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Initial Public Offerings (IPOs), Lock-ups and Market Efficiency

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Abstract

In this paper we have examined 174 lock-up agreements in 142 unique firms. A lock-up refers to the prespecified time, usually 180 days, following an IPO, where pre-IPO shareholders enter into an agreement with the underwriter not to sell, or contract to sell any of their shares. We find the Oslo Stock Exchange to be efficient, as there are no significant price reactions around the lock-up expiry, and therefore we find support for the efficient market hypothesis. We also found a permanent increase in trading volume of 85 percent. Further, we found some support for the commitment hypothesis as a potential explanation for the existence of lock-ups. On the other hand, we found no support for the signaling and additional underwriter compensation hypothesis.

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1 Introduction

Market efficiency is a widely and thoroughly studied hypothesis. In this context, the study of lock-ups is particularly interesting, as it enables a different approach to test market efficiency and downward sloping demand curves. A lock-up agreement refers to a prespecified time period following an Initial Public Offering (IPO), where insiders and other pre-IPO shareholders are not allowed to sell their shares. The unique feature with lock-up agreements is that the terms and length is included in the IPO prospectuses, and therefore making the lock-up expiry a completely observable event. Further, the study of lock-ups is interesting as there exists several possible, but no commonly agreed upon, explanation for the existence of lock-up agreements.

The main finding in our paper is that we find the Oslo Stock Exchange to be efficient, and therefore we find support for the Efficient Market Hypothesis, as there are no significant price reactions around the lock-up expiry. Consequently, there are no arbitrage opportunities. In addition, we found a permanent increase in trading volume of 85 percent. Further, contrary to the findings in the US, we find a positive relationship between abnormal return and abnormal trading volume, and thus we find some evidence against the theory of downward sloping demand curves.

Similar studies in the US, among others Brav and Gompers (2000), Ofek and Richardson (2000) and Field and Hanka (2001), have found a consistent and significant negative abnormal return around the lock-up expiry date. In contrast, Espenlaub et al. (2001) and Goergen, Renneboog and Khursted (2006) found no significant price reaction in UK, Germany and France. In this context, our contribution is unique, since there has, to our knowledge, been committed little to none effort into research of the effect of lock-ups at the Oslo Stock Exchange.

There are several possible explanations why our results do not correspond to the results found in the US. First, the number of observations in our sample is significantly smaller. Second, the sample we study is from a different and more recent time, i.e. 1993 to 2008. Third, Norwegian firms lock-up, on average, a smaller fraction of their shares than American firms. Lastly, there may have been early releases of the locked-up shares that we were unable to observe. Even

though the empirical evidence from Germany and France seem to correspond with our findings, it is worth noting that lock-ups are compulsorily in Germany and France, while in Norway (and UK and US) they are not.

Testing three potential explanations for the existence of lock-ups, we find some support for the explanation that lock-ups serve as a commitment device to reduce moral hazard. Through our study of the determinants of lock-up length, we find that firms associated with a higher degree of information asymmetry tend to lock-up their shares for a longer period of time. We find no support for the explanations that lock-ups serves as a signal of firm quality or as a mechanism for underwriters to extract additional compensation.

We found that the typical Norwegian lock-up agreement consists of approximately 40 percent of the outstanding shares and lasts for 180 days. We have further found that lock-up length is shorter and the fraction of shares locked-up is higher for firms where information asymmetry and adverse selection problem is less severe. The reason for this could be that firms associated with a higher degree of information asymmetry tend to sell a higher fraction of their shares in the IPO (e.g. they are on average smaller) and consequently have fewer shares remaining to lock-up. Therefore, they must accept longer lock-up periods. In addition, we have found that the percentage locked-up is negatively related to the lock-up length. Thus, a firm can either commit by locking-up more shares or by accepting a longer lock-up period.

In our thesis we will first present key findings from existing literature and previous studies. We will then use the key findings as motivation to develop hypotheses. We will then present the data and descriptive statistics, before we go through the methodology. Lastly, we will present the empirical evidence of our findings, as well as an interpretation of the results.

2 Literature Review

In this section we will present and review the most significant literature available on lock-up effects of IPOs and their empirical findings, as well as the most relevant literature on market efficiency and downward sloping demand curves for stocks.

Several articles, such as Brav and Gompers (2000), Ofek and Richardson (2000) and Field and Hanka (2001), emphasizes that the length of lock-ups are publicly available, thus, if markets perfectly anticipated the release there should be no abnormal price reaction at the time of the expiration, as the information should already be fully reflected in the price.

Brav and Gompers (2000) represent one of the pioneer explorers in the research of lock-up agreements. They explore the motivation for the lock-ups by examining the structure and how it affects underpricing at the time of the IPO. Further, they explore the price reaction and trading activity at the time of the lock-up expiration. Their paper finds support for the theory that lock-ups serve as commitment mechanisms at the time of the IPO, to credibly convey its quality, since IPOs are potentially subject to adverse selection problems (Meyers and Majluf 1984). Further, they find that IPO underpricing is higher for firms with longer lock-up period and firms that lock up a larger fraction of their shares. They find an average abnormal return of -1.2% at the time of lock-up expiry, and that the negative abnormal return is greater for firms that lock up a greater fraction of their shares, firms with high market value of equity, firms with a low book-to-market ratio and for firms that are backed by venture capitalists. They argue that the stock price drop challenges the framework of rational expectations, and that it is potentially consistent with downward sloping demand curves for stocks and/or investors' incorrect prior beliefs.

Brav and Gompers (2003) extend their previous work, and develop three different hypotheses regarding reasons for the existence of lock-up agreements. They explore whether lock-ups serve the purpose of being a signaling mechanism for firm quality, a commitment device to alleviate problems of moral hazard or a mechanism for underwriters to extract additional compensation from the issuing firms. More specifically, when they focus on the commitment hypothesis, they also test for the cross-sectional differences in abnormal return. While they are able to find support for the commitment hypothesis, they find little support for the signaling hypothesis. To support their commitment hypothesis, they find that firms who perform an SEO between the IPO and the lock-up expiry, as well as sell secondary shares in the offering, are associated with less information

asymmetry and therefore experience a smaller price drop. In addition, firms associated with low information asymmetry have, in average, shorter lock-up periods. The rejection of the signaling hypothesis is considerably challenged by Brau, Lambson and McQueen (2005), who argue that the dismissal of the signaling theory is at best premature. They extend Brav and Gompers's (2003) work along several dimensions. First, they develop the signaling hypothesis into a formal model, and argue that that it is costly to send a false signal, as the insiders must spend money on negative NPV projects in order to keep up appearances. Further, the insiders are facing considerable risk, as the lock-up period prevents them from selling their shares, and therefore the true value may just as well be revealed prior to lock-up expiry. In other words, as formulated by Brau, Lambson and McQueen (2005:519): "The lockup forces insiders to not only put their money where their mouth is but to keep them there as well". Second, they argue that the support Brav and Gompers (2003) find for the commitment hypothesis also can be interpreted as support for the signaling hypothesis. Having provided support for the signaling hypothesis, they conclude that the signaling theory continues to possess both theoretical and empirical merit.

In their paper, Ofek and Richardson (2000) investigate excess trading volume and price patterns at the expiration of lock-up periods, and test whether they find any evidence for market efficiency and/or downward sloping demand curves. Through their research, they document a stock price decline of 1-3 percent at expiry, while trading volume increases with about 40 percent. They conclude that the decline in stock prices provide new anomalous evidence against market efficiency. They explore several possible explanations, such as bid-ask bounce, liquidity effects and biased expectations of supply shocks. However, they find little support for these explanations. Further, they found some support for downward sloping demand curves. In addition, they also attempt to empirically explain the cross-sectional differences in abnormal return between different firms. They find that certain variables, such as stock price volatility, are clearly associated with larger stock price drops at lock-up expiration. Even though they find a significant drop in stock prices at expiry, they conclude that due to capital gain taxes, bid-ask spread and transaction costs there are no arbitrage opportunities.

Similar results are reached by Field and Hanka (2001), who reports a permanent 40 percent increase in average trading volume and a statistically prominent three-day abnormal return of -1.5 percent. They find that the abnormal return and excess volume are larger when the firm is financed by venture capitalists. They also find that venture capitalists sell more aggressively than insiders and other pre-IPO shareholders. In addition, they find that companies with a positive run up, i.e. the stock price has risen since the time of the IPO, experience a higher negative abnormal return at the lock-up expiry. Further, when examining the microstructure effects, they find a permanent, parallel decline in the bid and ask spread, and therefore argue that the abnormal return is not caused by a change in the proportion of trades at the bid price, temporary price pressure or increased transaction costs. They conclude that the negative abnormal returns may be partly, but not completely, caused by downward sloping demand curves or investor's incorrect prior beliefs, and that the predictable price drop at expiry challenges the efficient market hypothesis. Like Ofek and Richardson (2000), they find that there are no arbitrage opportunities, as investors must trade at bid and ask prices.

The findings of Field and Hanka are supported by Bradley et al. (2001), which find that firms backed by venture capitalists are associated with significant negative abnormal returns at lock-up expirations. Further, they document that within the group of venture capital backed firms the largest losses occur for "high-tech" firms, firms with highest stock price increases since the IPO, the largest relative trading volume around lock-up expiration, and firms using the highest quality underwriters. The intuition behind the latter is that venture capitalists typically bring several firms to the market, and thus potentially have a closer relationship with the higher quality underwriters, giving them increased possibilities to negotiate shorter lock-up agreements.

However, studies of lock-up expiry outside the US do not seem to coincide with the results of the studies conducted in the US. Espenlaub et al. (2001) find no statistically significant abnormal return at the expiry of lock-up agreements in the UK market. Although, not statistically significant, their results are consistently showing negative abnormal return. However, looking at the sample size used in the UK, it is evident that the sample size is relatively small, consisting of only 54 observations, whereas in US, the sample size is consistently larger than thousand

observations. Therefore, one potential explanation for the lack of statistically significant results is the small sample size. Further, Goergen, Renneboog and Khursted (2006) make similar conclusions regarding the French and the German markets, where they find no statistically significant abnormal returns. It is, however, worth noting that lock-up agreements in Germany and France are compulsory[1], while this is not the case in Norway, UK and the US, and could therefore potentially explain the lack of significant results, since firms with voluntary lock-ups can enter the lock-up agreements to e.g. signal their quality or commitment. In contrast, insiders in French firms are required to lock-up 100 percent of their shares for a minimum of 6 months, and it would therefore, at best, be difficult to infer any signals about the firm from the lock-up agreement.

In the efficient market hypothesis (EMH), Fama (1970) suggests that stock prices fully reflect all available information on a particular stock and/or market. Thus, investors cannot take advantage in predicting stock returns because no one has access to information not already available to everyone else. In this context, the study of lock-ups is particularly interesting because lock-up expiration is a completely observable event and should, according to Fama, already be fully reflected in the stock price.

Scholes (1972) represents one of the early works, suggesting that demand curves for stocks are downward sloping, thus challenging theories based on the no arbitrage condition. More specifically, if demand curves for stocks are downward sloping, this implies that firms issuing shares are not only price takers, but they are also able to influence share price by regulating the amount of shares outstanding. This is contradicting the theories of Modigliani and Miller (1958), which implies that the supply of shares has no impact on the stock price, and firms issuing shares are, thus, price takers. Shleifer (1986) provides empirical support for downward sloping demand curves, as he find an immediate positive abnormal return for stocks at the announcement day of inclusion to the S&P 500 index, because investors know that there will be increased demand for the stock, e.g. by

[1] The German market imposes a minimum lock-up of 6 months on all the pre-IPO shareholder's shares retained immediately after the floatation. The French market requires insiders to be locked-up with 100% of the shares for 6 months or 80% of the shares for 1 year.

passive mutual index funds. This is further supported by Levin and Wright (2006), who are also able to provide empirical support for downward sloping demand curves for stocks, and further argue that downward sloping demand curves for stocks are inconsistent with the traditional view of market efficiency, that stock prices are determined only by expectations of future cash flows and the discount rate. However, other studies, such as Mikkelson and Partch (1985), Holthausen, Leftwich and Mayers (1990) and Keim and Madhavan (1996), are only able to provide ambiguous empirical evidence for the existence of downward sloping demand curves for stocks.

As the length of the lock-up period is clearly stated in the IPO prospectus, making the event completely observable, investors should, according to EMH, on average correctly predict the stock price at expiry. The study of lock-up expiration can therefore potentially provide useful information regarding the hypotheses of downward sloping demand curves and market efficiency. A significant change in stock price at lock-up expiration would imply anomalous evidences against the efficient market hypothesis. Further, since additional stocks are released for trading in the market at lock-up expiry, a significant price drop would provide support for the theory of downward sloping demand curves for stocks.

