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In the Aftermath of a Venture Capitalist

– An Examination of Market Reactions Caused by
Venture Capitalists' Disposals

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Abstract

Insider trading creates price fluctuations because of insider's access to better information. Venture capitalist has great insight in the firm due to its large stake and long historical ownership of the firm. This study examines the market reaction when venture capital funds decreases their positions in venture-backed companies by selling off shares and distribute cash to its owners. The exit is exercised after the lock-up period post an IPO. The venture-backed company's stock performance should respond to the Venture capitalist's investment decisions which will be examined conducting an event study. Our results indicate a negative initial relationship between Venture capitalists' sell transactions and stock price performance of the venture-backed firms. The short-term stock price performance post the Venture capitalist's disposal is significantly positive.

Key words: Insider trade; Venture capitalist; Market reaction; Event study; Abnormal return; Cumulative abnormal return; Economic significance; Signalling.

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1. Introduction

In this initiating section the authors strive to give the reader an overview of the function and nature of Venture capitalist together with a discussion about insiders and its relevance. Statements of purpose, methods used and expectations are specified as well.

A dictionary of commonly used words is to be found in the Appendix, under the headline “*Definitions through the report*”.

1.1 Background and problem discussion

Venture capitalists (VCs) are investors or groups of investors that privately funds new companies in an early life stage, commonly within the technology sector. The VC provides an important role for innovation by making it possible for new companies and ideas to reach the market. In exchange for financial support, known as Venture capital, the VCs often require some control over the venture-backed company’s operations. The VC provides financial support, business management, experiences and network, which adds value to their investments. The VCs great insight positions and large stake converts the VCs to one of the most influential insiders post an IPO, thereby making the VCs transactions public events. Looking at VCs sell transactions are relevant since the timing of the disposals is a necessary factor to achieve good yield to investors; if yield to investors are to be eliminated the investors will abandon the VC by pure investor rationale, leaving the fund insolvent, choking the investments, slowing down innovation and hurting society. This study focus on VCs niched within the life science sector, an important distribution channel for new medicines to reach the market.

VCs’ investment philosophy is to invest in firms’ early life cycle stages with the intentions of holding the position during a 5-8 year horizon and hopefully exit post an IPO¹ (Gompers & Lerner, 2001). Their investment philosophy forces the VC to unwind their investment after the end of the holding horizon due to finite life of funds. The VC’s acquisitions of large stakes in the venture-backed firms turn them into insiders post an IPO, making further transactions public events. Other institutional investors, such as Hedge Funds or Private Equity, instead seek to invest in larger firms at later stages in the life cycle. Venture capitalists² portfolios are

¹ Described in appendix under “*Definitions through the report*”

² Be aware of the difference between a Venture capitalist and venture capital where the first one refers to a specific institution that provides capital to small companies in early stages and the second is a generic name for the money supported by any kind of institutional investor.

therefore less liquid than peers, creating difficulties when exiting investment positions on the open market.

Insiders possess superior information than the rest of the market, making the market unfair for outsiders³. Their informational advantage creates abnormal returns for insiders since they know more than other market participants (Seyhun, 1986). The academic context categorises the insider discussion under benefits and disadvantages. Shareholders and the company at large can, depending on the scholar, gain or lose due to insider activities. It exists two camps that are for and against insider regulation and suggest different approaches to enhance the efficiency of the market (Leland, 1992). The insider regulation promoters say that insider's activities cause greater market asymmetry and weaken efficiency, while they who are against insider regulation instead say that insider transactions enhance its efficiency.

Investors are supposed to base their investment decisions on investor rationale. Individuals that are defined as insiders (individuals in management positions) do not always base their decisions on profit-maximizing arguments, but can instead be influenced by rational behaviour⁴ and base decisions on social psychological factors e.g. personal need for liquidity to buy a house (Seyhun, 1998). The signalling value of insider's sell and buy transactions are therefore of different amount depending on the type of the insider (Chen, Chiang & So, 2003). Will data cleaned from individual insiders, who are more likely to be influenced by social psychological factors, yield a higher signalling value?

Research about insider trade is highly examined in both a business-like and academic context. The focus has been concentrated to insider's transactions and how their activities create market movements. Gompers & Lerner (1998) examined the market reaction when Venture capitalist's distribute portfolio shares to its owners. Their article assumes direct distributions of securities as the most frequent approach VC's uses to distribute wealth and solely covers that phenomenon. Another distributional channel of wealth for the VC is to sell off their investments on the open market and distribute the cash received instead. The Gompers & Lerner (1998) article covers a non-public event that clearly expresses a relationship, both short-term and long-term, between the market reaction and the VC's transaction. A clear relationship for the event is established, even though the market is not fully aware of the transaction taking place since it is non-public. This inspired us to take the investigation further

³ Outsiders through the report: "investors who do not have access to the information that insiders can access"

⁴ A decision-making process that is based on making choices that result in the most optimal level of utility or benefit for the individual who makes the decision

and cover a public event⁵ where the VC's choose to distribute cash instead of shares. The research questions established in this report strive to answer how the market reacts due to VCs' investment decisions when chosen to distribute cash instead of shares.

1.2 Research question

Can a relationship between Venture capitalist's transaction activities and market reactions be statistically confirmed?

- How does the stock market react when Venture capitalists start to unwind investments in their portfolios by disposing shares on the open market?
- What is the short-term reaction post the event?
- How good are Venture capitalists at timing their exits?

Our expectations are related to Gompers & Lerner's (1998) study but we expect a market reaction of greater magnitude since our event is of public nature, which increases the market's awareness of the event's time and size. We expect to see a negative relationship between VCs' disposals and the abnormal return during the event. If the VCs rightfully use their superior corporate information they should be exiting their positions in a share price peak. The stock performance should then continue to fall after the event since the VCs state that they are exiting their investment, signalling stock overvaluation. The market may overreact initially at the transaction but should normalise the negative abnormal return after some days.

1.3 Purpose

The objective of this thesis is to determine the relationship between Venture capitalist's disposal and stock market returns, when the VC exits their position by disposing shares and distributes cash to its owners.

1.4 Method

Our thesis will examine the market reaction caused by a specific event. The financial literature frequently uses event study methodologies to examine how different events affect the financial markets. An event study was therefore chosen for this report due to its empirical recognition of studies alike our own and its legitimacy within financial research. The Event

⁵ The event is public since the VC is categorized as an insider and is obliged to follow the market regulations accordingly, stating a disclosure of the transaction to the Security and Exchange Commission.

method is further explained under the section “Methodology – Event study”. The study has been enhanced with a Buy and hold return model for more accurate long-term indications and different robustness tests to dissect the results from possible explaining factors that lay outside the scope of this paper.

2. Theory

The theory section is a compilation of theories partly used to explain the results of the study.

2.1 The efficient market hypothesis (EMH)

Since the beginning of our century there have been on-going discussions about the efficiency of markets. One of the most cited and respected theories in the subject were published by Fama (1970:1997). He argued that for a market to be efficient there are some sufficient conditions that must be satisfied. For a financial market to be perfectly efficient, the following requirements must be fulfilled (Fama, 1970:1997);

- I. No transaction costs when trading securities
- II. All available information is costless available to all market participants
- III. All agree on the implications of current information for the price and distributions of future prices of each security.

To deal with the fact that financial markets do not operate under such conditions in reality, Fama (1970:1997) created three categories for efficient markets; Weak form efficient, semi-strong efficient and strong-form efficient.

I. **Weak form efficient**

In a weak form efficient market, share prices reflect all historical data and adjust to new historical information. The market's share prices therefore reflect all historical data. Abnormal return can thereby never be achieved by analysing historical data, but investors must trade on information that is not yet public to achieve abnormal return. (Fama, 1970:1997).

II. **Semi-strong efficient**

Semi-strong efficiency implies that the market's share prices reflects all historical data but also adjust to new public information. The price transformation is supposed to occur both rapidly and unbiased. This means that abnormal return cannot be achieved by investment decisions based on public data since share prices are a reflection of all publically available information. Abnormal return can therefore only be achieved by investments based on information that is not yet public, e.g. insider information. Semi-strong efficiency markets are characterized, and tested, by looking at how instantaneous and reasonable the magnitude share prices changes when previously unknown information becomes public. (Fama, 1970:1997).

III. Strong-form efficient

The strong-form efficiency implies that all existing information is reflected in the share price. Historical, public and private information are all included in the price and abnormal return is not possible to realize in the market, zero arbitrage opportunities. Testing for strong efficiency market; Investors cannot consistently earn abnormal returns over a long period of time. (Fama, 1970:1997).

The only relevant measure of risk according to the efficient market theory is beta (β)⁶ – a tendency measurement of a security's prices that response due to an event that changes all the market prices. Beta is usually measured by a broad-based market index and can simply be explained as the risk obtained after a portfolio has been diversified.

