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Do New Product Announcements Have an Impact on Stock Prices of Consumer Electronic Firms?

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Abstract

This paper examines the stock price impact of new product announcements on the consumer electronic market by conducting event studies. Cumulative average abnormal returns are estimated for event windows of different lengths centered on the new product announcements. Cumulative abnormal idiosyncratic risk is estimated for the same event windows with the intention to research if new product announcements are associated with increased risk. Three out of five event windows are found to have positive cumulative average abnormal returns and all five event windows are found to have an increase in idiosyncratic risk on average. Different trading strategies are presented that can be adopted to exploit the empirical results.

Keywords: Event Study, Cumulative Average Abnormal Return, Cumulative Abnormal Idiosyncratic Risk

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1. Introduction

In high technology industries, such as the consumer electronic industry, a continuous and quick launch of new products is essential for the future prosperity of a firm. A McKinsey & Co (1991) study reports that if shipments of products are six months late, the firm, on average, loses 33% of after-tax profits. This compared to losses of 3.5% when product development costs exceed the predicted cost by 50%. Cohen et al. (1997) called successful new products "engines of growth" and Chaney et al. (1991) stated that for firms to generate future profitability it is required that they do not let their product lines become obsolete. Mahajan and Wind (1991) found that 25% of firm sales, on average, are generated by products introduced within the last three years. Stalk (1988) coined the term *time-based competition* in order to emphasize the importance of *time-to-market*[1].

Furthermore, in several empirical studies (e.g. Cooper & Kleinschmidt 1987; Zurger and Maidique 1990) it has been concluded that the success of new products not only depends on continuous and quick launches, but on performance, specifications and value to consumers.

To summarize above research; 20 to 30 years ago, the importance of quick time-to-market, product performance and product value to customers were identified. Quick time-to-market development strategies have been adopted by firms such as General Electric and Hewlett Packard (Cohen et al., 1996). Another example is Sony Mobile Communications who recently attempted to launch their flagship mobile series Xperia Z twice a year in order to win market shares[2], rather than the once a year launch adopted by competitors such as Samsung Electronics (Galaxy S series) and Apple (iPhone series) (Bell, 2014).

An exemplary example of a consumer electronics firm who failed to meet specification expectations and thereby lost value to consumers was Nokia, who lost its once mighty position in the mobile phone industry. Nokia was initially hesitant to adopt new technologies such as touch screens and apps and chose to continue developing the mobile phone, rather than focusing on smartphones, the fastest growing segment of the market. In 2009 Nokia reported a $1.36 billion loss due to 20% loss in sales. This should be compared to the $1.63 billion profit the previous year (O'Brien, 2009). In 2011 Nokia and Microsoft announced a partnership to make the Windows Phone operating system the primary operating system for Nokia smartphones. The Windows Phone only managed to account for 3.7% of the smartphone market, and on

[1] The time it takes for a product to go from an idea to be available for sale (Kahn, 2004, pp. 173-187).
[2] A strategy quickly abandoned due to high costs and critique of similarities in specifications between the updated product and its predecessor (Spence, 2015).

September 3rd 2013, Microsoft announced the acquisition of the handset and services business of Nokia (Wingfield, 2013). On October 21st 2014 Microsoft made it official that they would start to phase out the Nokia brand and replace it with the Lumia brand name (Warren, 2014).

In summary, the importance of continuous and quick new product launches (particularly in high technology industries) that meet consumer expectations has been known for decades. Firms have adopted this knowledge in pursuit of future prosperity, and those who failed to do so have suffered devastating consequences. The importance of new products from a long time perspective seems to be beyond a doubt. What is of great interest is to investigate the actual financial effects. Since the importance of new products has been known for decades, it may very well be the case that the market expects new products to such a degree that new product announcements, whose purpose is to inform potential consumers, are no new information at all. To further strengthen the theory that new product announcements are not necessarily new information, imagine all pre-announcement media coverage regarding the yearly early-autumn Apple event when new iPhones are almost certain to be announced (Painter, 2015).

Having above theory in mind and applying the efficient market hypothesis to it, which states that all available information is integrated in the stock price[3] (Fama, 1970) raises a question. To what degree (if any) and in what direction (in terms of gains and losses) do new product announcements impact firm market value? This question has been raised in previous research (e.g. Eddy and Saunders 1980; Chaney et al. 1991; Pauwels et al. 2003; Lee & Chen 2009) and what is found are results ranging from no excess returns during a time window associated with new product announcements to cumulative excess returns reaching just short of 5%[4]. Both the studies conducted by Chaney et al. (1991) and Lee & Chen (2009) find proof of greater financial effects for firms that specialize in more sophisticated technology, such as consumer electronics and pharmaceuticals[5].

What previous studies mutually suffer from is old data. The most relevant studies use data from different time periods within the second half of the 20th century. Technology has taken huge steps ever since. This leap in technology is especially prominent for consumer electronics (Christensen et al., 2005). This high level of development, the old data in previous research as well as the discovery of a greater financial impact upon new consumer electronic product announcements justify the necessity of a deeper understanding of this specific industry, and is

[3] See more about the efficient market hypothesis in section 3.2.
[4] See more about these studies in section 2. Previous Research.
[5] See more about these studies in section 2. Previous Research.

in essence the motivation for this study. The purpose of this study is to thoroughly investigate if any measurable impact on stock prices associated with new consumer electronic product announcements still exists, and to quantify any such effects. The analysis will examine effects in terms of both returns and risk.

The main question of this study is as follows:

Do new product announcements have an impact on stock prices of consumer electronic firms?

Two different types of event studies will be conducted to answer this question as well as four later defined hypotheses[6]. The event studies share a sample of daily stock returns from January 1st 2009 to April 27th 2015 of 20 different consumer electronic firms, containing a total of 118 new flagship product announcement events[7] occurring between January 5th 2010 and March 13th 2015.

The first event study applies the market model to research if excess returns (further referred to as abnormal returns) exist for a time window centered on new product announcements, whereas the second event study researches changes in idiosyncratic risk centered on the same windows[8].

The second event study, where conditional volatilities are estimated, is conducted in order to research if the time window when announcing new consumer electronic products is relatively volatile compared to times with no announcements. Since the stock prices may already contain expectations about future product announcements, it is possible that when actual specifications of new products are published, they do not live up to consumer expectations. This could in turn have a negative impact on the stock prices for that particular event. Consequently, if new product announcements have an effect on stock prices, both "good" and "bad" announcements can be expected to occur. Since risk can never be negative, both abnormal returns and abnormal losses would increase the risk, and their effects can never cancel each other out as is the case when estimating average abnormal returns, but only add to one another.

The second event study has a second purpose as well. If positive abnormal returns are found during a time associated with new product announcements (which they are, see below) it may indicate an anomaly of the efficient market hypothesis. However, if excess risk is located during this period, it can also be the case that the excess returns are a compensation for the increased

[6] These hypotheses are defined in section 2.3.
[7] See appendix for a list of events used in the study.
[8] See section 5.1 for further explanations of the event study methodology.

risk exposure in relation to the capital asset pricing model (CAPM). If the risk exposure increases in this way, it is required to be compensated for with increased returns, otherwise no incentive to take on the extra risk would exist. If this risk is not compensated for, it would be an unattractive investment for the risk averse agent. So, any positive abnormal returns found may not be abnormal at all, but rather a compensation for a greater risk exposure.

With above discussion in mind, let's take a look at the results. The first event study finds proof of a positive cumulative average abnormal return when announcing new products in the consumer electronic industry. The most significant result is found for the widest event window estimated, which consists of 21 days. An average abnormal increase in stock price returns of 1.569% is estimated for this window. This cumulative abnormal return is significantly different from zero at the 0.01 level. A confidence interval which holds the true value to a probability of 95% is estimated to 1.256% - 1.881%.

The second event study finds that new product announcements affect the risk level of the firms' stocks on average. The daily increase in risk is greatest with the shortest event window of 3 days centered on the announcement and diminishes as the size of the event window increases. This diminishing trend does not hold for the widest event window of 21 days, when the daily risk is higher than that of the 11 day-long event window. The event window to show the greatest aggregated average increase in risk is the widest 21 day-long window, indicating that the stock prices of the firms examined on average suffer from a more volatile period and that this effect continues to last even for the widest event window. Whether the excess risk level, an anomaly of the efficient market hypothesis or some other explanation explains the cumulative average abnormal returns is difficult to say. However, by studying the components of the dividend discount model and having in mind that CAPM only advocates compensation for the systematic risk act against the risk compensation theory[9].

1.1 Outline

The remainder of this paper is organized as follows. Section 1.2 covers necessary limitations of this paper. Section 2 contains information about previous research related to this study, followed by comments on said research. Section 3 outlines the economic theory. Section 4 presents the data. Section 5 describes the empirical methodology applied in the study. In section 6 the results are presented and in section 7 the results are discussed and suggestions of trading

[9] See section 3.1 for a more detailed discussion.

strategies to exploit found results are presented. Finally, section 8 concludes the study and leaves proposals to future research.

1.2 Limitations

1.2.1 Industry limitations

In order for this study to focus on depth rather than width, some necessary limitations have been made. Unlike previous similar research which is covered in section 2, this study focuses on only one industry. In the introduction it was mentioned that the consumer electronic industry is of particular interest for this kind of analysis, since previous research has found that new product announcements have a particularly large impact on market value for firms in this industry. Having that said, it is still a limitation to focus on only one industry. Another industry where previous research indicates that new product announcements play a large role is in pharmaceuticals. For the same reason that justifies this study, a similar study of the pharmaceutical industry would be of interest.

As mentioned in the introduction, the data used in previous studies are decades old. A similar study to this one, where the majority of industries are included, but conducted with new data would offer valuable information of how the market as a whole reacts to new product announcements, as well as the opportunity to compare these effects of today with the effects they had in time periods covered by previous studies. Furthermore, it would offer an insight in the changes of risk associated with new product announcements that previous studies have overlooked.

Unfortunately, a study of this wide scope on new data would result in a tremendously time-consuming process of announcement collection. The underlying reason is that no public database of recent product announcements could be found. In similar previous research new product announcements were collected from the *Wall Street Journal Index* (which contained all product announcements reported by the *Wall Street Journal*) or from the *Frank and Scott index*. These indices gave researchers of previous studies access to a tool that shortened the data collecting process immensely. For unknown reasons, these indices are no longer available. Due to time constraints and the lack of such databases, this study focuses on a single, particularly announcement-sensitive industry.

1.2.2 Announcement limitations

This study does not include every single new product announcement made by the included firms during the sample period. This study focuses on flagship products and the reasons are as follows:

- Flagship products are supposedly more likely to impact stock prices since they are the most important product produced by a firm and account for a relatively large part of a firm's revenue compared to minor products (Stevenson, 2010, p. 663).
- By only focusing on flagship products, the probability of intertwining event windows (which causes the issue of covariance between effects from different announcements) is reduced.
- Announcements of flagship products are more likely to be documented.
- Flagship products are supposedly more expected. This is highly relevant since this study researches if expectations have changed the impact of new product announcements since similar previous studies.

Representing the last limitation of this study is the occasional announcement of multiple products at the same time. When conducting this study, these announcements have been treated as any other announcement.

2. Previous research and hypotheses development

2.1 Previous research

Chaney, Devinney & Winer (1991) "The Impact of New Product Introductions on the Market Value of Firms"

The authors conducted an event study to test if new product announcements affect stock prices by applying the market model on 231 firms listed on either the American Stock Exchange or the New York Stock Exchange. The events were product announcements taking place in the years 1975 – 1984 collected from the *Wall Street Journal Index*. The sample included all new products announced through the *Wall Street Journal* with exceptions of automobile firms and airlines.

The authors tested cumulative abnormal returns (CAR) on stock prices with four event windows of different length: (- 1, *t*, + 1), (- 3, *t*, + 3), (- 5, *t*, + 1) and (- 5, *t*, + 5) where *t* is the date of the announcement. The CAR of the event windows were compared to an estimation window of 600 days, ending the day before the first day of the event.

The authors found that the effect on stock prices was diminishing with an increased length of the event window. The widest window of 11 days (- 5, *t*, + 5) showed no effect, while the shortest window of 3 days (- 1, *t*, + 1), showed a statistically significant average daily excess return of 0.25% ($p < 0.05$).

Furthermore, the authors found that multiple-product announcements have a significantly greater effect on the 3-day excess return (0.93%) than single-product announcements (0.61%). A product's level of originality also impacts excess returns. Original inventions show a 3-day excess return of 0.74% versus 0.41% for product updates.

In order to make the study conducted by Chaney et al. more comparable to this paper for future reference, their estimated daily excess returns for the computer industry and the electric equipment/appliances industry are presented in the table below.

	Event Window		
Industry	**(- 1, *t*, + 1)**	**(- 3, *t*, + 3)**	**(- 5, *t*, + 5)**
Computers	0.22%***	0.14%*	0.03%
Electronic equipment/appliances	0.31%***	0.10%	0.07%

Table 1. Daily returns exported from Chaney et al. (1991).
*** Significant at the 0.01 level*
** Significant at the 0.05 level*
* Significant at the 0.10 level*

Eddy & Saunders (1980) "New Product Announcements and Stock Prices"

The authors applied the market model to new product announcements of 66 firms taking place in years 1961 – 1969 collected from the *Frank and Scott Index*. Abnormal returns were estimated for an event window of 31 days (- 15, *t*, + 15) where *t* is the date of the announcement with an estimation window consisting of the 20 months prior and the 20 months after the event window. A null hypothesis that new product announcements does not affect stock returns was formulated.

The authors were not able to find any statistically significant CAR during the event window, hence the null hypothesis could not be rejected. Based on this result, Eddy & Saunders concluded that one cannot successfully design a trading strategy to profit from new product announcements.

Lee & Chen (2009) "The Immediate Impact of New Product Introductions on Stock Price: The Role of Firm Resources and Size"

To research if new product introductions have an immediate impact on stock prices, the authors conducted an event study by applying the market model on new product announcement collected by the *Wall Street Journal Index* between years 1990 – 1998. Only announcements occurring within three days of unrelated firm events such as mergers and acquisitions or changes of chief executive officers were excluded. The sample used contained 409 product announcements from 200 different firms.

A 125-day estimation window beginning six days before the new product announcement was used. CAR was estimated for a three day event window containing the day of the event and its previous two (- 2, - 1, *t*) where *t* is the day of the announcement.