In the literature review we have presented and reviewed the relevant existing literature. Several papers, such as Brav and Gompers (2000), Ofek and Richardson (2000) and Field and Hanka (2001), have explored the lock-up expiry effect in the US market, where the prevailing findings are negative abnormal return and positive excess volume at expiry. In contrast, Espenlaub et al. (2001) and Goergen, Renneboog and Khursted (2006) did not find any statistically significant abnormal returns for UK, France and Germany markets. Several reasons for the existence of lock-up agreements have been explored, where commitment hypothesis and signaling hypothesis are the most prominent theories proposed. Brav and Gompers (2003) find support for the commitment hypothesis, while Brau, Lambson and McQueen (2005) find support the signaling hypothesis. Further, since the lock-up expiration is a completely observable event, it can be used to test the efficient market hypothesis and downward sloping demand curves for stocks.

Having reviewed the most interesting existing literature, we continue with developing hypotheses.

3 Hypotheses

During the paper we are going to go through hypotheses intended to explore market efficiency, downward sloping demand curves and price pressure. In addition, we will explore possible explanations for the existence of lock-up agreements, namely signaling quality, commitment device or mechanism for underwriters to extract additional compensation.

3.1 Efficient Market Hypothesis

The first hypothesis is based on the traditional view of efficiency in the stock market. Investors form rational expectations, and since all information about the terms and length of the lock-up is fully available, it should be embedded in the stock price at the first day of IPO trading and prior to lock-up expiry. Thus investors will not systematically fail in their pricing of the stock, and there should be no significant price reaction at lock-up expiration. Moreover, as a consequence of Modigliani and Miller (1958), firms issuing shares are price takers and the supply of shares has no impact on the stock price.

We therefore formulate the following prediction based on the efficient market hypothesis:

There will, on average, be zero abnormal return in the time around the lock-up expiration.

3.2 Downward Sloping Demand Curves for Stocks

The competing hypothesis is inspired by the research and empirical findings of Ofek and Richardson (2000), Field and Hanka (2001) and Brav and Gompers (2000 and 2003), which document a statistically significant negative abnormal returns on the time around lock-up expiration. The theory of downward sloping demand curves for stocks suggests and supports a negative abnormal return. At the event of lock-up expiration a significant number of shares are suddenly released to the market, causing a positive shift in the supply curve of stocks. With downward sloping demand curves this implies a drop in the stock price. However,

we note that the theory of downward sloping demand curves is not directly contrasting market efficiency, as investors can still correctly predict the positive shift in the supply curve at expiry. Therefore the information should already be embedded in the stock price at the time of the IPO. For this reason, the theory of downward sloping demand curves must be supported by either investor's incorrect prior beliefs or costly arbitrage.

From this we form the following prediction based on the theory of downward sloping demand curve:

There will, on average, be negative abnormal returns in the time around the lock-up expiration.

3.3 Commitment Hypothesis

As in Brav and Gompers (2003), the commitment hypothesis is intended as a potential explanation regarding the existence of lock-ups. The hypothesis implies that lock-up agreements serve as a commitment device to reduce moral hazard problems. While firm quality is observable ex ante, there is asymmetric information regarding the actions of the manager subsequent to the IPO. In order to induce insiders to act in the best interest of the shareholders, they are obliged not to sell their shares for a prespecified period of time. The first prediction of the commitment hypothesis is related to abnormal returns at lock-up expiration, and is rooted in the idea that firms which are less informationally transparent will experience higher price reactions at lock-up expiration. Such firms have higher information asymmetry and are more subject to moral hazard. With these firms, it might be more difficult to predict how many shares hitting the market at lock-up expiration, and insiders can take advantage of this. If this is not accounted for by investors, they may be consistently surprised by how many shares hitting the market by such firms. Thus, the first prediction is formulated as follows:

Firms associated with a higher degree of information asymmetry will experience larger negative abnormal returns around lock-up expiration.

The second prediction (Brav and Gompers 2003) of the commitment hypothesis is related to the lock-up length. The idea is that firms with higher information

asymmetry have greater potential to take advantage of outside investors, and will thus need to commit with a longer lock-up period. The prediction is formulated as follows:

Firms associated with a higher degree of information asymmetry will lock-up their shares for a longer period of time.

We may however find that if the lock-up length is correctly set, information asymmetry may be dealt with in such a way that the first prediction is no longer valid. We will account for this effect when we test the first prediction.

3.4 Signaling Hypothesis

The motivation for the signaling hypothesis is that firms might want to signal their quality, e.g. signal that they are high quality firms, in order to extract a higher IPO offering price, or to achieve a better price in a subsequent SEO. Brav and Gompers (2003) argue that if high-quality firms are able to separate themselves from low-quality firms, we should observe a positive price revision, defined by the difference between the actual offering price and the midpoint of the initial offering range, for firms that lock-up their shares for a longer period. Based on the argument that firms can signal quality by locking up their shares for a longer period, we thus formulate the first prediction of the signaling hypothesis as follows:

High-quality firms will, on average, lock-up their shares for a longer period.

Brav and Gompers (2003), further argue that an alternative motivation for firms to signal quality, by setting a long lock-up length, is to achieve a higher price in subsequent SEO. We would therefore expect to find that firms with a long lock-up length should have a higher probability of having a subsequent SEO. We therefore formulate the second prediction of the signaling hypothesis as follows:

Firms with a long lock-up length will, on average, perform more SEO than firms with a short lock-up length.

3.5 Additional Underwriter Compensation Hypothesis

The third hypothesis regarding the existence of lock-ups is that underwriters use lock-ups to extract additional compensation from firms going public (Brav and Gompers 2003). The idea is that, during the lock-up period, insiders are only allowed to sell if the shares are released by the underwriter. In case of release, underwriters would then allow block trades through the lead underwriter or potentially perform an SEO. In either case, the underwriter would be able to extract additional fees. In our research, we test this hypothesis very briefly, based on the assumption that high quality underwriters are able to extract more compensation due to their greater prestige. Thus, we formulate the following prediction:

Lock-ups are longer for firms going public with high quality underwriters.

Having formulated our hypotheses, we will now present the data, the selection process and the descriptive statistics.

4 Data Description

In the period between 2003 and 2008, there has been 428 IPOs (including spinoffs, private placements etc.) on the Oslo Stock Exchange. Examining the IPO prospectuses, provided by the Department of Finance at BI Norwegian Business School, we found 205 lock-up agreements in 167 unique companies. We excluded lock-up agreements where the companies were either delisted prior to lock-up expiry, the length of the lock-up were unspecified, or there were regulatory issues related to the release (e.g. the lock-up is contingent on stock price development), making the final sample 174 lock-up agreements in 142 unique companies. The final sample size is slightly larger than we anticipated in our preliminary report, mainly due to the fact that some companies use varying lock-up lengths for different shareholder groups. The sample size is, not surprisingly, much smaller than the sample size used for similar studies in e.g. the US. However, we believe that the sample size is still sufficiently large to provide reliable results. A summary of the sample selection is presented in table 1.

Sample selection	N (Unique)	N (Lock-ups)
Initial Sample (1993 – 2008)	428	-
Exclusion no lock-up agreement	180	-
Exclusion missing prospectus	81	-
Total number of lock-ups	**167**	**205**
Delisted prior to expiry	9	10
Lock-up length unspecified	9	11
Regulatory issues related to release	5	8
Other reasons	2	2
Final Sample	**142**	**174**

Table 1: Sample Selection. N is the number of observations and N (Unique) is the unique firms.

From the IPO prospectuses we collected information about the length of the lock-up agreements, the lock-up expiration date, total number of outstanding shares, the amount of shares locked-up and whether or not Secondary Shares were sold in the offering. We checked the total number of shares against the list changes provided on the Oslo Stock Exchange webpage. In addition, we used NewsWeb to determine whether the potential overallotment options were fully utilized or not.

The Department of Finance at BI Norwegian Business School provided us with information regarding the first day of trading, daily return (accounted for dividend) and volume, market value of equity, book-to-market ratio of equity (BM), initial midpoint offering price, final offering price, whether the company was backed by Venture Capitalists or not, and whether the company had an Seasoned Equity Offering (SEO) after the IPO, but before lock-up expiry. In addition, they provided a value-weighted index of the stocks listed on the Oslo Stock Exchange, which we used as the market benchmark.

In the data from the Department of Finance at BI Norwegian Business School, there were some missing data regarding the book-to-market ratio of equity. In these cases, we calculated the BM based on the information provided in the IPO prospectuses.

4.1 Descriptive Statistics

To summarize the data we have gathered, we will present descriptive statistics to describe the main characteristics of the typical firm using lock-up agreements, examine possible time trend for lock-ups and frequency of lock-up lengths, as well as exploring the cross sectional differences in percentage of shares locked-up and the length of the lock-up agreements.

4.1.1 Firm Characteristics

The typical firm in our sample has an average market capitalization, adjusted to 2000 level, of NOK 3.456 billion, while the median market capitalization is NOK 725 million. Because a few companies, such as Statoil, Telenor and REC, have extremely high market capitalization, we will use the median market capitalization as the appropriate descriptive measure. Further, the typical firm has a book-to-market ratio of equity of 0.40, is taken public by an underwriter with rank 7, and locks-up approximately 40 percent of their shares for 180 days. The 25th percentile, 75th percentile, as well as mean and median is presented in table 2 below.

Firm characteristics (Full Sample)	25th Percentile	Median	Mean	75th Percentile
MV of Equity (in millions)	335	725	3 456	1 664
Book-to-Market ratio	0.26	0.40	0.44	0.55
Underwriter Rank (1-10)	6.00	7.00	6.76	7.00
Lock-up Length (Days)	180	180	267	360
Fraction Locked (%)	13.91	39.01	37.38	55.54

Table 2: Firm Characteristics.

4.1.2 Time Trend

When sorting our lock-up observations into the respective years of the IPO, we see a clear pattern of time-clustering. These findings are not very surprising, as the time-clustering of IPOs is extensively documented, among others, by Ibbotson and Jaffe (1975) and Ritter (1984). The former conclude that periods of high IPO volume are likely to be followed by another period of high IPO volume, while the latter find that IPO waves can be attributed to industries. For example, the high number of observations in 2000 is to a large extent attributed to the boom of high-

tech companies going public. The annual number of lock-up observations is presented in table 3 below.

Year	1993	1994	1995	1996	1997	1998	1999	2000
N	2	2	1	4	16	8	4	21
Fraction	22 %	15 %	8 %	33 %	41 %	33 %	44 %	70 %
Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
N	7	2	1	18	28	26	28	6
Fraction	41 %	40 %	20 %	62 %	65 %	74 %	49 %	43 %

Table 3: Time Trend – N is the Annual number of lock-up observations (1993-2008). Fraction is the number of lock-ups in a given year, divided by all IPOs in the same year.

4.1.3 Frequency of Lock-up Length

The most frequent lock-up length is 180 days, used in approximately 40 percent of the total observations in our sample. The lock-up length in our sample appears to be clustering around quarterly or annual intervals, such as 90, 180 or 270 days and 1, 2 or 3 years. This tendency is consistent with the observations from the US and Germany, where Brav and Gompers (2000) and Goergen, Renneboog and Khursted (2006) observed a lock-up length of 180 days in respectively 68 and 47 percent of the cases. A summary of the frequencies of lock-up length is presented in table 4.

Days	<90	90	91-179	180	181-269	270	271-359	360	>360
N	2	9	15	67	8	8	20	28	17
%	1	5	9	39	5	5	11	16	10

Table 4: Frequency of Lock-up Length – N is the number of a given observations and % is the fraction the given number represents out of the entire sample.

We find that a lock-up length of exactly 180 days is more common in the later stages of our sample period. By assessing the periods before and after 2001, we find that a lock-up length of 180 days is used in respectively 17 and 49 percent of the cases. Dividing the sample further into two time groups, 2001-2004 and 2005-2008, we find that the fractions consisting of 180 days are respectively 43 and 51 percent. Thus, the length of lock-up agreements seems to trend towards a

standardization of 180 days. Field and Hanka (2001) find a similar trend in the US market, where more than 90 percent of the lock-up lengths are exactly 180 days after 1996. We have no complete explanation as to why the standardization seems to lag behind in Norway. However, one plausible explanation is that the US is likely the most researched market in world, and thus one of the early pioneers. Then later, Norwegian firms (more specifically in this case, the underwriters operation in the Norwegian market) will imitate the US trend.

4.1.4 Cross-sectional Differences in Fraction and Length

In order to test for cross-sectional differences in our sample, we divided the full sample into different criterion-determined subsamples. First, we will present the major findings. Then, we will give a short interpretation, as well as relating our results to the findings in other countries, mainly the US. A summary of the results is presented in table 5.