Empiricism shows that investors acquire long-term abnormal return within the financial markets. Strong form efficiency is thereby concluded to not really exist in reality but mainly in theory. Nor are investors truly objective in there assumptions or holds equal resources to manage large volumes of information. The result is a market price dissonance, where existing share prices do not act as a good objective measurement for all information available in the market.

We assume that the existing financial markets are semi-strong efficient since abnormal returns are realised by investors, the market rapidly adjust to new information and arbitrage possibilities exists. Existing information is priced into the stock price and trading on such information will not yield abnormal return, even though different estimates will be given for different analysts and therefore no acknowledged consensus about the stock's real price will exist.

2.2 Asymmetrical information.

Akerlof (1970) identified problems within financial markets that he thought only could be explained as a cause of asymmetrical information. He concluded that asymmetrical information is the source of adverse selection. The asymmetrical information theory is a study of how some agents, or market participants, have more or better information than others, creating market imbalances. This theory is of contradiction to EMH where each participant is assumed to have perfect information. Akerlof's theory was later applied and examined by

⁶ Further described in appendix under the headline "Definitions through the report"

Chen et al. (2003) in an asymmetrical context of how returns and volatility are products of past information in the US market. They also proved that negative news caused a larger price decline than what an equal magnitude of good news caused positive return. The conclusion from the result was that the variance appears to be more volatile to bad news than good news.

The asymmetrical information theory is relevant due to insider's access to better and more accurate corporate information. The following scenario will be that insider's transactions tend to create enlarged market reactions due to outsider's determination to follow insiders. Outsiders assume the insider has found or seen something, due to her superior information, within the company that is not yet public and not available for outsider to see. The large volatility resulted by insider trades are something regulators try to minimize. The US stock markets, and many other financial markets, demand that insiders signal their transactions, giving the public a notification of intent. Ausubel (1990) defined confidence as a key characteristic for market to be efficient. Confidence for the market can be restored by market regulations enhancing the outsiders' return on investments due to increased investing appetite. Spence (1973) argued that non-insiders could interpret the superior information kept by the insider by acting accordingly.

The market responds with different magnitude to insider's buy and sell notifications. Insiders can sell shares due to many personal reasons and no single dominance is submissive. E.g. the insider can sell due to personal need of liquidity or tax issues (Jeng, Metrick & Zeckhauser 2003) etc. Insiders' sell transactions thereby contain less valuable private information than buy transactions do, creating smaller market reactions due to the fact that outsiders cannot rely on the signal value in the transactions to be fundamentals of pure investment rationale (Jeng et al 2003). Cumming & MacIntosh (2003) found significance for that the greater degree of asymmetric information between the selling VC and the buyer, the greater likelihood of a partial exit to signal quality.

2.3 Behavioural finance

EMH and many other financial theories are criticized for their narrow approach and not capturing psychological factors within the models. Behavioural finance is a relatively new branch within finance which aims to capture psychological and social factors that are ignored in other financial models by extending the scope of the model to capture behavioural aspects in the decisional process. Shiller (2003) declared that the view on market efficiency can be egregiously wrong and that the collaboration between finance and social science could better

explain speculative bubbles and abnormal return than theories that are not interdisciplinary. This intuitively makes sense since people are behind the investment decisions, making human emotions and possibility of errors constantly present in the decisional process, creating biasness and more fully understood with social science.

2.4 Insider trading

An insider is defined as an individual, physical or legal, that fall under the category of the Security and Exchange Act of 1934, meaning that the person has better insight in the corporation due to a beneficial position in the firm, acquiring more information than the public. Such positions are; Chairman of the board, Top Management or a beneficially owner with a 10 percentage stake minimum. Venture capitalist regularly becomes beneficially owners due to their large stake in their investments post IPO.

Seyhun (1986) conducted a study of 60,000 insider trades examining companies listed on the New York Stock exchange from the year 1975 to 1981. Seyhun successfully established a positive significance between insiders' capacities to yield higher abnormal return than the rest of the stock market, concluding that insiders better can predict the future performance of corporations due to better information. The study also concluded that since insiders are better informed about the importance of their information, large insider transactions contains greater informational value for outsiders than smaller transactions does, VC's falls under the first category. The abnormal return outsiders could generate in the study by following insiders was not large enough to cover brokerage fees and ask/bid spread; the return for outsiders received by following insiders was not of economic significance (Seyhun, 1986).

As mentioned in the introduction, sell transactions of insiders contain less informational value than buy transactions since sell decisions may be based on social psychological factors, e.g. need for liquidity to buy a house (Seyhun 1998). Different reasons can motivate an insider to sell her stake but a buy transaction can only be based on one reason (exceptions may apply to hostile takeover strategies); the insider enhances the position due to optimistic expectations. This creates biasness for signalling values depending of its buy/sell nature. Our study will only look at sell transactions. Jeng et al (2003) discussed the insider's informational advantage over outsiders and argued on short-term basis that the outsider could provide excess return by following the insider. Their paper states that the relationship is only legitimate for buy transactions since they did not find economic significance for sales.

Leland (1992) highlights pros and cons in the insider discussion.

Pro – Insider trading brings new and useful information to the market and the asset prices. Portfolio managers and firms making real investment decisions can reduce risk and improve performance when prices reflect more accurate information. Because of reduced risk, asset prices will be higher and more real investments will occur.

Con. – Outsiders will invest less because of the unfairness in the market. Asset prices will be lower and less real investment will occur. Market liquidity will reduce and disadvantage traders who must trade for life cycle or other reasons not related to information. Insider trading will make current stock prices more volatile, further hurting traders with liquidity needs.

According to Leland (1992), the net effect of insider trading will be increased risk aversion, more volatility on market prices and decreased investment flexibility.

Eckbo & Smith (1998) conducted studies about the insider performance on the Oslo stock exchange and could not identify a correlation between insider transactions and abnormal returns. Insider's transaction effects are highly discussed and coherence is not subtle between the groups.

2.5 Insider trading for Venture capitalists.

The VC's reputation is significantly important for further capital inflow from investors. When deciding about the unwinding off an investment, the VC will balance the cost of continued managerial/monitoring involvement against the adverse reaction to selling. Further, they facilitate the unwinding of investment positions by developing reputations for not selling overpriced shares; this was evidenced for venture capital firm's exit timing by Lin & Smith, (1998). The question that arise for VC's is how they choose to balance their exit timing on the open market since they do not wish to carry a reputation of only exiting overvalued investments, making unwinding more difficult on the open market, but can neither afford holding overvalued investments in their portfolio. Gompers & Lerner (2004) discussed how the VC reputation and age affects the willingness to go public and retrieved that younger non-established venture capital firms are willing to incur costs by taking companies public earlier than would maximizing their returns.

3. Methodology

This section provides an explanation of the approach and procedure of an event study and the Buy-and-Hold Abnormal Return model.

3.1 Background: Event study

Event studies go long back in time. The first published study was probably Dolley (1933), but it was not until late 1960 that studies by Ball & Brown (1968) and Fama (1969) introduced the methodology that is substantially the same as the modern version considering the stocks adoption to new information about earnings (MacKinley, 1997).

The event studies have numerous applications within finance. Event studies are a frequently used method for measurement of certain economic events impact's on a firm's value (MacKinley, 1997). By using financial market data you can easily examine the influence of certain actions and decisions. Given rationality in the marketplace the convenience of an event study lies in the fact that an event will affect stock's prices immediately (MacKinlay, 1997). Earlier research within accounting and finance has covered event studies examining the influences of economic event such as mergers and acquisitions, earnings announcement and issuance of new debt or equity (MacKinlay, 1997). Event studies are a powerful tool, which can result in valuable information about the consequences on stock prices when venture capital firms make insider transactions, by exiting their investment after an IPO (Initial Public Offering) or continuing to repurchase shares after the lock up period. Throughout this study the main focus will be on examining the impact on VC's disposal of shares.

Event studies can be used to investigate the presence of asymmetric information (MacKinley, 1997). By looking at abnormal return as an outcome of a certain event, conclusion about the VCs' inside information may be drawn. Measuring abnormal return is central in an event study. (MacKinley, 1997)

3.2 Procedure of an event study

There is no definite approach or structure to undertake an event study⁷. However, according to MacKinley (1997) an event study can be divided into seven steps. We will follow this approach in our event study and the procedure looks as follows;

1. **Defining the event and event window**
2. **Selection criterion** (determine selection criterion for selecting companies)
3. **Normal and Abnormal returns** (determine and define)
4. **Define Estimation Procedure** (choose procedure for estimation of normal return)
5. **Define the test framework and the null hypothesis**
6. **Results** (Reject null hypothesis or not?)
7. **Analysis and conclusion**

3.2.1 Defining the event

The preliminary tasks is to define the event of which the impact will be measured and determine the time period which the stock prices of the firms will be examined. This time period will be the event window. The event of this research will be the announcement of a venture capitalist selling of shares. Notice that the event date is not when the VC actually dispose their shares but the date when they declare their disposal, defined as day 0. Transmitting a document (Form 4⁸), to the U.S. Securities and Exchange Commission⁹ (SEC) within two trading days makes the announcement. This creates a three days wide event window (-2 days to 0 days) in which the transaction could have taken place. To measure the effects of the event after day 0, an analysis of a second event window is conducted. To look at the short-term market reaction we establish an event window of 7 (days 1 to days 7). Figure 1 gives an overview of the defined event windows.

