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IPO Lockup Length and its Implication for Post-IPO Performance

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ABSTRACT

Using a sample of 730 US IPO firms that went public between 2001 and 2011, this paper investigates the implication of lockup length for post-IPO performance over three time periods: (1) initial returns, (2) long-run abnormal returns, and (3) abnormal returns around lockup expiration date. Two theoretical frameworks are used to give predictions and explain the results - the signalling hypothesis and the commitment hypothesis. Our finding shows that that IPO firms with lockups longer than 180 days will have lower initial returns; IPO firms with lockups longer than 180 days perform significantly worse than firms with shorter lockups; IPO with firms with lockups longer than 180 days have significant positive abnormal returns at and around lockup expiration date. The first finding is consistent with the prediction of the signalling hypothesis and the second finding is consistent with the prediction of commitment hypothesis, the third finding, however, does not support the prediction of both hypotheses.

Keywords: IPO, lockup length, underpricing, long-run performance, lockup expiration
JEL Classification: G14, G32

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1. Introduction

Lockups agreement are contracts between the underwriters and corporate insiders wherein the firm's management and other pre-IPO investors are not allowed to sell their shares for a pre-specified period of time. After the lockup period ends, both management and pre-IPO shareholders are allowed to enter the market and unload their holdings. The widely accepted motivation for introducing lockups is to prevent oversupply of shares from hitting the market at once. And by restricting shares, lockup agreements ensure the public that insiders continue to hold a significant interest in the firm (Bartlett, 1999).

One of the interesting features about lockup agreements is the fact that many economists have constantly observed negative abnormal returns at and around lockup expiration (Bradley et al., 2004; Brav and Gompers, 2003; Ofek and Richardson, 2000). This evidence contradicts the efficient market theory. Since terms of the lockup, including its length, expiration date and number of shares locked, are all specified in the prospectus and, therefore, making the lockup expiration an observable event. Accordingly, there should not be any abnormal returns around lockup expiration.

Another interesting feature about lockup agreements is the diversity regarding contractual characteristics across the universe. Research shows that in some countries, lockup agreements are mandatory while in other countries lockup agreements are voluntary. For instance, in the UK, lockup agreements vary from 85 days to 1650 days. Contrary to the UK, the Netherlands implement a minimum lockup period of 365 days, France and German all implement a minimum period of 180 days (Hoque, 2011). Unlike European market where the lockup agreements are mandatory and the lengths may vary, lockup agreements are primarily voluntary in the US. Although most lockups are concentrated at 180 days, it varies from IPO to IPO.

The US trend towards a standardised lockup length of 180 days gives us excellent opportunity to investigate the post-IPO performance of firms that choose to depart from 180 days market equilibrium - especially when a longer lockup length comes at a cost of illiquidity and non-diversification to insiders. In addition, there has been a debate in the literature about the motives behind variations in lockup length. Previous literature provides support for two competing hypotheses: (i) signalling and (ii) commitment. The signalling hypothesis suggests that insiders lock-up their shares for a longer period of time to signal their quality to outside investors (Brau et al., 2005; Hoque, 2011). Alternatively, the commitment hypothesis suggests that insiders of firms that are associated with greater potential for moral hazard lock-up their shares for a longer period to alleviate the concerns of investors (Brav and Gompers, 2003). Furthermore, the above-mentioned studies seem to neglect the possible implication of lockup length for post-IPO performance from which we can obtain new insight into variations in lockup length.

The main purpose of this study is not to address the motivation behind variations in the lockup length. Rather, we extend the signalling-commitment theory to predict the implication of lockup length for post-IPO performance. The signalling and commitment hypothesis can predict the implication of lockup length for post-IPO performance differently. For instance, according to signalling hypothesis, all the information about the length of lockup agreements is specified in the prospectus. Accordingly, high-quality firms will be able to adjust its offer price upwards before the offering after investors have observed the signal in the IPO prospectus, thus a longer lockup length will be negatively correlated with underpricing (initial returns). On the other hand, if the commitment hypothesis is correct, then a longer lockup period might actually indicate severer moral hazard problems. However, none of these means very much for investors when they invest in IPO for the short-term, because insiders of firms with greater potential for moral hazard incentives have been "locked" for a longer period of time. In this setting, there should not be a significant difference between the initial returns for firms with longer and shorter lockups. Specifically, we investigate post-IPO performance over three periods: (1) initial returns, (2) long-run abnormal returns, and (3) abnormal returns around lockup expiration date. This approach enables us to combine the results of previous studies and analyse the effect of lockup length on post-IPO performance comprehensively.