	N	Days Locked	Percentage Locked (%)
Full Sample	174	267 [180]	37.38 [39.01]
Market Value ≥ Median	87	255 [180]	40.00 [43.86]
Market Value < Median	87	279 [180]	34.75 [34.86]
p-value		0.3414	0.1608
Venture Capital-backed	26	209 [180]	41.95 [43.39]
Not Venture Capital-backed	148	277 [180]	36.58 [38.52]
p-value		**0.0467****	0.3068
IPOs before 2001	58	324 [294]	39.56 [41.44]
IPOs after 2001	116	239 [180]	36.29 [37.33]
p-value		**0.0010****	0.4111
Book-to-market ≥ Median	87	264 [180]	39.92 [44.70]
Book-to-market < Median	87	270 [265]	34.83 [34.26]
p-value		0.7918	0.1740
Underwriter Rank ≥ Median	90	247 [180]	33.95 [30.51]
Underwriter Rank < Median	84	288 [265]	41.05 [44.06]
p-value		**0.0935***	**0.05756***

Table 5: Subsamples: Descriptive statistics of subsamples. The numbers reported are average [median]

*** Significant at a 10% level using a two-sided test**

**** Significant at a 5% level using a two-sided test**

Full Sample

The typical firm in our sample locks-up approximately 40 percent of their shares for 180 days. Comparing our findings to studies conducted in the US market, we see that while the typical length of the lock-up agreement is the same, Norwegian lock-up agreements seem to lock-up a smaller fraction of shares than American lock-up agreements, respectively 40 percent and 60-65 percent (e.g. Brav and Gompers 200) and Field and Hanka 2001). In addition, Norwegian firms also seem to lock-up a smaller fraction than German, French and UK firms, who lock-up respectively 52, 59 and 44 percent, according to Goergen, Renneboog and Khursted (2006) and Espenlaub et al. (2001). The finding that Norwegian firms tend to lock-up a smaller percentage of their shares, ceteris paribus, is potentially consistent with the size explanation, e.g. that US firms in average are larger than Norwegian firms.

Size

In order to assess the cross-sectional differences when accounting for firm size, as measured by the market value of equity, adjusted to year 2000 level, we split the sample into two groups. The first group is the firms where the size is larger than or equal to the median. The second group is the firms which are smaller than the median. As documented by several papers, e.g. Brav and Gompers (2000), we find, although not statistically significant, that smaller firms lock-up their shares for a longer period. In addition, the smaller firms lock-up a smaller fraction of their shares. These differences are typically attributed to two explanations. First, smaller firms are potentially associated with higher asymmetric information. Thus, in order to reduce the impact of the asymmetric information, smaller firms are willing to lock-up their shares for a longer time. Second, smaller firms tend to offer a higher percentage of their shares in the IPO, leaving the pre-IPO shareholders with a smaller stake in the company, and thus a smaller percentage locked-up. While we cannot prove these to be exhaustive explanations for the findings, we accept them as plausible explanations for the cross-sectional differences in firm size.

Time

To assess the cross-sectional differences in time, we divided the sample into two subsamples, where the first sample is from 1993 to 2000 and the second sample is

from 2001 to 2008. We see that the early sample of lock-up agreements have statistically significant longer lock-up periods, while there are no significant differences in the percentage of shares locked-up. These findings are contradicting the findings by Brav and Gompers (2000), who found no descriptive time-trend in the US market. One possible explanation for these differences is that they studied a shorter, as well as earlier, time-period.

Venture Capitalist

In order to assess whether there exists any cross-sectional differences when accounting for whether a firm was Venture Capital-backed or not, we split the full sample into two subsamples. The first subsample consists of firms backed by Venture Capitalists, while the second consists of the firms that were not Venture Capital-backed. We find that the firms backed by a Venture Capitalist enter lock-up agreements which are statistically significant shorter than for firms which were not backed by a Venture Capitalist. In addition, while not statistically significant, the Venture Capital-backed firms lock-up a higher percentage of their shares. Although the percentage of firms in our sample backed by Venture Capitalists is considerably smaller than in the US sample used by Field and Hanka (2001), respectively 15 and 48 percent, the findings are similar. Baker and Gompers (1999) find that Venture Capitalists help overcome informational problems and thus reduce the information asymmetry in the firms which they invest in. Further, Brav and Gompers (2000), argues that the potential adverse selection problem should be lower, since Venture Capitalists repeatedly bring companies public, and therefore wish to maintain the reputation they have developed. Accepting these explanations as plausible, we should expect that Venture Capital-backed firms are associated with less asymmetric information and adverse selection, and thus shorter lock-up lengths on average.

Book-to-Market Ratio

Dividing the full sample into subsamples of firms above and below the median book-to-market ratio, we see that firms with high book-to-market ratio have a shorter lock-up length, and also have a higher percentage of their shares locked-up. These findings are consistent with the ones found in the US, where Brav and Gompers (2000) argues that a low book-to-market ratio is associated with higher

information asymmetry, and thus we should expect a longer lock-up period for firms with a low book-to-market ratio.

Underwriter Rank

Again, dividing the full sample into two subsamples, one above and one below the median of underwriter rank, we see that the firms going public using the highest ranked underwriters, have considerably (statistically significant at 10 percent level) shorter lock-up periods and a smaller fraction of their shares locked-up. While the shorter lock-up periods for firms using a higher ranked underwriter are consistent with the findings in the US markets, the smaller fraction locked-up is not. The rationale behind the shorter lock-up period for companies using a highly ranked underwriter is similar to the explanations for venture capital-backed firms. Like Venture Capitalists, underwriters repeatedly bring firms public, and thus should be careful to maintain their reputation. Therefore, a highly ranked underwriter would typically bring a high quality firm, which can be associated with lower information asymmetry and adverse selection problem, public. Because the information asymmetric and adverse selection problem is expected to be lower, there is less need to lock-up the shares for a long period.

In sum, we have shown that the typical lock-up agreement lasts for 180 days and consists of approximately 40 percent of the shares, which is lower than the equivalent fraction documented in respectively France, Germany, UK and the US. In general, we find that the lock-up length is shorter and the fraction of shares locked-up is higher in the subsamples where we expect the information asymmetry and adverse selection problem to be less severe. The reason for this could be that firms associated with a higher degree of information asymmetry tend to sell a higher fraction of their shares in the IPO (e.g. they are on average smaller) and consequently have fewer shares remaining to lock-up. Therefore, they must accept longer lock-up periods. With the exception of underwriter rank, we find that the percentage locked-up is negatively related to the lock-up length. This is identical to the findings of Brav and Gompers (2000), who argues that a firm can commit by either locking-up more shares or be accepting a longer lock-up period.

Having presented data description, sample selection and descriptive statistics, we will now present the methodology.

5 Methodology

In this section, we will present the methodology. First we will present the dependent variables. Then, we present the independent variables, as well as the control variables. Lastly, we will go through and test the underlying assumptions of OLS-regressions.

In the first regression, our main focus will be to test if there are any cross-sectional differences in abnormal return. Through a regression with abnormal returns at expiration as the dependent variable, we can shed light on the first prediction of the commitment hypothesis of lock-ups and the theory of downward sloping demand curves for stocks. It is also economically interesting to explore whether different features of the stock or the lock-up contract can be used to predict abnormal returns and give anomalous evidence against market efficiency.

The explanatory variables will be several firm characteristics and stock characteristics which have received empirical support from existing literature, such as Brav and Gompers (2000/2003), Field and Hanka (2001) and Ofek and Richardson (2000). The variables relevant for the theory of downward sloping demand curves are the ones who can be seen as proxy for the greater number of shares hitting the market at the event day, and include VC-backing, abnormal volume and the percentage of shares locked. The variables relevant for the commitment hypothesis are the stock price volatility, the underwriter ranking, whether there were offered secondary shares in the IPO, whether the firm performed an SEO, the book-to-market ratio and the market value of equity. These variables are relevant since they all have implications for the level of information asymmetry at lock-up expiration. In the regressions for abnormal returns, the control variables include the price run-up of the firm's stock and the number of lock-up days. We have applied the natural logarithm to some of the variables in order to reduce excess skewness and kurtosis.

We will also perform a regression on determinants of lock-up length in order to explore the commitment hypothesis further, and briefly test the additional underwriter compensation hypothesis. In correspondence with Brav and Gompers

(2003) the independent variables are chosen to address issues related to information asymmetry. These include VC-backing, the market value of equity, the book-to-market ratio and the underwriter rank. The regression also includes the control variables percentage of shares locked and a dummy variable for before/after 2001.

5.1 Dependent Variables

Depending on the regression, we have two dependent variables. The first regression has the three-day cumulative abnormal return around lock-up expiration as the dependent variable, while the second regression has number as lock-up days as its dependent variable.

Cumulative Abnormal Return around Lock-up Expiry

The three-day cumulative abnormal return around lock-up expiration is the dependent variable in the first regression analysis. We will calculate the cumulative logarithmic returns from one day prior to one day following the lock-up expiration of each individual lock-up. The 3-day time window we use corresponds to the window used by e.g. Field and Hanka (2001), and the purpose of adding days to the event window is due to the fact that, in some instances, the exact lock-up expiry date is ambiguous. Further, from each individual return, we will then subtract the benchmark index cumulative logarithmic return for the same three days, and this will represent abnormal return around expiration for each lock-up. Initially, we intended to compute the abnormal return using the market model. However, previous literature (e.g. Brav and Gompers (2000), Ofek and Richardson (2000) and Field and Hanka (2001)) consistently use realized return and benchmark index, ignoring the beta, to compute abnormal return. In addition, Kothari and Shanken (1998) find that the economical differences, particularly in the short-run, are small. Thus, we chose our definition of abnormal return as follows:

$$AR_{it} = R_{it} - R_{It}$$

where AR_{it} is the abnormal return of stock i on day t, R_{it} is the logarithmic return of stock i on day t, and R_{lt} is the logarithmic return on the benchmark index I on day t. The variable has been winsorized at the 1 percent and 99 percent tails.

Number of Lock-up Days

The number of lock-up days will be used as a dependent variable in the regression of lock-up length, in order to shed further light on the commitment hypothesis and the additional underwriter compensation hypothesis. The distribution of days is highly clustered around six and twelve months. Consequently, we have applied the natural logarithm to the variable in order to improve its fit with a normal distribution.

5.2 Independent Variables

In order to shed light on the theory of downward sloping demand curves and market efficiency, we have used many of the same independent variables as Field and Hanka (2001) and Ofek and Richardson (2000). To explore the commitment hypothesis of lock-up agreements, we have used many of the same variables as Brav and Gompers (2003).

5.2.1 Testing of Downward Sloping Demand Curves

VC-backing

The first independent variable of our regression is a dummy variable, equal to one if the company is venture capital backed, and zero otherwise. Employing the reasoning of Brav and Gompers (2000), VC-backing proxies for a greater number of shares sold by insiders at lockup expiration, and will thus shed light on the theory of downward sloping demand curves. Gompers and Lerner (1998) report that most VCs are required to distribute securities in the companies that go public once lock-ups expire. The investors of venture capital funds are not considered insiders, and have no restrictions to immediately sell their equity positions. Thus we expect venture capital backing to increase the negative abnormal return, unless this effect is rationally expected by investors. In our sample, we found that 26 of the lock-ups were venture capital-financed, while 148 lock-ups were not.

Three-day Abnormal Volume

The next variable in the regression is the three-day cumulative abnormal volume around the lock-up expiration. If demand curves for stocks are downward sloping, this variable will put a negative pressure on the stock price if investor's prior beliefs are consistently wrong about how many stocks are hitting the market (Brav

and Gompers 2003). Our definition of the abnormal volume corresponds to the definition used by Field and Hanka (2001):

$$3AV_{expiry} = \ln\left(1 + \frac{AV_{expiry}}{AV_{historical}}\right)$$

Where $3AV_{expiry}$ is the three-day abnormal volume around lockup expiration, AV_{expiry} is the three day average volume around lock-up expiration, and $AV_{historical}$ is the three day average volume for day -61 to day -11. Further, the variable has been winsorized at the 1 percent and 99 percent tails.

Percentage of Shares Locked

Similar to the VC-backing variable, this variable is intended to proxy for a greater number of shares to hit the market at the time of the lockup expiration (Brav and Gompers 2000), and will consequently be related to the theory of downward sloping demand curves combined with incorrect prior beliefs of how many stocks are hitting the market. According to theory, we are expecting a negative coefficient for the variable.

The variable will also, in accordance with Brav and Gompers (2000 and 2003) be used as a control variable in the regression of lock-up length, since a firm can commit by either locking-up more shares or accepting a longer lock-up period.

5.2.2 Testing of the Commitment Hypothesis

VC-backing

The variable VC-backing is according to Brav and Gompers (2003), associated with less information asymmetry, and is then expected to play an important role in the regression of lock-up length to test the commitment hypothesis.