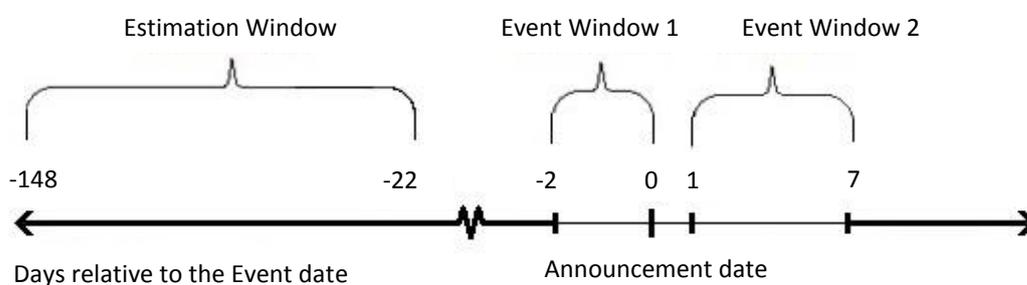


Figure 1. Estimation Window and Event Windows

⁷ Flow chart of the decisional processing in an event study is attached in appendix, "Flow chart of event study"

⁸ Described in appendix under "Definitions through the report"

⁹ Described in appendix under "Definitions through the report"

3.2.2 Selection criterion

A lot of things have to be taken into account when gathering data. First of all a sufficient amount of transactions in favour of our defined events has to be collected. We have chosen to collect data from Nasdaq Stock Exchange (NDAQ) to acquire enough samples for statistical significance. The data will be adjusted to only contain Venture capitalists transactions to clear for, or at least minimize, the personal biasness described under 2.2 *Asymmetrical information*.

3.2.3 Normal and Abnormal return

By measure and analysing the abnormal return one can estimate the event's impact on the stock price (MacKinley, 1997). The abnormal return is defined as the difference between the actual outcome and normal return. The normal return is the expected return with the assumption that the event does not take place and is calculated from historic returns. The actual return is calculated with observed data using the following equation:

$$R_{i\tau} = \ln\left(\frac{P_{\tau}}{P_{\tau-1}}\right)$$

P_{τ} = Stock price at time τ

$P_{\tau-1}$ = Stock price at time $\tau - 1$

There are several reasons why you may want to use logarithmic return, the main empirically reason is that logarithmic returns are more likely to be normally distributed and therefore complies with the assumptions of standard statistical techniques (Strong, 1992).

The abnormal return for firm i and event date τ can be expressed in the following equation:

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau})$$

$AR_{i\tau}$ = Abnormal return

$R_{i\tau}$ = Actual return

$E(R_{i\tau})$ = Expected normal return

3.2.4 Define estimation procedure

The Capital Asset Pricing Model (CAPM), the Constant mean return and the Market model are examples on models measuring normal return. The CAPM model was frequently used in event studies back in the 1970's, but since weaknesses in the CAPM model has been discovered usage of the model has almost ceased (MacKinlay, 1997). The market model can be viewed as an improvement of the Constant mean return model. By eliminating the portion of return that is related to variance in the market's return, the variance of abnormal return is reduced (MacKinlay, 1997). This leads to better ability of identifying possible event effects. Due to these characteristics of the Market model it was chosen for this study. It is a statistical model, which gives the return of a given security based on the return of the market portfolio. The market portfolio in our case is the Nasdaq Biotechnology Index. Beta (β) is the firms systematic risk measure and shows the sensitivity of the firm's return to the market return. Alpha (α) is the intercept of the regression and corresponds to the average return of the firm compared to market average return. Alpha and beta can change depending on what estimation window that is used. Since they are based on historical values one has to keep in mind that it will affect long event windows. It may be a risk in looking too far back when calculating normal return, since the occurrence of other events can make alpha and beta estimations uncertain. We have established an estimation window of 126 trading days (6 months). The length of the estimation window is determined to exclude happenings, which create abnormalities in the historical prices by not being too backward looking, but still long enough to adjust and normalise random fluctuations.

The normal return is calculated with the statistical programme STATA[®]. Separate regressions for each company are calculated based on the data in each unique estimation window. The betas and alphas will in the next step be used to predict the normal return during the event window. When calculating the expected normal return, the estimation window should not cover the period in which information about the event can bias the results (MacKinlay 1997). That could affect the results which would be problematic since the event study methodology is built around the assumption that the event impact is captured by the abnormal returns (MacKinley, 1997). Our analysis therefore leaves a gap between the first days of the event window and the last days of the estimation window. *Figure 1* gives a visualisation of the windows established.

Following formula was used to calculate the normal return:

$$E(R_{i\tau}) = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau}$$

$R_{m\tau}$ = Market return Nasdaq Biotechnology Index

α_i = Intercept of regression

β_i = Beta

$\varepsilon_{i\tau}$ = Error term

As soon as all the abnormal returns are calculated we can get the cumulative abnormal return. It is given by summing the abnormal return for the stock from one date to another, t_{i1} to t_{i2} .

$$CAR(\tau_{i1}, \tau_{i2}) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau}$$

Then Cumulative average abnormal returns is used to examine the overall abnormal return for a certain period and is retrieved by summing all the CAR values and divide it by the number of observations (MacKinlay 1997).

$$CAAR = \frac{1}{N} \sum_{\tau=\tau_1}^{\tau_2} CAR_{i\tau}$$

3.2.5 Define the test framework and Null Hypothesis

When the empirical result is completed it has to be tested for significance. The null hypothesis states that cumulative average abnormal return is equal to 0. The alternative hypotheses states that CAAR is significantly separated from zero over the event window. The formulations of the hypotheses are to examine if the event has any significant impact on the stock's price. The hypotheses are mutually exclusive and the alternative hypotheses say that the cumulative average abnormal return is separated from zero. We test all our results, both at (event window one) and post the event date (event window two).

$$H_0: CAAR = 0 \text{ (CAAR is not separated from zero)}$$

$$H_A: CAAR \neq 0 \text{ (CAAR is separated from zero)}$$

Two types of statistical tests will be used to assess the reliability of the results. First a t-test and then a robustness test for the median; Wilcoxon sign rank test.

3.3 Significance Tests

The first essential assumption in order to test the null hypothesis is normality. If this assumption is not considered, results and interpretations may not be as reliable as necessary. In order to assess normality in the data set we refer to the central limit theorem. The central limit theorem present that the sum of n variables from any probability distribution will approximately be normally distributed if just n is large enough (Newman, Carlson and Thorne, 2013). In applied statistics the probability distribution of the population is often unknown and the researcher cannot be certain that the underlying population is normally distributed. According to Newman, Carlson and Thorne (2013) the central limit theorem can embrace normality if the sample size is around 20 to 25. Since we use two samples of 129 and 50 respectively this requirement is fulfilled and we assume normality. This is further described under section 4. *Data*.

As a complement to the application of the central limit theorem to assess normality, we have run two separate normality tests. Shapiro-Wilks and Shapiro-Francia both tests if the sample data are normally distributed. Their null hypothesis states that the data is normally distributed and rejects the null hypothesis at a p-value lower than 0.05. When run, the tests indicated a quite strong non-normality of CAAR with p-values lower than the critical value. Though, when testing if CAAR is differentiated from zero both the t-test and the Wilcoxon Sign-rank test gives the same result; reject the null hypothesis. Wilcoxon is a non-parametric test which does not require normally distributed samples or populations. The results can thereby still be considered reliable.

