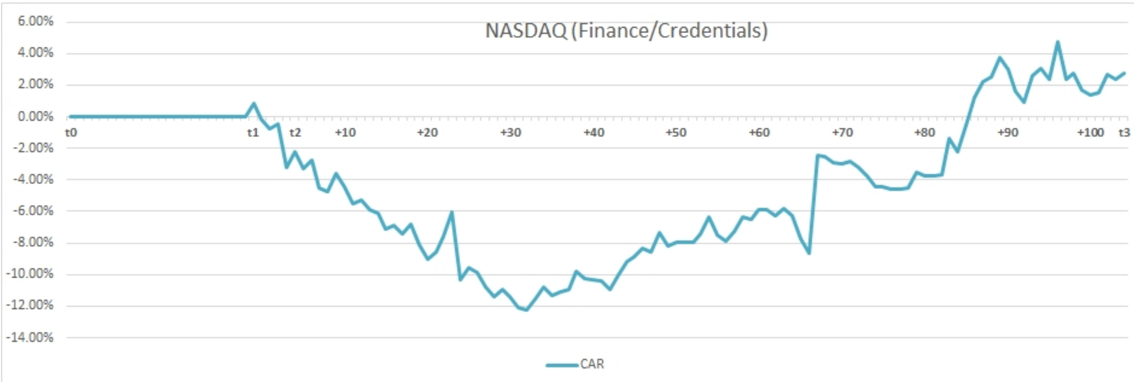

Figure 50: Inc35 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc35	CAR	S2 CAR	CAR t-test
t1	0,842 %	2,677E-04	5,144E-01
	-0,118 %	5,354E-04	-5,121E-02
	-0,770 %	8,030E-04	-2,718E-01
	-0,431 %	1,071E-03	-1,317E-01
	-3,185 %	1,338E-03	-8,707E-01
t2	-2,223 %	1,606E-03	-5,548E-01
+10	-4,471 %	3,212E-03	-7,888E-01
+20	-8,989 %	5,889E-03	-1,171E+00
+30	-11,378 %	8,566E-03	-1,229E+00
+40	-10,300 %	1,124E-02	-9,714E-01
+50	-7,951 %	1,392E-02	-6,739E-01
+60	-5,912 %	1,660E-02	-4,589E-01
+70	-3,016 %	1,927E-02	-2,172E-01
+80	-3,732 %	2,195E-02	-2,519E-01
+90	2,997 %	2,463E-02	1,910E-01
+100	1,393 %	2,730E-02	8,432E-02
t3	2,748 %	2,837E-02	1,632E-01

Table 50: Inc35 Summary data

Inc36

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

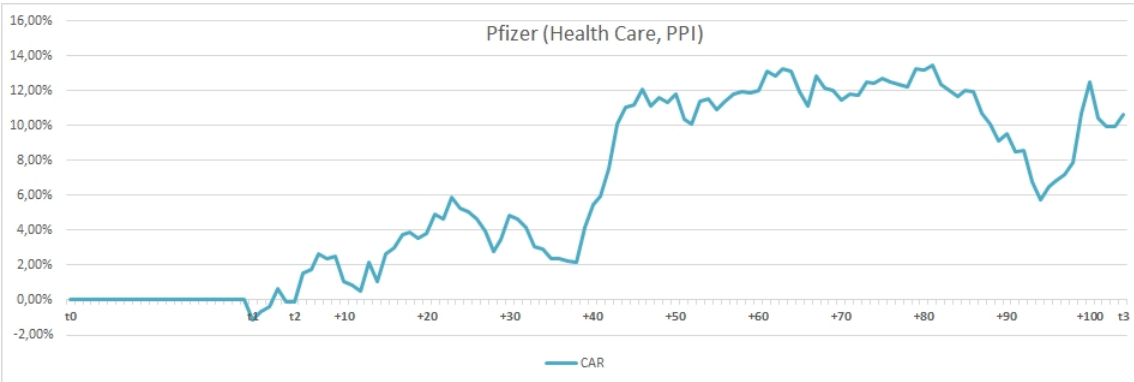

Figure 51: Inc36 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc36	CAR	S2 CAR	CAR t-test
t1	-1,132 %	4,445E-05	-1,698E+00
0	-0,650 %	8,889E-05	-6,898E-01
+1	-0,383 %	1,333E-04	-3,315E-01
+2	0,630 %	1,778E-04	4,721E-01
+3	-0,127 %	2,222E-04	-8,543E-02
t2	-0,137 %	2,667E-04	-8,399E-02
+10	1,048 %	5,333E-04	4,540E-01
+20	3,839 %	9,778E-04	1,228E+00
+30	4,854 %	1,422E-03	1,287E+00
+40	5,437 %	1,867E-03	1,258E+00
+50	11,772 %	2,311E-03	2,449E+00
+60	12,002 %	2,756E-03	2,286E+00
+70	11,484 %	3,200E-03	2,030E+00
+80	13,160 %	3,644E-03	2,180E+00
+90	9,563 %	4,089E-03	1,496E+00
+100	12,520 %	4,533E-03	1,859E+00
t3	10,607 %	4,711E-03	1,545E+00

Table 51: Inc36 Summary data

Inc37

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

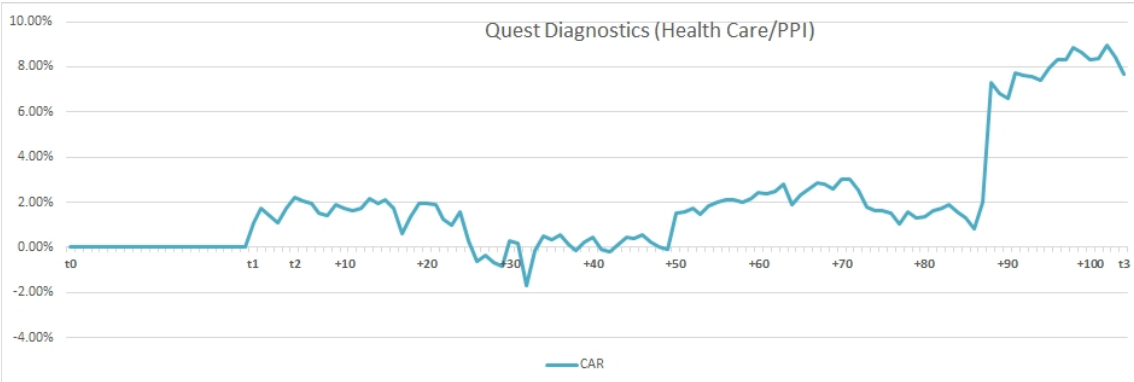

Figure 52: Inc37 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc37	CAR	S2 CAR	CAR t-test
t1	1,063 %	9,243E-05	1,106E+00
	1,749 %	1,849E-04	1,286E+00
	1,392 %	2,773E-04	8,361E-01
	1,091 %	3,697E-04	5,671E-01
	1,729 %	4,622E-04	8,041E-01
t2	2,202 %	5,546E-04	9,349E-01
+10	1,758 %	1,109E-03	5,279E-01
+20	1,927 %	2,034E-03	4,274E-01
+30	0,311 %	2,958E-03	5,721E-02
+40	0,468 %	3,882E-03	7,519E-02
+50	1,542 %	4,807E-03	2,224E-01
+60	2,440 %	5,731E-03	3,223E-01
+70	3,034 %	6,655E-03	3,719E-01
+80	1,332 %	7,580E-03	1,530E-01
+90	6,596 %	8,504E-03	7,152E-01
+100	8,327 %	9,428E-03	8,575E-01
t3	7,676 %	9,798E-03	7,755E-01