Stock Price Volatility

Like Ofek and Richardson (2000), we computed the stock price volatility as the standard deviation of returns from the day of the IPO until day t-6. We also adjusted the stock price volatility into annual terms. This variable will shed light on Brav and Gompers' (2003) commitment-hypothesis for the existence of lock-ups, as price volatility could proxy for information asymmetry. Stock price volatility will thus be applied both in the regression for abnormal returns and in the regression for lock-up length. This variable is also related to the supply side of

the stock due to diversification needs (Ofek and Richardson 2000). The rationale is that a large volatility of the stock price will cause the investor to face greater asset risk, thus wanting to sell the stock to reduce their portfolio risk. Both of the arguments predict a negative price pressure at lock-up expiration from higher stock volatility. We have applied the natural logarithm to the data series, in order to get it closer to a normal distribution.

Underwriter Rank

The variable underwriter rank is used as a proxy for lower information asymmetry, corresponding Brav and Gompers's (2000 and 2003) claim that higher underwriter rank is associated with higher firm transparency. The variable will provide evidence concerning the commitment hypothesis using the regression of abnormal returns. The hypothesis predicts, after controlling for other factors, a smaller price drop for firms with higher underwriter rank.

The underwriter rank will also be used as an independent variable in the regression of lock-up length, since firms with higher information asymmetry have greater potential to take advantage of outside investors, and thus will need to commit with a longer lock-up period. However, the additional underwriter compensation hypothesis predicts the opposite direction, as it claims that high quality underwriters will use their greater prestige to extract more compensation by imposing longer lock-up periods (Brav and Gompers 2003).

The underwriter rank variable is calculated based on each underwriter's respective market share. Our sample period is divided into three sub-periods: 1993-2000, 2001-2004 and 2005-2008. First, for each IPO within a sub-period, the underwriter has been attributed a share equal to the gross proceeds. If several underwriters were involved in the same IPO, the underwriters have been given an equal share of the gross proceeds. Lastly, they have been ranked by their total gross proceeds for the respective sub-period. This ranking method of underwriters corresponds to the method used by Field and Hanka (2001). The underwriter ranking for each period is available in appendix 1. The variable is for regression purposes calculated as follows:

$$Underwriter\ rank = ln(1 + Underwriter\ market\ share)$$

Secondary Shares in IPO

This is a dummy variable equal to one if there were sold secondary shares in the IPO, zero otherwise. Brav and Gompers (2003) argue that insiders selling secondary shares in the IPO are less likely to sell shares at the lock-up expiry, and thus information asymmetry is expected reduced. Consequently, this leads to smaller price drops. Since the variable is related to information asymmetry, the results concerning this variable will provide insight regarding the commitment hypothesis of the existence of lock-ups. In our sample, 84 of the lock-ups were registered with sale of secondary shares in the IPO, while 90 lock-ups were not.

SEO after IPO but Before Lock-up Expiry

This is a dummy variable equal to one if the firm did a seasoned equity offering after the IPO but before the lock-up expiration, zero otherwise. Brav and Gompers (2003) argue that insiders in firms that perform a SEO are less likely to sell shares at the lock-up expiration, and hence reducing the information asymmetry problem. We expect smaller price drops for firms having an SEO after the IPO but before the lock-up expiration. In our sample 42 of the cases included an SEO while 132 did not.

Book-to-Market Ratio

A lower book-to-market ratio is used as a proxy for higher information asymmetry, as pointed out by Brav and Gompers (2000) and will therefore provide testing of the commitment hypothesis. Thus, after controlling for other factors, we expect lower book to market firms to have larger price drops. Moreover, low book-to-market ratios are usually associated by fast growing firms, and it is possible that investors are consistently surprised by high insider sales in such firms, again leading to larger price drops. The natural logarithm is applied to this variable in order to improve the fit with a normal distribution.

Since this variable is associated with information asymmetry, it will also be applied as an explanatory variable in the regression of lock-up length to test the commitment hypothesis.

Market Value of Equity

As pointed out earlier, smaller firms are potentially associated with higher asymmetric information, and are therefore interesting in order to test the commitment hypothesis. After controlling for other factors, we will expect that firms with smaller market value of equity will experience higher price drops. However, Brav and Gompers (2000) and Field and Hanka (2001) do not find significant results from this variable. The natural logarithm of the variable is applied in order to improve its fit with a normal distribution.

The market value of equity variable will also serve as a proxy for information asymmetry in the regression of lock-up length, in order to test the commitment hypothesis.

5.2.3 Control Variables

Run-up

The price run-up variable is used as a control variable in our regression, and is related to the supply side of the share. Odean (1998) finds that investors have a tendency to hold onto losers, and consequently sell winners. Moreover, Ofek and Richardson (2000) argue that the main motivation for selling shares at lock-up expiration seem to be diversification needs. Thus the price run-up can proxy for such diversification needs, as a run-up of an individual share will induce the investors to rebalance their portfolio in order to deal with higher portfolio risk. On the other hand, if investors tend to sell losers due to tax-benefits, there will be selling pressure for the shares that have performed poorly. Empirics will show which effect is the strongest. We have calculated the variable as the price run-up from the offering price until the stock price at day -6. The numbers are based on logarithmic returns data for each stock.

Dummy Variable for Before/After 2001

This variable is only added to the regression of lock-up length, in order to account for the results in the descriptive part, where we found that the early sample of lock-up agreements have statistically significant longer lock-up periods than the most recent lock-up agreements. The dummy variable is assigned a value of 1 for all lock-ups after 2001, otherwise zero. Brav and Gompers (2003) also accounted

for the time effect in their regression of lock-up length, applying an annual time dummy.

Dummy Variable for Lock-up Length Shorter than Predicted

This dummy variable appears in the regression for abnormal returns, and accounts for the effect that if the lock-up length is correctly set, there might be no price reaction at lock-up expiration since the information asymmetry is dealt with. The dummy variable takes the value 1 if the lock-up length is shorter than predicted by the lock-up length regression, zero otherwise. We expect a negative relationship, since shorter lock-ups than predicted might leave some information asymmetry at lock-up expiration to put downward pressure on the stock when insiders exit.

5.3 Testing the Underlying Assumptions of the OLS-procedure

In our research we will employ OLS-regression to explore differences in abnormal returns and to explore determinants of lock-up length, therefore we first assess whether the models fulfill the underlying assumptions of the OLS-procedure.

The consequences of ignoring heteroscedasticity and autocorrelation in the error terms would cause a too easy rejection of the null hypothesis (Brooks 2008). To deal with this problem, each regression suffering from either heteroscedasticity or autocorrelation has been provided with heteroscedasticity and autocorrelation consistent standard errors (HAC), resulting in a more conservative hypothesis testing. This applies to both the regression of abnormal returns and the regression of lock-up length.

The assumption of no multicollinearity is also tested in our models through matrices of correlation for each sample. The correlation-matrix for the explanatory variables in the regression of abnormal returns is available in appendix 2, where we see that the highest correlation is -0.358. We need to be aware that the individual explanatory variables may not be significant since it is potentially difficult to isolate the contribution of each variable. As a consequence, there might be difficult to draw sharp inferences (Brooks 2008). The highest correlation

for the regression of lock-up length is 0.230, which is probably low enough to make reasonable inferences about the individual variables.

Another important assumption underlying the OLS-procedure is the one of normality in the disturbance terms. Initially, we winsorized the excess volume and abnormal returns data at the 1 percent and the 99 percent tails in order to cope with the effect of outliers. We also applied the natural logarithm to several of the variables. However, in the Jarque-Bera test, we had to reject the null of normality at the 5% level for both the regression of abnormal returns and the regression of lock-up length. If we remove more outliers we would only artificially improve the fit of the model. Furthermore, there is to our knowledge no theoretical justification for introducing a dummy variable for extreme abnormal returns at lock-up expiration. Deciding to proceed with the data set, we take notice that the non-normality might have an undue effect on the coefficient estimates (Brooks 2008).

The regressions also embody the implicit assumption that the coefficient estimates are constant through time (Brooks 2008). This assumption is tested on the abnormal returns regression with a cut-off point at primo 2001, and the Chow test reports an F-statistic of 1.04, indicating stable parameters through time. The same test is also applied to the regression of lock-up length, and the Chow test reports an F-statistic of 3.10, which strongly rejects parameter stability at the 1% level. This is consistent with our findings in the descriptive part, that early sample of lock-up agreements have statistically significant longer lock-up periods. To control for this effect, we have added a dummy variable in a second regression to account for IPOs before/after 2001.

Finally, we tested the underlying assumption that the appropriate functional form is linear (Brooks 2008). Initially we applied the natural logarithm to several of the variables in order to deal with possible non-linear relationships. Performing a Ramsey RESET test (Ramsey 1969), we are not able to find any non-linearity in the regression equations either for abnormal returns or lock-up length. The F-statistic reports 2.10 and 0.25 respectively, and we conclude that the linear model is appropriate.

Having presented the methodology, we will present the empirical results we obtained.

6 Empirical Evidence and Interpretation

In this section we present the results and empirical evidence of our analysis, give an interpretation of the results, and then compare our results to the findings in other countries, mainly the US. First, we present the results regarding event-day abnormal return and volume. Then, we proceed with presenting the cross-sectional differences in abnormal returns and the determinants of lock-up length.

6.1 Event-day Abnormal Return and Volume

The first tests we performed were the event-day abnormal return and volume. These tests were intended to test market efficiency, downward sloping demand curves and incorrect prior beliefs/costly arbitrage. A summary of the results are presented in table 6 below.

	N	Fraction CAR Negative (%)	Abnormal Return (%)	Abnormal Volume (%)
Full Sample	174	51	0.35	89.50
p-value			0.5317	**0.0100****
Market Value ≥ Median	87	55	-0.28	69.44
Market Value < Median	87	46	0.97	109.56
p-value			0.2592	0.5612
VC-backed	26	50	-0.99	56.72
Not VC-backed	148	51	0.58	95.26
p-value			0.3129	0.6907
IPOs before 2001	58	48	0.25	94.40
IPOs after 2001	116	52	0.39	87.05
p-value			0.9066	0.9201
BM ≥ Median	87	51	0.84	125.37
BM < Median	87	51	-0.14	53.63
p-value			0.3756	0.2982
U.R. ≥ Median	90	56	0.13	83.12
U.R. < Median	84	45	0.58	96.35
p-value			0.6812	0.8482
Price has Risen	82	57	-0.04	50.29
Price has Fallen	92	45	0.69	124.45
p-value			0.5073	0.2830

Table 6: 3-day Abnormal Return and Volume

*** Significant at a 10% level using a two-sided test**

**** Significant at a 5% level using a two-sided test**

Full Sample

For the full sample, we find that the 3-day abnormal return is positive, being 0.35 percent, and statistically insignificant. Further, we find a statistically significant and positive 3-day abnormal volume of 89.50 percent. In order to determine whether the increased trading volume is only temporary or permanent, we compared the average trading volume prior to the event (day -61 through -11) with the average trading volume following the event (day 11 through 42). We find

a statistically significant increase in trading volume of 85 percent, thus the abnormal volume seems to be permanent rather than mean-reverting. The positive abnormal return is contradicting the findings in the US, where a negative event-day abnormal return is widely documented. The positive abnormal volume, on the other hand, is corresponding with the evidence from the US market, where e.g. Field and Hanka (2001) found an event-day abnormal volume of 80 percent and a permanent increase in trading volume of 40 percent. We note, however, that while the temporary abnormal volume is similar to our findings, the permanent and long-term increase in trading volume seems to revert more in the US. A possible explanation for this difference is that we use a slightly shorter time-window, and thus might not capture the entire reversion effect.

As earlier noted, the exact lock-up expiry dates are, in some instances, ambiguous. Therefore, as a robustness test, we have explored abnormal return and volume for other time windows, such as 5-day and 6-day. The results are presented in table 7 below.

Time window	**Abnormal Return (%)**	**Abnormal Volume (%)**
3-day [-1 to +1]	0.35	89.50
p-value	0.5317	**0.0100****
5-day [-2 to +2]	0.42	70.42
p-value	0.4808	**0.0000*****
6-day [0 to +5]	-1.49	57.19
p-value	**0.0335***	**0.0124****

Table 7: Robustness test of Abnormal Return and Volume. Numbers in brackets represent the event window, where 0 is the expiry date.

*** Significant at a 10% level using a two-sided test**

**** Significant at a 5% level using a two-sided test**

***** Significant at a 1% level using a two-sided test**

We see that the results are virtually unchanged with respect to the 5-day abnormal return and volume. In contrast, the 6-day abnormal return, which is the abnormal return from day 0 to day +5, is negative and both significantly and economically significant. There are several possible explanations for the negative 6-day event window. First, in our sample, small firms often experience several consecutive

days with no trading. Consequently, by expanding the event window, the likelihood of trades of small firms increase, thus influencing the abnormal return. Second, investors may need some time to organize and/or facility the sale of their shares, thus creating a gap between the practical (the day they actually start selling shares) and theoretical (the day which they are allowed to start selling shares) lock-up expiry. In that case, the price reaction should be visible in the days following the expiry. In particular, a gap between the sale of shares and the lock-up expiry is reasonable for VC-backed firms, where the VC must distribute the shares to their own investors before the sale happens.