Our empirical results confirm that length of lockup agreements significantly influences the post-IPO performance. More specifically, we find that IPO firms with lockups longer than 180 days have a significantly negative effect on initial returns and long-run abnormal returns. The former is in line with the prediction of signalling hypothesis. And the latter is in line with the prediction of commitment hypothesis. Furthermore, we document significant positive abnormal returns at and around lockup expiration for firms with lockup periods longer than 180 days, which contradicts the prediction of commitment hypothesis and the US studies where the negative abnormal returns surrounding lockup expiration are constantly documented. The impact of multiple lockup periods (more than one lockup period) on post-IPO performance is also analysed. However, we do not find any statistically meaningful effects on post-IPO performance.

By examining the implication of lockup length for post-IPO performance, this paper contributes to the existing literature in the following ways. First, the relationship between lockup length and post-IPO performance remains unexplored and has never been subjected to a sufficient degree research. Second, this paper gathers additional empirical evidence for the presumed discrepancy between signalling and commitment hypothesis. Third, and most importantly, we present new evidence about post-IPO performance anomaly. Additionally, the examination of the effect of multiple lockups on post-IPO performance has never been done before. This paper analysed this unexplored area of research.

The remainder of this paper proceeds as follows: The next chapter presents the literature review and hypothesis development. Chapter three presents the research methodology used to test the effect of lockup length on post-IPO performance as well as the explanation of variables. Chapter four presents the sample selection criteria and descriptive statistics. Chapter five presents the findings of the study. Chapter six presents the summary of the findings, followed by the limitations of this study and directions for future research.

2. Literature review

This chapter presents the overview of the currently available literature that is relevant to the topic. Section 2.1 presents the literature on IPO underpricing and long-run underperformance. Section 2.2 presents the literature on IPO lockup agreements. Section 2.3 focuses on the development of our hypotheses.

2.1 Post-IPO performance

The post-performance of IPO firms has attracted considerable attention in prior studies because of the wealth of initial investors in various countries that are involved. Post-IPO performance commonly evaluated in the literature over two time periods: short-run performance and long-run performance. IPO initial returns, also referred to as underpricing, is widely accepted as the norm in short-run performance and is also a worldwide phenomenon. IPO long-run underperformance is generally accepted as typical of long-run performance, but it is not as widespread as IPO underpricing. Since the research is aiming at investigating the impact of lockup length on post-IPO performance, we first review previous literature on IPO underpricing and IPO long-run underperformance.

2.1.1 IPO underpricing

Dimovski and Brooks (2004) argue that the price of new issues being below the price at which the shares subsequently trade is known as underpricing. The terms "underpricing" and "initial returns" have been used interchangeably by academics (Ritter and Welch, 2002). IPO underpricing is defined as the percentage change from the offer price to the first-day closing price of an IPO. According to Loughran and Ritter (2003), underpricing is considered as "money left on the table" which implies the transfer of wealth from the issuing firms to IPO initial investors. Ritter[1] provides a compilation of the equally weighted average initial returns reported by various empirical studies in 18 countries worldwide, which he updates on yearly basis. This is presented in Table 1.

Table 1. Equally weighted average initial returns for 18 countries

Sources: http://bear.cba.ufl.edu/ritter/Int2015.pdf
Note: where more than one set of authors is listed as source of information, combined sample sizes have been constructed. Average initial returns are constructed in different manners from study to study. The average initial returns are equally weighted average returns, which are calculated using issue prices and first day closing prices.