Table 52: Inc37 Summary data

Inc38

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

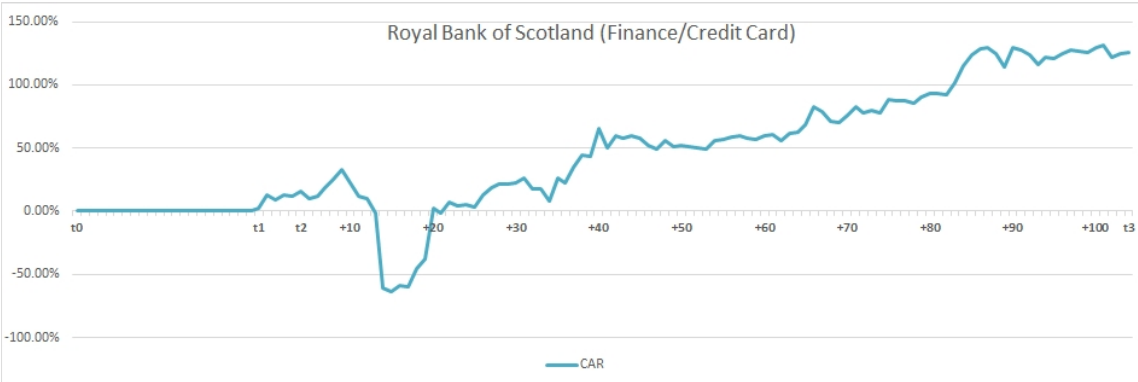

Figure 53: Inc38 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc38	CAR	S2 CAR	CAR t-test
t1	1,901 %	6,466E-03	2,364E-01
	12,461 %	1,293E-02	1,096E+00
	9,249 %	1,940E-02	6,641E-01
	13,089 %	2,586E-02	8,139E-01
	12,385 %	3,233E-02	6,888E-01
t2	15,952 %	3,879E-02	8,099E-01
+10	22,583 %	7,759E-02	8,108E-01
+20	2,047 %	1,422E-01	5,427E-02
+30	22,573 %	2,069E-01	4,963E-01
+40	65,865 %	2,716E-01	1,264E+00
+50	52,231 %	3,362E-01	9,008E-01
+60	59,677 %	4,009E-01	9,426E-01
+70	75,959 %	4,655E-01	1,113E+00
+80	93,096 %	5,302E-01	1,279E+00
+90	129,036 %	5,948E-01	1,673E+00
+100	129,841 %	6,595E-01	1,599E+00
t3	126,057 %	6,853E-01	1,523E+00

Table 53: Inc38 Summary data

Inc39

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

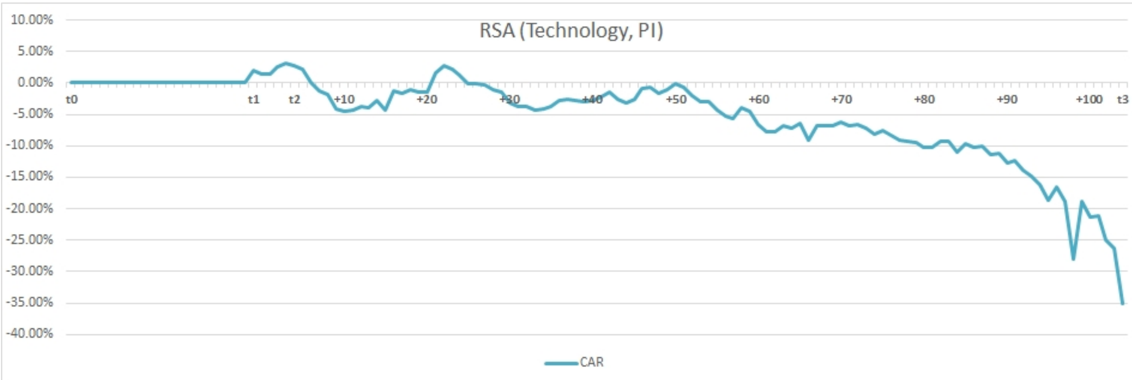

Figure 54: Inc39 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc39	CAR	S2 CAR	CAR t-test
t1	2,078 %	1,009E-04	2,069E+00
0	1,458 %	2,017E-04	1,026E+00
+1	1,449 %	3,026E-04	8,332E-01
+2	2,561 %	4,034E-04	1,275E+00
+3	3,126 %	5,043E-04	1,392E+00
t2	2,751 %	6,052E-04	1,118E+00
+10	-4,553 %	1,210E-03	-1,309E+00
+20	-1,526 %	2,219E-03	-3,239E-01
+30	-3,074 %	3,228E-03	-5,412E-01
+40	-2,699 %	4,236E-03	-4,146E-01
+50	-0,041 %	5,245E-03	-5,682E-03
+60	-6,526 %	6,253E-03	-8,252E-01
+70	-6,302 %	7,262E-03	-7,395E-01
+80	-10,228 %	8,271E-03	-1,125E+00
+90	-12,670 %	9,279E-03	-1,315E+00
+100	-21,355 %	1,029E-02	-2,105E+00
t3	-34,999 %	1,069E-02	-3,385E+00

Table 54: Inc39 Summary data

Inc40

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

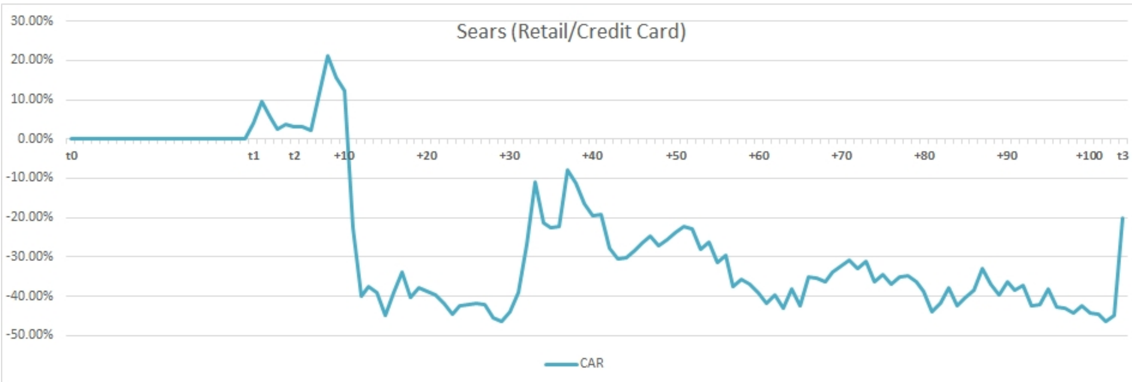

Figure 55: Inc40 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc40	CAR	S2 CAR	CAR t-test
t1	3,992 %	3,825E-03	6,455E-01
0	9,478 %	7,650E-03	1,084E+00
+1	5,641 %	1,148E-02	5,266E-01
+2	2,417 %	1,530E-02	1,954E-01
+3	3,870 %	1,913E-02	2,799E-01
t2	3,008 %	2,295E-02	1,986E-01
+10	12,302 %	4,590E-02	5,742E-01
+20	-38,900 %	8,415E-02	-1,341E+00
+30	-43,861 %	1,224E-01	-1,254E+00
+40	-19,510 %	1,607E-01	-4,867E-01
+50	-23,892 %	1,989E-01	-5,357E-01
+60	-39,156 %	2,372E-01	-8,040E-01
+70	-32,275 %	2,754E-01	-6,150E-01
+80	-38,723 %	3,137E-01	-6,914E-01
+90	-36,357 %	3,519E-01	-6,129E-01
+100	-44,424 %	3,902E-01	-7,112E-01
t3	-20,158 %	4,055E-01	-3,166E-01