Brav and Gompers (2000) argue that, in an efficient market, investors should guess the number of shares sold at expiry correctly on average. Consequently, some returns should be positive and some should be negative at expiry, but on average the abnormal return should be insignificantly different from zero. In this context, we see that approximately half of the returns in our sample are negative, and that the abnormal return is insignificantly different from zero. Based on our results, it therefore seems that investor's prior beliefs are correct, and we thus conclude that our results give support to the efficient market hypothesis. In contrast, although we cannot dismiss the theory, we find no support for downward sloping demand curves. In addition, we find no support for costly arbitrage.

Size

To assess whether there are any differences when accounting for size, we divided the full sample into two groups, one above and one below the median. We see from the results that the firms with market value above the median have a negative abnormal return of 0.28 percent, and the firms below the median have a positive abnormal return of 0.97 percent. While the differences are not statistically significant, they are economically interesting. The observation that large firms seems to have a relative lower abnormal return than smaller firms at expiry is consistent with the results from the US. More specifically, Brav and Gompers (2000), find that abnormal return is lower (i.e. more negative) for firms where information asymmetry and adverse selection problem is less severe, such as larger size. Further, we find that smaller firms have a higher abnormal volume than larger firms, respectively 109.56 and 69.44 percent. These results are contradicting the observations from the US market, where they found that larger

firms had higher negative abnormal return. A possible explanation why our results, with respect to abnormal volume, differ from the results in the US market is that we have not found any proof for a negative correlation between return and volume in our data. As we pointed out in the descriptive statistics part, larger firms lock-up a higher percentage than smaller firms, respectively 40 and 34 percent. Larger firms will therefore have a larger fraction unlocked at the expiry date, and thus have a larger amount of shares available for trading. The results obtained, with respect to size, is therefore potentially supporting downward sloping demand curves. In order to test the robustness of the data, we also explored the 5-day abnormal return and volume. The results were consistent with the 3-day results.

Venture Capitalist

In order to examine the effect of Venture Capital-backing, we divided the full sample into two subsamples, one with and one without Venture Capital-backing. We find that firms backed by a Venture Capitalist experience an insignificant, but economically interesting, negative abnormal return of 1 percent. Firms without VC-backing, on the other hand, experienced a positive abnormal return of 0.58 percent. The evidence that Venture Capital-backed firms experience a relative lower abnormal return is widely documented in the US, e.g. by Bradley et al. (2001). Further, we see VC-backed firms experience a lower 3-day abnormal volume than firms without VC-backing, respectively 57 and 95 percent. This is contrary to the findings made by Brav and Gompers (2000) in the US market, which found that the abnormal volume was higher for VC-backed firms. Assessing the robustness of the findings, we also explored the 5-day abnormal return and volume. We then find that the abnormal volume is higher for VC-backed firms, which is exactly the same as found in the US. Gompers and Lerner (1998) note that many Venture Capitalists are required to distribute the shares in the firm going public to their own investors once the lock-up expires. We believe that a potential time-lag from the initiation until the completion of the transfer can potentially explain why the 3-day abnormal volume is lower for VC-backed firms, while the 5-day abnormal volume is higher. Brav and Gompers (2000) further argue that the investors in the VC-firms often have an automatic sell-policy when receiving the distributed shares, and therefore contributing to the negative abnormal return. In contrast, we find that when VCs potentially distribute and

their own investors subsequently sell the shares, the 5-day positive abnormal return is higher for the VC-backed firms than for firms not VC-backed, respectively 1 and 0.32 percent. A possible explanation for this is that we did not find a negative correlation between return and volume. The results, where higher abnormal volume seems to give a higher positive abnormal return, gives no support to the downward sloping demand curve theory.

Time

Dividing the sample into two subsamples, consisting of the IPOs before and after 2001, we find that both subsamples have positive abnormal returns. There does not seem to be any significant differences with respect to time-trend, and the results are consistent with the 5-day abnormal return and volume. Further, the results are consistent with the results from the US, e.g. Brav and Gompers (2000).

Book-to-Market Ratio

Examining the firms with book-to-market ratio above and below the median we see that firms with a lower BM-ratio experience lower abnormal return than firms with a high BM-ratio, although the differences are not statistically significant. This is consistent with the commitment hypothesis by Brav and Gompers (2003), which predicts that firms with higher information asymmetry (i.e. low BM), in general, are associated with a lower abnormal return at expiry. Further, we see that firms with a higher BM-ratio are associated with higher abnormal volume. Again, this can potentially be explained by the fact that we do not find a negative correlation between return and volume. In addition, testing the robustness of the findings, the results are consistent when looking at the 5-day abnormal return and volume. We have earlier documented that firms with high BM-ratio locks-up a larger fraction of their shares, and seen in light of both higher abnormal return and volume, when comparing to firms with low BM-ratio, we find no support for downward sloping demand curve.

Underwriter Rank

Dividing the full sample into two subsamples, above and below the median of underwriter rank, we find that firms going public with the highest ranked underwriter experience, although insignificant, lower abnormal return and volume than firms going public with a low ranked underwriter.

The lower abnormal return is inconsistent with the prediction that firms with low information asymmetry and low adverse selection problem (i.e. going public with a highly reputable underwriter), in general, is associated with higher abnormal return. However, the results for the lower abnormal return are consistent with the initial findings of Brav and Gompers (2000), while the lower abnormal volume is not. The 5-day abnormal return is consistent with the 3-day abnormal return. However, looking at the 5-day abnormal volume, we find that the abnormal volume for the firms using the highest ranked underwriter is slightly higher than for firms using a lower ranked underwriter.

Price Run-up

We define the price run-up as the cumulative return from the IPO-day to the lock-up expiry day. We then sorted the firms into subsamples, conditional upon whether the firm had experienced as positive run-up (i.e. price has risen) or a negative price run-up (i.e. price has fallen). We find that firms where price has risen experience a relative lower, although statistically insignificant, abnormal return than firms where the price has fallen. This finding is consistent with what Field and Hanka (2001) document in the US. We further see that abnormal volume is higher when the price has fallen. A possible explanation for this is the lack of negative correlation between return and volume in our data. In general, our results are potentially inconsistent with Odean (1998), who finds that investors have a tendency to hold onto losers, and consequently sell winners. Defining the firms with a negative price run-up as losers, we see that they have, contrary to previous findings, an economically significant higher abnormal volume than the winners (i.e. firms where price has risen). We can think of two plausible explanations as to why this is the case. First, pre-IPO shareholders and insiders might want to cash out at the first opportunity, as they may fear the stock price to decline further, making their claim less valuable. Second, investors might perceive it as a good opportunity to purchase a significant stake in the firm for a desirable price. In addition, testing the robustness of the data, the results remain the same when looking at the 5-day abnormal return and volume.

Exploring the 3 and 5 day event-window at lock-up expiration, we have shown that the average abnormal return for the full sample is positive, although not

statistically significant. We have also shown that the abnormal volume is large, positive and statistically significant. Further, the positive abnormal volume does not seem to revert back to mean, and therefore the increase in trading volume seems to be permanent. While the increased trading volume is consistent with the findings in other countries, the positive abnormal return is not. However, examining the cumulative abnormal return for the period 10 days prior to and 10 days following the lock-up expiration (table 8), we find a negative buy-and-hold return (Figure 1). Plotting the abnormal volume for the same time period (Figure 2), we find that, not surprisingly, the trading volume trend upwards. In addition, from the figures, it seems that a relatively steep decline in cumulative abnormal return is immediately followed by an increase in trading volume.

Days from expiry	AR (%)	t-statistics	CAR (%)	t-statistics
-10	0.12	0.92	0.12	0.92
-9	-0.12	-0.33	0.00	0.69
-8	0.00	0.02	0.00	0.59
-7	0.05	0.23	0.05	0.69
-6	-0.15	-0.16	-0.10	0.45
-5	-0.65	-1.42	-0.75	-0.14
-4	-0.44	-1.25	-1.19	-1.46
-3	0.39	1.02	-0.80	-0.88
-2	0.30	1.01	-0.50	0.11
-1	0.29	0.64	-0.21	0.33
0	-0.01	-0.62	-0.22	0.00
+1	0.26	0.82	0.03	0.30
+2	-0.49	-1.73	-0.45	-0.24
+3	-0.14	-0.22	-0.60	-0.29
+4	-0.54	-1.57	-1.13	-0.83
+5	-0.56	-1.46	-1.69	-1.67
+6	0.13	0.28	-1.56	-1.57
+7	0.01	-0.05	-1.55	-1.60
+8	0.09	0.36	-1.46	-1.32
+9	-0.60	-1.73	-2.05	-1.77
+10	0.02	0.09	-2.04	-1.73

Table 8: Event-day abnormal return

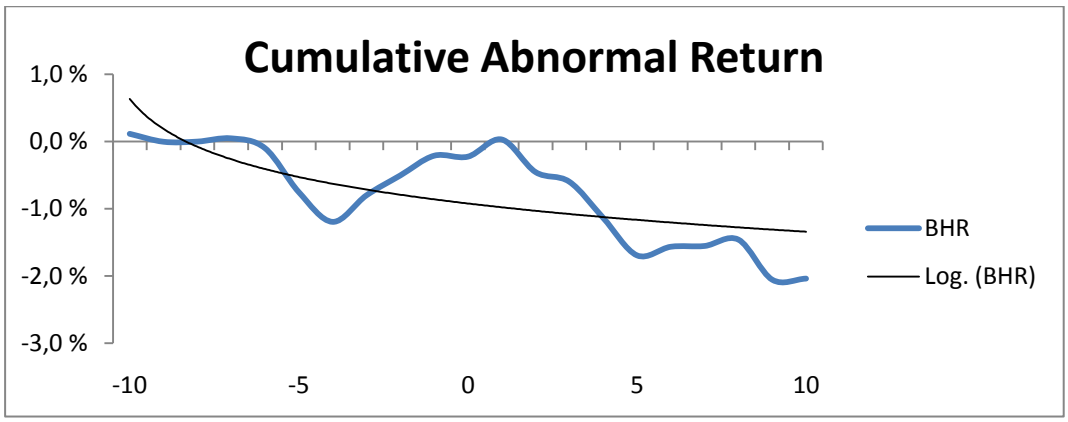

Figure 1: Cumulative Abnormal Return for the period t-10 through t+10.

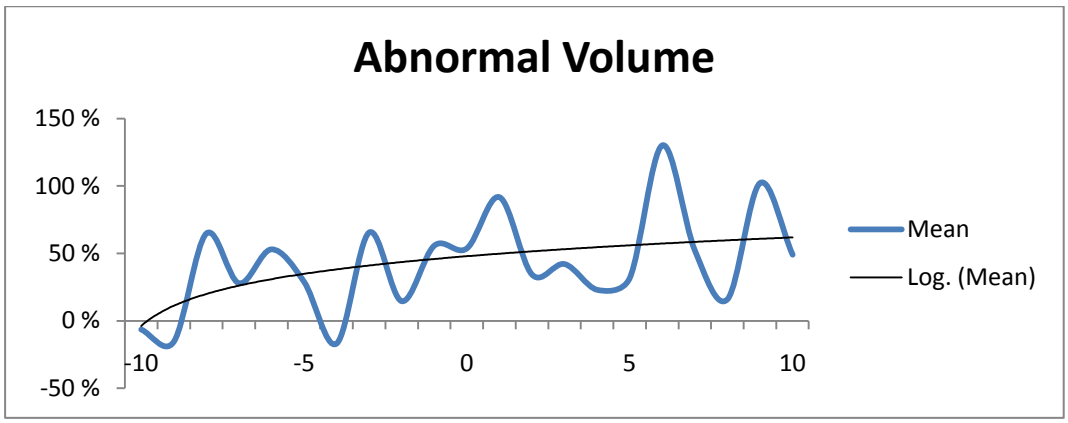

Figure 2: Abnormal Trading Volume for the period t-10 through t+10.

As pointed out earlier, previous empirical results show, contrary to the theoretical prediction (e.g. Brav and Gompers 2003), that firms where information asymmetry and adverse selection problem is less severe, would experience a relative lower abnormal return than firms associated with high information asymmetry and adverse selection problem. We find that this is the case for the larger firms, venture capital-backed firms and for firms using the highest ranked underwriters. In contrast, firms with a high book-to-market ratio experience higher abnormal return than firms with a low BM-ratio. In general, we find that a higher abnormal return is associated with higher abnormal volume. As we did not find a negative correlation between abnormal return and volume, this does not seem too surprising, even though it is contradicting the empirical results from other countries, mainly the US. In addition, we find that firms with a positive price run-up experience lower abnormal return than firms with a negative price run-up. Apart from the size subsample, we find little to no support for downward sloping demand curves. In general, and based on our results, we find that investor's prior beliefs are correct, and we cannot dismiss the efficient market hypothesis, and thus we conclude that the market appears to be efficient.