3.3.1 T-tests

To tests the null hypothesis a two sided t-test is used since the population variance is unknown. A two-sided t-test test both positive and negative values at a 95% confidence level. The critical values for rejecting the null hypothesis are ± 1.96 . P-values will be calculated to show at what level of significance the null hypothesis may be rejected. The t-test was conducted in the statistical programme STATA¹⁰.

$$t_{\tau} = \frac{CAAR - H_0 \text{ value}}{(\sigma^2 / \sqrt{n})}$$

reject H_0 if: $-1.96 > t > 1.96$

¹⁰ The STATA version used is Stata SE 12 (64-bit)

3.3.2 Wilcoxon sign-rank test

Since the t-test simply tests the average value a Wilcoxon sign-rank test will be carried out as another robustness check. A Wilcoxon sign-rank is a one-sided test that tests if the median value is statistically separated from zero. As well as the t-test it was performed in STATA. The test is conducted at a 5% level of significance, which gives us a critical value of 1.645.

$$Z = \frac{T - \mu_T}{\sigma}$$

$$\mu_T = \left[\frac{n(n+1)}{4} \right]$$

$$\sigma = \sqrt{\frac{n(n+1) * (2n+1)}{24}}$$

reject H_0 if: $-1.645 > Z > 1.645$

n = number of disposal transactions

T = minimum sum of positive or negative ranks

3.4 Buy-and-Hold Abnormal Return

Gompers and Lerner states that CAAR contains limitations for long-term analyses thus do not provide a good long-run proxy (Gompers & Lerner, 1998). The limitations are present due to CAAR being based on historical values. The buy and hold portfolio model (BHPM), analysing the Buy-and-Hold Abnormal Return (BHAR), or a CAPM regression analysis is preferable for long-run conclusions (Gompers & Lerner, 1998).

Since CAAR only gives indicative results when examining long-term performance, a BHAR model have been implemented, which ranges from the day of the event (day 0) to 260 trading days forward (one year), to examine the long-term results for the venture-backed firms post VC's disposal. The magnitude of price movements may be biased by cumulating average abnormal returns (CAARs) over such a long-term horizon. (Gompers & Lerner, 1998)

When conducting a BHAR model the performance of the portfolio companies is compared to a market index performance. The same index used in the CAAR analysis will be used in the BHAR model, further discussed in chapter 4.3 *Choice of Index*.

The following formula defines the calculation of BHAR (Barber & Lyon (1997));

$$BHAR_i = \prod_{\tau=1}^{260} (1 + R_{i\tau}) - \prod_{\tau=1}^{260} (1 + R_{m\tau})$$

$R_{i\tau}$ = Daily return for company i

$R_{m\tau}$ = Market return, Nasdaq Biotechnology Index

The companies in the sample are equally weighted and an average buy-and-hold abnormal return is given by using the following formula (Eckbo, 2007).

$$\overline{BHAR}_i = \frac{\sum BHAR_i}{n}$$

n = sample size

4. The Data

This section describes the data and the process of why and how it was assembled.

4.1 Insider transactions

An initial data set was retrieved from our supervisor's personal research and contained information about major institutional investors and the size of their stake post IPO. The sample includes 61 venture-backed companies within the life science sector with IPOs taking place between October 2003 and April 2013 with an offer price of at least \$5 per. The data set also declare the size of the stake for each investor on yearly basis making it possible to detect in what year a disposal or acquisition of shares have been made. From the data set we have also been able to identify which of the investors that was considered Venture capitalists. The sample is later constructed using the Thomson Reuters Datastream database with additional items and corrections using the Nasdaq website. Information on institutional investors are collected from IPO prospectuses (for the year of the offering) and from DEF 14A annual proxy statements for each following year thereafter. IPO prospectuses and annual proxy statements list shareholdings of directors and beneficial owners with a stake of 5% or more. In the data set, an institutional holder is classified as a Venture capitalist based on two criteria;

- The prospectus notes define him as such
- Or*
- The shareholder has the word "venture" and/or "capital" in its title. The information is cross-checked using information on venture capitalists from Pratt's Guide to Venture Capital Sources.

The event data for dates and volume is then gathered from the U.S. Security and Exchange Commission¹¹ (SEC) by going through all Form 4 for the companies and dates listed in the initial data set, creating a new data set solely containing Venture capitalists' transactions. Prices are later downloaded from Thomson Reuters' DataStream¹². As earlier mentioned, insiders have to file a Form 4 to the SEC within two trading days of the transaction in which SEC publically announces the transaction through its webpage. This is the reason for the chosen time line in event window 1 since it aims to cover the transaction based on the

¹¹ The mission of the U.S. Securities and Exchange Commission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation (SEC, 2014). The Security and Exchange Commission is a federal agency established 1934 to supervise and regulate issues of and transactions in securities and to prosecute illegal stock manipulation (World English Dictionary, 2014)

¹² Thomson Reuters is one of the world leading sources of intelligent information for businesses and professional and offers a huge range of global financial data.

announcement date. By gathering public data regulated by the SEC's we can successfully assume high legitimacy of the data. The examined Venture capitalists in the study all fall under the Securities Exchange Act of 1934 and are thereby obliged to apply under the SEC's form 4 criterions given that they are minimum 10-percentage shareholder. All events in this report fall under the stated category.

The relationship between disposals and abnormal return conducts 129 samples yielded from 34 venture capital funds. These samples are all events were VC's have publically disposed shares. The relationship between first event disposals and abnormal return contains 50 samples generated from 32 venture capital funds.

Insider transactions in all listed companies can be found by anyone in the SEC's archive accessed through their web portal. We had to do eliminate transactions not executed by a venture capital fund, meaning going through all historical Form 4s for the venture-backed securities. Further, a high percentage of these transactions were not common shares, but different kinds of derivatives, such as options, warrants etc. (all transactions of that sort have been excluded from our data resulting in clean events of common shares transactions). Finally, our event is focused on the signal value of disposals; thereby the data have been cleansed from transactions where shares have been purchased¹³.

4.2 Historical prices

For calculations of the securities abnormal return, in which VC's have disposed shares, we need historical prices related to the events. Prices have later been downloaded to all collected Form 4s. Daily historical prices were downloaded from Thomas Reuters DataStream Professional and are adjusted for financial actions such as splits and dividends pay-out. The data has been adjusted for financial actions to isolate the effect of the VC's transaction. The first prices downloaded are for 2003-09-01, which is -200 days prior our first event; 2004-06-04. Historical daily prices are all gathered in a spreadsheet for every trading day until 2014-04-24. The securities of choice for each test have later been collected from the spread-sheet depending on which test we are conducting. Period and securities used in each test are described for each test uniquely under the chapter 5. *Results and Analysis*.

¹³ Although venture capital investors may purchase shares in a subsequent follow-on offering or use derivate products to decrease their stake, this study focus on the unwinding of investments in portfolio companies.

4.3 Choice of index

The purpose of the index is to provide representable values of the market performance over a chosen time horizon related to the event. The index will be used for calculating normal stock return with a market model. This study examines VC-backed life science companies. Comparing equity performance with broader indices, like the S&P 500 etc., does not yield good proxies for the life science equities' performance over time. We seek to compare the life science sector with our venture-backed equities and have therefore chosen the Nasdaq Biotechnology price index for calculations of the abnormal return. The Nasdaq Biotechnology index act as a good proxy for the American life science market returns, the overall performance of the index is presented in figure 2.

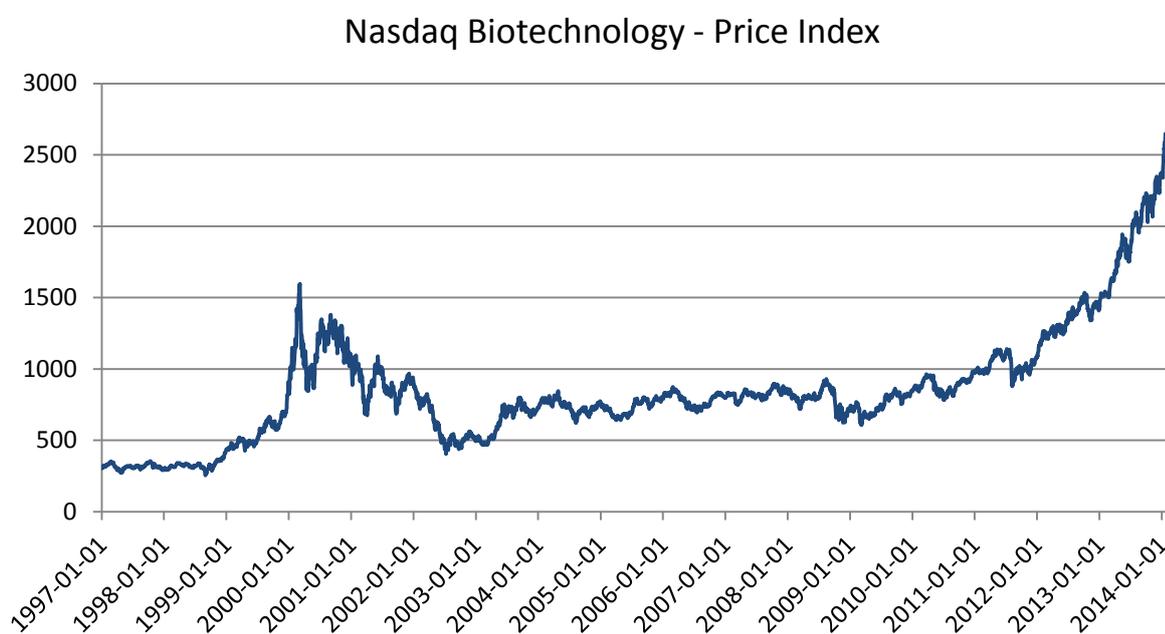


Figure 2. Nasdaq Biotechnology index performance 1997 - 2014

4.4 Reliability and Validity

Reliability and objectivity is vital for a report to achieve higher legitimacy. References used in our study are all frequently cited and published in recognized journals. The data is gathered from reliable and objective sources. Analysis and treatment of data has occurred in Excel and STATA[®]. By manually processing data there is a possibility of errors during the process. To minimize such errors, all steps of the data processing and tests have been operated repeatedly and separated by the authors. The results have than been compared by the authors and only accepted when the same test yields the same results for each author.