Table 55: Inc40 Summary data

Inc41

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

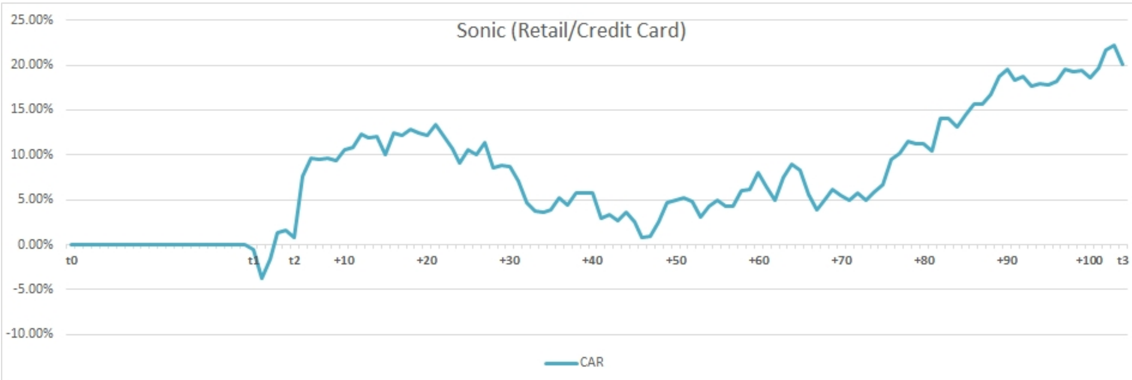

Figure 56: Inc41 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc41	CAR	S2 CAR	CAR t-test
t1	-0,571 %	2,093E-04	-3,947E-01
0	-3,779 %	4,186E-04	-1,847E+00
+1	-1,590 %	6,278E-04	-6,345E-01
+2	1,344 %	8,371E-04	4,644E-01
+3	1,616 %	1,046E-03	4,994E-01
t2	0,859 %	1,256E-03	2,424E-01
+10	10,592 %	2,511E-03	2,114E+00
+20	12,166 %	4,604E-03	1,793E+00
+30	8,647 %	6,697E-03	1,057E+00
+40	5,785 %	8,790E-03	6,171E-01
+50	4,911 %	1,088E-02	4,707E-01
+60	8,007 %	1,298E-02	7,029E-01
+70	5,520 %	1,507E-02	4,497E-01
+80	11,195 %	1,716E-02	8,546E-01
+90	19,557 %	1,925E-02	1,409E+00
+100	18,562 %	2,135E-02	1,270E+00
t3	20,122 %	2,218E-02	1,351E+00

Table 56: Inc41 Summary data

Inc42

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

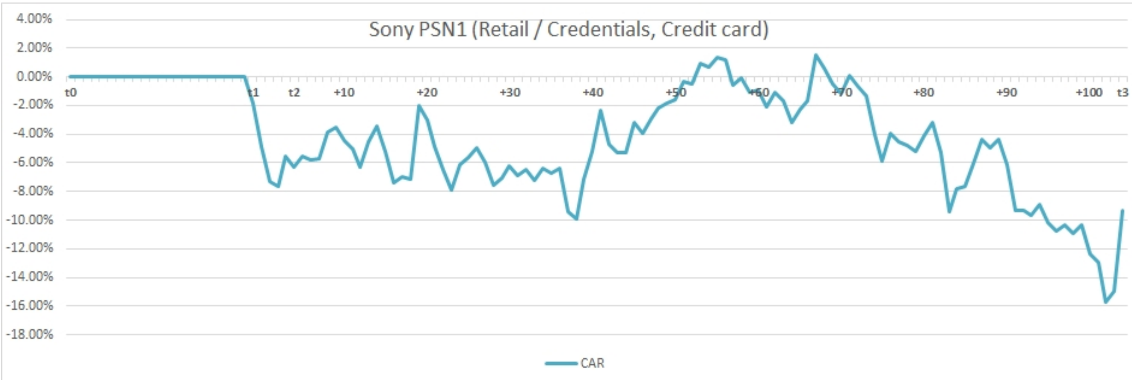

Figure 57: Inc42 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc42	CAR	S2 CAR	CAR t-test
t1	-1,816 %	1,927E-04	-1,308E+00
0	-4,884 %	3,855E-04	-2,488E+00
+1	-7,307 %	5,782E-04	-3,039E+00
+2	-7,667 %	7,709E-04	-2,761E+00
+3	-5,566 %	9,636E-04	-1,793E+00
t2	-6,265 %	1,156E-03	-1,842E+00
+10	-4,456 %	2,313E-03	-9,265E-01
+20	-3,040 %	4,240E-03	-4,669E-01
+30	-6,235 %	6,167E-03	-7,939E-01
+40	-5,203 %	8,095E-03	-5,783E-01
+50	-1,580 %	1,002E-02	-1,578E-01
+60	-0,927 %	1,195E-02	-8,482E-02
+70	-1,136 %	1,388E-02	-9,647E-02
+80	-4,096 %	1,580E-02	-3,258E-01
+90	-6,117 %	1,773E-02	-4,594E-01
+100	-12,380 %	1,966E-02	-8,830E-01
t3	-9,358 %	2,043E-02	-6,547E-01