Country	Source	Period	Size	Return
Australia	Lee, Taylor & Walter; Woo; Pham; Ritter	1976-2011	1,562	14.80%

[1] http://bear.cba.ufl.edu/ritter

Brazil	Aggarwal, Leal & Hernandez; Saito	1979-2011	275	33.10%
China	Chen, Choi, & Jiang; Jia, Xie & Zhang	1990-2013	2,512	118.40%
France	Husson & Jacquillat; Leleux & Muzyka; Paliard & Belletante; Derrien & Womack; Chahine; Ritter; Vismara	1983-2010	697	10.50%
Germany	Ljungqvist; Rocholl; Ritter; Vismara	1978-2011	736	14.20%
Greece	Nounis, Kazantzis &Thomas; Thomadakis, Gounopoulos & Nounis	1976-2013	373	50.80%
India	Marisetty and Subrahmanyam; Ritter	1990-2011	2,964	88.50%
Indonesia	Suherman	1990-2014	464	24.90%
Ireland	Dealogic	1991-2013	38	21.60%
Malaysia	Isa; Isa & Yong; Yong; Ma; Dealogic	1980-2013	474	56.20%
New Zealand	Vos & Cheung; Camp & Munro; Alqahtani; Dealogic	1979-2013	242	13.60%
Norway	Emilsen, Pedersen & Saettem; Liden; Dealogic	1984-2013	209	8.10%
Poland	Jelic & Briston; Woloszyn	1991-2014	309	12.70%
Rusia	Dealogic	1999-2013	64	3.30%
Spain	Ansotegui & Fabregat; Alvarez Otera; Dealogic	1986-2013	143	10.30%
Turkey	Kiymaz; Durukan; Ince; Kucukkocaoglu; Elma	1990-2013	399	9.70%
United Kingdom	Dimson; Vismara; Levis	1959-2012	4,932	16.00%
United States	Ibbotson, Sindelar & Ritter; Ritter	1960-2014	12,702	15.90%

As shown in Table 1, it can be noticed that developing countries experienced a higher degree of underpricing compared to developed economies, with the average initial returns beyond 25% (e.g. Malaysia, Indonesia, Brazil, China, and India). Meanwhile, the average initial returns for developed countries are between 10-15%. Under efficient market hypothesis, all publicly available information will be reflected immediately in the current stock price. Therefore, it is not possible for investors to generate abnormal returns using already public information (Malkiel and Fama, 1970). However, since evidence shows that underpricing virtually exists in almost every financial market. Thus one must either reject the efficient market hypothesis or choose to believe that issuers intentionally underprice their shares.

Economic literature provides three main theories for IPO underpricing. The first theory considered in this study is information asymmetry. Rock (1986) presents a model of underpricing where he splits investors into two groups: the informed investors and the uninformed investors. According to his model, uninformed investors are assumed to submit orders for all IPOs, because they cannot distinguish between profitable and unprofitable IPOs. Consequently, uninformed investors submitting orders in profitable IPOs will encounter the risk of receiving smaller allocation due to the participation of informed investors. In contrast, the chance of uninformed investor receiving an allocation in unprofitable IPOs is high as informed investors do not participate in these issues. This disadvantageous position is known as the winner's curse. To compensate uninformed investors for the winner's curse, IPOs need to be underpriced to keep them active in the market.

The second theory of underpricing examines the relationship between the underwriters and issuing firms. Baron (1982) develops a model of underpricing based on of principal-agent theory. According to his model, the issuers are less informed than the underwriters. As a result, the issuers are unable to monitor the underwriter's activity without incurring costs. To induce optimal use of the underwriter's superior information about investor demand, the issuers can compensate the underwriters by delegating them the right to price the IPO and letting them gain from underpriced shares. In other words, the issuing firms leave some money on the table for the underwriters to induce them to act in the best interest of the issuers.

The third theory of underpricing is the signalling theory, Allen and Faulhaber (1989) present a signalling model in which firms with excellent future prospects find it optimal to signal these prospects by intentionally underprice their shares. IPO underpricing represents a loss that only high-quality firms can expect to recover, while low-quality firms cannot afford to do the same. High quality firms believe that they will recoup the loss of underpricing from seasoned equity issue.