Lee & Chen found that the day prior the day of the announcement (i.e. $t - 1$) as well as the day of the announcement showed significant abnormal returns. These two days showed abnormal returns of 3.96% and 1.02% respectively ($p < 0.01$).

Furthermore, the authors confirm the findings of past studies that high-technology firms (such as firms specialized in computer and electronics technology, as well as pharmaceuticals) (Reed & DeFillippi, 1990) with more sophisticated products tend to have a greater impact on stock prices upon new product announcements (Chaney et al., 1991). They find statistically significant proof that firms with products of differently sophisticated levels require different levels of R&D resources and that the stock price impact caused by invested resources depends

on the level of the investment. Significant R&D investments have a more positive stock price impact than moderate investments.

Pauwels, Silva-Risso, Srinivasan & Hanssens (2003) "The Long-Term Impact of New-Product Introductions and Promotions on Financial Performance and Firm Value"

In previous marketing research, researchers have identified key factors for a successful new product introduction (Booz et al.,1982; Montoya-Weiss and
Calantone 1994; Cooper and Kleinschmidt, 1990; Urban and Hauser, 1980). However, this research suffers from self-report bias. Furthermore, the research suffers from ambiguity because the respondents' time perspective of a successful launch is subjective (Moorman & Miner, 1997). The authors conduct a time-series analysis of both short-run and long-run effects on financial performance and firm value on six car manufacturers to overcome these defects.

Pauwels et al. (2003) used data from four sources. Sales transaction data was collected from J.D. Power and Associates, containing every new car sales transaction from 1,100 dealerships from October 1996 to December 2001. The second source of data was expert opinions by JDPA about vehicle updates for the same time period. Firm value data was obtained from the Center of Research into Stock Prices database and firm-specific information from Standard and Poor's 1999 COMPUSTAT database.

The authors find that in both short-term and long-term, product introductions increase firm top-line performance, firm bottom-line performance and firm value. They also find that the impact of product introductions on firm value increases over time.

2.2 Comments on previous research and hypothesis motivation

Comparing the results found by Chaney et al. (1991) in their study "The Impact of New Product Introductions on the Market Value of Firms" and the results from Lee & Chen (2009) "The Immediate Impact of New Product Introductions on Stock Price: The Role of Firm Resources and Size" with the results found by Eddy & Saunders (1980) "New Product Announcements on Stock Prices", different results are found to seemingly the same question. However, as Chaney et al. (1991) find in their study, the length of the event window has an effect on the results. With the trend they find of declining abnormal returns with increased event window length, it is not surprising that Eddy & Saunders (1980) with a 31 day-long event window are unable to find any statistical proof. Furthermore, neither the sample nor the sample periods are the same, explaining divergences in results even further.

What previous studies mutually suffer from is that none of them are conducted recently. The market changes and trends are not constant. As they are found, investors will seek to exploit them and as a result they tend to disappear (Byström, 2010, p. 191). At the same time, marketers are working hard to reach as many potential customers as possible to maximize sales. New ways to reach potential customers are constantly developed and due to the explosion of available information, analysts can successfully pinpoint which strategies that are successful. Big launch events with extensive media coverage such as the Apple Launch Events are today a reoccurring occurrence. With all these forces working in different directions, new estimates of stock price impacts associated with new product announcements are of great interest.

To continue with the Apple example, Apple Launch Events for new products in an existing product chain such as the Apple iPhone take place in approximately the same time each year. This causes speculations and expectations on the upcoming product before the actual announcements, which is hypothesized to have a diminishing effect on the abnormal returns should they still exist. The logic is that the product announcement is to some degree expected and cannot be assumed to be completely new information. The expected value should already be incorporated in the stock price if the efficient market hypothesis holds[10].

Furthermore, for many products (e.g. Apple iPhone) information leakage about product specifications prior to the announcement is fairly common. Consequently, not only the product to be announced is expected, but its specifications as well.

[10] See section 3.2 for a description of the efficient market hypothesis.

If the efficient market hypothesis holds, product expectations and product leakage could result in a diminished, or possibly even negative impact on stock prices associated with the announcement. A negative impact would indicate that the new product announced did not live up to consumer and/or investor expectations.

Much and more has happened since earlier studies, and it is difficult to have overlooked the rapid evolution of the consumer electronic industry. To keep the financial research of this industry up to date, recent research on the subject is required. Furthermore, since new product announcements tend to be expected and prior leakage is not uncommon, it is of interest to pinpoint what role these announcements actually play in modern markets. Is the net stock price effect of new consumer electronic product announcements still positive? Do some firms actually experience a negative impact when announcing new products due to new information not living up to expectations? Is the market more "risky" during these events? To answer these questions, both the industry as a whole and each firm individually must be analyzed.

Cooper (1984) and Chaney et al. (1991) confirm the necessity of new products to pursue future prosperity of a firm. However, due to a more or less anticipatory market, the effects by announcing these new products might be much more complex than one would believe at a first glance. To capture this complex dynamic, it may not be enough to only examine abnormal returns as in traditional event study methodology. For example, if the net effect of new product announcements in the consumer electronic industry is found to be positive, it does not automatically mean that this is always the case. By analyzing each firm individually as recently mentioned, this may provide information otherwise hidden when the industry is examined as a whole. However, incorporating this information to one's understanding of the market as a whole might be difficult. Let's say that the event study generates following results: on average the stock price impact of new product announcements is positive, but some firms are found to react negatively when announcing. To understand this dynamic further, a different kind of event study is necessary. This is where conditional volatility is introduced. If a risk measure is the unit used in an event study, effects both negative and positive would not cancel each other out, but add to one another[11].

[11] See more about this in section 5. Empirical Methodology.

2.3 Hypotheses formulation

Based on the discussion above, following hypotheses are formulated:

Hypothesis 1*: New product announcements do not have an impact on stock prices.*

This hypothesis is rejected if cumulative average abnormal returns estimated for one or more event windows are found to be significantly different from zero.

Hypothesis 2*: New product announcements impact stock prices of all firms in the same direction.*

This hypothesis is rejected if statistically significant cumulative average abnormal returns are found to be both negative and positive for different firms.

Hypothesis 3*: New product announcements do not affect the risk of stock prices.*

This hypothesis is rejected if abnormal conditional volatilities estimated for one or more event windows are found to be different from zero.

Hypothesis 4*: The length of the event window does not affect the results.*

This hypothesis is rejected if different significant results are found for different event windows.

Note following:

- All hypotheses are for the consumer electronic industry.
- Any impacts found on stock prices are experienced only by the firm or firms examined.
- Any impacts found occur during event windows of different lengths centered on the announcement date.
- Any patterns found are based on historical data and cannot be guaranteed to remain in the future.

3. Economic theory

3.1 Dividend discount model

The discussion in this section is mainly based on Byström (2010). The dividend discount model (DDM) is a stock pricing model which states that the price of the stock is equal to the present value of all expected future dividends. The expected return of a stock, with which the future dividends are discounted, is known as the *market discount rate*, *k*. The market discount rate consists of the expected dividend, D_1, plus the expected stock price value increase, $P_1 - P_0$, divided by the initial stock price, P_0. This is illustrated in equation 1 below. (Byström, 2010, pp. 83-86)

$$k = \frac{D_1 + P_1 - P_0}{P_0} \tag{1}$$

By rearranging above equation the present value of the stock price is equal to the sum of the expected dividend and the expected price at $t = 1$ discounted with the market discount rate. This is illustrated in equation 2 below.

$$P_o = \frac{D_1 + P_1}{1 + k} \tag{2}$$

In order to get the stock price at $t = 0$, the stock price at $t = 1$ must be estimated. This is done according to equation 3 below.

$$P_0 = \frac{D_1 + \left(\frac{D_2 + P_2}{1 + k}\right)}{1 + k} = \frac{D_1}{1 + k} + \frac{D_2 + P_2}{1 + k} \tag{3}$$

If the same process is repeated indefinitely the present value will be equal to all expected future dividends discounted with the market discount rate. This relation is presented in equation 4 below.

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1 + k)^t} \tag{4}$$

In this paper the purpose of above derivation is not to actually price stocks in practice, but to understand the forces affecting the stock price. By studying equation 4 above, one can see that if the price of a stock increases it is either the result of an increase in expected future dividends, a decrease in the market discount rate, or both. The opposite holds if the stock loses value. So, if new product announcements are found to have an impact on stock prices, either the

expectations of the future dividends have changed, the market discount rate has changed, or both.

Let's take a closer look at the market discount rate. One model that can estimate the market discount rate is the Capital Asset Pricing Model (CAPM). CAPM will not be described in detail in this paper but some general knowledge is necessary to understand the market discount rate (*k*) and how it may or may not be affected by a new product announcement. CAPM is an equilibrium model that in general terms estimates what the risk premium of risky assets would be if all investors had the same expectations of risk and returns and designed their portfolios optimally through diversification. CAPM introduces the market portfolio as an optimal portfolio which contains all risky assets in the world. Below is the equation of the Security Market Line (SML) which is how expected returns are estimated according to the CAPM. (Byström, 2010, pp. 164-174)

$$k = \mu_i = r_f + \beta_i(\mu_{market} - r_f) \tag{5}$$

μ_i is the expected return of asset *i*, r_f the risk free interest rate, μ_{market} the expected return of the market portfolio and β_i[12] is the risk measure defined as following:

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2} = \frac{\rho_{i,m}\sigma_i}{\sigma_m} \tag{6}$$

$\sigma_{i,m}$ is the covariance between asset *i* and the market portfolio, σ_m^2 the variance of the market portfolio, $\rho_{i,m}$ the correlation between asset *i* and the market portfolio, σ_i the volatility of asset *i* and σ_m the volatility of the market portfolio. Study the components of the SML and the definition of β_i. A new product announcement does not affect the risk free interest rate or the return and risk of the market portfolio. That leaves the numerators in the equalities defining β_i. If excess risk associated with new product announcements is found in this study, σ_i is temporarily increased. If the volatility of asset *i* changes yet the volatility of the market portfolio is unaffected the covariance or correlation (depending on which equality is used to estimate β_i) is likely to decrease. It is not unreasonable to speculate that the increase in volatility of asset *i* and its possible decrease in covariance and correlation with the market portfolio would cancel

[12] The β is a risk measure indicating how the returns of a risky asset responds to changes in the market. If $\beta = 1$ it is indicated that the return of the risky asset will move with the market portfolio. If $\beta < 1$ it is indicated that the risky asset is less volatile than the market portfolio and if $\beta > 1$ it is indicated that the risky asset is more volatile than the market portfolio. For example, if a stock's beta is estimated to 1.3, the stock is estimated to be 30% more volatile than the market portfolio. (Byström, 2010, p. 170)

each other out and leave β_i unchanged, thus leaving the market discount rate unchanged. Based on this discussion it is unlikely that the market discount rate would be responsible for any potential stock price impact associated with a new product announcement.

More likely to be responsible for any potential stock price impact is the expected future dividends. An announcement with a positive stock price reaction would then increase expected future dividends and the opposite would hold for an announcement with a negative stock price impact.

3.2 The efficient market hypothesis

The discussion in this section is mainly based on Fama (1970). The Efficient market hypothesis states that the market is said to be efficient, i.e. share prices incorporate all available information, thus making it impossible to outperform the overall market. According to the efficient market hypothesis, stocks are always traded at their intrinsic value.

For a market to be efficient a large number of investors who analyze securities for profit are assumed, as well as quick price adjustments. According to the article presenting the hypothesis by Fama (1970), the market has three different states of efficiency:

Weak efficiency:

A market characterized by *weak efficiency* has all historical information included in the share price. Historical data and old news have no impact on share prices and only new information impacts future abnormal returns. Technical analysis cannot outperform a weakly efficient market.

Semi-strong efficiency:

A market characterized by *semi-strong efficiency* has all historical information as well as new public information included in the share price. Semi-strong efficiency makes it impossible to outperform the market with fundamental analysis, thus only giving way for investors with insider information to predict future abnormal returns.

Strong efficiency:

Strong efficiency is the strongest degree of market efficiency. If strong efficiency holds, not even a well-informed investor with historical information, new public information as well as insider information can successfully predict future stock movements.

3.2.1 Level of efficiency on the market

Whether the market is weakly efficient, semi-strongly efficient or strongly efficient is a well disputed question. A modest answer to which most financial professionals would agree is quoted below (Byström, 2010, p. 183):

> *"Markets are* probably *weakly efficient and* possibly *also semi-strongly efficient!"*

3.2.2 Anomaly

An empirical result which is incompatible with a well-established and generally accepted scientific theory is known as an anomaly. If cumulative average abnormal returns are found to still exist in this study even though such trends were located decades ago, it could amount for an anomaly. The market should have been able to learn that new product announcements generate excess returns on average and not have the constant need to readjust stock prices after each new announcement. If this is found to not be the case, market inefficiency is a possible explanation. (Byström, 2010, p. 190)

3.3 Random walk

If a market instantaneously incorporates all available information and stock price changes have no "memory" of previous adjustments, as is the case if the efficient market hypothesis holds, the changes in stock prices are said to be independent. Since new information is announced randomly, the changes in stock prices which are just a reflection of the new information, too become random. By definition, a market where changes in stock prices that are independent of its historical changes is a random walk market. (Fama, 1965)

3.4 The standard economic model of consumer behavior

The Standard Economic Model of Consumer behavior (hereafter referred to as the standard model) is an economic model that attempts to explain how individuals make decisions. The standard model is both **descriptive** and **normative**. A descriptive model is a model which describes how people behave and a normative model is a model which describes how people *should* behave to reach a specified objective (Wilkinson & Klaes, 2012, p. 4).

The standard model is centered on rational behavior. Rational behavior is usually explained as people using reason when making decisions, rather than basing their decision-making on emotion and instinct. However, this definition of rationality is generally assumed too vague and economists have designed a well specified framework of rational decision-making. In this framework, rationality is defined as individuals having preferences over choices and taking the

course of action to reach the most preferred outcome, and by doing so, they are maximizing the expected utility.

To mathematically prove a preferred outcome a utility function is used. Von Neumann and Morgenstern (1947) proved that for an individual to have a utility function, four axioms must be satisfied. These axioms are (Wilkinson & Klaes, 2012, p. 68; Mas-Colell et al., 1995, pp. 167-179):

Completeness: For all courses of actions individuals can take, the individual has a preference ordering.