Table 57: Inc42 Summary data

Inc43

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

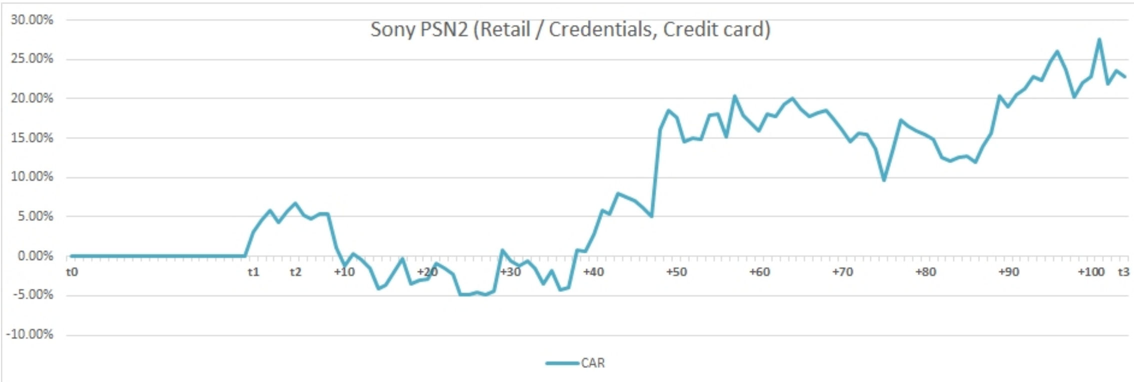

Figure 58: Inc43 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc43	CAR	S2 CAR	CAR t-test
t1	3,132 %	3,043E-04	1,796E+00
0	4,567 %	6,085E-04	1,851E+00
+1	5,853 %	9,128E-04	1,937E+00
+2	4,361 %	1,217E-03	1,250E+00
+3	5,747 %	1,521E-03	1,473E+00
t2	6,797 %	1,826E-03	1,591E+00
+10	-1,197 %	3,651E-03	-1,981E-01
+20	-2,940 %	6,694E-03	-3,594E-01
+30	-0,560 %	9,737E-03	-5,677E-02
+40	2,833 %	1,278E-02	2,506E-01
+50	17,671 %	1,582E-02	1,405E+00
+60	15,903 %	1,887E-02	1,158E+00
+70	16,061 %	2,191E-02	1,085E+00
+80	15,412 %	2,495E-02	9,757E-01
+90	18,976 %	2,799E-02	1,134E+00
+100	22,878 %	3,104E-02	1,299E+00
t3	22,776 %	3,225E-02	1,268E+00

Table 58: Inc43 Summary data

Inc44

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

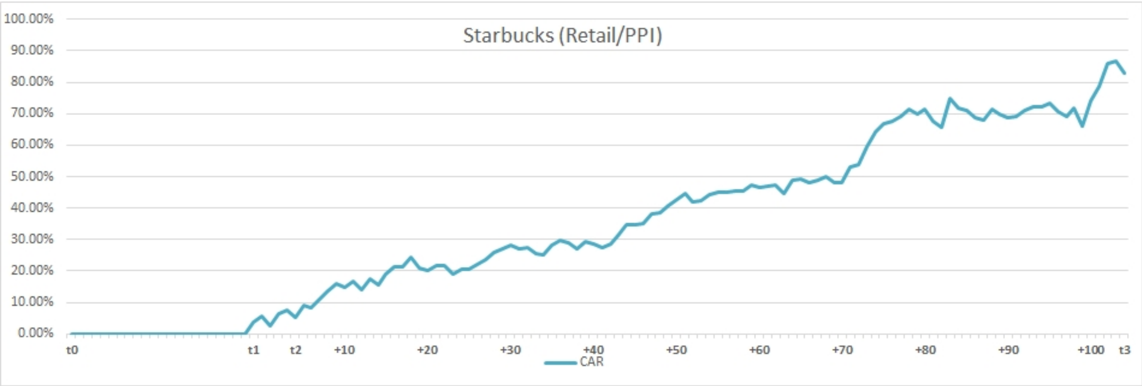

Figure 59: Inc44 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc44	CAR	S2 CAR	CAR t-test
t1	3,596 %	7,241E-04	1,336E+00
0	5,767 %	1,448E-03	1,515E+00
+1	2,610 %	2,172E-03	5,600E-01
+2	6,550 %	2,896E-03	1,217E+00
+3	7,653 %	3,620E-03	1,272E+00
t2	5,310 %	4,344E-03	8,056E-01
+10	14,829 %	8,689E-03	1,591E+00
+20	20,325 %	1,593E-02	1,610E+00
+30	28,381 %	2,317E-02	1,865E+00
+40	28,736 %	3,041E-02	1,648E+00
+50	42,793 %	3,765E-02	2,205E+00
+60	46,526 %	4,489E-02	2,196E+00
+70	48,128 %	5,213E-02	2,108E+00
+80	71,476 %	5,937E-02	2,933E+00
+90	68,571 %	6,661E-02	2,657E+00
+100	74,040 %	7,386E-02	2,724E+00
t3	83,006 %	7,675E-02	2,996E+00

Table 59: Inc44 Summary data

Inc45

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

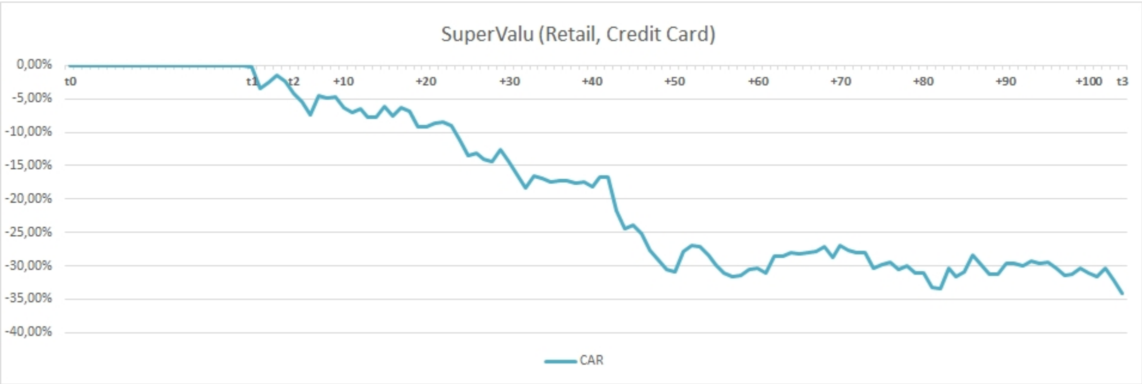

Figure 60: Inc45 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc45	CAR	S2 CAR	CAR t-test
t1	-0,263 %	4,246E-04	-1,277E-01
0	-3,439 %	8,493E-04	-1,180E+00
+1	-2,583 %	1,274E-03	-7,236E-01
+2	-1,451 %	1,699E-03	-3,521E-01
+3	-2,426 %	2,123E-03	-5,264E-01
t2	-4,080 %	2,548E-03	-8,083E-01
+10	-6,362 %	5,096E-03	-8,912E-01
+20	-9,112 %	9,342E-03	-9,427E-01
+30	-14,353 %	1,359E-02	-1,231E+00
+40	-18,165 %	1,783E-02	-1,360E+00
+50	-30,950 %	2,208E-02	-2,083E+00
+60	-30,309 %	2,633E-02	-1,868E+00
+70	-26,956 %	3,057E-02	-1,542E+00
+80	-31,104 %	3,482E-02	-1,667E+00
+90	-29,577 %	3,907E-02	-1,496E+00
+100	-30,980 %	4,331E-02	-1,489E+00
t3	-34,109 %	4,501E-02	-1,608E+00