2.1.2 IPO long-run underperformance

Most of the recent papers documented IPO underpricing as a short-run phenomenon as it will disappear as soon as the information about the true value of the firm is disclosed to the public. Unlike underpricing, IPO underperformance is a long-term phenomenon. Most empirical studies show that long-run performance of IPOs seems to be poor and the returns to the initial investors prove to be negative. Table 2 provides a summary of the findings.

Table 2. Summary of literature on IPO long-run underperformance

Author	Country	Sample Period	Number of IPO	Methodology	Main Finding
Gompers and Lerner (2003)	US	1935-1972	3661	Event-time-buy and hold Abnormal Returns and Cumulative Abnormal returns	The sample displays some evidence of underperformance when event-time-buy-and-hold abnormal returns are used. However, the underperformance disappears when cumulative abnormal returns are utilized.
Aggarwal and Rivoli (1990)	US	1970-1990	4753	Event-time-buy and hold Abnormal Returns	The sample displays some evidence of two-year negative abnormal returns for investors buying shares at the day-1 closing price and investors buying shares at the IPO price.
Loughran and Ritter (1995)	US	1970-1990	4753	Event-time-buy and hold Abnormal Returns	The sample displays some evidence of three-year and five-year negative abnormal returns of -60% for IPO and seasoned equity issuing (SEO) firms.

Ritter and Welch (2002)	U.S.	1980-2001	6249	Event-time-buy and hold Abnormal Returns	The sample displays evidence of three-year negative abnormal returns of -23.4% (relative to market).
Kooli and Suret (2004)	Canada	1991-1998	445	Value-weighted (VW) cumulative abnormal returns and Event-time-buy and hold Abnormal Returns	The sample displays some evidence of underperformance when the VW cumulative abnormal returns are used. However, the underperformance is less pronounced when buy-and-hold abnormal returns are utilized.
Jaskiewicz et al. (2005)	Spain and Germany	1990-2001	810	Event-time-buy and hold Abnormal Returns	The sample displays some evidence of three-year negative abnormal returns of -32.8% and -36.7% for German firms and Spanish firms respectively. However, they do not find underperformance for family owned IPO firms in relation to non-family owned IPO firms.
Schuster (2003)	Germany, Switzerland, Spain, France, Italy, Netherlands, Sweden	1988-1998	973	Event-time-buy and hold Abnormal Returns and matched portfolio approach	The sample displays some evidence of underperformance during period of 1988-1995. However, the underperformance disappears during the period of 1995-1998.
Levis (1993)	UK	1980-1988	712	Event-time-buy and hold abnormal returns + set of matching firms	The sample displays some evidence of three-year negative abnormal returns. However, the magnitude of underperformance is more pronounced when account is taken of the superior performance of smaller firms.

As presented in Table 2, numerous literatures across the world have confirmed the existence of IPO long-run underperformance. However, as noted by Ritter and Welch (2002), the results of long-run performance studies are highly sensitive to the chosen methodology and the choice of a sample period. For instance, Gomper and Lerner (2003) documented a significant underperformance of IPOs between 1935 and 1972 when the buy-and-hold abnormal returns (BHAR) method is used. However, this finding disappeared when the cumulative abnormal returns (CAR) method is used. Moreover, Schuster (2003) find that IPOs between 1995 and 1998 did not underperform.

The theoretical explanations for IPO underperformance are less developed than those for underpricing. However, the next behavioural theories have been proposed to explain the long-run underperformance of IPOs. The first explanation considered in this study is the pseudo market timing hypothesis (Schultz, 2003). As many firms go public when their valuation is at peak, this consequently leads to more clustering of IPOs around valuation peaks. As a result, IPO underperformance is merely a statistical illusion caused by clustering of IPOs after a period of unusual high abnormal returns (the hot-issue periods).

The second explanation for IPO long-run underperformance is the divergence of opinion hypothesis (Miller, 1977). This theory argues that investors who are most opportunistic about the future returns of

the IPO will be the buyer whereas pessimistic investors will not participate in the offering. As the time passes, more information becomes publicly available, the divergence of opinion between pessimistic and optimistic investors will narrow, and therefore the share price will fall.