6.2 Cross-sectional Differences in Abnormal Returns

Even though the results from testing abnormal returns around expiration were rather ambiguous, it is still worthwhile to explore the cross-sectional differences in abnormal returns at lock-up expiration after controlling for other factors. This way we can test the first prediction of the commitment hypothesis regarding information asymmetry, and also test whether demand curves for stocks slope downward.

The regression for abnormal returns is applied to three different event windows in order to provide robustness to the results. The results are shown in table 9[2]:

	Abnormal return		
	3-day [-1 to +1]	**5-day [-2 to +2]**	**6-day [0 to +5]**
Intercept	0.078 (1.27)	**0.123**** (2.38)	-0.147 (-0.94)
Log (1+ Three day A.V.)	0.003 (1.15)	0.003 (1.12)	**0.007*** (2.04)
Underwriter rank	-0.084 (-1.77)	-0.0002 (-0.003)	-0.046 (-0.67)
Log (Book-to-market ratio)	0.002 (0.32)	0.010 (1.55)	-0.018 (-1.35)
Log (Market value of equity)	**-0.015***** (-3.53)	**-0.010*** (-2.09)	**-0.020*** (-2.18)
Log (Stock price run-up)	0.007 (0.71)	-0.005 (-0.37)	0.008 (0.47)
Log (Std dev of stock returns)	-0.019 (-0.98)	0.011 (0.58)	-0.082 (-1.34)
Fraction of post-IPO shares locked up	0.002 (0.10)	-0.002 (-0.07)	0.047 (1.37)
Dummy variable for SEO after IPO but before lock-up expiration	-0.022 (-1.88)	-0.014 (-0.89)	-0.015 (-0.81)

[2] In unreported results we run the regression with an interaction term for the VC-variable and the abnormal volume variable. The interaction term was not statistically significant (t-value 1.022), and the term was omitted in order to improve interpretation of the other variables.

Dummy variable for secondary shares in IPO	-0.022 (-1.94)	-0.022 (-1.94)	-0.010 (-0.69)
Dummy variable for VC-backing	-0.015 (-0.92)	0.008 (0.50)	-0.057 (-1.62)
Dummy variable for lock-up length shorter than predicted	0.013 (1.16)	0.010 (0.92)	0.011 (0.58)
Adjusted R2	0.078	0.036	0.156
N	174	174	174

Table 9: Regression results for cumulative abnormal return around lock-up expiration (Dependent variable: Abnormal return around lock-up expiration). The regressions have White heteroskedasticity consistent coefficients and standard errors. T-statistics in parentheses.

*** Significant at a 10% level using a two-sided test**

**** Significant at a 5% level using a two-sided test**

***** Significant at a 1% level using a two-sided test**

In general, the results provide little in support of the commitment hypothesis. The variables relevant for testing of the commitment hypothesis are the ones related to information asymmetry. These include the underwriter rank, the book-to-market ratio, the market value of equity, the stock price volatility, whether there were offered any secondary shares in the IPO, and whether the firm performed an SEO within the lock-up period. The prediction is that variables indicating a higher information asymmetry will be negatively related to abnormal returns. Our results show that the book-to-market variable supports the commitment hypothesis for the three- and five-day event window, the volatility variable supports the commitment hypothesis for the three- and six-day event window, but none of these results are significant. Further, the rest of the information asymmetry variables points in the opposite direction. Most importantly, the market value of equity variable goes in the opposite direction for all of our samples, and is also statistically significant. Note that although this is inconsistent with the commitment hypothesis, Brav and Gompers (2003) experienced the same results with this variable. The results are also consistent with our discussion of size in the section of Event-day Abnormal Return and Volume. The dummy variable of lock-up length is positive for all the event-windows. This means that a lock-up length shorter than predicted by our lock-up length regression yields a positive abnormal return, although statistically insignificant. This is also opposite to the argument of

information asymmetry. In any case, we conclude that our regression results provide little support in favor of the commitment hypothesis.

With respect to testing of downward sloping demand curves for stocks the regression provides ambiguous results. The first variable abnormal volume is expected to be negatively related to abnormal returns but this is not the case for any of our event-windows[3]. The relationship is positive, and is significant for the six-day event window. This is however consistent with Ofek and Richardson's (2000) argument about liquidity effects; if there is increased liquidity in a stock, the stock price should rise. The second variable, the fraction of post-IPO shares locked up is expected to have a negative relationship with abnormal returns, but this is only the case for the five-day event window, however not statistically significant. The third variable, VC-backing is expected to have a negative relationship with abnormal returns and this is the case for the three- and six-day event window, although not significant. These results are in general inconclusive with respect to whether demand curves for stocks slope downward. The negative coefficient of stock price volatility in the three- and six-day event window is, according to Brav and Gompers (2003), potentially consistent with costly arbitrage since higher volatility will limit the ability of arbitrageurs to profit from short selling before the lock-up expiration.

All in all, we believe that the reason for our ambiguous results is mainly because of high degree of stock market efficiency. We find little evidence to make predictions about abnormal returns around lock-up expiration. We do however acknowledge the fact that the findings regarding lock-ups in the US had much higher sample sizes. The sample of Norwegian IPOs may be too small to bring meaningful results from the returns data at lock-up expiration.

[3] In unreported results, we test the robustness of this result. In accordance with Ofek and Richardson (2000) we test the correlation between abnormal return and excess volume in the 6-day event window [0 to +5], where there was a significant cumulative abnormal return of -1.49% (p-value 0.0335). The results displayed a positive but insignificant correlation of 0.12 (t-stat. 1.55). Qualitatively the results remain the same.

6.3 Determinants of Lock-up Length

Next, we explore the determinants of lock-up length by testing the commitment hypothesis, additional compensation hypothesis and the signaling hypothesis.

6.3.1 Commitment and Additional Underwriter Compensation Hypothesis

We will now explore the determinants of lock-up length in order to test the second prediction of the commitment hypothesis, claiming that a higher degree of information asymmetry leads to longer lock-up periods. We will also briefly test the prediction of the additional underwriter compensation hypothesis, that lock-ups are longer for firms going public with high quality underwriters. This regression corresponds to the regression of lock-up length by Brav and Gompers (2003). The results are presented in table 10:

	Log (Number of lock-up days)	
Intercept	**5.590***** (29.46)	**5.703***** (24.07)
Dummy variable for venture backing	**-0.239**** (-2.49)	**-0.185*** (-2.16)
Log (Market value of equity)	-0.034 (-1.38)	-0.03 (-1.07)
Fraction of post-IPO shares locked up	0.126 (0.74)	0.098 (0.59)
Log (Book-to-market ratio)	-0.089 (-1.68)	-0.069 (-1.62)
Underwriter rank	-0.114 (-0.22)	0.034 (0.07)
Dummy variable for before/after 2001		**-0.193*** (-1.99)
Adjusted R2	0.024	0.048
N	174	174

Table 10: Regression results for lock-up length (Dependent variable: Log (Number of lock-up days)). The regressions have White heteroskedasticity consistent coefficients and standard errors. T-statistics in parentheses.

*** Significant at a 10% level using a two-sided test**

**** Significant at a 5% level using a two-sided test**

***** Significant at a 1% level using a two-sided test**

The results of the first regression provide some support for the second prediction of the commitment hypothesis, as all the variables associated with lower information asymmetry have a negative relationship with lock-up length, but only the VC-variable is statistically significant. In the second regression we have accounted for the time effect, and we see that the effect is significant. Qualitatively, the results remain the same, except that the relationship between underwriter rank and lock-up days turns positive, but still not significant.

The results, however, provide little in support of the additional underwriter compensation hypothesis. After accounting for time effects and information asymmetry the underwriter rank is positive but far from significant. Overall, the results are consistent with to the findings of Brav and Gompers (2003).

6.3.2 Signaling Hypothesis

Brav and Gompers (2003) argue that investors are unable to separate firms based on signal prior to the submission of the IPO prospectuses. However, since the lock-up length and the percentage of shares locked-up are specified in the IPO prospectuses before the IPO, investors should be able to observe the signal subsequent to the submission of the IPO prospectuses, and high-quality firms should therefore be able to revise the IPO offering price, in order to extract a higher price.

We test the signaling hypothesis by creating two subsamples. The first subsample is consisting of firms with a positive price revision, defined by the difference between the actual offering price and the midpoint of the initial offering range, indicating a high-quality firm. The second subsample is the firms with a negative price revision, indicating low-quality firms. In addition, we excluded firms where the midrange offering price was equal to the actual offering price.

According to the first prediction we made from the signaling hypothesis, we expect that high-quality firms lock-up their shares for a longer period than low-quality firms. Contrary to the prediction, we find by examining the results, presented in table 11, that the opposite is the case. In fact, while not statistically significant, firms with a positive price revision lock-up their shares for a shorter period than firms with a negative price-revision. Thus, we find no support for the

evidence of the signaling hypothesis. The lack of support for the signaling hypothesis is similar to the findings of Brav and Gompers (2003). It can further be argued that the percentage of shares locked-up is a signal of quality in itself. However, as the percentage locked-up is practically identical for both subsamples, we conclude that the percentage locked is unrelated to the price revision, and therefore confirming the lack of support for the signaling hypothesis.

Price revision	N	Days Locked	Percentage Locked (%)
Positive	25	238	41.08
Negative	38	262	41.63
p-value		0.2399	0.4659

Table 11: Signaling Hypothesis – Price revision from midpoint initial offer range to final offer price.

*** Significant at a 10% level using a one-sided test**

**** Significant at a 5% level using a one-sided test**

The second part of the signaling hypothesis predicts that firms with longer lock-up length should have a higher probability of having a subsequent SEO. In order to test the second prediction, we made two subsamples of firms above and below the median lock-up length. In addition, we excluded the firms where the lock-up length was equal to the median. Contrary to the prediction, we see by examining the results, presented in table 12, that firms with a lock-up length shorter than the median had a higher probability of having a subsequent SEO. These results are similar to what Brav and Gompers (2003) discovered. Therefore, while the results are not statistically significant, they provide no empirical support for the signaling hypothesis. Further, Brav and Gompers (2003) argue that firms with a short lock-up length should lock-up a higher fraction of their shares. However, examining the results we see that the opposite is true. In fact, firms with a lock-up length above median lock-up a significantly higher percentage than firms with lock-up length below median.

	N	Days Locked	Percentage Locked (%)	Probability of SEOs (%)
Length > Median	81	385	35.35	64.20
Length < Median	26	124	27.71	69.23
p-value		**0.0000*** **	**0.0884***	0.3212

Table 12: Signaling Hypothesis

*** Significant at a 10% level using a one-sided test**

**** Significant at a 5% level using a one-sided test**

***** Significant at a 1% level using a one-sided test**

Having found no support for the signaling hypothesis, we therefore conclude that it seems unlikely that the length of the lock-up agreements is used by insiders to signal firm quality. This conclusion is consistent with the findings of Brav and Gompers (2003).

7 Conclusion

In our research, we find that the Oslo Stock Exchange seems to be efficient, as there appears to be no significant price reaction around the lock-up expiry, and therefore we find some support for the efficient market hypothesis. Consequently, there are no arbitrage opportunities. There are several possible explanations as to why we did not find a negative abnormal return. The first, and probably the most prominent explanation is that there may have been early release of shares by the underwriter with we are unable to observe. Second, the numbers of observations with lock-ups in the Norwegian market is relatively low. Lastly, Norwegian firms lock-up a relatively smaller fraction of their shares than what researchers have shown from empirical studies in other countries. In addition, we found a permanent increase in trading volume of approximately 85 percent, thus we find no support for the theory of downward sloping demand curves.

Further, we have found some support for the commitment hypothesis. More specifically, we found that lock-up length is shorter and the fraction of shares locked-up is higher for firms where information asymmetry and adverse selection problem to be less severe. In addition, we have found that the percentage locked-up is negatively related to the lock-up length. Thus, a firm can either commit by locking-up more shares or be accepting a longer lock-up period. On the other

hand, we found no support for the signaling and additional underwriter compensation hypothesis.

Lastly, we found that the typical Norwegian lock-up agreement consists of approximately 40 percent of the outstanding shares and lasts for 180 days.

While we have not explored these areas, we have a few suggestions for further studies of lock-up agreements in the Norwegian market. First, it might be useful to explore whether there exist any cross-sectional differences between firms with and firms without lock-ups, in order to shed further light on the explanation for the existence of lock-ups. Second, examine if, and to what extent, there has been early release from lock-up agreements. Third, the model we used for the signaling hypothesis was relatively simple. A potential extension can be to construct a more formal model, such as Brau, Lambson and McQueen (2005). Fourth, explore if there are any differences with respect to the forecasts of affiliated and unaffiliated analysts in Norway, such as Brav and Gompers (2000). Lastly, if newer and more extensive research on Norwegian lock-up agreements is able to documents a significant price decline, it may be useful to study potential price pressure and microstructure effects as a explanation for the price reaction.