Table 60: Inc45 Summary data

Inc46

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

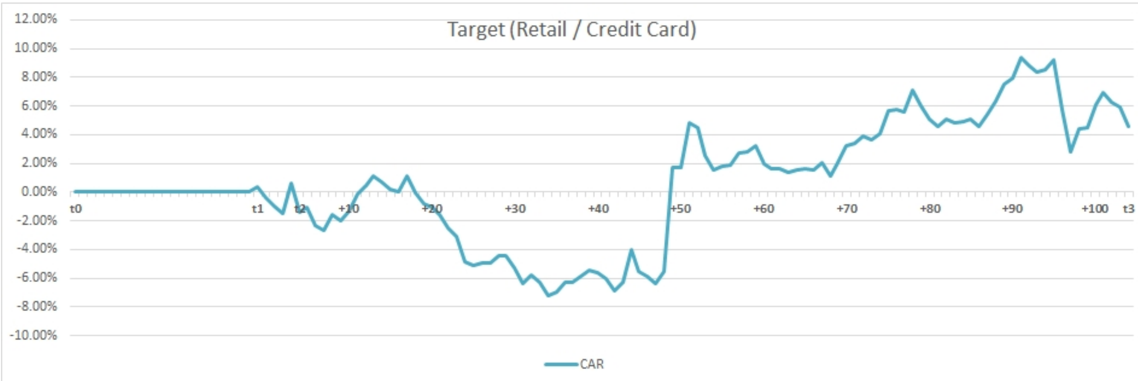

Figure 61: Inc46 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc46	CAR	S2 CAR	CAR t-test
t1	0,333 %	7,572E-05	3,828E-01
0	-0,367 %	1,514E-04	-2,984E-01
+1	-0,974 %	2,272E-04	-6,462E-01
+2	-1,457 %	3,029E-04	-8,374E-01
+3	0,598 %	3,786E-04	3,072E-01
t2	-1,434 %	4,543E-04	-6,726E-01
+10	-1,297 %	9,086E-04	-4,301E-01
+20	-1,055 %	1,666E-03	-2,584E-01
+30	-5,299 %	2,423E-03	-1,077E+00
+40	-5,586 %	3,180E-03	-9,906E-01
+50	1,753 %	3,937E-03	2,794E-01
+60	1,942 %	4,694E-03	2,834E-01
+70	3,211 %	5,452E-03	4,349E-01
+80	5,087 %	6,209E-03	6,456E-01
+90	7,935 %	6,966E-03	9,507E-01
+100	6,084 %	7,723E-03	6,923E-01
t3	4,546 %	8,026E-03	5,075E-01

Table 61: Inc46 Summary data

Inc47

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

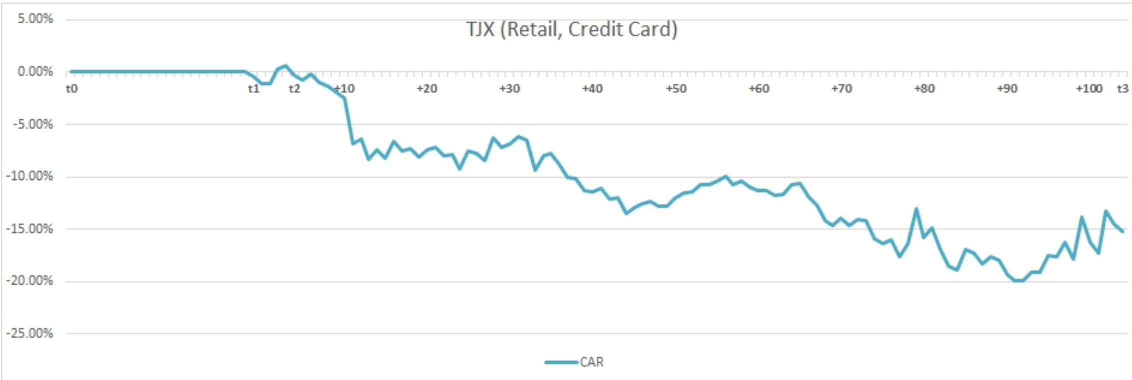

Figure 62: Inc47 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc47	CAR	S2 CAR	CAR t-test
t1	-0,450 %	1,749E-04	-3,406E-01
0	-1,119 %	3,498E-04	-5,980E-01
+1	-1,139 %	5,247E-04	-4,974E-01
+2	0,233 %	6,997E-04	8,802E-02
+3	0,600 %	8,746E-04	2,030E-01
t2	-0,289 %	1,049E-03	-8,924E-02
+10	-2,417 %	2,099E-03	-5,275E-01
+20	-7,357 %	3,848E-03	-1,186E+00
+30	-6,875 %	5,597E-03	-9,189E-01
+40	-11,377 %	7,346E-03	-1,327E+00
+50	-12,030 %	9,096E-03	-1,261E+00
+60	-11,325 %	1,084E-02	-1,087E+00
+70	-13,922 %	1,259E-02	-1,241E+00
+80	-15,757 %	1,434E-02	-1,316E+00
+90	-19,378 %	1,609E-02	-1,528E+00
+100	-16,202 %	1,784E-02	-1,213E+00
t3	-15,224 %	1,854E-02	-1,118E+00

Table 62: Inc47 Summary data

Inc48

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

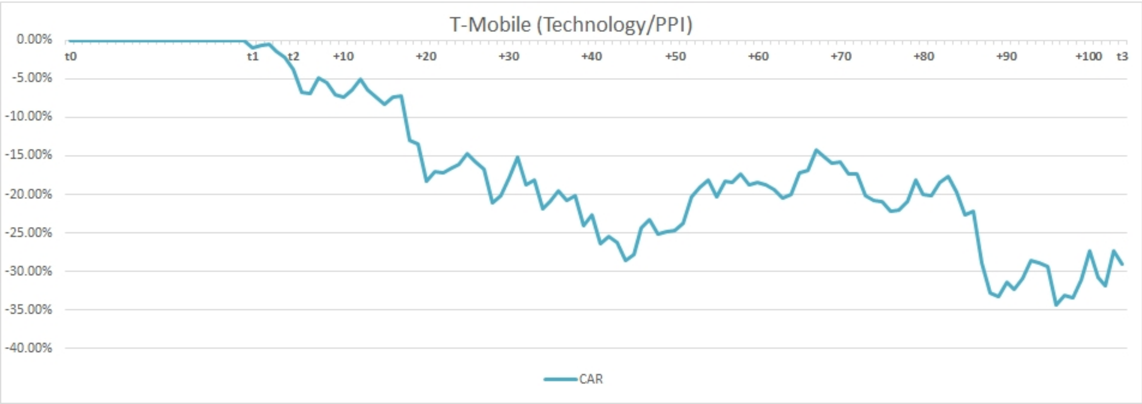

Figure 63: Inc48 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc48	CAR	S2 CAR	CAR t-test
t1	-1,040 %	2,188E-04	-7,029E-01
0	-0,633 %	4,375E-04	-3,026E-01
+1	-0,530 %	6,563E-04	-2,067E-01
+2	-1,504 %	8,751E-04	-5,083E-01
+3	-2,243 %	1,094E-03	-6,783E-01
t2	-3,781 %	1,313E-03	-1,044E+00
+10	-7,335 %	2,625E-03	-1,432E+00
+20	-18,246 %	4,813E-03	-2,630E+00
+30	-17,762 %	7,001E-03	-2,123E+00
+40	-22,698 %	9,188E-03	-2,368E+00
+50	-24,599 %	1,138E-02	-2,306E+00
+60	-18,505 %	1,356E-02	-1,589E+00
+70	-15,863 %	1,575E-02	-1,264E+00
+80	-19,981 %	1,794E-02	-1,492E+00
+90	-31,440 %	2,013E-02	-2,216E+00
+100	-27,354 %	2,231E-02	-1,831E+00
t3	-29,054 %	2,319E-02	-1,908E+00