The third explanation for long-run underperformance is the speculative bubble hypothesis (Aggarwal and Rivoli, 1990). This theory argues that there is emerging 'speculative bubble' in the aftermarket in response to the large first-day initial returns to compensate uninformed investors for their allocation disadvantage (winner's curse). This speculative appetite of the market may temporarily increase the price of IPO issues in the aftermarket. When the speculative demand declines, this bubble should burst and negative excess returns are expected on post-IPO shares.

However, the efficient market theory seems to challenge the existence of long-run underperformance. If markets are efficient, share prices of newly issued firms should adjust to their fundamental value quickly. Thus, no shares are consistently underperformed or outperformed (Malkiel and Fama, 1970).

2.2 IPO lockup agreements

Most academic literature concerning lockup agreements focus itself on the US market. Since this study uses a sample of US firms, the characteristics of US lockup agreements must be mentioned. First, in most US IPOs, owners tend to offer around 15%-20% of the total firm shares. Leaving the remaining 80-85% shares to be locked-up for a pre-specified period of time (Ofek and Richardson, 2000). Second, the Security Exchange Commission (SEC) does not impose any regulation concerning lockup agreements. This means that the management and pre-IPO investors "voluntary" enter to lockup agreements with the underwriters. Interestingly, while firms can choose whether to implement lockups or not, 80-90% of US IPOs have lockup length equal to 180 days (Bradley et al., 2004). However, they could not provide a clear explanation for this. Mohan and Chen (2002) state that the 180 days lockups seem to be the norm and any departure from the 180 days equilibrium can influence investor uncertainty about firm value. After lockup period ends, insiders are permitted to sell their shares. Interestingly, recent studies have documented anomalous stock returns around lockup expiration. These studies are discussed below.

2.2.1 Abnormal returns around lockup expiration

Brav et al. (2000) represent one of the first studies in the research of lockup agreements. They explore the share price reaction around lockup expiration. By plotting average abnormal buy-and-hold returns over 21 event days from day -10 to day +10, they find negative abnormal returns of 1.25% on the lockup expiration date. Later on, Ofek and Richardson (2000) conducted a similar study as Brav et al. (2000).

They observe significant drop in returns averaging at 1.15% and permanent shift in volume of around 38%, when lockup expires. Comparable findings are obtained by Field and Hanka (2001) where they find significant three-day negative abnormal returns of 1.5% and a permanent increase in trading volume of around 40% around the lockup expiration. They also report that the negative abnormal returns are larger when firms are backed by venture capital (VC). The findings of Field and Hanka (2001) are supported by Bradley et al. (2004), using a sample of 3334 US IPOs between 1988 and 1997, they find that VC-backed firms tend to experience more negative abnormal returns on lockup expiration day. Moreover, within that group of VC-backed firms, the largest negative abnormal returns occur for high-tech firms, firms with the highest share price increases following their IPOs, firms with a disproportionately high trading volume surrounding lockup expiration, and firms using reputable underwriters.

Several theories have been developed to explain the negative abnormal around lockup expiration. The simplest explanation is the price pressure hypothesis (Scholes, 1972), which asserts that the large flow of sell orders during lockup expiration may temporarily depress the share prices. After the waves of selling subside, prices typically return to their previous levels.

The second theory is the demand curve hypothesis (Field and Hanka, 2001). Unlike price pressure theory which assumes a temporary price change in share prices, Demand curve theory assumes that shares have downward sloping demand curves. Thus, insider sales around lockup expiration will shift the equilibrium price to a point where larger quantities of shares are sold at a permanently lower price. Particularly, IPO firms with more information asymmetry and valuation uncertainty are likely to have downward sloping demand curve.

The third theory considered in this study is the diversification hypothesis (Ofek and Richardson, 2000). In the case of management holding shares, risk-averse managers would desire to diversify their portfolio. Although they often use IPO as a first opportunity to diversify their shares, they usually required to hold the remaining of their holdings to sell after lockup expiration date.

In contrast to above-mentioned theories, the efficient market theory argues that the lockup expiration date is part of prospectus, and therefore the effect should be incorporated since first trading day. In this regard, the demand curve for stock should be flat and there should be no meaningful abnormal price impact around lockup expiration date (Ofek and Richardson, 2000).