The Event Study Method is a highly established method within quantitative analysis for short-horizons and frequently used by researchers all over the world¹⁴, making our results easier to compare with previous research. Using a reputed methodology adds validity to the study's output and also standardises the research process that again minimizes errors.

The event study was conducted on the Nasdaq Biotechnology index. Just for comparison we also conducted an event study with the S&P 500 index just to compare the data outputs, the differences were tiny and statistical significance could be found using the S&P 500 index as well. Figure 3 gives a visual comparison of the both indices.

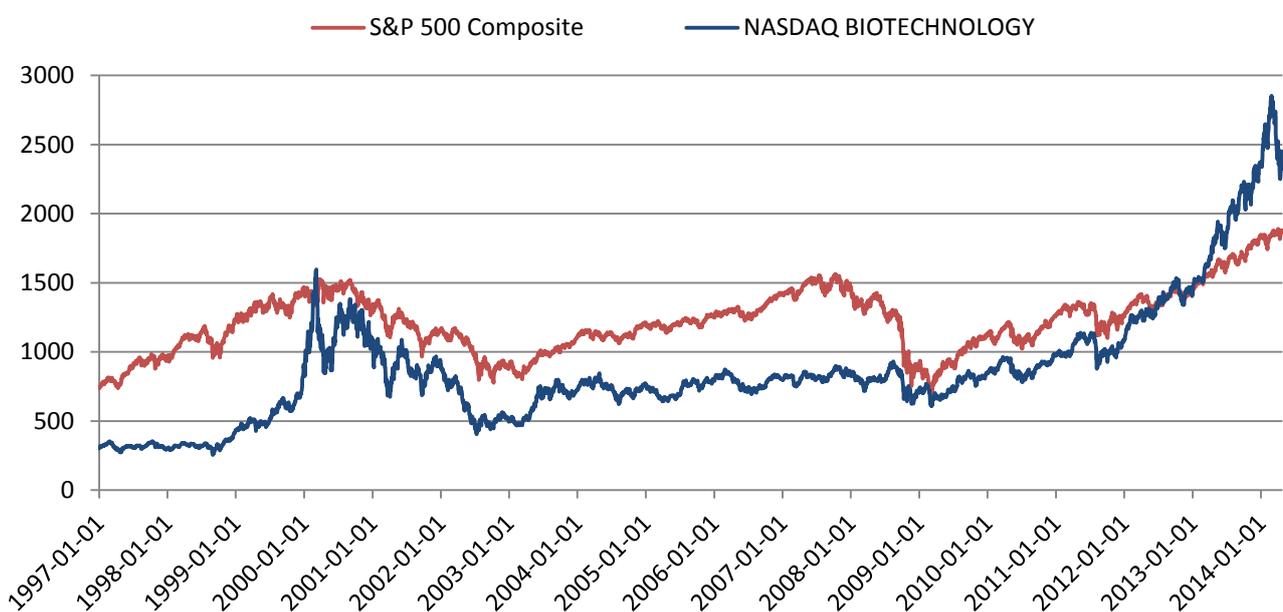


Figure 3. Nasdaq Biotechnology Index and S&P 500 Composite index performance 1997 - 2014

¹⁴ The Event Study Methodology was initially established during the late 1960's as a statistical tool for empirical research for accounting and finance but have since then migrated to other disciplines; Marketing, economics, strategy research, information technology/systems, political science and law. Eugene Fama was awarded the Nobel Prize 2013.

5. Results and Analysis

Through this section the empirical results of the study will be presented and analysed.

5.1 Stock market reaction at event: Event window 1

Looking at how the cumulative abnormal return is affected at the event, decisions about the stock market impact can be determined. Comparing return at the event with the normalised historical performance of the stock, abnormal return is calculated. Because that many events have been conducted to one study; the cumulative abnormal return represents the overall stock price return for our sample. Cumulative Average Abnormal Return (CAAR) is the measurement tested to examine the events impact on the stock price performance. A negative correlation between the stock return and the VC's disposal of shares is presented in figure 4. The CAAR at day 0 (-2.76%) means that the average price of the securities will fall 2.76 % below index during day -2 until day 0.

Testing the null hypothesis we concluded, with 95 % level of confidence, that CAAR is significantly separated from zero with a t-statistic of -2.05 and p-value of 0.043, leading to us rejecting the null hypothesis. Asymmetrical information (Akerlof 1970 and Chen 2003) explains that market reacts negatively to VC's disposal since they are considered to have better information than the rest of the market, Seyhun (1986) proved outsiders to have confidence for insider's decision. Seyhun (1998) found statistical significance for a positive correlation between insider's buy transactions and abnormal return, which he explained with the signal value but that the signal value consequently was less valuable for sell transactions than buys since it contained a wider range of social psychological rationale. His research covered all types of insiders, our dataset only contains institutional insiders, VC's who are beneficially owners, which seldom rely their investment decisions on social psychological factors; increasing the signalling value of their sell transactions.

Event Window	CAAR	t-Statistic	p-Value	Wilcoxon	Reject H0
Days -2 to days 0	-2.76%	-2.05	0.043	-3.066	Yes

Table 1. Test results for t-test and Wilcoxon Sign-rank test. Testing CAAR for event window days -2 to days 0.



Figure 4. Cumulative average abnormal return over event window days -2 to days 0
 During the event window one can see a statistically significant negative cumulative abnormal return. This is based on a sample of 129 disposals by 34 venture capital funds.

5.1.2 Robustness check

The t-test examines the significance for the average value; therefore we also like to test the median for significance. Such a test has been conducted from the Wilcoxon Sign-Rank test, resulting in a Z-value of -3.066 (presented in table 1). The Sign-rank test is a one-sided non-parametric test with a critical Z-value of -1.645 for a 95 % confidence interval. Since our Z-value is lower than the critical value, the null hypothesis can once again be rejected.

The relationship indicates that the stock price of the venture-backed firm will fall when VC's dispose shares. Since the plunge in share price starts before the announcement we have to consider possible scenarios that causes the decline. We highlighted two potential factors; price elasticity (Ricardo, 1817) and leakage of information prior the announcement. To be able to discard these factors we have to test each factor for significance. To test price elasticity we conducted a regression between the cumulative abnormal return and the size of the VC's disposal in relation to its stake. If the price elasticity was the driving force behind the share price decline, we should see a relationship between the volume of shares sold and the significance of the cumulative abnormal return. We conducted a regression analysis between cumulative abnormal return and the percentage of the stake disposed, but could not statistically conclude a relationship, with a t-value of -1.19 , nor determine price elasticity to be an explaining factor. Leakage of information may be the explaining factor of the decline but cannot be statistically tested. As a further robustness check, we also examined if solely

looking at lead investors¹⁵ transactions had any impact on the significance. Our test resulted that so was not the case.

5.1.3 First Event Disposal

The earlier test indicated that the signal value of leaked information might be the explaining factor of the stock prices reaction. We also assessed another test where the sample data was cleansed to solely cover first events¹⁶ of disposal transactions executed by the VC. The first event test was conducted to examine if initial transactions by the VC causes a greater market reaction. Subsequent disposal transactions may have smaller market reactions since the first event reveals the VC's intentions; the firm is overvalued and we are realising our investment (Gompers & Lerner, 1998). The level of asymmetrical information for the venture-backed securities should be high because of the low media coverage due to the firms' small sizes (Gompers & Lerner 1998). First event disposal results are presented in figure 5.



Figure 5. Cumulative average abnormal return over event window days -2 to days 0 for first events. During the event window one can see a negative cumulative abnormal return. Though, we cannot say that it is statistically significant. This is based on a sample of 50 disposals by 32 venture capital funds.

¹⁵ Lead investors are investors with the largest stake in the portfolio company at the time of the IPO, usually because an early investment entrance into the company, and sometimes accused of knowing more about the company due to superior holding.

¹⁶ VC keeps positions in companies that usually are not very liquid. This creates a problem when the VC decides to exit their position where the VC has to issue many sell orders at different dates to exit their full position. The first event in this study is defined as the first time a VC execute a sell transaction in a portfolio company.