Transitivity: The choices of individuals are consistent. If A is preferred to B, and B is preferred to C, A is also preferred to C.

Continuity: Small changes in probability do not change ordering between two choices.

Independence: If two alternative choices are mixed with a third choice, the preference ordering of the two mixes does not depend on the third choice.

With above axioms, one can successfully model decisions under certainty. However, most decisions are not certain. For clarity, imagine a gamble with two outcomes; either you win or you lose. You don't know if you will win or lose before participating, hence the decision to participate must be done under *uncertainty*. To help us understand these more complex frameworks, we turn to mathematical theories such as expected utility maximization and Bayesian probability estimation.

3.5 Risk-return tradeoff

In order to fully understand this paper and to avoid jumping to hurried conclusions it is essential to understand the risk-return tradeoff. The risk-return tradeoff states that an investor cannot maximize his expected return and minimize his risk at the same time (Byström, 2010, p. 141). If excess returns associated with new product announcements are found to still exist even though this trend was located decades ago, it may be tempting to interpret this result as an anomaly and evidence of market inefficiency. However, the full picture is more complex. An anomaly is only one possible explanation. A second possible explanation is that any located excess return acts as a risk premium for some hidden excess risk associated with this kind of event.

3.5.1 Risk preferences

Rational choice under certainty and its axioms have already been covered above. However, to purchase, hold and sell stocks are not decisions made under certainty. According to economic theory, individuals have different risk preferences which affect their decision making under uncertainty. Individuals are generally categorized to either have risk averse preferences, risk neutral preferences or risk loving preferences. To simplify the understanding of risk preferences, imagine following example. An individual is given the choice to either accept $500 as a guaranteed payment or participate in a lottery where two outcomes of equal probabilities are possible; winning and losing. If the individual chooses the lottery and wins, he or she receives $1000. If the individual loses, he or she gets nothing. With the help of elementary statistics it is easily calculated that the expected payoff of both scenarios are $500[13]. (Charness et al., 2012)

Risk averse:

The risk averse individual prefers to avoid zero-mean risk and would prefer the guaranteed payment of $500. A risk averse individual is willing to pay to avoid zero-mean risk (by buying insurance for instance). This does not mean that a risk averse individual always prefer the choice with the certain outcome. If the expected payoff of the lottery is higher than the guaranteed payment, the risk neutral individual may choose to participate in the lottery. How much higher the expected payoff must be for the individual to participate is determined by the individual's level of risk aversion. (Eeckhoudt et al., 2004, p. 21)

Risk neutral:

The risk neutral individual would be indifferent between accepting the guaranteed payment of $500 and to participate in the gamble. A risk neutral individual ranks decisions solely based on their expected outcome (Eeckhoudt et al., 2004, p. 19).

Risk loving:

A risk loving individual prefers to seek risk and would thereby choose the lottery. A risk loving individual would be willing to accept a lottery even if the guaranteed payment was higher than the expected payoff of the lottery. How much higher than the expected payoff the guaranteed

[13] Expected payoff of scenario 1 = guaranteed sum of $500. Expected payoff of scenario 2 = ($1000+0)/2 = $500.

payment is allowed to be for an individual to still participate in the lottery indicates the individual's level of risk lovingness. (Eeckhoudt et al., 2004, p. 19)

In a graph with wealth on the x-axis and the utility of wealth on the y-axis, risk averse individuals have concave utility functions, risk neutral individuals have linear utility functions and risk loving individuals have convex utility functions. This is illustrated in Figure 1 to the right. (Eeckhoudt et al., 2004, p. 20)

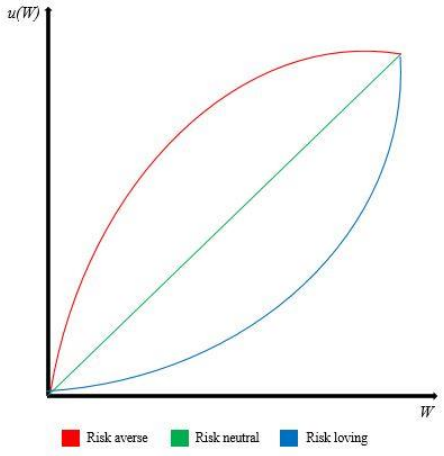

Figure 1. Utility functions of individuals with different risk preferences.

Most individuals are risk averse. Why it is so is explained by evolution. Risk loving individuals seek risks and risk can be mortal. By this logic risk loving individuals are more inclined to pass away prematurely, allowing risk averse individuals to remain alive and pass on their prudent genes (Zhang et al., 2014).

Above framework is highly relevant for this study. Replace the lottery with stocks and replace the guaranteed payment with a risk free interest rate offered by some bank account with deposit insurance. Since the majority of the population is risk averse the expected return of stocks must be greater than the return of the risk free bank account for people to be willing to invest their money in them. The same goes for different levels of risk, rational risk averse investors are only prepared to take on more risk if they are compensated by a higher expected return.

3.6 Behavioral economics

Behavioral economics is a supplementary model to the standard model. Behavioral economics introduces psychology to economics in order to understand economic decisions which allows for a high level of accuracy at the expense of a wide scope as offered by the standard model. The standard model pays no mind to behavioral economics because it argues that non-standard behavior will be eliminated when examining the market as a whole (Croson & Gächter, 2009). Nevertheless, behavioral economics is a growing field which takes the standpoint that people do not always act rational. Individuals adopt beliefs and heuristics (rules of thumb) and suffer from biases when making decisions, causing the decisions to be irrational but more cognitively manageable (Wilkinson & Klaes, 2012, p. 117). By discovering these inconsistencies, irrational behavior can actually be predictable as Dan Ariely explains in his book *Predictably Irrational* (2008).

Behavioral economics offers an alternative explanation to why the market sometimes acts as it does. For example, behavioral economics suggests that the equity premium puzzle[14] may be explained by myopic loss aversion, suggesting the frequency with which investors close their accounts and resetting their reference point[15] affects their risk attitude. Losses are heavier felt than gains of the same size, and if an investor keeps a daily track of his or her risky assets and resets the reference point on a daily basis, close to 50% of the daily closing prices will be losses. The stock investment may then feel like a bad investment unless the equity premium is high enough. (Wilkinson & Klaes, 2012, pp. 160-168)

In a first step to adopt behavioral economics to this study, imagine the launch events mentioned in the introduction which firms often host when announcing new products. These events, as well as the actual product, are part of a firm's marketing strategy. The more people the announcement reaches, the greater pool of potential customers. Launch events often attract the attention of media.

Research indicates that media may play a greater role than one would expect after having studied the efficient market hypothesis. Engelberg and Parsons (2011, p. 29) find that "the presence or absence of local media coverage is strongly related to the magnitude of the local trading". Imagine following example. EntreMed (ENMD) is a biotechnology firm. Figure 2 shows the adjusted closing stock prices of the firm ranging from October 1st 1997 to the end of 1998.

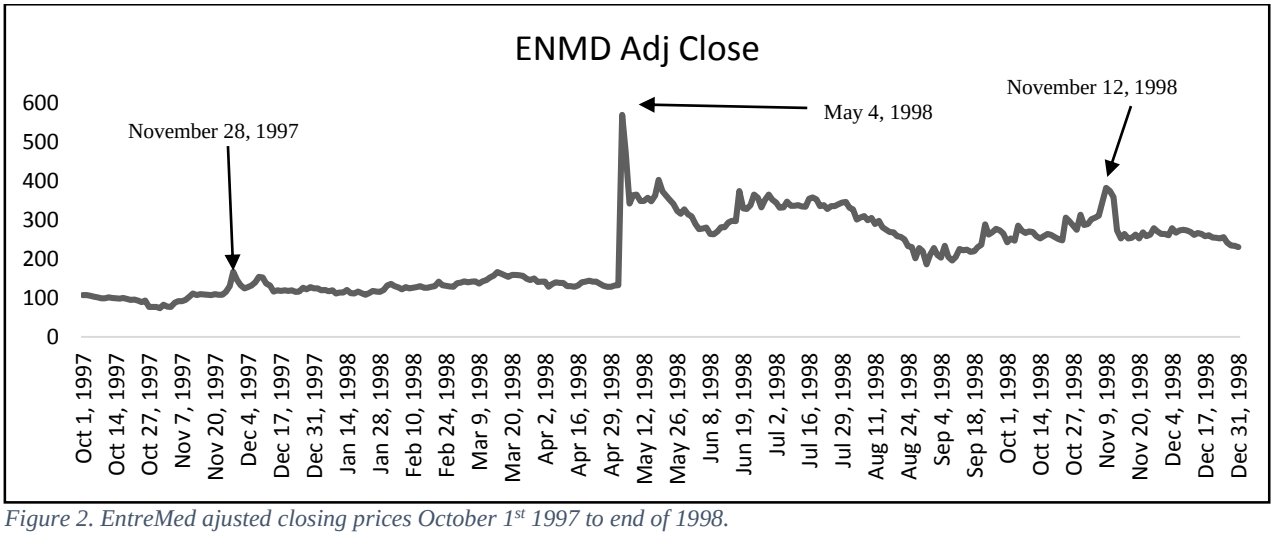

Figure 2. EntreMed ajusted closing prices October 1st 1997 to end of 1998.

[14] The equity premium puzzle is the phenomenon that stocks generate much higher returns than the risk free rate (an average yearly difference of approximately 6% over the latest 80 years) which indicates a level of risk aversion inconsistent with economic research (Mehra & Prescott, 1985).
[15] The reference point is experienced as a zero point for an individual. Deviations from the reference point are experienced as gains or losses (Wilingson & Klaes, 2012, p. 164).

A small spike occurs at November 28th 1997. At this date a scientific paper was published stating a breakthrough in cancer research. EntreMed had licensing rights to this breakthrough, thus experiencing a (temporary) impact on its stock prices. At May 4th 1998, the *New York Times* reports about this breakthrough and mentions EntreMed, causing a huge spike in the firm's stock prices. Initially, the stock price falls after the impact, indicating a temporary overvaluation of the stock. However, even after the stock price has adjusted from this overreaction, some of the impact remains. The stock price is still more than twice the stock price before the *New York Times* article. Even at November 12th 1998, when the *New York Times* publishes a new article, on its front page no less, about how other laboratories fail to replicate the result in the original November 28 paper, the stock price of EntreMed remains twice as high as it was on May 1st. (Huberman & Regev, 2001)

The important role media plays is visualized by above example. It even has the power to permanently impact a supposedly efficient market with old news. The permanent stock price impact experienced by EntreMed despite failed attempts to replicate the results by other laboratories can possibly be explained by a cognitive bias known as anchoring. Anchoring is a cognitive bias where the decision of an individual tend to rely too heavily on the first information received. In the EntreMed example, the anchor is the stock price at the top of the huge spike at May 4th 1998 and may act as a reference point for future stock prices. With a high reference point, stock prices will show resistance to adjust to old levels since losses are, according to prospect theory, felt more heavily than gains for loss averse individuals. (Wilkinson & Klaes, 2012, p. 167)

Based on above discussion about the role of media, any differences in results between event windows of different sizes centered on new product announcements found in this study may be explained by the reception of media. Since this reception may not be published immediately after the announcement and because investors may need time to assimilate it, the role media plays on the stock price impact may be prolonged. In order to capture this effect event windows of different lengths are examined.

Behavioral economics may also explain possible negative stock price impacts associated with new product announcements. Previously, it has been argued that any such effects may occur if the product does not live up to expectations. In this case, the expectations of the product in people's minds act as a reference point, and any losses in utility due to for example disappointing specifications, design or price will reflect negatively on the stock price.

3.7 Options

In this paper trading strategies involving options will be suggested in section 7 in order to exploit any changes in idiosyncratic risk the empirical study finds. The trading strategies of interest are the *butterfly spread* and the three *combinations* described below. These are strategies that increase in value when the volatility of the underlying asset changes.

An option is a contract which gives the holder the right to either buy the underlying asset (if a *call option*) or sell the underlying asset (if a *put option*) at a certain date (the *expiration date*) for a certain price (the *strike price*). The agent buying the contract is said to go *long* on the contract while the seller goes *short*. Two types of options are American and European options. The difference between the two is that the American option can be exercised at any time up to the expiration date while the European option can only be exercised at the expiration date. (Hull, 2011, p. 7)

3.7.1 Butterfly spread

A *butterfly spread* consists of three European option positions with different strike prices (K_1, K_2 and K_3, where K_2 is generally close to the current stock price, S_0) and the same underlying asset. The butterfly spread is most valuable when the underlying asset is the same at the expiration date as it was when the contract was signed, and is worth less the more the price of the underlying asset deviates from this value. The trading strategy is appropriate when a speculator expects a period of low volatility and the price of the underlying asset to remain at about the same level as when the trading strategy was created. Figure 3 below is an illustration of the profit from a butterfly spread using put options. (Hull, 2011, p. 242)

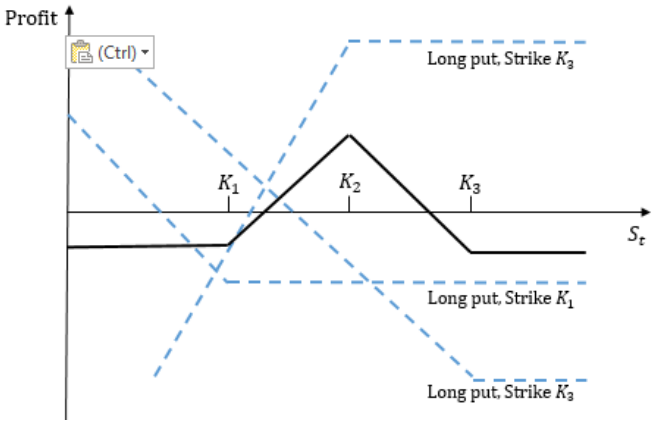

Figure 3. Profit from a butterfly spread using put options.