Table 63: Inc48 Summary data

Inc49

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

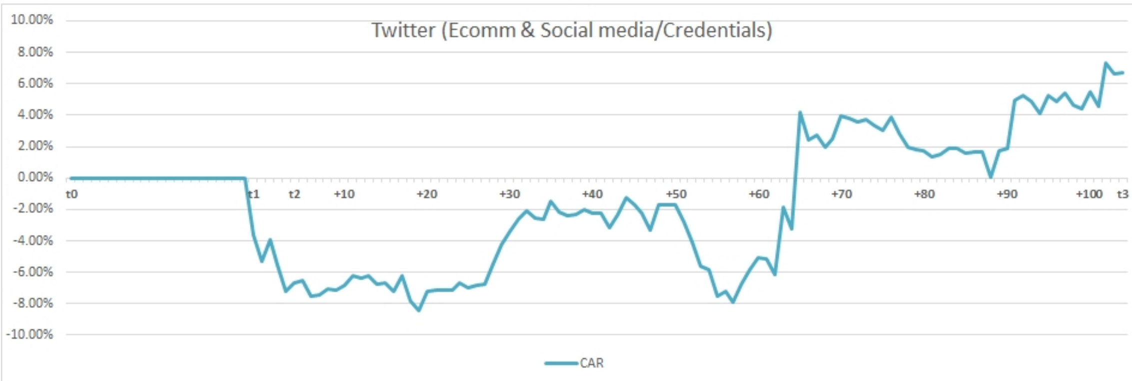

Figure 64: Inc49 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc49	CAR	S2 CAR	CAR t-test
t1	-3,584 %	2,018E-04	-2,523E+00
0	-5,271 %	4,036E-04	-2,624E+00
+1	-3,935 %	6,054E-04	-1,599E+00
+2	-5,498 %	8,071E-04	-1,935E+00
+3	-7,200 %	1,009E-03	-2,267E+00
t2	-6,677 %	1,211E-03	-1,919E+00
+10	-6,860 %	2,421E-03	-1,394E+00
+20	-7,203 %	4,439E-03	-1,081E+00
+30	-3,390 %	6,457E-03	-4,219E-01
+40	-2,268 %	8,475E-03	-2,463E-01
+50	-1,712 %	1,049E-02	-1,671E-01
+60	-5,038 %	1,251E-02	-4,505E-01
+70	3,939 %	1,453E-02	3,268E-01
+80	1,732 %	1,655E-02	1,346E-01
+90	1,917 %	1,856E-02	1,407E-01
+100	5,452 %	2,058E-02	3,800E-01
t3	6,676 %	2,139E-02	4,565E-01

Table 64: Inc49 Summary data

Inc50

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

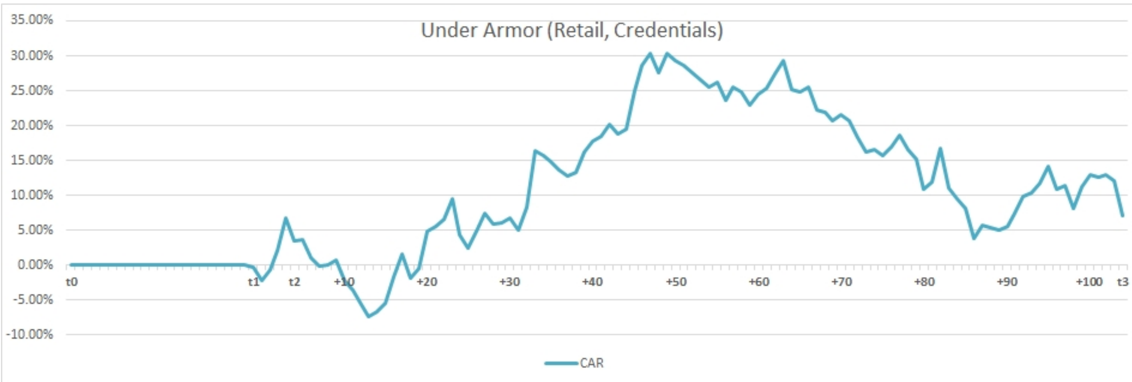

Figure 65: Inc50 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc50	CAR	S2 CAR	CAR t-test
t1	-0,311 %	1,445E-03	-8,182E-02
0	-2,117 %	2,889E-03	-3,938E-01
+1	-0,627 %	4,334E-03	-9,519E-02
+2	2,075 %	5,779E-03	2,730E-01
+3	6,810 %	7,224E-03	8,013E-01
t2	3,480 %	8,668E-03	3,738E-01
+10	-2,129 %	1,734E-02	-1,617E-01
+20	4,857 %	3,178E-02	2,724E-01
+30	6,827 %	4,623E-02	3,175E-01
+40	17,751 %	6,068E-02	7,206E-01
+50	29,272 %	7,513E-02	1,068E+00
+60	24,472 %	8,957E-02	8,177E-01
+70	21,531 %	1,040E-01	6,676E-01
+80	10,880 %	1,185E-01	3,161E-01
+90	5,525 %	1,329E-01	1,516E-01
+100	12,922 %	1,474E-01	3,366E-01
t3	7,128 %	1,531E-01	1,822E-01

Table 65: Inc50 Summary data

Inc51

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

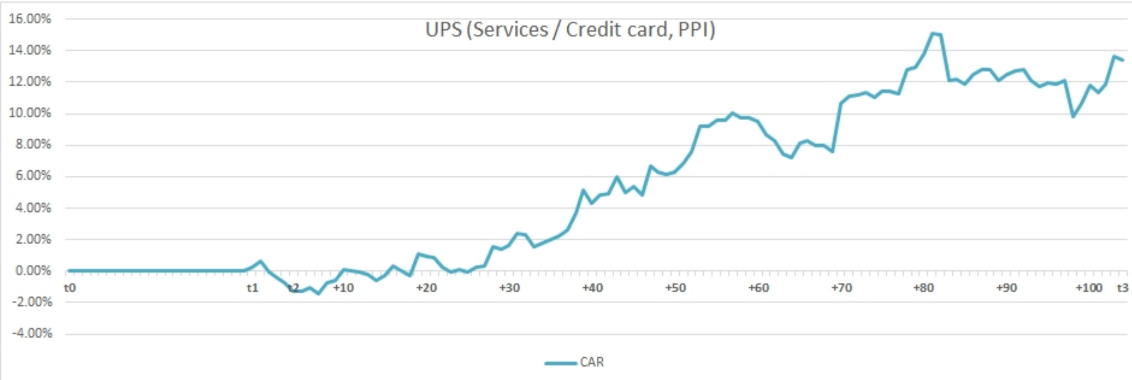

Figure 66: Inc51 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc51	CAR	S2 CAR	CAR t-test
t1	0,252 %	3,303E-05	4,387E-01
0	0,599 %	6,606E-05	7,374E-01
+1	-0,021 %	9,909E-05	-2,135E-02
+2	-0,464 %	1,321E-04	-4,033E-01
+3	-0,733 %	1,652E-04	-5,701E-01
t2	-1,282 %	1,982E-04	-9,107E-01
+10	0,082 %	3,964E-04	4,137E-02
+20	0,953 %	7,267E-04	3,536E-01
+30	1,652 %	1,057E-03	5,081E-01
+40	4,283 %	1,387E-03	1,150E+00
+50	6,289 %	1,718E-03	1,518E+00
+60	9,535 %	2,048E-03	2,107E+00
+70	10,628 %	2,378E-03	2,179E+00
+80	13,817 %	2,709E-03	2,655E+00
+90	12,497 %	3,039E-03	2,267E+00
+100	11,795 %	3,369E-03	2,032E+00
t3	13,382 %	3,501E-03	2,262E+00