Comparing cumulative abnormal return for first event's disposals with disposals in fig. 4 explain that the average negative stock price performances for first events are larger. First events must therefore contain a greater level of information, resulting in an increased signalling value. Testing if the relationship could be statistically proven the results did not yield high enough values for economic significance. Lack of statistical significance may be caused by several variables; we assess the smaller sample size as a potential factor of explanation.

5.2 Stock market reaction post event: Event window 2

Looking at the second event window (days 1 to days 7) we can see a positive cumulative abnormal return. Unlike our expectations the share price increases post the event at a higher rate with a statistical significance. Table 3 shows that CAAR is positive at day 1 but negative at day 2 and 3, followed by an increase in CAAR for the next four days. Figure 6 indicates that CAAR continues to rise after seven days as well. This means that the stock price normalizes after just a few days and then continues to rise in contrary to our expectations. The decline may be explained as a combined outcome of price elasticity and signalling triggered by the VC's disposal. All that we certainly can state from the results is that there is a positive relationship between the short-time periods posts the event and the VC's disposal.

Event Window	CAAR	t-Statistic	p-Value	Wilcoxon	Reject H0
Days 1 to days 7	2.53%	2.48	0.019	1.818	Yes

Table 2. Test results for t-test and Wilcoxon Sign-rank test. Testing CAAR for event window days 1 to days 7.

Table 3 shows the abnormal returns for each period, cumulative abnormal return together with the statistical t-value. The cumulative abnormal return is calculated by summing all abnormal returns for each specific period. An estimation window of six months¹⁷ ending at day -40 has been used to predict the normal return. CAAR is significantly differenced from zero at the day of the event given a 95% confidence interval (critical value -1.96, p-value of 0.05). The table contains accumulated information of how the abnormal return has performed prior and after

¹⁷ Stock price data have been adjusted for trading days.

the event date as well as a t-statistic value for each day divided in three periods; Prior event (-20 days to days -3), Event (days -2 to days 0), Post event (1 days to days 20). Table 3 do not represent the established event windows, but solely gives an indicative overview of abnormal return prior and post event. As stated under *3.4 Buy-and-Hold Abnormal Return* one has to keep in mind that CAAR contains limitations for long-term analyses thus do not provide a good long-run proxy (Gompers & Learner, 1998).

Day from Disposal	AAR	t-Statistic	CAAR	t-Statistic	Days from Disposal	AAR	t-Statistic	CAAR	t-Statistic
Day -20	-0.59%	-1.97	-0.59%	-1.97	Day 1	0.96%	1.99	0.96%	1.99
Day -19	0.27%	0.67	-0.32%	-0.64	Day 2	-0.37%	-0.96	0.60%	0.96
Day -18	0.58%	1.00	0.26%	0.34	Day 3	-0.08%	-0.22	0.51%	0.71
Day -17	0.32%	0.84	0.58%	0.67	Day 4	0.31%	0.95	0.82%	1.03
Day -16	-0.17%	-0.54	0.40%	0.44	Day 5	0.43%	1.32	1.25%	1.46
Day -15	1.27%	1.68	1.67%	1.41	Day 6	0.75%	1.83	2.00%	2.10
Day -14	-0.26%	-0.88	1.41%	1.15	Day 7	0.53%	1.43	2.53%	2.48
Day -13	0.17%	0.57	1.58%	1.25	Day 8	-0.20%	-0.54	2.32%	2.14
Day -12	-0.42%	-1.34	1.16%	0.89	Day 9	0.84%	2.11	3.16%	2.73
Day -11	0.67%	1.83	1.83%	1.35	Day 10	-0.14%	-0.47	3.02%	2.53
Day -10	1.58%	2.37	3.41%	2.25	Day 11	0.47%	1.35	3.50%	2.81
Day -9	0.75%	1.23	4.15%	2.55	Day 12	-0.99%	-1.35	2.51%	1.73
Day -8	0.03%	0.09	4.18%	2.52	Day 13	0.12%	0.33	2.63%	1.76
Day -7	-0.63%	-1.43	3.56%	2.07	Day 14	-0.14%	-0.22	2.48%	1.52
Day -6	-0.63%	-0.80	2.92%	1.54	Day 15	0.08%	0.24	2.56%	1.54
Day -5	-0.41%	-0.93	2.52%	1.30	Day 16	0.00%	-0.01	2.56%	1.50
Day -4	1.13%	1.03	3.65%	1.64	Day 17	0.61%	1.93	3.17%	1.83
Day -3	-0.20%	-0.30	3.46%	1.49	Day 18	0.27%	0.98	3.44%	1.96
Day -2	-1.22%	-1.42	-1.22%	-1.42	Day 19	0.07%	0.17	3.51%	1.95
Day -1	-0.46%	-0.88	-1.67%	-1.67	Day 20	0.79%	1.60	4.30%	2.31
Day 0	-0.88%	-2.11	-2.55%	-2.36					

Table 3. Compilation of average abnormal returns and cumulative average abnormal returns 20 days prior event, at event and 20 days after the event.

Figure 6 plots the results from table 3, thus indicate a positive abnormal return both before and after the event. We assume the market to be semi-strong efficient market since abnormal return can be realised and that the market rapidly reacts to new information (Fama, 1970:1997). The price transformation occurs very rapidly to new public information. Already at day -3 there is a negative abnormal return. This means that the decline begins even before the event window, indicating that information may have leaked to the public in advance. This can be said since we have already rejected the possibility of price elasticity; the pattern provides the same conclusion about price elasticity since abnormal return declines before the shares had the chance to even hit the market.

Venture capitalists have significant experience of bringing companies public and exiting investments in their portfolio companies. Asymmetrical information theory is relevant due to the VC's access to better information. VC's acquires large positions in their portfolio investments and have great influence in how the firms are operated (Lin & Smith, 1998). This affects the signalling value by increasing the effect on the price of the stock market when VC disposes shares. This is probably the main reason that we can achieve statistical significance for sell transactions, which is not very common. If the VC believes that their investments are overvalued they would want to exit the investment with the right timing. At the same time this creates a market paradox for the VC since no investor wish to invest in an overvalued security and their disposal indicates just that. Because the stock price adjusts itself after the event and seems to react excessively at the event, we can assume that the market is overreacting, behavioural finance is one explaining factor (Shiller, 2003) but price elasticity may also force the stock price down at the event. Some days after the event investors appears to realise the overreaction and the abnormal return adjust itself back to positive values once more.

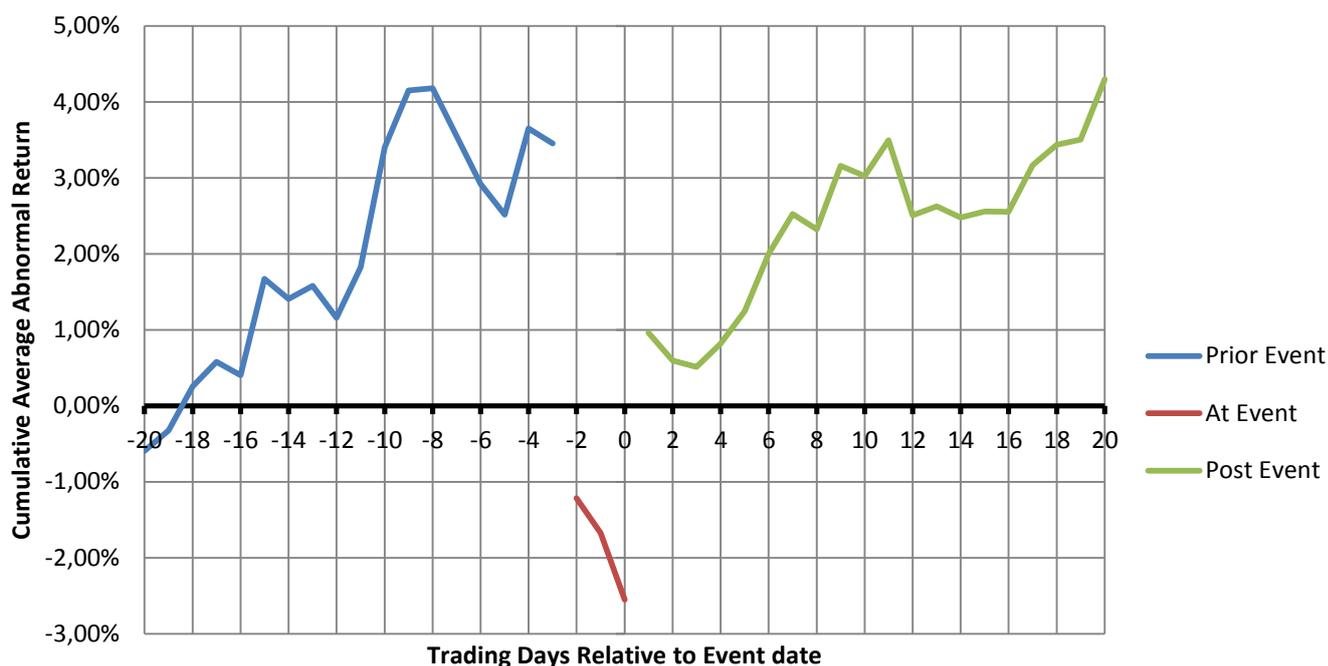


Figure 6. Cumulative average abnormal return prior, at and after event .