3.7.2 Combinations

Trading strategies consisting of positions in both calls and puts on the same underlying asset are known as combinations. In this paper *straddles*, *strips* and *straps* are described. The more the price of the underlying asset deviates from the price when the trading strategies were created, the more valuable are the strategies. Intuitively, these strategies increase in value if the volatility increases. In technical terms these strategies have high *vegas*[16], i.e. having a high sensitivity to volatility. (Hull, 2011, p. 246)

3.7.2.1 Straddle

The *straddle* consists of a long position in one European call and one long position in a European put with the same strike price (K) and expiration date. The straddle is appropriate when a speculator expects a large price movement in the underlying asset but has no opinion about the direction. Figure 4 below is an illustration of the profit from a straddle. (Hull, 2011, p. 246)

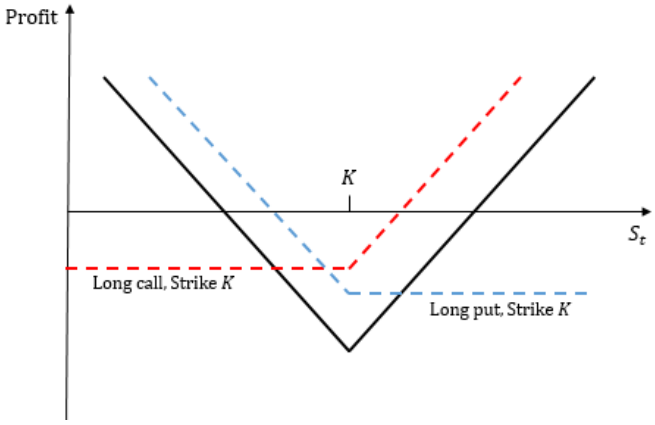

Figure 4. Profit from a straddle.

3.7.2.2 Strip

The *strip* consists of a long position in one European call and two long positions in European puts with the same strike price (K) and expiration date. The strip is appropriate when a speculator expects a large price movement in the underlying asset and expects the probability of a decrease in price to be higher than an increase. Figure 5 below is an illustration of the profit from a strip. (Hull, 2011, p. 247)

[16] Mathematically vega is the derivative of the option value with respect to the volatility of the underlying asset.

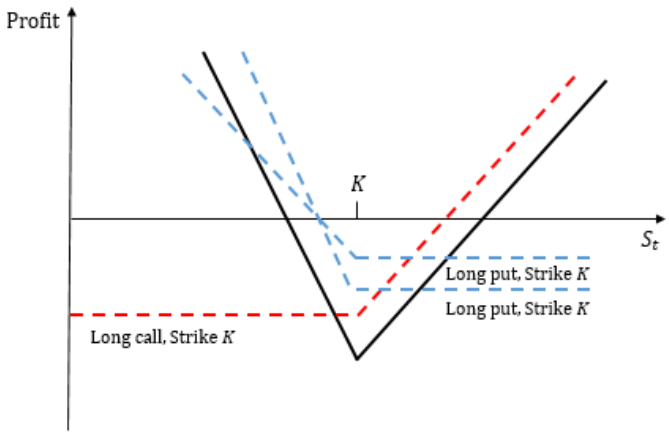

Figure 5. Profit from a strip.

3.7.2.3 Strap

The *strap* consists of two long positions in European calls and a long position in one European put with the same strike price (*K*) and expiration date. The strap is appropriate when a speculator expects a large price movement in the underlying asset and expects the probability of an increase in price to be higher than a decrease. Figure 6 below is an illustration of the profit from a strap. (Hull, 2011, p. 247)

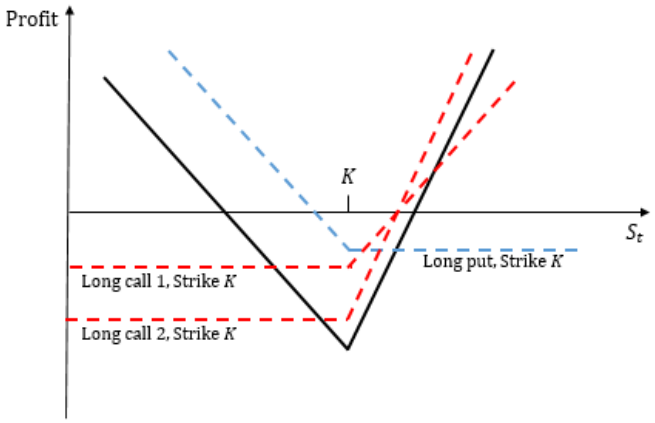

Figure 6. Profit from a strap.

4. Data

The data collecting process has been twofold. First, major product announcements from 20 of the largest publicly traded consumer electronic firms have been collected. The announcements have been collected from press conferences made by respective firm, press releases and news articles. Major products are in this paper defined as flagship products and are in most cases announced one to two times a year. All product announcements took place after the Global Financial Crisis of 2007-2008 with the intention to produce results relevant for today's economy[17]. The complete series of announcements used in the empirical analysis consists of 118 announcements made by 20 firms. Canon and Nikon (both consumer electronic firms specializing in cameras) tend to launch series of products at one day each year. Several of the firms in the sample tend to announce new products on trade shows such as the Consumer Electronics Show (CES) taking place in Las Vegas, Nevada, USA in January each year, and the Internationale Funkausstellung Berlin (IFA) taking place in Berlin, Germany in August or September each year.

The definition of a flagship product may be argued to be somewhat ambiguous which could be perceived as a problem with the data. In the most relevant previous studies data sets consisting of news articles about new product announcement posted in *The Wall Street Journal* have been used. Only product announcements defined as "major announcements" are part of the data sets. These studies define a "major announcement" as an announcement published by *The Wall Street Journal* in a news article. Which announcements to be published are decided by individuals such as reporters and editors of *The Wall Street Journal*. Previous research could thereby also be argued to suffer from ambiguity. This potential issue is difficult to evade and the only way to do so would be to include *all* product announcements made by firms included in the study for a predetermined period. This would result in a problematic data collection process due to deficient documentation of minor product innovations. Furthermore, a data set of this structure would suffer from reduced empirical findings due to the presumed weaker stock price impact of minor product announcements.

An issue similar to the one described above is ambiguity when choosing firms for the study. A solution much like the one stated above would be required to solve this problem, namely to include *all* public firms for a chosen industry. To follow this design would result in an immense data collecting process.

[17] See appendix for list of firms and announcements.

The second part of the data collecting process was to collect daily data of adjusted closing stock prices for each of the 20 firms as well as the market index for respective stock exchange where each firm is traded. The sample period starts at January 1st 2009 and ends at April 27th 2015 and contains a total of 118 new flagship product announcement events occurring between January 5th 2010 and March 13th 2015[18]. Data from 2009 is solely used for estimation purposes and thereby contains no events.

Thomson Reuters Datastream was used to collect the data. From the daily changes in stock and index prices log returns were calculated. The log returns were used for the estimation of abnormal returns.

[18] See appendix for the stock exchanges each firm is traded on and the stock exchanges' respective market indices.

5. Empirical methodology

5.1 Event study

The discussion in this section is mainly based on MacKinlay (1997). The event study methodology is primarily used to locate estimated effects on stock prices occurring as a result of new information.

In this study, two different event studies will be conducted. The first event study will research if abnormal returns centered on the announcement of new consumer electronic products exist. The new product announcement is the *event* of interest. The second event study will research if any change in conditional volatilities occur with the release of this new information. In other words, the second event study will attempt to capture effects of changes in risk associated with new product announcements on the consumer electronic market.

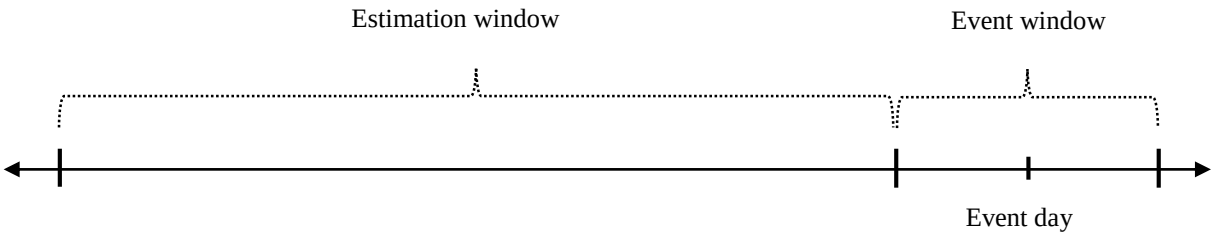

Figure 7. Illustration of the event study timeline.

Figure 7 above illustrates the event window timeline. The event study divides a time period of interest into two sections. The first section is the e*stimation window* which is a time period usually occurring before the even. In this paper the estimation window is 1 year, or 252 trading days. The estimation window is followed by the much shorter *event window* which includes the *event day* (the day when the event occurs). The estimation window is used to estimate *normal returns* or *expected returns* for the event window, i.e. returns that were to be expected if no major events were to take place. During the event window *actual returns* generated by the stock market are collected. The difference between the actual returns and the estimated normal returns are called *abnormal returns.* If abnormal returns are found, they are assumed to be a response to the new information.

In order to capture how long the financial effects (if any) of new consumer electronic product announcements last, five event windows of different lengths are analyzed. The lengths of the event windows and their location relative to the event day (*t*) are illustrated in Table 2 below.

Length of event window	Location of event window relative to event day (*t*)
3 days	(- 1, *t*, + 1)
5 days	(- 2, *t*, + 2)
7 days	(- 3, *t*, + 3)
11 days	(- 5, *t*, + 5)
21 days	(- 10, *t*, + 10)

Table 2. Illustration of the event windows used in the study.

5.1.1 Abnormal returns

As described above, when conducting event studies abnormal returns are key. The idea is that the estimated abnormal returns are the financial effect of the event in question. To locate such effects contributes with valuable information for firms and investors and facilitates their decision making. With this knowledge, firms and investors have some idea of what kind of effect to expect on firm market value due to the release of new firm specific information in the future. This information can be used for speculative purposes as well as for risk managing. Take the study in this paper as example: by locating expected changes in firm market value associated with the announcement of new consumer electronic products, speculators can get a hint of what the expected economic impact on the stock price may be upon the release of similar information in the future. With this knowledge they can attempt to exploit this abnormal return with different trading strategies.

To generate the abnormal returns, actual returns must be calculated with stock price information generated from the stock market and normal/expected returns must be estimated. The actual return is the log return and is calculated according to equation 7 below.

$$r_t = \ln\left(\frac{S_t}{S_{t-1}}\right) \tag{7}$$

where r_t is the log return of the stock at time t, S_t is the stock price at time t and S_{t-1} is the stock price at time $t-1$.

The expected return can be estimated using different methods. However, the most commonly used method is the *market model*. The market model is an example of a one factor model. More advanced multifactor models exist, however the gains from applying such models for event studies are in general small. This is explained by the empirical fact that the marginal explanatory power of additional factors are small. Due to the redundancy of more advanced models, the market model is chosen for this study.

The market model assumes a linear relation between a firm's stock returns and the market index. A linear regression with the market index as the explanatory variable and the firm's stock price as the dependable variable is run on the sample. The parameters α (the intercept) and β[19] (the risk exposure to general market movements) are estimated by following linear regression.

$$E(R_{it}|X_t) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (8)$$

R_{mt} is the log return of the market index at time t and ε_{it} is the error term.

The abnormal return for a specific day is estimated by taking the actual return of this day subtracted by the estimated normal/expected return for the same day. This is illustrated in equation (9) below.

$$AR_{it} = r_{it} - E(R_{it}|X_t) \quad (9)$$

In the next step average abnormal returns (AARs) are calculated for each day of the event windows. The AARs are the average daily abnormal returns of all events included in the study. The AAR of the event day would for example be the average of all abnormal returns for that day over all events included in the study. Note that in this study, AARs are estimated for each firm represented in the study as well as for the industry as a whole. The AARs are calculated according to equation 10 below. Note that the "A" representing "average" is in the equation represented by a bar above the abnormal return.

$$\overline{AR_t} = \frac{1}{N}\sum_{t=1}^{N} AR_{i,t} \quad (10)$$

In order to draw conclusions of the financial impact of the event, the AARs must be aggregated over the event window. This is done by calculating the cumulative average abnormal return (CAAR) according to equation 11 below.

$$\overline{CAR}(t_1, t_2) = \sum_{t=t_1}^{t_2} \overline{AR_t} \quad (11)$$

Finally, the test statistic to test if the null hypothesis of CAAR = 0 is calculated according to equation 12. A *p*-value is then generated from the critical value to display significance level.

$$\theta = \frac{\overline{CAR}(t_1, t_2)}{var\left(\overline{CAR}(t_1, t_2)\right)^{\frac{1}{2}}} \sim N(0,1) \quad (12)$$

[19] The β is the same risk measure as defined in section 3.1.

5.2 Variance and standard deviation

Two risk measures of particular importance for this study are the *variance* and the *volatility*. The volatility is also known as the *standard deviation*.

Variance is a measure of risk that quantifies how far numbers of a population is spread out. If the numbers are identical the variance is zero. Due to its mathematical definition, the variance can never be negative. Mathematically it is defined as the expected value of the square of the difference between the random variable *X* and the population mean μ_x.

$$var(X) = \sigma_X^2 = E\{(X - \mu_X)^2\} \tag{13}$$

The square root of the variance is called volatility or standard deviation and has the same dimension as the data. (Dougherty, 2011, p. 11)

$$Standard\ Deviation(SD) = \sigma_X = \sqrt{\sigma_X^2} \tag{14}$$

5.3 Conditional variance

Imagine a random variable y_t whose value depends on past information. The random value y_t could for example be drawn from the density function $f(y_t|y_{t-1})$, meaning that the value of y_t depends on the value of the conditioning variable y at time *t-1*. The expected value at y_t is given by $E(y_t|y_{t-1})$ and the variance of this forecast is given by $var(y_t|y_{t-1})$. This expression recognizes that the conditional variance depends on past information, hence may be a random variable. (Engle, 1982)

Conventional time series and econometric models assume that the variance is constant. Bollerslev (1986) proposes the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) process to model conditional variances. In the GARCH process the conditional variance depends on past values of the squared errors and on past conditional variances. This process generates conditional variances which are allowed to change over time, a method most commonly used to capture so called volatility clustering[20]. The square root of the conditional variance generates the conditional volatility.

5.4 Probability distribution

When applying econometrics to financial data, a common assumption is that the returns are conditionally normally distributed. However, Bollerslev (1987) finds evidence of conditional

[20] A period in time when volatility is relatively high.

leptokurtosis[21] when analyzing the S&P 500 Composite Index returns. Estimates generated with the use of the normal distribution are still consistent, but may not be efficient. In response of this issue, scientists usually select one of two methods.

1. They use the normal distribution and accept that the estimates may not be efficient.
2. They use some other distribution with leptokurtosis properties, such as the Student's t-distribution.