Table 66: Inc51 Summary data

Inc52

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

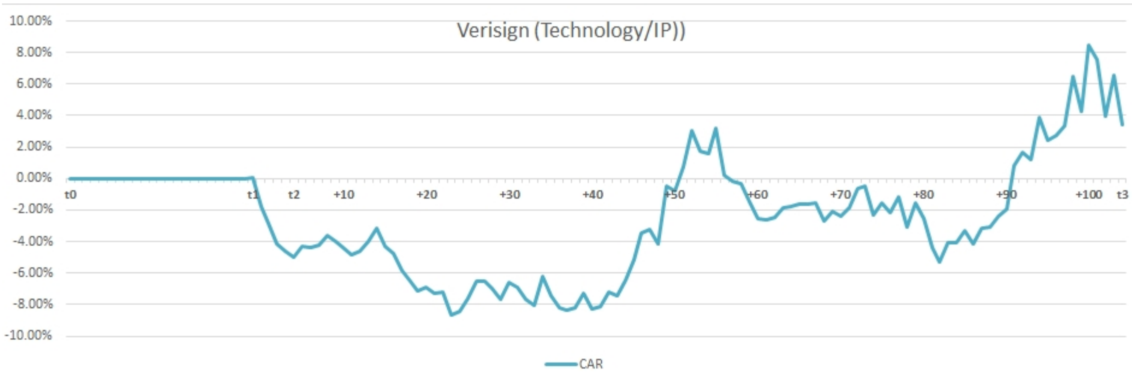

Figure 67: Inc52 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc52	CAR	S2 CAR	CAR t-test
t1	0,095 %	3,106E-04	5,410E-02
0	-1,807 %	6,212E-04	-7,251E-01
+1	-2,873 %	9,318E-04	-9,413E-01
+2	-4,123 %	1,242E-03	-1,170E+00
+3	-4,632 %	1,553E-03	-1,175E+00
t2	-4,992 %	1,864E-03	-1,156E+00
+10	-4,399 %	3,727E-03	-7,206E-01
+20	-6,873 %	6,834E-03	-8,314E-01
+30	-6,618 %	9,940E-03	-6,638E-01
+40	-8,303 %	1,305E-02	-7,269E-01
+50	-0,769 %	1,615E-02	-6,054E-02
+60	-2,567 %	1,926E-02	-1,850E-01
+70	-2,404 %	2,236E-02	-1,607E-01
+80	-2,525 %	2,547E-02	-1,582E-01
+90	-1,958 %	2,858E-02	-1,158E-01
+100	8,474 %	3,168E-02	4,761E-01
t3	3,410 %	3,293E-02	1,879E-01

Table 67: Inc52 Summary data

Inc53

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

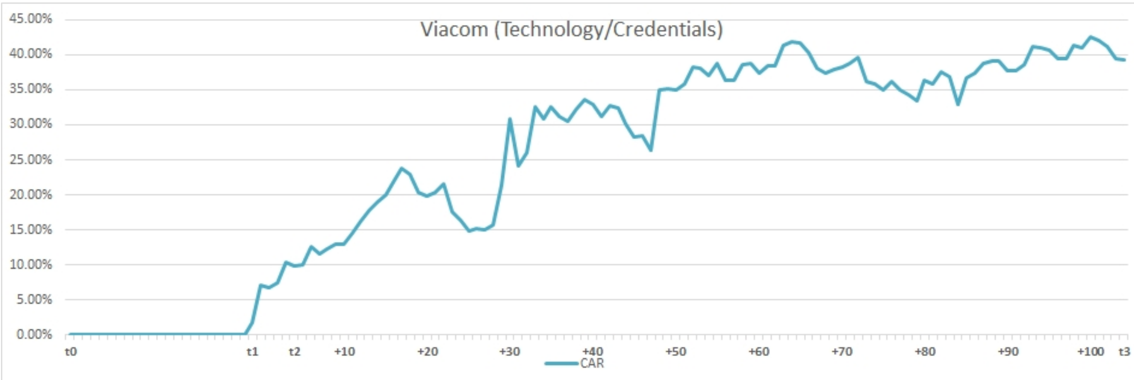

Figure 68: Inc53 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc53	CAR	S2 CAR	CAR t-test
t1	1,784 %	6,816E-04	6,834E-01
0	7,161 %	1,363E-03	1,939E+00
+1	6,795 %	2,045E-03	1,503E+00
+2	7,359 %	2,727E-03	1,409E+00
+3	10,359 %	3,408E-03	1,774E+00
t2	9,868 %	4,090E-03	1,543E+00
+10	12,866 %	8,180E-03	1,423E+00
+20	19,902 %	1,500E-02	1,625E+00
+30	30,926 %	2,181E-02	2,094E+00
+40	32,851 %	2,863E-02	1,942E+00
+50	35,022 %	3,545E-02	1,860E+00
+60	37,435 %	4,226E-02	1,821E+00
+70	38,281 %	4,908E-02	1,728E+00
+80	36,359 %	5,589E-02	1,538E+00
+90	37,717 %	6,271E-02	1,506E+00
+100	42,505 %	6,953E-02	1,612E+00
t3	39,281 %	7,225E-02	1,461E+00

Table 68: Inc53 Summary data

Inc54

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

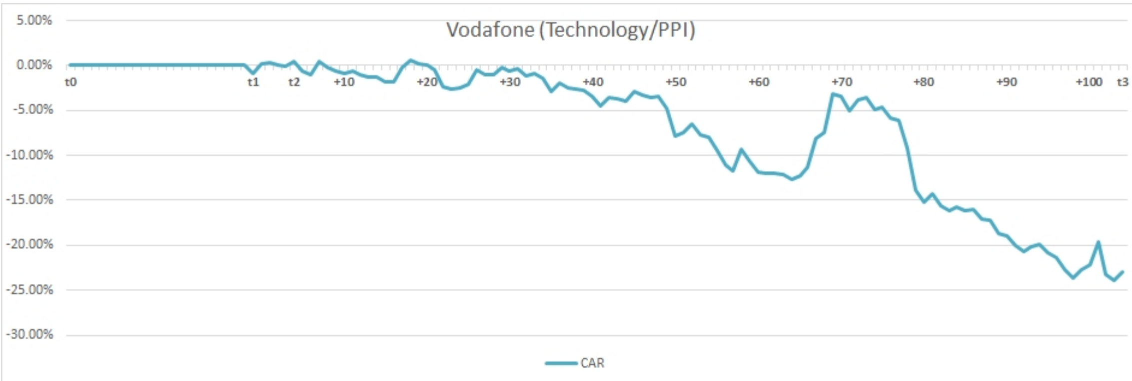

Figure 69: Inc54 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc54	CAR	S2 CAR	CAR t-test
t1	-0,927 %	1,285E-04	-8,176E-01
0	0,132 %	2,570E-04	8,231E-02
+1	0,357 %	3,856E-04	1,819E-01
+2	0,110 %	5,141E-04	4,833E-02
+3	-0,148 %	6,426E-04	-5,822E-02
t2	0,390 %	7,711E-04	1,406E-01
+10	-0,882 %	1,542E-03	-2,246E-01
+20	0,053 %	2,827E-03	1,001E-02
+30	-0,676 %	4,113E-03	-1,054E-01
+40	-3,494 %	5,398E-03	-4,756E-01
+50	-7,838 %	6,683E-03	-9,587E-01
+60	-11,908 %	7,968E-03	-1,334E+00
+70	-3,488 %	9,253E-03	-3,626E-01
+80	-15,179 %	1,054E-02	-1,479E+00
+90	-18,977 %	1,182E-02	-1,745E+00
+100	-22,157 %	1,311E-02	-1,935E+00
t3	-23,005 %	1,362E-02	-1,971E+00