Even though CAAR is not a valid measure before the event and in the long run after the event, one can spot a positive abnormal return in these time periods.

5.3 Exit timing

Plotting cumulative average abnormal return for the trading days -60 to 100, shown in figure 7, shows the overall pattern of the event but is only suggestive for long-term returns. The abnormal return increases during the period prior the event date and falls during the event window (-2 days to 0 days). The stock price then peak at day 22 and then decline until 100 days. The establishment of the venture capital firm will affect the IPO timing (Gompers & Lerner, 2004) and its return. Since the IPO's occurrence depends on the Venture capitalists' establishment and reputation, it can also affect the exit timing of the VC. The VC's limited partnership structure influence the exit timing of the investment since the investment has a limited time horizon in which the return must be realized. This creates a liquidity risk which refers to the risk of not being able to effectively exit the investment thus forced to either remain much longer in the position or sell off the shares at a great discount (Cumming, Fleming & Schwienbacher, 2005). The liquidity risk is one factor that yield the higher returns required by VCs as a form of compensation. The VC balances their exit timing with investor reputation and financial performance (Lin & Smith, 1998). CAAR in fig. 7 indicates that the exit timing is not optimal. The share price inclines post the VC's disposal. The decline at the event may be described as a combination of an overreacting market and price elasticity, CAAR normalises over a 40 days period post the event. Price elasticity has not achieved significance in our tests but can still be an influencing factor of the decline. As earlier mentioned, long-term statements based on CAAR have its limitations and therefore a BHAR model has been conducted in chapter 5.3.2 *Buy and Hold Abnormal Return*.

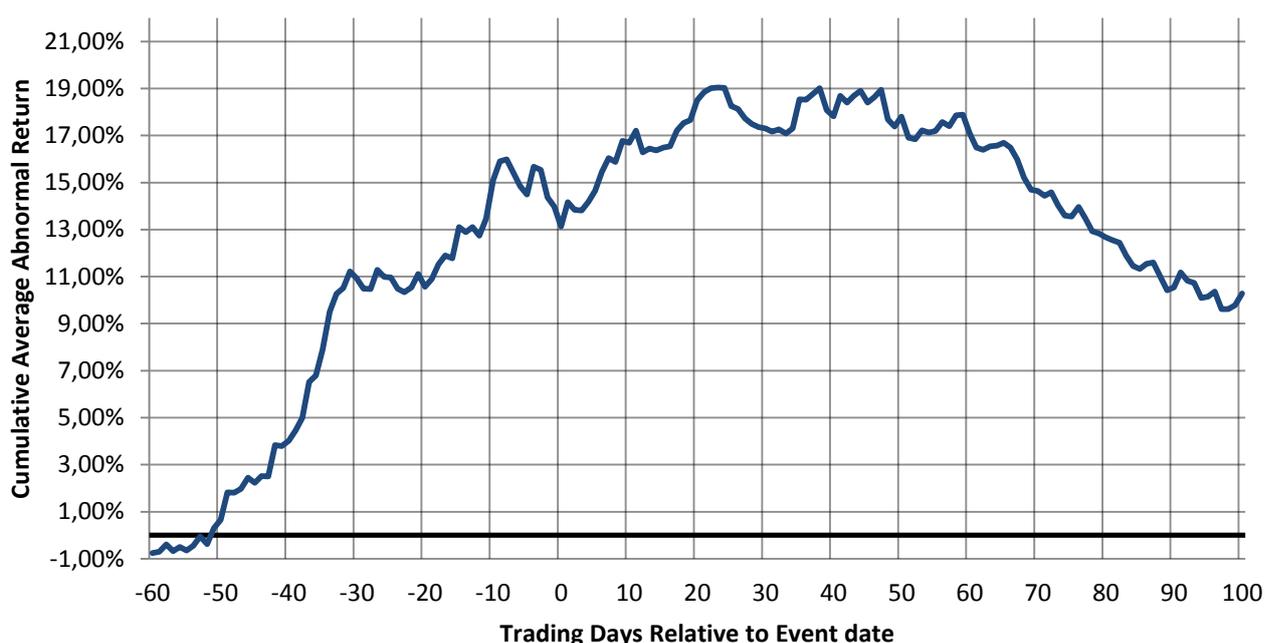


Figure 7. Cumulative average abnormal return over days -60 to days 100

Abnormal return are derived with a market model using Nasdaq Biotechnology Price Index in a one factor model. Cumulative average abnormal return is calculated by summing the average abnormal returns. The sample contain 129 disposals made by 34 venture capital funds between 2003 and 2010.

5.4 Buy-and-Hold Abnormal Return

The Buy and Hold portfolio (BHAR) ranges for 260 trading days (one year) to examine the long-term results for the venture-backed firms post the VC's disposal. As earlier mentioned, The BHAR is used for long-term analysis since the price movements in the average cumulative abnormal returns (CAARs) may bias the results over a long-term horizon (Gompers & Lerner, 1998). The BHAR analysis yielded a result of 9.02 %, confirming the indications seen in CAAR. The results in BHAR means that historical long-term performance for venture-backed securities post VC's disposal have overachieved index by 9.02 % between the event until 260 trading days. The BHAR thereby indicates that the abnormal return will stabilise at a 9% abnormal return. CAAR and BHAR hold different methodologies and should not be assorted; fig. 7 is thereby not connected with the BHAR but the both methods indifferently tests abnormal return, still indicating a similar conclusion. This means that an investor historically could expect an abnormal return of 9.02 % while holding the position for one-year post a VC's disposal. Reservations shall be made that historical stock price performance does not guarantee future performance thus will historical relationships not assure future relationships alike.

6. Conclusion

This section provides a summation of the results and reconnects to the research questions and expectations.

Our study indicates a negative relationship in event window one between Venture capitalists' sell transactions and stock price performance of the venture-backed firm. The Venture capitalists in the study have sold their stake and distributed the cash received to its owners. The results has completed different robustness tests of explaining variables such as first events, price elasticity and lead investors, but not any have achieved economic significance for being an explaining factor. The outcome of the disposal test thereby shows a negative relationship with the venture-backed stock price performance of -2.76% on average in the first event window. The drop in share price at the event is greater in size for first events but could not achieve statistical significance with the smaller sample conducted in the study. For an investor to achieve abnormal return, by trading on VC's disposals, the investor requires to uniquely know the transaction date prior its exercitation and that the market does not, which is in conjunction with Jeng et al (2003), but seems as a very unlikely situation for reality.

Unlike our expectations, the second event window has a positive relationship with the VC's disposals. The share price thereby increases during the days post the event and investors may expect a rise in the venture-backed security. This means that the market initially reacts very strongly to the disposals but later recovers, which could be a consequence of price elasticity even though it was not statistically significant in our study. With the results received in our study we may say that the positive relationship is a consequence of an overreacting stock market, based on the initial signalling value of the transaction, which is aligned with Lin & Smith, (1998) and Chen et. al (2003).

Our study did find statistical significance for a market reaction based on the insider's sell transactions, which the study of Jeng et al (2003) did not. The explanation may be that our data have been cleansed to only contain institutional insiders, thereby increasing the signalling value of transactions since social psychological factors may not be as commonly present (Seyhun, 1998).

The venture capital funds exit their investments at relatively good dates but do not successfully hit the share price peak. Worth mentioning is that our results act as an average exit performance for all the VCs, but that reputation and establishment of each VC will affect

the individual exit timing as described by Gompers & Lerner (2004). The question that arises is if the VC actually has better information about its investment's stock price performance. How can the VC explain its exiting to investors if they knew the price would incline the following period after the disposal? One answer to the question is that they actually do not know more about the future share performance than the market, even though they have insider information. The other possibility is that their exit strategy is more structured and complex than described through the report. By selling off small stakes at different time periods with different derivatives, which falls outside the scope of this study, the VC's can decrease their position below a 10 % stake and later dispose the rest of the shares, dodging the commitments of an insider (Cumming & MacIntosh, 2003). Discussions about the VC's timing can be developed further and imply that their timing actually is optimal since the VC strives to both balance the reputation of the firm with a high enough return to satisfy investors (Lin & Smith, 1998). By exiting in a high peak related to the later performance measured in the BHAR, the VC yield higher return to investors but still remain a reputation of not exiting overvalued shares since the stock price rises post the event, this might be the whole strategy of the VC and in that case their timing is optimal.