Since the leptokurtic property of financial data is a widely known phenomena, using the Student's t-distribution is a common solution. However, if the Student's t-distribution is used erroneously (meaning that the t-distribution is not the true distribution of the sample), the estimates are no longer consistent. Furthermore, with a large sample of observations, the Student's t-distribution converges to the normal distribution (Dougherty, 2011, p. 50). In this study, one of the objectives is to examine possible changes in risk when consumer electronic firms announce new products by estimating conditional volatilities using GARCH. Since the sample used in this study is considered large and inconsistent estimates are unwanted, the normal distribution is used in the process of generating conditional volatilities.

5.5 Estimation of conditional volatilities

What the CAAR represents is the firm specific abnormal returns corrected for market movements with the market model. For this reason it is the firm specific risk (i.e. idiosyncratic risk) that is of interest in the second event study. Conditional variances of the abnormal returns were generated with the GARCH process below (Bollerslev, 1986).

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma I_{\{t\epsilon window\}} \quad (14)$$

where ω is the intercept. α is the parameter describing the impact of ε_{t-1}^2, which is the squared error of the day before. β is the parameter describing the impact of the conditional variance from the day before. $I_{\{t\epsilon window\}}$ is a dummy variable which is 0 for the estimation window and 1 for the event window. γ is the differential intercept coefficient representing the increase or decrease in the intercept of the conditional variance on a daily basis during the event window. If $\gamma \neq 0$ for a firm, the firm encounters a change in risk on average when announcing new consumer electronic products.

[21] A distribution with leptokurtosis properties has positive excess kurtosis and is characterized by fatter tails and is more clustered around the mean (Verbeek, 2004, p. 400).

The conditional variances for each firm and for each event window presented in Table 2 were estimated in EViews and then converted to conditional volatilities by taking the square root of them.

6. Empirical results

In this section the empirical results will be presented and organized as follows. Presented first are the results from the event study where CAARs and AARs were estimated. These results account for the consumer electronic industry as a whole. In the second section the results of CAARs for each firm included in the study are presented. In the third section industry specific results from the second event study where conditional volatilities were estimated are presented. In the fourth section firm specific results from the second event study are presented. In the fifth section the results are presented in relation to the hypotheses.

6.1 Cumulative average abnormal return – industry specific results

The results generated by the cross-sectional event study are presented in Table 3 below.

Event window	CAAR		*p*-value
(- 1, *t*, + 1)	0.024%		0.8793
(- 2, *t*, + 2)	0.522%	***	0.0011
(- 3, *t*, + 3)	0.062%		0.6990
(- 5, *t*, + 5)	0.577%	***	0.0003
(- 10, *t*, + 10)	1.569%	***	0.0000

Table 3 CAARs – industry specific.
**** Significant at the 0.01 level*
*** Significant at the 0.05 level*
** Significant at the 0.10 level*

In Table 3 the CAARs estimated for the different event windows are presented. These CAARs are the average change in excess returns during the event windows over all firms included in the study.

The CAARs are followed by respective test statistic and the *p*-values represent the probability that the null hypothesis is rejected when actually true (Thisted, 1998). Remember that the null hypothesis in this test is: H_0: CAAR = 0. The significance level is illustrated by asterisks following the CAARs. As can be seen in Table 3, the event windows (- 2, *t*, + 2), (- 5, *t*, + 5) and (- 10, *t*, + 10) generated statistically significant results. These results are all significant at the 0.01 level and conclude that the historical CAARs for the firms included in the study are on average different from zero. Since the CAARs are positive, it is concluded that the new product announcements historically on average have a positive impact on stock prices.

In Table 4 below, confidence intervals for the statistically significant CAARs are presented. The confidence intervals hold the true value of the CAARs to a probability of 95%.

Event window	Confidence interval for CAAR
(- 2, *t*, + 2)	$0.210\% < \bar{x} < 0.835\%$
(- 5, *t*, + 5)	$0.264\% < \bar{x} < 0.978\%$
(- 10, *t*, + 10)	$1.256\% < \bar{x} < 1.881\%$

Table 4. Confidence intervals containing true CAAR to 95%.probability for event windows with significant results.

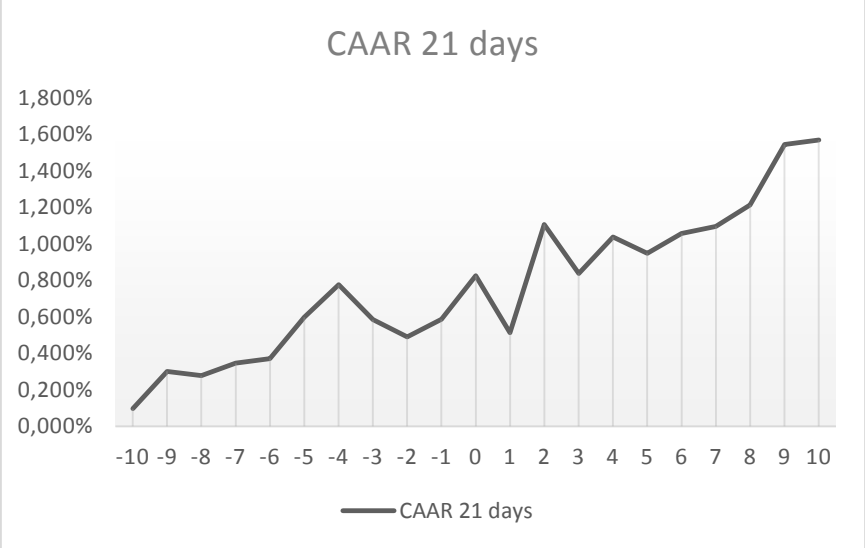

Figure 8. CAAR over 21 day event window centered on event day.

Day relative to event	AAR	*p*-value
-10	0.097%	0.5436
-9	0.204%	0.2006
-8	-0.024%	0.8810
-7	0.069%	0.6647
-6	0.025%	0.8732
-5	0.226%	0.1558
-4	0.179%	0.2625
-3	-0.192%	0.2288
-2	-0.095%	0.5501
-1	0.097%	0.5435
0	0.239%	0.1335
1	-0.312%	0.0504*
2	0.593%	0.0002***
3	-0.268%	0.0922*
4	0.199%	0.2121
5	-0.089%	0.5779
6	0.109%	0.4950
7	0.039%	0.8068
8	0.117%	0.4630
9	0.331%	0.0380**
10	0.025%	0.8758

Table 5. AARs.
**** Significant at the 0.01 level*
*** Significant at the 0.05 level*
** Significant at the 0.10 level*

In Figure 8 the CAAR for the 21 day-long event window for the consumer electronics industry, concluded to be significant at the 0.01 level, is presented. Any pattern in the graph should be analyzed with care since a majority of the movements in the CAAR curve are not significantly different from zero.

Notable is the steep increase in CAAR occurring two trading days after the event. In Table 5 the AARs for each day in the event window are presented. The AAR responsible for the steep increase in CAAR is in Table 5 found to be estimated to 0.593% and is significant at the 0.01 level. This result indicates that an AAR of a size larger than one third of the event window's total CAAR have occurred in a single day.

Just as interesting are the three other trading days that represent statistically significant results (see asterisks in Table 5). On the trading day after the announcement and the trading day three days after, negative AARs are estimated. Based on the statistically significant results of both positive and negative nature found for the three days following the announcement, the market

seems to appear more volatile during this time period. This effect should be remembered for the second event study where conditional volatilities are estimated.

According to table 5 the last statistically significant result is found on the ninth day after the announcement. An increase in AAR of 0.331% is estimated for this day, significant at the 0.05 level.

6.2 Cumulative abnormal returns – firm specific results

In Table 6 below, estimated CAARs are presented for each firm included in the study and for each event window analyzed. The CAARs are followed by their test statistic as well as the *p*-value for significance information.

ACER, AMD, HTC, MSI and Nikon experience CAARs of over 5%, indicating a relatively large positive stock price impact associated with new product announcements for these firms. Each of these firms experience the greatest stock price impact over the two widest event windows. In fact, there is a clear trend that the wider event windows hold the most distinct results. For all firms (where the percentages are statistically significant) except Amazon, Google and Nintendo, the percentages farthest away from zero are found in either the (- 5, *t*, + 5) window or in the (- 10, *t*, + 10) window. Nintendo is the only firm to show the largest impact over the shortest event window. This trend is opposite to the trend found by Chaney et al. (1991), where CAARs were diminishing with an increase in event window length.

Table 6 shows that there are some firms experiencing statistically significant cumulative abnormal losses during the windows examined. Firms to show such effects are Amazon, Apple, Asus, Canon, Google, HP and Panasonic. Conclusively, 7 out of 18 firms with significant results show proof of this effect.

Lenovo and Microsoft are the only firms who do not reject the null hypothesis of CAAR = 0 in any of the five event windows at any of the three significance levels. This indicates that the study does not find any proof that new product announcements have any impact on Lenovo's and Microsoft's stock prices.

Apple is the only firm that experiences both significant excess returns and excess losses in different event windows. The widest event window is the only event window with excess returns. This indicates that the positive stock price effects associated with new product announcement occur relatively far away from the announcement day for Apple.

	Event Window														
	(- 1, *t*, + 1)			**(- 2, *t*, + 2)**			**(- 3, *t*, + 3)**			**(- 5, *t*, + 5)**			**(- 10, *t*, + 10)**		
Firm	CAAR	z-stat	*p*-value	CAAR	z-stat	*p*-value	CAAR	z-stat	*p*-value	CAAR	z-stat	*p*-value	CAAR	z-stat	*p*-value
Acer	2.833%	3.52	0.0004***	3.258%	4.05	0.0001***	2.568%	3.19	0.0014***	6.532%	8.11	0.0000***	4.055%	5.04	0.0000***
Amazon	-1.291%	-2.01	0.0445**	-1.917%	-2.98	0.0029***	-1.234%	-1.92	0.0548*	-1.460%	-2.27	0.0231**	0.336%	0.5226	0.6013
AMD	-0.873%	-0.94	0.3469	0.822%	0.89	0.3756	-0.778%	-0.84	0.4018	3.201%	3.45	0.0006***	5.332%	5.75	0.0000***
Apple	-0.627%	-1.05	0.2938	-1.211%	-2.03	0.0427**	-2.428%	-4.06	0.0000***	-2.664%	-4.46	0.0000***	1.935%	3.24	0.0012***
ASUS	-0.095%	-0.16	0.8726	0.587%	0.99	0.3206	0.513%	0.87	0.3853	-0.412%	-0.70	0.4856	-1.281%	-2.17	0.0303**
Canon	-0.120%	-0.18	0.8547	-0.991%	-1.51	0.1312	-1.675%	-2.5523	0.0107**	-0.020%	-0.03	0.9754	-1.732%	-2.64	0.0083***
Google	-0.974%	-1.9894	0.0467**	-2.094%	-4.28	0.0000***	-1.745%	-3.56	0.0004***	-1.640%	-3.35	0.0008***	-0.424%	-0.87	0.3865
HP	0.071%	0.10	0.9168	-0.158%	-0.23	0.8168	-0.789%	-1.16	0.2471	-1.108%	-1.62	0.1044	-3.056%	-4.48	0.0000***
HTC	1.421%	1.31	0.1901	3.116%	2.87	0.0041***	3.504%	3.23	0.0012***	4.345%	4.01	0.0001***	6.096%	5.62	0.0000***
Intel	0.079%	0.15	0.8824	1.086%	2.04	0.0414**	0.140%	0.26	0.7925	1.566%	2.94	0.0033***	4.336%	8.14	0.0000***
Lenovo	0.416%	0.62	0.5375	0.550%	0.81	0.4153	-0.368%	-0.54	0.5861	-0.539%	-0.80	0.4246	-0.544%	-0.81	0.4208
LG	-0.799%	-1.23	0.2191	0.861%	1.32	0.1853	0.075%	0.11	0.9085	1.287%	1.98	0.0476**	0.614%	0.94	0.3451
Microsoft	-0.173%	-0.34	0.7318	0.088%	0.17	0.8619	0.139%	0.27	0.7837	-0.646%	-1.28	0.2010	0.240%	0.48	0.6347
MSI	1.212%	1.73	0.0834*	4.389%	6.27	0.0000***	1.947%	2.78	0.0054***	2.434%	3.48	0.0005***	5.568%	7.95	0.0000***
Nikon	-1.176%	-1.63	0.1034	1.425%	1.97	0.0484**	1.524%	2.11	0.0348**	3.978%	5.51	0.0000***	5.673%	7.86	0.0000***
Nintendo	1.703%	1.71	0.0864*	1.157%	1.17	0.2440	-0.170%	-0.17	0.8643	1.194%	1.20	0.2291	0.070%	0.07	0.9437
NVidia	0.740%	1.24	0.2164	2.046%	3.42	0.0006***	1.955%	3.27	0.0011***	2.391%	4.00	0.0001***	2.912%	4.87	0.0000***
Panasonic	0.676%	1.08	0.2780	-0.033%	-0.05	0.9578	0.505%	0.81	0.4177	-1.042%	-1.67	0.0945*	0.995%	1.60	0.1103
Samsung	0.617%	1.26	0.2088	1.042%	2.12	0.0340**	0.462%	0.94	0.3474	0.899%	1.83	0.0671*	3.472%	7.07	0.0000***
Sony	0.218%	0.30	0.7665	-0.494%	-0.67	0.5021	0.248%	0.34	0.7357	-0.982%	-1.33	0.1819	2.454%	3.34	0.0009***

Table 6. CAARs – firm specific.
**** Significant at the 0.01 level*
*** Significant at the 0.05 level*
** Significant at the 0.10 level*

6.3 Cumulative abnormal risk – industry specific results

In this section changes in idiosyncratic risk during the event windows of different lengths are presented. The risk measure used is conditional volatility, allowing the dimensions of the risk to be the same as the data. The abnormal volatilities for the event windows presented in Table 7 below are aggregated over the length of each event window. For example, conditional volatilities estimated for the 3 day-long event window (- 1, *t*, + 1) is the average one-day volatility multiplied by 3.