Table 69: Inc54 Summary data

Inc55

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

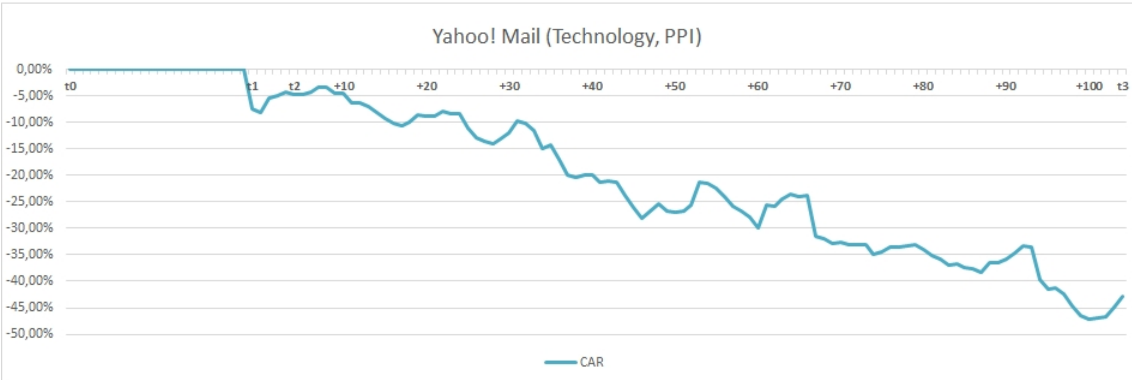

Figure 70: Inc55 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc55	CAR	S2 CAR	CAR t-test
t1	-7,323 %	2,164E-04	-4,978E+00
0	-8,096 %	4,329E-04	-3,891E+00
+1	-5,311 %	6,493E-04	-2,084E+00
+2	-5,025 %	8,657E-04	-1,708E+00
+3	-4,256 %	1,082E-03	-1,294E+00
t2	-4,625 %	1,299E-03	-1,283E+00
+10	-4,479 %	2,597E-03	-8,788E-01
+20	-8,672 %	4,762E-03	-1,257E+00
+30	-11,936 %	6,926E-03	-1,434E+00
+40	-19,871 %	9,090E-03	-2,084E+00
+50	-26,926 %	1,125E-02	-2,538E+00
+60	-29,992 %	1,342E-02	-2,589E+00
+70	-32,619 %	1,558E-02	-2,613E+00
+80	-34,033 %	1,775E-02	-2,555E+00
+90	-35,912 %	1,991E-02	-2,545E+00
+100	-47,066 %	2,208E-02	-3,168E+00
t3	-42,913 %	2,294E-02	-2,833E+00

Table 70: Inc55 Summary data

Inc56

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

Figure 71: Inc56 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc56	CAR	S2 CAR	CAR t-test
t1	0,789 %	2,763E-04	4,744E-01
0	0,546 %	5,525E-04	2,323E-01
+1	0,398 %	8,288E-04	1,383E-01
+2	2,110 %	1,105E-03	6,348E-01
+3	1,401 %	1,381E-03	3,770E-01
t2	1,808 %	1,658E-03	4,440E-01
+10	5,107 %	3,315E-03	8,869E-01
+20	0,111 %	6,078E-03	1,422E-02
+30	2,572 %	8,841E-03	2,736E-01
+40	-5,044 %	1,160E-02	-4,683E-01
+50	-5,286 %	1,437E-02	-4,410E-01
+60	-5,402 %	1,713E-02	-4,127E-01
+70	-4,424 %	1,989E-02	-3,137E-01
+80	-4,360 %	2,265E-02	-2,896E-01
+90	-3,445 %	2,542E-02	-2,161E-01
+100	-2,434 %	2,818E-02	-1,450E-01
t3	-1,826 %	2,928E-02	-1,067E-01

Table 71: Inc56 Summary data

Inc57

Cumulative Abnormal Return of the event during the analysis window is shown in the figure below:

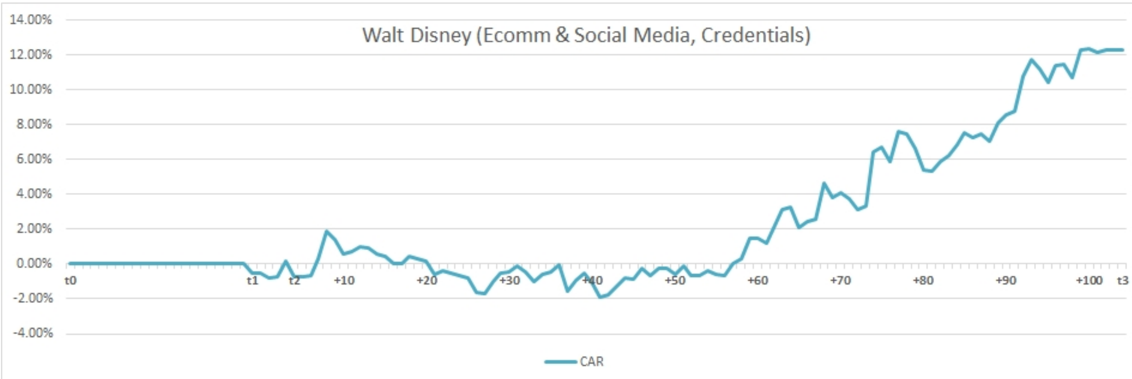

Figure 72: Inc57 CAR

The Cumulative Average Abnormal Returns of the relevant events with their associate variances, t-stats and 95% significance level for the specified periods within the analysis window are shown in the table below:

Inc57	CAR	S2 CAR	CAR t-test
t1	-0,514 %	5,139E-05	-7,169E-01
0	-0,552 %	1,028E-04	-5,448E-01
+1	-0,804 %	1,542E-04	-6,474E-01
+2	-0,734 %	2,055E-04	-5,116E-01
+3	0,190 %	2,569E-04	1,188E-01
t2	-0,732 %	3,083E-04	-4,171E-01
+10	0,611 %	6,166E-04	2,462E-01
+20	0,160 %	1,131E-03	4,771E-02
+30	-0,467 %	1,644E-03	-1,151E-01
+40	-1,110 %	2,158E-03	-2,390E-01
+50	-0,619 %	2,672E-03	-1,197E-01
+60	1,476 %	3,186E-03	2,615E-01
+70	4,088 %	3,700E-03	6,720E-01
+80	5,390 %	4,214E-03	8,303E-01
+90	8,539 %	4,728E-03	1,242E+00
+100	12,317 %	5,242E-03	1,701E+00
t3	12,247 %	5,447E-03	1,659E+00

Table 72: Inc57 Summary data

C Event Study Analysis

THe Excel file with all the data and calculations for the event study anaysis is called named “Event Study Analysis Calculations.xlsx” and has been uploaded as an attachment to the thesis.

Adil F. Shaikh

Stock price value: Using event study analysis on the effect of information security incidents to your advantage

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