7. Further Research

In this final section some issues of interest, that lay beyond the coverage of this report and might be topics for further research, are discussed.

Since this study is based on Venture capitalists' activities in the life science industry it could be of interest to conduct a similar study on other samples from other industries.

Another study of interest could be to look at buy transactions, to see if there is positive effects on the stock price if the VC continues to purchase shares after the lock-up period, instead of disposing them. Existing theory in the insider scholar proves a larger signalling value for buy transactions, does this relationship also applies to institutional investors?

As this study focus on the American market, a study analysing whether there are differences between geographical markets could be of interest.

Finally, it would be interesting to examine the signalling value separated between different institutional holder like Venture capitalists, Private Equity and Hedge Funds. If the market reacts differently for each venture capital fund it would indicate that outsiders have greater or lesser confidence for each institutional investor.

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World English Dictionary: <http://dictionary.reference.com/>

Event study tools: <http://www.eventstudytools.com/>

Appendix

A.1 Definitions through the report

Abnormal return – Defined as the difference between the actual return and normal return. Normal return refers to the average return on the market, usually measured against index.

Beta (β) – A volatility measure of systematic risk, which is the risk that cannot be eliminated through diversification in the portfolio as it is the embedded risk for the accumulated stock market.

Venture Capital (VC) – A financial body that provide financial capital to early-stage, high risk and high potential, start-up companies. The VC can provide both capital and managerial know-how to the company and usually aims to keep their position under a 7 year period under which the company hopefully is taken public, where the VC's assistance will be of great value.

First event – The first event is defined in the dataset as the first time a Venture capitalist (VC) is acquiring or disposing shares on the public market after the lock-up period. Each VC thereby owns two possible dates that will be referred to as a first event. The date is acquired through SEC's Form 4.

Form 4 – The form in which investors that are categorized under the Securities Act of 1933 (insiders) must fill in and send to SEC within two trading days after a transaction. The SEC will thereafter take the document public, making the transaction public knowledge.

Insider – A legal or physical person that is categorized under the Securities Act of 1933. The insider is considered to have access to better information than the public due to its beneficial position in the Firm. Insiders are therefore regulated to follow criterions stated by the SEC to avoid arbitrage opportunities gained by the insiders or market inefficiency.

Initial Public Offering (IPO) – When shares of a company's stock are sold to the public, on a securities exchange market, for the first time. This is when a firm goes from being a private company to becoming a public company.

Lock-up period – The period after an Initial Public Offering (IPO), in which the VC and underwriters have an agreement to not dispose shares during the defined period.

Private Equity (PE) – A financial body that provide financial capital to a later stage in the company's living cycle. Much like the VC, PE provides capital to the company and sometimes managerial know-how and aims to keep their position under a 5-7 year period. PE invests in private companies and takes them public or delists public companies by taking them private. PE is generally greater in capital size compared to the VC.

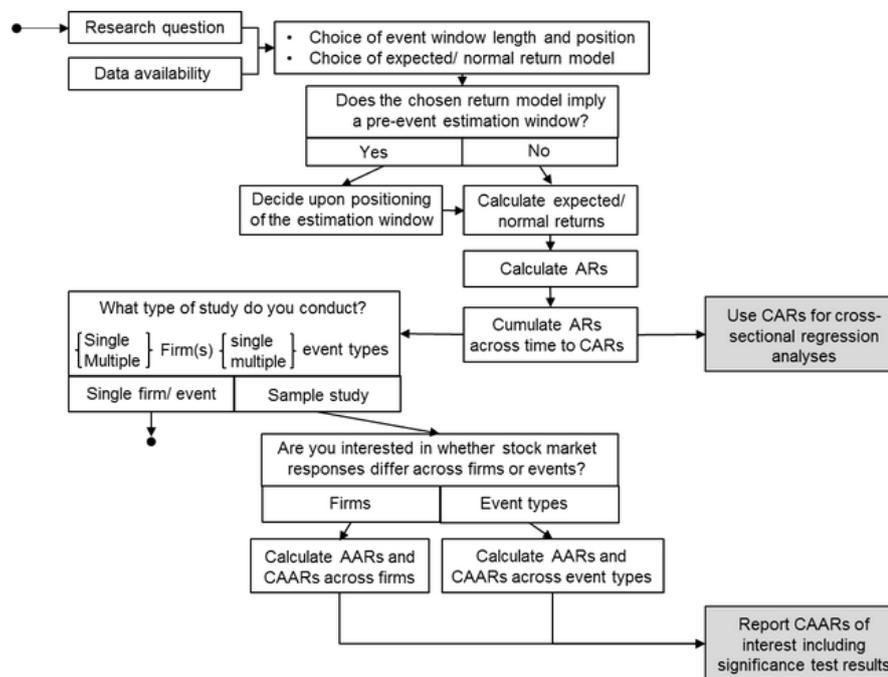
P-value – When testing for statistical significance, the *p-value* is the probability of obtaining a result at least as extreme as the one that was actually observed, assuming that the null hypothesis is true

SEC – Security and Exchange Commission, - The American government bureau that aims to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation.

Signalling – The informational market value a beneficially owner projects by disclosing his intentions.

A.2 Flow chart of event study

Figure 1: Flow Chart of Event Study Choices and Analysis Steps



Own Illustration

Depending on the return model chosen, event studies either imply the use of an event window only (e.g., the market-adjusted model) or an event and an estimation window (e.g., the market model). Most often, scholars opt for the 'market model', which establishes the normal returns based on a regression analysis that regresses stock returns on market returns over the 'estimation window'. Through this analysis, the typical relationship between the stock and its reference index is established and captured in two parameters (i.e., alpha, beta). Figure 2 illustrates the concepts required for an event study using the market model.

Retrieved from: <http://www.eventstudytools.com/event-study-blueprint>

A.3 Companies and Institutional holders in the study

Companies	Institutional holders	
Acadia Pharmaceuticals	Abingworth Management Ltd	MVM International Life Sciences Fund No. 1 L.P. and related entities and individuals
Acusphere	Advanced Technology Ventures VII LP.	New Enterprise Associates 10 L P
Adeza Biomedical	Alloy Corporate 2000, L.P. and its affiliates	Oxford Bioscience Partners IV affiliates
Advanced Life Sciences	Atlas Venture	Pequot Capital Management, Inc.
Advancis Pharmaceutical	BAVP, L.P.	Perseus-Soros BioPharmaceutical Fund, LP
Alnylam Pharmaceuticals	Enterprise Partners V, L.P.	Polaris Venture Partners
Altus Pharmaceuticals	Entities affiliated with Alta Partners, LLP	Presido Management Group VIII L L C
Anadys Pharmaceuticals	Entities affiliated with Biotechnology Value Fund, L.P.	Prospect Management Co. II, LLC
Auxilium Pharmaceuticals	Entities affiliated with InterWest Partners VIII, L.P.	Rho Ventures
Barrier Therapeutics	Entities affiliated with Merlin Biomed	Sanderling Venture Partners V, L.P. and its affiliates
Coley Pharmaceutical	Entities affiliated with Morgenthaler Partners VII, LLC	SCP Private Equity Partners II, L.P.
Corcept Therapeutics	Entities affiliated with New Enterprise Associates	Sicor INC
Corgentech	Entities affiliated with ProQuest Investments	Sutter Hill Ventures
Cotherix	Entities affiliated with Sevin Rosen Funds	Thomas Weisel group
Critical Therapeutics (Cornerstone Therapeutics)	Entities affiliated with Sofinnova Ventures, Inc.	TL Ventures
Cytokinetics	Entities affiliated with Thomas, Mc Nerney & Partners, L.P.	Tullis-Dickerson & Co., Inc. affiliated funds
Eyetechnical	Entities affiliated with Three Arch Partners	Warburg Pincus Private Equity VIII, L.P.
Favrille	Entities related to HBM BioVentures AG	William Blair Capital Partners VII, L.P. and its affiliate
Immunicon	Flavin Ventures, LLC	
Inhibitex	Forward Ventures IV L.P. and its affiliates	
Iomai	Funds affiliated with The St. Paul Companies, Inc.	
Metabasis Therapeutics	Healthcare Ventures Group	
Momenta Pharmaceuticals	InterWest Management Partners VII, LLC and its affiliates	
Myogen	J.P. Morgan Partners (SBIC), LLC	
Nitromed	MDS Pharma Services (US) Inc.	
Pharmion	Merrill Lynch Ventures LP 2001	
Santarus	MPM Capital L.P.	
Senomyx		
Somaxon Pharmaceuticals		
Sunesis Pharmaceuticals		
Tercica		
Threshold Pharmaceuticals		
Viacell		
Xenogen		
Xenogen		