Event window	**Abnormal** $\overline{\sigma_t}$	$\overline{\sigma_{t,normal}}$	**% increase**
(- 1, *t*, + 1)	0.0068	0.0494	13,765%
(- 2, *t*, + 2)	0.0071	0.0832	8.564%
(- 3, *t*, + 3)	0.0066	0.1164	5.670%
(- 5, *t*, + 5)	0.0062	0.1837	3.375%
(- 10, *t*, + 10)	0.0171	0.3466	4.934%

Table 7. Cumulative abnormal risk and normal/expected risk – industry specific

Table 7 should be read as follows: the values under "**Abnormal** $\overline{\sigma_t}$" are the cumulative abnormal conditional volatilities (the cumulative abnormal idiosyncratic risk) the consumer electronic industry has experienced during the event windows. In other words, it is the differential intercept coefficient estimated with the dummy variable multiplied by the length of respective event window. The values under "$\overline{\sigma_{t,normal}}$" are the average idiosyncratic risk for the estimation window multiplied by the length of the event window. Percentages under "**% increase**" are the increase in average conditional volatility during a day in the event window compared to the average conditional volatility of the estimation window.

The daily conditional volatilities are aggregated over the event windows to facilitate the comparison between event windows of different lengths in a similar manner as done with the CAARs before.

The 4 shorter event windows show about the same level of cumulative abnormal risk. The cumulative abnormal risk estimated for the event window (- 10, *t*, + 10) of 21 days stands out from the other 4 windows with a higher value. This result indicates a persistent increase in abnormal risk associated with new product announcements that lasts for the longest period estimated.

According to the "**% increase**" column in Table 7, the increase in daily risk is found to be greatest in the shortest event window, indicating a particularly volatile period close to the new product announcement. A diminishing increase in risk as the length of the event window

increases exists for four of the five event windows, a trend broken by the widest window. An increase in conditional volatility is found for all event windows. This result concludes that new product announcements are associated with increased risk and this risk is present in all event windows examined.

6.4 Cumulative abnormal risk – firm specific results

In Table 8 below, the firm specific results of the second event study are presented. The table contains estimated information for each of the 20 firms included in the study for each of the five event windows of different lengths. Below follows an explanation of how the table should be interpreted.

The coefficient named "γ" is the average aggregated *increase* or *decrease* (depending on the sign in front) in conditional volatility for *all* days in the event windows. This column represents the cumulative abnormal idiosyncratic risk for each firm and displays the differential intercept coefficients estimated with each dummy variable for the different event windows included in the study multiplied by the length of the event window. For example, consider the first estimated coefficient under γ in the table. Here, the average *increase* (since the number is positive) in conditional volatility for Acer is 0.007791. This coefficient is for the 3 day-long event window (- 1, *t*, + 1). The *p*-value is for the daily differential intercept coefficient and is estimated to 0.0002 which declares it significant at the 0.01 level. Based on the sign of the coefficient and the significance level, it is concluded that Acer historically, on average, has experienced increased idiosyncratic risk over this time window when announcing new products.

Next, consider the last coefficient for Sony under γ in the table found at the bottom of the 21 day-long event window (- 10, *t*, + 10). The value of this coefficient is -0.05431. A negative value states that Sony historically, on average, has experienced a *decrease* in idiosyncratic risk over a time window of 21 days centered on a new product announcement.

The column following γ has the header "*%"* and serves with the purpose to increase the understanding of the differential intercept coefficient. What the percentages in this column states are the increase or decrease in conditional volatilities during a day in the event windows compared to the average idiosyncratic risk for the estimation window. Again, consider the result found for Acer over the three day event window. This should be interpreted as following: Acer experiences an average increase in conditional volatility of 14.85% over this event window when announcing new products.

HTC and NVidia are the only firms not to show any results significant from zero and the null hypothesis that new product announcement have no impact on a firm's stock price risk cannot be rejected for these firms.

Remaining 18 firms showed statistically significant proof of changes in risk different from zero when announcing new products at some of the three significance levels for one or more event

window. These changes in risk were found in both directions and the hypothesized effect that new product announcements would temporarily impact the idiosyncratic risk of stock prices was confirmed for these firms.

	Event Window														
	(- 1, *t*, + 1)			**(- 2, *t*, + 2)**			**(- 3, *t*, + 3)**			**(- 5, *t*, + 5)**			**(- 10, *t*, + 10)**		
Firm	γ_3	%	*p*-value	γ_5	%	*p*-value	γ_7	%	*p*-value	γ_{11}	%	*p*-value	γ_{21}	%	*p*-value
Acer	0.0077909	14.851%	0.0002***	0.008940	10.230%	0.0002***	0.0104658	8.560%	0.0002***	0.0118598	6.175%	0.0002***	0.0129926	3.539%	0.0017***
Amazon	0.0373733	75.860%	0.0008***	0.032138	39.004%	0.0002***	0.0227703	19.642%	0.0062***	0.0061488	3.348%	0.6603	-0.0085361	-2.413%	0.0016***
AMD	0.0003187	0.408%	0.3421	0.000060	0.046%	0.0955*	0.002396	1.310%	0.1423	0.0102475	3.558%	0.4043	0.0179116	3.250%	0.1252
Apple	0.0089808	23.255%	0.0634*	0.009586	14.908%	0.0830*	0.009653	10.733%	0.1174	0.0188547	13.397%	0.0114**	0.0566792	21.130%	0.0046***
ASUS	0.0006303	1.195%	0.0524**	0.002486	2.823%	0.0519**	0.0066095	5.355%	0.4656	0.0089205	4.583%	0.1350	0.0108692	2.884%	0.0005***
Canon	0.0021206	5.727%	0.0751*	0.002873	4.655%	0.0608*	0.0036213	4.190%	0.0507*	0.004989	3.672%	0.0477**	0.0081095	3.124%	0.1370
Google	-0.0062727	-18.044%	0.0061***	0.001851	3.199%	0.9744	-0.0160771	-19.849%	0.0000***	0.0069557	5.572%	0.3118	0.1141365	49.009%	0.0000***
HP	-0.0077588	-14.126%	0.0000***	-0.016104	-14.763%	0.0000***	-0.0113537	-8.851%	0.0000***	-0.0199759	-9.890%	0.0000***	0.0157533	4.099%	0.0553*
HTC	-0.003725	-5.275%	0.1613	-0.002525	-2.143%	0.3405	-0.0024973	-1.512%	0.2816	0.0004978	0.192%	0.3434	0.0004257	0.086%	0.2517
Intel	0.0043047	13.050%	0.5092	-0.004276	-7.750%	0.2202	0.0039316	5.104%	0.8187	-0.0010345	-0.853%	0.6746	-0.0365701	-15.616%	0.0000***
Lenovo	0.0102371	18.645%	0.0146**	0.011486	12.556%	0.0162**	0.0124597	9.726%	0.0179**	0.0139985	6.949%	0.0321**	0.018602	4.836%	0.1394
LG	0.000351	0.712%	0.2521	0.001102	1.339%	0.2539	0.0016501	1.431%	0.1537	0.002896	1.596%	0.0703*	0.006171	1.773%	0.0135**
Microsoft	0.0181977	56.926%	0.0000***	0.018776	35.336%	0.0000***	0.0193593	26.062%	0.0000***	0.022122	19.007%	0.0000***	0.0217213	9.787%	0.0000***
MSI	0.0049562	10.350%	0.0114**	0.005665	7.103%	0.0198**	0.0060032	5.379%	0.0746*	0.0072341	4.132%	0.2440	0.0114755	3.454%	0.4076
Nikon	0.0171088	34.436%	0.0634*	0.018655	22.573%	0.0928*	0.0086438	6.357%	0.0781*	0.0135252	5.910%	0.5243	0.0429294	12.608%	0.0000***
Nintendo	0.0285754	48.240%	0.0276**	0.033343	33.813%	0.0131**	0.0325919	23.606%	0.0149**	0.0185822	8.536%	0.1782	0.0395445	9.545%	0.0085***
NVidia	0.001823	3.543%	0.8801	0.002797	3.255%	0.6884	0.0039648	3.291%	0.6483	0.0062566	3.294%	0.4482	0.0121079	3.310%	0.2031
Panasonic	0.0147478	30.203%	0.0083***	0.018288	22.448%	0.0095***	0.0219937	19.270%	0.0252**	0.029426	16.394%	0.1742	0.0457329	13.249%	0.2669
Samsung	0.0016309	4.447%	0.2845	0.001377	2.252%	0.5626	0.0024549	2.868%	0.2770	0.0040737	3.030%	0.0913*	0.0061009	2.374%	0.0734*
Sony	-0.0046684	-8.332%	0.0688*	-0.005377	-5.747%	0.0238**	-0.00764	-5.819%	0.0021***	-0.0415632	-20.053%	0.0000***	-0.0543106	-13.715%	0.0001***

Table 8. Cumulative abnormal risk ("γ" in table) and percental difference from normal/expected conditional volatility ("%" in table) – firm specific.
**** Significant at the 0.01 level*
*** Significant at the 0.05 level*
** Significant at the 0.1 level*

6.5 Results in relation to the hypotheses

Hypothesis 1*: New product announcements do not have an impact on stock prices.*

Since the first event study rejected the null hypothesis of CAAR = 0 and concluded that CAAR > 0, this hypothesis is rejected. New product announcements in the consumer electronic industry do (historically on average) have an impact on stock prices and this impact is of a positive nature. The hypothesis is rejected.

Hypothesis 2*: New product announcements impact stock prices of all firms in the same direction.*

The statistically significant results in Table 6 show that there are firms experiencing positive impacts on stock prices when announcing new products, as well as firms experiencing negative impacts. The hypothesis is rejected.

Hypothesis 3*: New product announcements do not affect the risk of stock prices.*

The results in Table 8 show that 18 of the 20 firms in the study experience statistically significant changes in risk in some of the event windows estimated. Based on this result the hypothesis is rejected for all firms except HTC and NVidia.

Hypothesis 4*: The length of the event window does not affect the results.*

Since statistically significant results are of different sizes in differently sized event windows, as well as occasionally displaying both negative and positive values depending on the event window size, this hypothesis is rejected.

7. Discussion

The purpose of this study was to research if consumer electronic firms experience any stock price impact when announcing new products, and to quantify any impact proven to exist. Based on the results found and with the help of economic theory, possible explanations to why the stock prices of included firms in the study as well as the consumer electronic industry as a whole react as they do were to be presented. The result that CAARs associated with new product announcements still exist even though they were located decades ago introduces doubt to the explanatory power of the efficient market hypothesis. In section 3.2.2 it was mentioned that if the efficient market hypothesis were to hold, the market should have been able to learn that new product announcements generate excess returns on average and not have the constant need to readjust stock prices after each new product announcement. The conclusion is that the event windows which hold positive CAARs could possibly be explained by an anomaly of the efficient market hypothesis.

A second possible explanation presented in section 3. Economic Theory was that located CAARs act as a risk premium for some hidden excess risk associated with new product announcements. It was said that if such risk existed a risk premium might be required by investors to carry the excess risk. In order to research the existence of any change in risk the second event study was conducted to estimate excess risk for the same event windows. As seen in table 7 excess risk was found to exist on average and opens up this explanation as a possibility. However, since CAPM advocates that an investor is only compensated for the systematic risk, and based on the discussion in section 3.1 where it was deemed unlikely for new product announcements to affect the market discount rate, this explanation should be approached with much care.

When comparing the event studies it is seen that the widest event window of 21 days both had the highest estimated CAAR and the highest estimated cumulative idiosyncratic risk. The same stock reaction but not as large is seen for the 5 day-long event window (- 2, *t*, + 2) and the 11 day-long event window (- 5, *t*, + 5). No excess return was found for the shortest event window (- 1, *t*, + 1) of 3 days, yet this window was estimated to have the largest daily increase in risk compared to the estimation window. This result indicates that this time window experiences both relatively large returns and relatively large losses (compared to both the estimation window and the other event windows) and that they cancel each other out on average. This results in excess risk but no excess returns. The same stock reaction but not as large is seen for the 7 day-long event window (- 3, *t*, + 3).

A possible explanation to why new product announcements cause an abnormally volatile period on average is given by behavioral economics. This explanation stresses the importance of expectations, how those expectations may act as a reference point and the loss of utility the market players may suffer should the product turn out to be a disappointment. According to the results, the stock impacts which occur in the smallest event window do not account for any significant positive AARs (only a loss), yet is the most volatile on a daily basis, indicating a relatively trade intensive time window. The fact that the AARs are delayed indicates that the market needs some time to interpret the announced information and to calibrate. Based on this, it is not unreasonable to speculate that the market players incorporate information reported by media in the days following the announcement, such as product specifications, how they live up to expectations and how they compare to equivalent products of competitors before stabilizing in a more homogenous reaction. Media would in this case initiate a phenomenon known as the bandwagon effect. The bandwagon effect is the psychological term of a cognitive bias where individuals' probability to adopt a belief is increased with the size of the portion to have already done so (Colman, 2003, p. 78).

The theory that new product announcements are not always received as good news is supported by the existence of statistically significant negative CAARs in Table 6. From the behavioral economic standpoint this stock price reaction is interpreted as a reflection of the loss in utility the investor experiences due to disappointment. According to the discussion about the DDM in section 3. Economic Theory the disappointing product announced would decrease investors' expectations of future dividends. 7 of the 18 firms with statistically significant results show results of negative CAARs for some event window. This result presents an alternative view of new product announcements that prior research left undiscussed. New products may be "engines of growth" as so poetically put by Cohen et al. (1997) and they may on average have a positive impact on stock prices, but reoccurring negative impacts should not come as a surprise to the investor.

7.1 Trading strategies

Despite occasional negative impacts and also *because* of them, different trading strategies can be designed that would be *expected* to generate future abnormal returns. Below follows two sections that suggest such strategies. The first section suggests strategies that exploit abnormal returns found in the study and the second section suggests strategies that exploit the abnormal idiosyncratic risk which was found.

7.1.1 Speculation on the abnormal return

The widest event window (- 10, *t*, + 10) of 21 days was estimated to generate the largest CAAR, so logically the trading strategy to maximize one's return would be to hold stocks for this period. (Or go long on futures contracts or call options with expiration date at the end of the event window if the speculator wants to leverage his or her investment.) However, this trading strategy has some complications. 1. A new product announcement may not be known to occur in advance. As discussed previously in this paper, it is sometimes the case that the announcement is expected, such as the early-autumn Apple Launch Event example when Apple announces new iPhones, but not all announcements can be predicted. 2. Since the strategy begins before the announcement, it is difficult to speculate if the product will live up to expectations. 3. None of the estimated AARs occurring previously to the announcement are significantly different from zero. 4. This event window was estimated to suffer from the largest cumulative abnormal idiosyncratic risk. This additional risk will have to be carried by the speculator. These complications may cause the strategy to be perceived as unattractive.