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9 Appendices

9.1 Underwriter Rank

Manager	1993-2000	2001-2004	2005-2008
Pareto	0,0083	0,0207	0,1582
Sundal Collier	0,0039	0,0638	0,1353
Carnegie	0,0152	0,0069	0,1340
DnB	0,2866	0,4849	0,1326
Enskilda	0,0017	0,2224	0,0945
UBS	0,0000	0,0000	0,0757
Credit Suisse	0,0387	0,0000	0,0714
Glitnir	0,0000	0,0000	0,0305
Fondsfinans	0,0023	0,0010	0,0218
Morgan Stanley	0,0715	0,0000	0,0205
Nordea	0,0000	0,0098	0,0160
Kaupthing	0,0000	0,0000	0,0102
CAR	0,0000	0,0000	0,0095
First	0,0000	0,0187	0,0095
Terra	0,0000	0,0007	0,0093
Goldman Sachs	0,2803	0,0000	0,0063
Lehman	0,0000	0,0000	0,0063
Alfred Berg	0,0481	0,0000	0,0020
Handelsbanken	0,0000	0,0017	0,0013
Nordnett	0,0000	0,0000	0,0011
SPB Midt-Norge	0,0000	0,0000	0,0007
Fearnley	0,0447	0,0000	0,0005
Netfonds	0,0000	0,0010	0,0000
Christiania	0,0039	0,0000	0,0000
Orkla	0,0070	0,0000	0,0000
Karl Johan	0,0096	0,0000	0,0000
Deutsche Bank	0,0000	0,0000	0,0000
Norse	0,0093	0,0000	0,0000
Orion	0,0000	0,0000	0,0000
Elcon	0,0016	0,0000	0,0000
Kristiania Fonds	0,0387	0,0000	0,0000
Noka Securities	0,0074	0,0000	0,0000
Danske Securities	0,0150	0,0000	0,0000

9.2 Correlation Matrix

	Ln(1+AV	Underwr. rank	Ln(BM)	Ln(MV)	Ln(Runup)	Ln(SD)	% locked	SEO after IPO	SS	VC	Length dummy
Ln(1+AV)	1,000	0,055	0,012	0,195	0,082	-0,268	-0,061	0,148	-0,057	0,035	-0,005
Underwriter rank		1,000	0,119	0,084	0,024	-0,066	-0,115	0,105	-0,219	0,012	0,048
Ln(BM)			1,000	0,081	-0,037	-0,067	0,039	0,024	-0,152	-0,071	0,069
Ln(MV)				1,000	0,106	-0,358	0,230	0,024	0,049	-0,048	-0,026
Ln(Run-up)					1,000	-0,338	0,128	-0,058	0,089	0,035	0,010
Ln(SD)						1,000	-0,162	0,056	-0,172	0,066	-0,005
% locked							1,000	-0,169	0,195	0,078	0,022
SEO after IPO								1,000	-0,169	-0,161	0,044
SS									1,000	0,176	0,076
VC										1,000	-0,036
Length dummy											1,000

9.3 List of All Firms

List of all companies using lock-up agreements in our sample period, market value of equity is adjusted for 2000 level.

Company	IPO	MV of Equity
24SevenOffice	2007	159 279 203
Ability Drilling	2007	712 632 040
Ability Group ASA	2006	2 629 523 832
ACL Atlantic Container Line AB	1994	746 191 513
Acta Holding ASA	2001	683 409 890
Active 24	2004	202 093 491
Aker Floating Production	2006	1 557 850 467
Aker Kvaerner	2004	6 481 958 922
Aker Seafoods	2005	1 288 612 254
Akva Group	2006	539 884 822
Algeta	2007	644 361 265
Allianse ASA	2005	263 278 063
Aqua Bio Technology	2008	143 476 572
ARROW Seismic ASA	2007	1 466 414 418
AS Eltek	1998	520 838 220
Austevoll Seafood	2006	6 358 069 274
Axxessit ASA	2004	462 939 214
Badger Explorer ASA	2007	556 039 262
Bergen Group	2008	1 054 293 810
Bergesen Worldwide Offshore Ltd.	2006	4 448 202 769
Biotec Pharmacon ASA	2005	492 417 354
Bjørge	2004	285 629 378
Block Watne Gruppen	2006	1 484 350 042
Bluewater Insurance ASA	2005	262 666 252
Bouvet	2007	394 957 841
Camillo Eitzen & Co	2004	997 346 531
Catch Communications ASA	2004	587 030 680
Cecon ASA	2007	942 908 474
Cermaq ASA	2005	3 739 017 159
Choice Hotels Scandinavia	1997	1 118 006 989
Clavis Pharma	2006	567 051 556
Codfarmers	2006	344 869 371
Computer Advances Group ASA	1996	280 802 819
Consafe Offshore	2005	2 674 191 268
Conseptor	2004	295 420 485
Consorte	2001	238 618 289
ContextVision	1997	359 217 791
Copeinca ASA	2007	1 613 189 292
CRI-Gruppen	1998	114 313 950

Customax	2000	643 610 323
Deep Ocean	2005	1 070 407 950
Deep Sea Supply	2005	501 296 495
Dockwise	2007	4 700 423 516
Dolphin Interconnect Solutions ASA	2006	163 697 777
DynaPel Systems	2005	44 732 312
EDB - Elektronisk Databehandling ASA	1997	316 048 389
Eidesvik Offshore	2005	1 381 765 856
Eitzen Chemical	2006	4 342 799 490
ElectroMagnetic GeoServices ASA	2007	9 506 282 985
Enitel ASA	1999	1 888 603 073
Etman International	2007	75 855 923
Exense ASA	2000	138 000 000
Expert Eilag ASA	2000	1 992 982 560
Factor Eiendom	2006	1 948 066 015
Findexa	2004	4 707 041 262
Fjord Seafoods	2000	3 685 072 765
Fred Olsen Production	2007	2 336 890 826
Fred. Olsen Energy	1997	11 762 494 888
Funcom	2005	518 780 897
Future Information Research Management	2005	276 025 816
Geo ASA	2005	2 129 363 054
Global Geo Services	2000	495 000 000
Global IP Solutions	2008	193 237 262
Grenland Group	2005	553 814 046
Grieg Seafood ASA	2007	1 599 429 815
HafslundInfratek	2007	669 893 866
Havila Shipping ASA	2005	545 291 095
Ige Nordic AB	2007	286 249 254
Infostream_ASA	1999	258 583 785
Int_Gold_Exploration	1997	48 844 990
Intellinet	2000	331 551 330
Interoil_Web_Prospekt	2006	590 329 418
Iplast	1997	603 181 504
Jøtul	1994	146 988 248
Kongsberg Automotive	2005	1 928 428 703
Kredittkassen	1993	7 186 120 223
Lerøy Seafood Group	2002	902 750 372
London Mining	2007	1 573 090 396
Luxo	1998	400 160 878
Mamut ASA	2004	263 012 897
Marine Farms	2006	4 121 397 656
Media & Research Group	2005	124 730 148
Medi-Stim	2004	185 910 182
Navamedic ASA	2006	100 117 587
NEAS ASA	2007	222 741 990

NetCom	1996	4 860 296 645
NextGenTel Holding	2003	524 404 211
NorCool Holding	1997	352 906 130
Noreco (Norwegian Energy Company)	2007	3 468 173 731
Norema	1998	418 702 249
Norkom	2000	235 200 000
Nortrans Offshore Limited, USD	1998	474 750 000
Norway Seafoods ASA	1997	3 854 518 295
Nutri Pharma	2000	4 136 471 337
Oceanteam Power & Umbilical ASA	2007	800 438 997
Odim	2005	316 257 332
Odim Hitec	2001	570 138 341
Opera Software ASA	2004	1 031 264 828
Opticom	1997	1 437 572 773
Otrum Electronics	1998	807 075 000
PA Resources AB	2001	84 726 109
Pan Fish	1997	705 986 227
PC Lan	1999	521 458 734
Pertra ASA	2006	1 532 696 291
Petrojack ASA	2005	400 857 287
Petrojarl	2006	2 756 265 563
PetroMENA ASA	2007	1 900 121 823
PhotoCure	2000	2 591 600 000
Polimoon	2005	750 164 579
Powel	2005	263 607 928
Protector Insurance ASA	2007	1 379 204 151
Q-Free	2002	716 332 155
Questerre Energy	2005	97 641 036
REM Offshore ASA	2007	1 515 806 832
Remedial Offshore PCL	2008	779 657 855
Renewable Energy Corporation ASA	2006	51 816 389 573
Revus Energy	2005	1 330 880 033
RGI	1996	5 251 854 590
Romreal	2007	1 051 385 780
ScanArc	2007	1 151 462 226
SeaBird Exploration LLT	2006	1 680 352 281
Seamteam Tech ASA	1997	923 394 683
Selmer AS	1995	733 484 214
Sense Communications International	2000	1 210 908 000
Sevan Marine	2004	603 823 151
Spits	2006	100 356 078
Statoil ASA	2001	146 633 747 702
Stavdal Maskinutleie	1998	581 684 262
Stepstone	2000	11 022 508 950
Synnøve Finden Meierier	1998	267 054 260
System etikettering AS	1993	226 098 377

TeleComputing ASA	2000	1 616 942 513
Telenor	2000	72 086 075 960
Telio Holding	2006	490 817 014
Thraneguppen ASA	1997	286 427 215
Trefoil	2005	1 323 570 644
Trolltech	2006	801 621 170
Ulstein Holding	1997	2 378 630 184
Wavefield Inseis ASA	2007	5 438 629 522
Wega Mining	2007	1 384 567 411
Wilson ASA	2005	777 768 365
Yara International	2004	15 169 987 467

9.4 Preliminary Thesis Report

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Preliminary Thesis Report

Initial Public Offerings (IPOs), lock-ups and market efficiency

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Table of Contents

Introduction

According to Ofek and Richardson (2000), only around 15-20 percent of the total shares outstanding are offered to the public through Initial Public Offerings (IPOs), thus the majority of the shares are held by insiders and other pre-IPO shareholders.

Typically, insiders possess more information about the firm than outside investors. Due to the information asymmetry between traders, and the fact that the value of a firm going public is always connected with a degree of uncertainty, there is a risk that a single large shareholder trying to sell his shares in the first week of trading could be interpreted by the market as a sign of stock overpricing, and thus send the stock price downward, to the detriment of all shareholders.

To prevent the market from getting flooded with too much supply of a company's shares too rapidly, insiders and other pre-IPO shareholders are often, for a prespecified time, prohibited from selling their shares. This contractual agreement between underwriters and existing shareholders (such as founders, executives, employees and venture capitalists) is a phenomenon referred to as lock-up or lock-up agreement. The length of lock-ups varies from 90 days to 2 years, though the most common length is 180 days. In addition to temporarily constraining the supply of stocks, lock-ups can, potentially, serve as a commitment device and a signal of firm quality.

The terms and lengths of the lock-ups are included in the IPO prospectuses, making the expiration date of lock-ups publicly available information, therefore making lock-ups a completely observable event. Thus, assuming market efficiency, it should be expected that the effect and information regarding lock-ups should be fully reflected in the stock price. However, Ofek and Richardson (2000) found in their study of the American Stock Market a stock price decrease of 1-3 percent, while average trading volume increased with 40 percent at the time of lock-up expiration.

Similar studies have been conducted by Field and Hanka (2001), where they found a statistically three-day abnormal return of -1.5 percent, and a permanent increase in average trading volume of 40 percent when lock-ups expire.

While research papers such as Ofek and Richardson (2000), Field and Hanka (2001) and Brav and Gompers (2003) have provided some evidence from the US market, there has, to our knowledge, been committed little to none effort into research of the effect of lock-ups at the Oslo Stock Exchange.

Therefore, throughout this paper we want to examine whether there exists a significant relationship between stock price and lock-up expiration in the Norwegian Market, and whether it is possible to predict and/or exploit the abnormal return at lock-up expiration. In addition, among possible extensions to our research can be to develop and test different hypotheses to find explanations as to why this is the case.

In order to proceed with our analysis of the effect lock-ups have on IPOs in the Norwegian Market, we will collect and analyze data from Oslo Stock Exchange for the period 1997 to 2009, as well as going through the prospectuses from the IPOs to learn about the lock-up terms and conditions.

In our thesis we will first present key findings from existing literature and previous studies. We will then use the key findings as motivation and tools to develop hypotheses. Then we will proceed to describe the intended process for data and sample selection. Lastly, we will provide a brief evaluation of our progress and a plan for further research.

Theoretical background

In this section we will start by briefly defining key concepts for our research. We will then present and review the most significant literature available on lock-up effects of IPOs and the empirical findings.

Definitions

Initial Public Offering

An Initial Public Offering (IPO) refers to the first sale of a private company's shares to the public, and is often associated with the private firm being listed, and thereafter, publicly traded on a stock exchange, such as the Oslo Stock Exchange (OSE). Among benefits of going public is easier and cheaper access to capital, as well as making the company's shares more liquid, thus enabling founders and other long-time insiders to cash-out for their work.

Lock-up

A lock-up, often called lock-up period, lock-up agreement, or lock-in, refers to a prespecified time period following an IPO where insiders and other pre-IPO shareholders are not allowed to sell their shares. The length of the lock-up period is typically 180 days, though it varies from 90 days and up to 2 years.

Abnormal Return

In our paper, abnormal return refers to the difference between a single stock and an index's (e.g. OBX) performance at given time t.

Excess Trading Volume

Abnormal daily trading volume, or excess volume, refers to the difference between a single firm's daily mean trading volume in the lock-up period, and the daily average trading volume at lock-up expiration.

Having defined the key concepts, we will proceed with presenting and reviewing existing literature.

Literature review

In the efficient market hypothesis, Fama (1970) suggests that stock prices fully reflect all available information on a particular stock and/or market. Thus, investors cannot take advantage in predicting stock returns because no one has access to information not already available to everyone else. In this context, the study of lock-ups is particularly interesting because lock-up expiration is a

completely observable event and should, according to Fama, already be fully reflected in the stock price.

Scholes (1972) represents one of the early works, suggesting that demand curves for stocks are downward sloping, thus challenging theories based on the no arbitrage condition. More specifically, if demand curves for stocks are downward sloping, this implies that firms issuing shares are not only price takers, but they are also able to influence share price by regulating the amount of shares outstanding. This would challenge the dividend policy and capital structure irrelevance theorems of corporate finance, developed first and foremost by Modigliani and Miller (1958 and 1961).

Levin and Wright (2006) argues that downward sloping demand curves for stocks are inconsistent with the traditional view of market efficiency, that stock prices are determined only by expectations of future cash flows and the discount rate. Further, by estimating the slope of the demand curve using an econometric model and market maker's transaction data for specific stocks, they are able to provide empirical support for downward sloping demand curves for stocks. However, other studies, such as Mikkelson and Partch (1985), Holthausen, Leftwich and Mayers (1990) and Keim and Madhavan (1996), are only able to provide ambiguous empirical evidence for the existence of downward sloping demand curves for stocks.

As the length of the lock-up period is clearly stated in the IPO prospectus, making the event completely observable, investors should, according to market efficiency, on average correctly predict the stock price at expiry. The study of lock-up expiration could therefore potentially provide useful information regarding the hypotheses of downward sloping demand curves, market efficiency and the capital structure irrelevance theorem. A significant change in stock price at lock-up expiration would imply anomalous evidences against the efficient market hypothesis. Further, since additional stocks are released for trading in the market at lock-up expiry, a significant price drop would provide support for the theory of downward sloping demand curves for stocks and evidence against the capital structure irrelevance theorem.

In their paper, Ofek and Richardson (2000) investigate excess trading volume and price patterns at the expiration of lock-up periods, and test whether they find any evidence for market efficiency and/or downward sloping demand curves. They emphasize that, as the length of lock-ups is publicly available, the information should already be fully reflected in the stock prices prior to lock-up expiry. Through their research, they are able to document a stock price decline of 1-3 percent, while trading volume increases with about 40 percent. They conclude that the decline in stock prices provides new anomalous evidence against market efficiency. They explore several possible explanations, such as bid-ask bounce, liquidity effects and biased expectations of supply shocks. However, they find little support for these explanations. In addition, they also attempt to empirically explain the cross-sectional differences in abnormal return between different firms. They find that certain variables, such as stock price volatility, are clearly associated with larger stock price drops at lock-up expiration. Even though they are able to find a significant drop in stock prices at expiry, they conclude that there are no arbitrage opportunities.

In their paper, Field and Hanka (2001) reports a permanent 40 percent increase in average trading volume and a statistically prominent three-day abnormal return of -1.5 percent. They find that the abnormal return and excess volume are larger when the firm is financed by venture capitalists. They also find that venture capitalists sell more aggressively than insiders and other pre-IPO shareholders. In addition, they find limited support for several their hypotheses, but no complete explanations.

The findings of Field and Hanka are supported by Bradley et al. (2001), which find that firms backed by venture capital are associated with significant negative abnormal returns at lock-up expirations. Further, they document that within the group of venture capital backed firms the largest losses occur for "high-tech" firms, firms with highest stock price increases since the IPO, the largest relative trading volume around lock-up expiration, and firms using the highest quality underwriters.

However, we find that not all studies of lock-up expiry coincide with the results from the studies conducted in the US. Espenlaub et al. (2001) find no statistically

significant abnormal return at the expiry of lock-up agreements in the UK market. Similar conclusions are made by Goergen, Renneboog and Khursted (2006) regarding the French and the German markets.

Brav and Gompers (2000) represent one of the pioneer explorers in the use of lock-up agreements. They explore the motivation for the lock-ups by examining the structure and how it affects underpricing at the time of the IPO. Further, they explore the price reaction and trading activity at the time of the lock-up expiration. In addition, they explore the recommendations of affiliated and unaffiliated analysts around the time of expiration. Their paper finds support for the theory that lock-ups serve as commitment mechanisms at the time of the IPO, and that IPO underpricing is higher for firms with longer lock-up period and firms that lock up a larger fraction of their shares. They find an average abnormal return of -1.2% at the time of lock-up expiry, and that the abnormal return is greater for firms that lock up a greater fraction of their shares, and for firms that are backed by venture capitalists. They imply that the stock price drop challenges the framework of rational expectations, and that it is potentially consistent with downward sloping demand curves for stocks and/or investors' incorrect prior beliefs.

Brav and Gompers (2003) extend their previous work, and develop three different hypotheses regarding reasons for the existence of lock-up agreements. They explore whether lock-ups serve the purpose of being a signaling mechanism for firm quality, a commitment device to alleviate problems of moral hazard or a mechanism for underwriters to extract additional compensation from the issuing firms. While they find support for the commitment hypothesis, they find little support for the signaling hypothesis. The rejection of the signaling hypothesis is considerably challenged by Brau, Lambson and McQueen (2005). They argue that the dismissal of the signaling theory is at best premature. By developing the hypothesis into a formal model, they are able to provide support for the signaling hypothesis, and conclude that the signaling theory continues to possess both theoretical and empirical merit.

Having reviewed most of the interesting existing literature, we continue with developing hypotheses.

Hypotheses

During our paper we will discuss and explore a few hypotheses.

Hypothesis 1

The first hypothesis is based on the traditional view of efficiency in the stock market. Investors form rational expectations, and since all information about the terms and length of the lock-up is fully available, it should be embedded in the stock price at the first day of IPO trading and prior to lock-up expiry. Thus investors will not systematically fail in their pricing of the stock, and there should be no significant price reaction at lock-up expiration. Moreover, as a consequence of Modigliani and Miller (1958), firms issuing shares are price takers and the supply of shares has no impact on the stock price. This leads us to the hypothesis of no statistically significant price reaction at the time around lock-up expiration. We can therefore formulate the first hypothesis as follows:

There will, on average, be zero abnormal return in the time around the lock-up expiration.

Hypothesis 2

The competing hypothesis is inspired by the research and empirical findings of Ofek and Richardson (2000), Field and Hanka (2001) and Brav and Gompers (2000), which document a statistically significant negative abnormal returns on the time around lock-up expiration. The theory of downward sloping demand curves for stocks suggests and supports a negative abnormal return. At the event of lock-up expiration a significant number of shares are suddenly released to the market, causing a positive shift in the supply curve of stocks. With downward sloping demand curves this implies a drop in the stock price. From this we form a competing second hypothesis:

There will, on average, be negative abnormal returns in the time around the lock-up expiration.

Possible extensions

As the existing empirical results are ambiguous with respect to different countries, we are uncertain which hypothesis we will find most empirical support for. We are aware there may be a need to extend our research and provide additional

hypotheses. Among additional hypotheses, we have hypotheses intended to explain differences in firm characteristics leading to differences in abnormal returns (e.g. firms with venture capital backing suffer higher negative abnormal return, etc). Note also that downward sloping demand curves imply negative abnormal returns, but one cannot conclude the other way around. The reason for this is that there are other possible explanations for abnormal returns, including bid-ask bounce, liquidity effects and biased expectations of supply shocks. We can also extend our research to assess whether it is possible to exploit arbitrage opportunities.

Having formulated our hypotheses, we will now present the methodology.

Methodology

The central issue of our thesis is to test whether there is abnormal return around the time of lock-up expiration. We will do this by collecting returns from the days around the lock-up expiration of each individual firm. Each return will then be subtracted by the index return for the same day, and this will represent abnormal return at expiration for each firm. Our definition of abnormal return is corresponding with the one of Ofek and Richardson (2000):

$$AR_{it} = R_{it} - R_{It}$$

where AR_{it} is the abnormal return of stock i on day t, R_{it} is the return of stock i on day t, and R_{It} is the return on the index I on day t. There are two ways of analyzing the lock-up expiration. We can calculate abnormal return for the lock-up day only, or we can calculate abnormal return for days prior and days following the expiration. At this point, we aim to explore both alternatives, in order to see how well the market accounts for the event of lock-up expiration. Finally, the data series of abnormal returns will be regressed upon a mean. If the mean proves to be significantly negative, hypothesis 2 is supported from our data set, otherwise hypothesis 1 is supported. We intend to apply standard OLS-procedure, but we will need to assess whether the assumptions behind the OLS-procedure is sufficiently satisfied in order to make a final assessment.

After obtaining the test results, our main focus will be to find explanations for the cross-sectional differences in abnormal return, in order to develop possible predictions. This will be done through a regression with abnormal returns at expiration as the dependent variable. The explanatory variables will be several firm characteristics and demand differences which have received empirical support from existing literature, such as Ofek and Richardson (2000) and Brav and Gompers (2000). Among possible relevant variables are the number of lock-up days, a dummy variable for venture capital backing, total return from offering price, standard deviation of stock return, daily trading volume, stock price at day -5, the equity value, the percentage of shares locked, standard deviation of analyst earnings forecast, book to market ratio and underwriter ranking.

Depending on the results, we have a few possible extensions to our research. If we are able to find evidence for a drop in stock price at expiry, we want to test whether the abnormal return is arbitrageable. An assessment of this may focus on the bid-ask spread, shorting possibilities and/or how many of the individual lock-up expiration events which actually experience negative returns.

Another potential extension to our research is to sort the sample into different groups, such as long and short lock-up periods, and assess whether there are any differences among the groups.

Having briefly presented the methodology we are going to use, we will explain how we intend to gather our data and sample selection.

Data

We intend to gather our sample from IPOs on the Oslo Stock Exchange for the period 1997 to 2009. We will further collect data from IPO prospectuses from the Department of Finance at BI Norwegian School of Management, in addition to a database on IPOs provided by BI Norwegian School of Management. We intend to collect the following information: Date of IPO, issue price, lock-up length and the date of lock-up expiration.

We will also collect additional data from the Oslo Stock Exchange (OSE), like daily return on stock indices, individual stock price development and trading volume. We intend to gather these data by e.g. Thomson Reuters Datastream.

Further, we intend to exclude firms with no lock-up period and firms with long lock-up periods (more than 365 days) from the sample selection. In addition, to avoid price discreteness, we will consider excluding firms with very low stock prices. The sample selection exclusion process is in correspondence with the one proposed by Ofek and Richardson (2000).

If a statistically significant price drop at lock-up expiry is evident, a possible extension is to explore the cross-sectional differences between firms. This will require additional data, such as the standard deviation of analysts forecast, which underwriter is used, whether the firm is venture backed or not, the stock price volatility over the lock-up period, and firm descriptive information like stock price level and size of the firm.

If we find no statistically significant drop in stock prices, we may extend our research to alternative areas of lock-up research, like Brav and Gompers' (2003) investigation of the reason for the existence of lock-ups, and the determinants of lock-up length. Again, this will require additional data, such as the number of shares locked up, the number of primary and secondary shares offered, book to market ratios, cash flow margins, and the percent of company's shares issued in the IPO.

Evaluation and Progression

Overall, we are satisfied with our progression. We have reviewed a large amount of the literature which we have found relevant for our thesis topic. For now, we have not gathered, or attempted to gather any data. Thus, we are aware, and to some extent even expect, that it may be required that we further expand our literature review.

We are also aware that previous studies on International Capital Markets may not be transferable to the Norwegian Market, thus we might have to revise and do changes to the methodology, data and sample selection if we find no statistical significant results supporting our hypotheses. Needless to say, we are excited and optimistic regarding further progression.

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