An alternative trading strategy would be to buy stocks just before the stock exchange closes on the day after the announcement. This trading day was estimated to have a significant negative AAR and was followed by the trading day to show the largest estimated AAR in the study. The speculator is then recommended to hold the stocks to the tenth trading day after the announcement, thus including the expected positive AAR estimated for the ninth trading day. (Long positions can be used for this trading strategy as well if the speculator wants to leverage his or her investment.) This trading strategy has the advantage that the stocks are bought by the end of a trading day expected to generate a negative return and then contains both trading days expected to generate positive returns. What makes this trading strategy even more powerful is that it takes place post-announcement. This eliminates the complication that the announcement may not be public knowledge which the first strategy suffered from. The trading strategy offers one more critical advantage. Since it starts by the end of the trading day after the announcement day, speculators may have time to include information about the reception published by media of how product specifications live up to expectations and speculations. Should it be the case that the product does not live up to expectations and speculations, the speculator may have time to decide whether or not to adopt the strategy for the current announcement.

Below is an illustration of expected CAAR when adopting the trading strategy just described. A confidence interval at the 95% level is applied to the sell price.

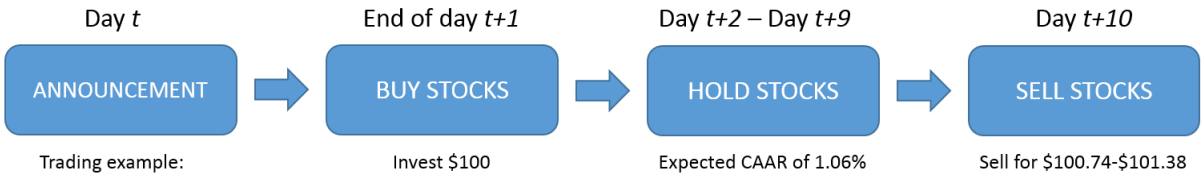

Figure 9. Trading strategy with $100 investment example and 95% confidence interval for expected sell price (general market movements affecting the stock prices excluded).

An additional estimation of excess risk was conducted to facilitate the analysis of above trading strategy. The daily increase in conditional volatility was estimated to 5.412%, which makes it about as risky as the first trading strategy on a daily basis. However, since this strategy is over a shorter time period, the cumulative abnormal conditional volatility is estimated to 0.0076. This is less than half the cumulative abnormal conditional volatility of 0.0171 the 21 day-long event window was estimated to suffer from.

7.1.2 Speculation on the abnormal risk

In section 3. Economic Theory some trading strategies involving two or more options were described. Based on the result that the stock prices of examined firms, on average, experience an increase in idiosyncratic risk when announcing new products, would suggest the appropriate trading strategies to be from the group called *combinations* if a stock of a consumer electronic firm is the underlying asset. For the three event windows with positive CAARs a positive increase in price is expected to be more likely for the stocks than a loss in value resulting in the strap to be the trading strategy to be recommended. The longest event window is estimated to have the highest cumulative abnormal idiosyncratic risk and is consequently expected to generate the highest profit of the three.

Event windows (- 1, *t*, + 1) and (- 3, *t*, + 3) show no proof of CAARs but both experience increases in idiosyncratic risk on average. Based on this, the straddle (which does not reward a loss or return more than the other) is the recommended trading strategy. The 3 day-long window was estimated to have a cumulative abnormal risk greater than that of the 7 day-long window, resulting in the trading strategy involving the shorter window to appear more appealing.

For trading strategies involving stocks of a specific firm as the underlying asset refer to statistically significant γ's in Table 8. The higher the γ the more attractive the trading strategy. If the γ is positive an increase in idiosyncratic risk associated with new product announcement is expected on average and one of the *combinations* is the appropriate choice. If γ is negative

the opposite holds and the *butterfly spread* is the appropriate choice[22]. If a statistically significant result is found in the corresponding cell of Table 6 and γ is positive, this information can be used to decide whether to use a strip (if the CAAR is negative) or a strap (if the CAAR is positive).

7.2 Comparison with previous research

The main result found in this study that new product announcements on average have a positive impact on stock prices is (despite the generally accepted assumption of market efficiency) the same as the previous studies conducted by Chaney et al. (1991) and Lee & Chen (2009). However, this is where the similarities end. Chaney et al. (1991) found that the smaller the event window, the greater the CAAR. In this study the opposite was found; the event window to show the greatest stock price impact on average was the widest window of 21 days. Lee & Chen (2009) found that the day before the announcement as well as the announcement day were the days that experienced the greatest impacts, while this study found no significant impact for these days. The fact that the results found in this study diverge from results found in previous similar research is hardly surprising. Neither is it a unique characteristic for this study. The same pattern is seen when comparing previous studies. The study conducted by Eddy & Saunders (1980) is such an example, where no excess returns were found. To fully understand the divergence consider the components of the study. In broad terms the two main components are the method applied and the sample used. The first event study that was conducted in this study estimated abnormal returns for the event window by calculating the difference between actual returns and normal/expected returns which were estimated with the market model. This methodology is very similar to the methodology adopted in previous research, but a difference is the size of the event windows. However, since this study estimated AARs for all days over a 21 day-long window (which subsequently were presented in differently sized windows), differences in CAAR caused by differently sized windows would be easy to notice had they existed. Where the true difference lies is in the other component; the sample. The samples are different in multiple ways. They are different in length, in firms included, in announcements and most importantly, in time. In section 2.2 it was mentioned that discovered trends on the stock market tend to disappear as the word spreads, since investors seek to exploit them to make an easy profit. This is partly what is seen when comparing this study on new data with research

[22] Have in mind that the risk estimated is the idiosyncratic risk corrected for market movements. If the market is experiencing a particularly volatile period the butterfly spread might be inappropriate even though a firm on average has experienced less volatility during event windows compared to the estimation window.

on old data. CAARs still exist but the trend that the CAARs were diminishing as the event window widened found in previous research is in this study found to no longer exist. In this study the widest event window is the window to show the highest excess return. That results differ over time should not be seen as disconcerting, but as motivating to keep the research up to date.

8 Conclusion

8.1 Future research

Proposals for future research are strongly connected to the limitations of this study. The most obvious direction for future research would be to apply the same methodology to different industries. An industry of particular interest is the pharmaceutical industry since previous research has found this industry to be particularly sensitive to new product announcements. A next step would be to expand the research by applying the same methodology to all industries and eventually the market as a whole.

Future research could also be conducted within the consumer electronic industry to create an even greater understanding of the industry. This could be done by categorizing announcements and estimate stock price impacts for each category. For example one category could include announcements of flagship products, another announcements of multiple products and a third announcements of minor products. A careful definition of which products belong to which category would have to be made to minimize the problem of ambiguity.

A proposal of future research in an entirely different direction is to study long term economic effects by new product introductions. Pauwels et al. (2003) have already conducted such research in their study "The Long-Term Impact of New-Product Introductions and Promotions on Financial Performance and Firm Value". However, this study only includes six car manufacturing firms. Conducting such a study on a grander scale would provide firms with important information of what to expect on the long term when launching new products.

The last proposal is to test the suggested trading strategies and see if they generate any abnormal returns after transaction costs. This would be a very interesting contribution to the research conducted in this study.

8.2 Concluding remarks

The purpose of this study was to expand our understanding of firm value reactions when consumer electronic firms announce new products and to complement similar previous research. Some interesting results that were hypothesized are now confirmed. This study concludes that the stocks of consumer electronic firms have historically experienced excess returns as well as excess idiosyncratic risk on average when announcing new products. An anomaly of the efficient market hypothesis as well as the less likely case of the CAAR acting as a compensation for the abnormal risk in relation to CAPM were presented as possible

explanations to why CAAR exist on average. Behavioral economics offers explanations to why new product announcements are associated with this temporary increase in idiosyncratic risk.

The event window to show the largest abnormal return was the widest window, consisting of 21 days. This window was also estimated to suffer from the highest cumulative abnormal idiosyncratic risk. Returns from the second and ninth trading days after the announcement contribute most to the CAAR. The shortest event window of 3 days was found to be the most volatile on a daily basis.

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Appendix

Announcements

Product	Date	Source
Acer Inc.		
Z220, Z520 Phones	2015-03-01	http://us.acer.com/ac/en/US/press/2015/152995
Aspire R13, R14	2014-09-03	http://us.acer.com/ac/en/US/press/2014/81628
Liquid Phones	2014-05-30	http://us.acer.com/ac/en/US/press/2014/78450
Liquid S2	2013-09-02	http://us.acer.com/ac/en/US/press/2013/66580
Aspire S5 Ultrabook	2012-01-08	http://us.acer.com/ac/en/US/press/2012/28709
Amazon.com Inc.		
Fire TV Stick	2014-10-27	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1981713
Fire Phone	2014-06-18	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1940902
Fire TV	2014-04-02	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1915168
Kindle Fire HDX	2013-09-17	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1969157
Kindle Fire HD	2012-09-06	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1732546
Kindle Fire	2011-09-28	http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle&ID=1610968
AMD, Inc.		
R9 285 Graphics	2014-08-23	http://www.amd.com/en-us/press-releases/Pages/amd-launches-r9285-2014sep02.aspx
R9 295X2	2014-04-08	http://www.amd.com/en-us/press-releases/Pages/fastest-graphics-card-2014apr8.aspx
R7, R9 Series	2013-09-25	http://www.amd.com/en-us/press-releases/Pages/amd-radeon-r9-2013sept25.aspx
HD 7990	2013-04-24	http://www.amd.com/en-us/press-releases/Pages/amd-unleashes-worlds-fastest-2013apr24.aspx
HD 7970 GHz	2012-06-22	http://www.amd.com/en-us/press-releases/Pages/amd-takes-graphics-2012jun22.aspx
HD 7970	2011-12-22	http://www.amd.com/en-us/press-releases/Pages/amd-launches-worlds-fastest-2011dec22.aspx
HD 6990	2011-03-08	http://www.amd.com/en-us/press-releases/Pages/amd-extends-graphics-2011mar08.aspx
HD 6900 Series	2010-12-15	http://www.amd.com/en-us/press-releases/Pages/6900-series-graphics-2010dec15.aspx
Apple Inc.		
iPhone 6, 6+	2014-09-09	http://www.apple.com/pr/library/2014/09/09Apple-Announces-iPhone-6-iPhone-6-Plus-The-Biggest-Advancements-in-iPhone-History.html
iPhone 5S, 5C	2013-09-10	http://www.apple.com/pr/library/2013/09/10Apple-Announces-iPhone-5s-The-Most-Forward-Thinking-Smartphone-in-the-World.html
iPhone 5	2012-09-12	http://www.apple.com/pr/library/2012/09/12Apple-Introduces-iPhone-5.html
iPhone 4S	2011-10-04	http://www.apple.com/pr/library/2011/10/04Apple-Launches-iPhone-4S-iOS-5-iCloud.html
iPhone 4	2010-06-07	http://www.apple.com/pr/library/2010/06/07Apple-Presents-iPhone-4.html
ASUSTeK Computer Inc.		
ZenBook Pro UX501	2015-03-13	http://www.asus.com/News/aYrdne2zge3Rp27m
ZenBook UX305	2015-02-09	http://www.asus.com/News/SQPFP4ijdnPDTj2M
ZenBook UX303	2014-10-08	http://www.asus.com/News/sImMdBUarWTBDsHB
ZenBook NX500	2014-06-02	http://www.asus.com/News/OpnWO7N8R64fFYCx
ZenFone	2014-01-03	http://press.asus.com/PressReleases/p/ASUS-Announces-ZenFone-4-ZenFone-5-and-ZenFone-6#.VQ2QeeGYI7A
Zenbook Infinity	2013-06-03	http://www.gizbot.com/tablet-pc-laptop/asus-zenbook-infinity-with-gorilla-glass-3-protection-012383.html

UX32A/UX32VD	2012-04-10	http://ultrabooknews.com/2012/05/10/asus-announces-ivy-bridge-ux32aux32vd-zenbook-ultrabooks-with-discrete-nvidia-graphics-and-more-ports-video/
ZenBook	2011-10-11	http://techcrunch.com/2011/10/11/asus-zenbooks-enter-the-ultrabook-fray-starting-at-999/
Canon U.S.A., Inc.		
Multiple cameras	2015-02-05	http://www.usa.canon.com/cusa/about_canon/newsroom/press_releases?pageKeyCode=pressrelsearch&month=2&year=2015&x=14&y=8&category=&searchPhrase=#
Multiple cameras	2014-02-11	http://www.usa.canon.com/cusa/about_canon/newsroom/press_releases?pageKeyCode=pressrelsearch&month=2&year=2014&x=19&y=9&category=&searchPhrase=#
Multiple cameras	2013-03-21	http://www.usa.canon.com/cusa/about_canon/newsroom/press_releases?pageKeyCode=pressrelsearch&month=3&year=2013&x=13&y=5&category=&searchPhrase=#
CES	2012-01-09	http://www.usa.canon.com/cusa/about_canon/newsroom/press_releases?pageKeyCode=pressreldetail&docId=0901e02480420024
Google Inc.		
Nexus 6, 9	2014-10-15	http://www.cnet.com/news/google-unveils-nexus-9-tablet-nexus-6-phone-nexus-player-streamer/
Android Wear	2014-03-18	http://www.theverge.com/2014/3/18/5522226/google-reveals-android-wear-an-operating-system-designed-for
Nexus 5	2013-10-31	http://googleblog.blogspot.se/2013/10/android-for-all-and-new-nexus-5.html
Google Glass	2012-04-04	https://plus.google.com/+GoogleGlass/posts/aKymsANgWBD
Nexus One	2010-01-05	https://sites.google.com/a/pressatgoogle.com/nexusone/press-release
Hewlett-Packard Company		
Pavilion Mini Desktop	2015-01-05	http://www8.hp.com/us/en/hp-news/press-release.html?id=1866916#.VTYkVZNc47A
ENVY, Pavilion x360 2nd gen	2014-06-01	http://www8.hp.com/us/en/hp-news/press-release.html?id=1697420#.VTYlrpNc47A
Pavilion x360	2014-02-23	http://www8.hp.com/us/en/hp-news/press-release.html?id=1575336#.VTYpCJNc47A
ENVY Recline series	2013-09-05	http://www8.hp.com/us/en/hp-news/press-release.html?id=1470129#.VTYqI5Nc47A
Pavilion 14 Chromebook	2013-02-04	http://www8.hp.com/us/en/hp-news/press-release.html?id=1366400#.VTYrGZNc47A
AiO PCs	2012-09-10	http://www8.hp.com/us/en/hp-news/press-release.html?id=1291545#.VTYsO5Nc47A
Multiple PC	2012-05-09	http://www8.hp.com/us/en/hp-news/press-release.html?id=1232177#.VTYs6JNc47A
AiO PCs	2011-09-07	http://www8.hp.com/us/en/hp-news/press-release.html?id=1065256#.VTYtZJNc47A
HTC Corporation		
One (M9)	2015-02-01	http://www.timesnews.co.uk/3841-htc-one-m9-launched-at-mwc-2015-with-snapdragon-810-octa-core-processor/
One (M8)	2014-03-25	http://www.anandtech.com/show/7892/htc-launches-the-one-2014-formerly-m8
One	2013-02-19	https://www.youtube.com/watch?v=cJRaAdghpo0
One X	2012-02-26	http://www.theverge.com/2012/2/26/2824075/htc-one-x-launch-release-date-specs-tegra-3-720p-android-4
Sensation	2011-04-12	http://www.tmonews.com/2011/04/watch-the-htc-sensation-announcement-online/
Intel Corporation		
5th Gen Processors	2015-01-05	http://blogs.wsj.com/digits/2015/01/05/intel-unveils-new-flagship-broadwell-chips-for-pcs/?KEYWORDS=intel
4th Gen Processors	2013-06-04	http://www.forbes.com/sites/patrickmoorhead/2013/06/04/intels-newest-core-processors-all-about-graphics-and-low-power/
3rd Gen Processors	2012-04-23	http://newsroom.intel.com/community/intel_newsroom/blog/2012/04/23/3rd-generation-intel-core-processors-bring-exciting-new-experiences-and-fun-to-the-pc
2nd Gen Processors	2011-01-06	http://www.cnet.com/news/ces-intel-debuts-2nd-gen-sandy-bridge-core-i-series-cpus/
Lenovo Group		
YOGA Laptop	2015-01-05	http://news.lenovo.com/article_display.cfm?article_id=1876
YOGA Tablet 2	2014-10-09	http://news.lenovo.com/article_display.cfm?article_id=1843

ThinkPad X1 Carbon	2014-01-05	http://news.lenovo.com/article_display.cfm?article_id=1743
ThinPad Ultrabook	2013-06-18	http://news.lenovo.com/article_display.cfm?article_id=1697
Smartphone Portfolio	2013-01-07	http://news.lenovo.com/news+releases/lenovo-launches-new-smartphone-portfolio.htm
IdeaPad Ultrabook	2012-08-31	http://news.lenovo.com/article_display.cfm?article_id=1625
IdeaPad YOGA	2012-01-09	http://news.lenovo.com/article_display.cfm?article_id=1551
ThinkPad X220	2011-03-08	http://news.lenovo.com/article_display.cfm?article_id=1427
LG Electronics Inc.		
G Flex 2	2015-02-11	http://www.lg.com/hk_en/press-releases/lg-g-flex-2-evolution-of-lgs-curved-smartphone
G3	2014-05-27	https://www.youtube.com/watch?v=ez0l1iBX83A
Curved OLED TV	2013-10-03	http://www.lg.com/hk_en/press-releases/lg-curved-oled-tv
G2	2013-08-07	http://live.cnet.com/Event/LG_G2_press_event?Page=0
Smartphones	2012-02-26	http://www.lgnewsroom.com/newsroom/contents/62070
3D TV	2011-03-30	http://www.lg.com/hk_en/press-releases/lg-2011-the-next-generation-3d-tv-launch-event-lg-electronics-announces-a-breakthrough-in-3d-technologies-enhancing-homes-with
Microsoft Corporation		
Hololens	2015-01-21	https://www.youtube.com/watch?v=aAKfdeOX3-o
Surface Pro 3	2014-05-20	http://news.microsoft.com/2014/05/20/microsoft-introduces-surface-pro-3-the-tablet-that-can-replace-your-laptop/
Surface 2, Pro 2	2013-09-23	http://news.microsoft.com/2013/09/23/microsoft-unveils-surface-2-surface-pro-2-and-new-accessories/
Xbox One	2013-05-21	http://www.ign.com/articles/2013/05/21/xbox-720-is-called-xbox-one
Surface Tablet PC	2012-06-18	http://www.pcworld.com/article/257840/microsoft_announces_new_surface_tablet_pc.html
MSI Co., Ltd		
GE72/GE62	2015-03-13	http://www.msi.com/news/2009.html
GT80 Titan	2014-10-31	http://www.msi.com/news/1885.html
Multiple	2014-03-25	http://www.msi.com/news/1695.html
GS70	2013-06-04	http://www.msi.com/news/1559.html
GT60, GT70	2012-03-01	http://www.msi.com/news/1377.html
GT780, GT683, GE620	2011-05-31	http://www.msi.com/news/1255.html
Nikon Corporation		
Multiple cameras	2015-02-09	http://www.nikonusa.com/en/About-Nikon/Press-Room/Press-Release/i5shbv4v/Compact%2C-Tough-and-Ready%2C-Nikon%27s-New-Rugged-COOLPIX-AW130-and-Family-Friendly-COOLPIX-S33-Combine-Durability-with-Impressive-Imaging-Prowess.html
Multiple cameras	2014-02-06	http://www.nikonusa.com/en/About-Nikon/Press-Room/Press-Release/hrafh7gk/The-Waterproof%2C-Shockproof-and-Freezeproof-Nikon-COOLPIX-AW120-is-an-Exciting-Option-for-Those-Who-Want-to-Take-Photos-When-They%27re-in-the-Action%2C-Instead-of-Watching-It.html
Multiple cameras	2013-01-07	http://www.nikonusa.com/en/About-Nikon/Press-Room/Press-Release/hbje2hwx/Nikon-Expands-the-Nikon-1-System-with-the-Announcement-of-the-Nikon-1-J3-and-Nikon-1-S1-as-well-as-the-New-1-NIKKOR-VR-6.7-13mm-f%252F3.5-5.6-and-VR-10-100mm-f%252F4-5.6-Lenses.html
Multiple cameras	2012-01-31	www.nikonusa.com/en/About-Nikon/Press-Room/Press-Release/h1jhd6hz/Nikon%E2%80%99s-New-S-Series-COOLPIX-Cameras-Are-The-Slim%2C-Stylish-And-Smart-Way-To-Capture-Life%E2%80%99s-Great-Moments.html
Multiple cameras	2011-02-08	www.nikonusa.com/en/About-Nikon/Press-Room/Press-Release/h1jhd6ct/Nikon%E2%80%99s-Newest-COOLPIX-Digital-Cameras-Are-The-Easy-Way-To-Amazing-Images%2C-Preserving-Memories%2C-Capturing-HD-Video-Or-Sharing-Photos-With-Friends-And-Family.html

Nintendo Co. Ltd.		
2DS	2013-08-28	http://www.ign.com/articles/2013/08/28/nintendo-announces-2ds
3DS XL/LL	2012-06-22	http://www.nintendo.co.jp/corporate/release/en/2012/120622.html
Wii U	2011-04-25	http://www.nintendo.co.jp/ir/pdf/2011/110425_4e.pdf
3DS	2010-03-23	http://www.nintendo.co.jp/ir/pdf/2010/100323e.pdf
NVidia Corporation		
GTX Titan X	2015-03-04	http://blogs.nvidia.com/blog/2015/03/04/smaug/
GTX 900 series	2014-09-18	http://nvidianews.nvidia.com/news/nvidia-unveils-full-power-of-maxwell-gpu-architecture-with-breakthroughs-in-performance-graphics-efficiency
GTX 780Ti	2013-11-07	http://nvidianews.nvidia.com/news/nvidia-unveils-geforce-gtx-780-ti-the-best-gaming-gpu-on-the-planet
GTX 780	2013-05-23	http://nvidianews.nvidia.com/news/new-nvidia-geforce-gtx-780-gpu-leads-the-industry-with-the-fastest-frame-rates-and-super-smooth-animation-for-next-generation-gaming
GTX Titan	2013-02-19	http://nvidianews.nvidia.com/news/nvidia-introduces-geforce-gtx-titan-dna-of-the-world-s-fastest-supercomputer-powered-by-world-s-fastest-gpu
GTX 690	2012-04-28	http://nvidianews.nvidia.com/news/nvidia-unveils-geforce-gtx-690-dual-graphics-card-combines-world-s-fastest-gaming-performance-with-sleek-sexy-design
GTX 580	2010-11-09	http://nvidianews.nvidia.com/news/nvidia-delivers-world-s-fastest-dx11-gpu-again
Panasonic Corporation		
CES	2015-01-05	http://www2.panasonic.com/webapp/wcs/stores/servlet/PressroomHome?storeId=11301&catGroupId=30531&sortByDate=TDown&startIndex=11&catalogId=13251
AX800 4K UHD TV	2014-10-30	http://www2.panasonic.com/webapp/wcs/stores/servlet/prModelDetail?storeId=11301&catalogId=13251&itemId=714006&modelNo=Content10302014014144007&surfModel=Content10302014014144007
CES	2014-01-06	http://www2.panasonic.com/webapp/wcs/stores/servlet/PressroomHome?storeId=11301&catGroupId=30531&sortByDate=TDown&startIndex=121&catalogId=13251
LUMIX LX7	2012-07-18	http://www2.panasonic.com/webapp/wcs/stores/servlet/prModelDetail?storeId=11301&catalogId=13251&itemId=681506&modelNo=Content07182012123450403&Viera
Viera smart	2012-01-09	http://www.bigbrownboxblog.com.au/av-talk/panasonic-announces-17-new-plasma-tvs
Viera IPS	2011-05-23	https://blogs.panasonic.com.au/consumer/2011/05/23/panasonic-announces-new-range-of-viera-ips-led-lcd-tvs/
Samsung Electronics Co. Ltd.		
Galaxy S6, Edge	2015-03-01	http://www.samsungmobilepress.com/2015/03/02/Beautifully-Crafted-from-Metal-and-Glass,-Samsung-Galaxy-S6-and-Galaxy-S6-edge-Define-Whats-Next-in-Mobility
Galaxy S5	2014-02-24	http://www.samsung.com/us/aboutsamsung/news/newsIrRead.do?news_ctgry=irnewsrelease&page=2&news_seq=22549&rdoPeriod=ALL&from_dt=&to_dt=&search_Galaxy
Galaxy S4	2013-06-12	http://www.samsung.com/us/aboutsamsung/news/newsIrRead.do?news_ctgry=irnewsrelease&page=10&news_seq=21007&rdoPeriod=ALL&from_dt=&to_dt=&search_Galaxy
Galaxy SIII	2012-05-03	http://www.samsungmobilepress.com/2012/05/03/Samsung-Introduces-the-GALAXY-S-III,-the-Smartphone--Designed-for-Humans-and-Inspired-by-Nature-1
Galaxy SII	2011-02-13	http://www.samsungmobilepress.com/2011/02/13/Samsung-announces-the-GALAXY-S-II,-Worlds-thinnest-Smartphone-that-Will-Let-You-Experience-More-with-Less-1
Galaxy S	2010-03-23	http://www.samsungmobilepress.com/2010/03/23/Samsung-Welcomes-You-to-the-35;38;DquotSmart-Life35;38;Dquot-with-the-Global-Launch-of-the-Galaxy-S
Sony Corporation		
Xperia Z3	2014-09-03	http://blogs.sonymobile.com/2014/09/03/sony-mobile-live-at-ifa-2014/
Xperia Z2	2014-02-24	https://www.youtube.com/watch?v=PoUzAbvbAB4
Xperia Z1	2013-09-04	https://www.youtube.com/watch?v=05gIlc4AH6c&list=UU1-FEEq7mbq5NwzJhTqyspA#t=543
PlayStation 4	2013-02-20	http://www.scei.co.jp/corporate/release/pdf/130221a_e.pdf
Xperia Z	2013-01-07	http://www.androidpolice.com/2013/01/07/eyes-on-announcement-the-xperia-z-and-zl-from-sonys-ces-2013-press-conference/
IFA	2012-08-29	http://live.theverge.com/sony-ifa-2012-event-live-blog/
IFA	2011-08-31	http://www.engadget.com/2011/08/31/live-from-sony-ifa-2011-press-event/

Table 9. Announcements and sources.

Stock exchange and index

Firm	Index	Stock Exchange
Acer Inc.	Taiwan Capitalization Weighted Stock Index	Taiwan Stock Exchange
Amazon.com Inc.	NASDAQ Composite	NASDAQ
AMD, Inc	NASDAQ Composite	NASDAQ
Apple Inc.	NASDAQ Composite	NASDAQ
ASUSTeK Computer Inc.	Taiwan Capitalization Weighted Stock Index	Taiwan Stock Exchange
Canon U.S.A., Inc.	S&P500 Composite	New York Stock Exchange
Google Inc.	NASDAQ Composite	NASDAQ
Hewlett-Packard Company	S&P500 Composite	New York Stock Exchange
HTC Corporation	Taiwan Capitalization Weighted Stock Index	Taiwan Stock Exchange
Intel Corporation	NASDAQ Composite	NASDAQ
Lenovo Group	Hang Seng China-Affiliated Corporation Index	Hong Kong Stock Exchange
LG Electronics Inc.	KOSPI	Korea Exchange
Microsoft Corporation	NASDAQ Composite	NASDAQ
MSI Co., Ltd	Taiwan Capitalization Weighted Stock Index	Taiwan Stock Exchange
Nikon Corporation	NIKKEI 225	Tokyo Stock Exchange
Nintendo Co. Ltd.	NIKKEI 225	Tokyo Stock Exchange
Nvidia Corporation	NASDAQ Composite	NASDAQ
Panasonic Corporation	NIKKEI 225	Tokyo Stock Exchange
Samsung Electronics Co. Ltd.	KOSPI	Korea Exchange
Sony Corporation	S&P500 Composite	New York Stock Exchange

Table 10. Indices used in market model and their stock exchange.