2.2.2 The motives behind lockup agreements

In the first section of the paper, we mentioned the international difference in lockup agreements between a numbers of countries. In some countries, lockups are mandatory while in other countries lockups are voluntary. The difference lies in the length of the lockup contracts, which suggests that some firms are willing to lock-up their shares for a longer or shorter period than other firms. The heterogeneity of lockup agreements has attracted the attention of several researchers to investigate the motives behind the design of lockup agreements and they provide two possible motives. The first motive is lockup agreements as a signalling device under conditions of information asymmetry (or signalling hypothesis). The second motive is lockup agreements as a commitment device to reduce moral hazard problems (or commitment hypothesis).

According to signalling hypothesis, high-quality firms may want to signal their quality to obtain higher proceeds from IPO. However, outside investors are unable to observe the quality of newly issued firm. Under the situation of information asymmetry, Leland and Pyle (1977) develop a firm valuation model in which outside investors perceive the fraction of shares retained by insiders as a signal of firm quality. Courteau (1995), later on his turn, extends the signalling model in Leland and Pyle (1977) to voluntary lockup in which insiders use the length of lockup period as a signalling mechanism. Therefore lockup agreements function as a signal of quality where high-quality firms can signal their quality to uninformed investors using a longer lockup period.

According to commitment hypothesis, lockup agreements play a crucial role in reducing moral hazard problems. Compared to the signalling theory that assumes managers signal firm quality for the sake of the firm. In the case of moral hazard, the managers may not always act in the best interest of outside investors. When moral hazard incentives in the aftermarket are likely to be large, firms would need a longer lockup period to induce the public to buy into the offering. In that case, lockup agreements serve as a commitment device.

Considerable empirical evidence has been presented to support both signalling and commitment hypothesis in the literature. Using a sample of 2794 US IPOs between 1988 and 1996, Brav and Gompers (2003) extend their previous work and proposed three different hypotheses to explain the existence of lockup agreements: (i) signalling hypothesis, (ii) commitment hypothesis, and (iii) rent seeking hypothesis. Empirically, they find evidence to support the notion that lockup as a commitment device to mitigate moral hazard problems, but reject the signalling hypothesis and rent seeking hypothesis. Their results indicate lockup period should be longer when the degree of moral hazard is high.

The rejection of the signalling hypothesis is hugely challenged by Brau et al. (2005) both theoretically and empirically. They argue that the proxies for moral hazard used in Brav and Gompers (2003) can also be interpreted as proxies for information asymmetry. Using a sample of 4,013 US IPOs for the period between 1988 and 1999, they develop a model showing how lockup periods can be a signalling device to reduce information asymmetry and not so much as a commitment device to reduce moral hazard problems. Their results indicate that longer lockup periods are associated with firms with high information asymmetry and low idiosyncratic risk.

With a sample of 4025 US IPOs for the period from 1998 to 2006, Yung and Zender (2010) reconcile the two opposing hypotheses in the literature. They argue that IPO firms suffer from both problems of information asymmetry and moral hazard. However, depending upon firm characteristics, either one of the two is dominant for a different set of firms. In other words, both the signalling hypothesis and the commitment hypothesis are not always to be considered as mutually exclusive as assumed in previous studies (e.g. Brav and Gompers, 2003, Brau et al., 2005). Using underwriter reputation as a proxy, they argue that moral hazard will be the dominant motive if the IPO firms are backed by prestigious underwriters, if that is not the case, then information asymmetry remains the dominant motive.

Hoque (2011) investigated lockups arrangement of 831 UK IPOs between 1999 and 2007. In contrast to the US market where most lockups are standardized at 180 days, the UK market has a great diversity not only in terms of the lockup lengths but also in terms of other lockup characteristics. He describes the four lockup types that unique to UK market namely absolute-date lockup, relative date lockup, single lockup period and multiple lockup periods. By comparing and contrasting different types of lockup, he finds that firms with greater information asymmetry will have a stricter lockup. Thus, his evidence lend support to the signalling hypothesis and partial support to commitment hypothesis.

In summary, above literature seems to limit their conclusion on two competing hypothesis, the signalling hypothesis based on information asymmetry and the commitment hypothesis based on moral hazard. They also neglect the possible implication of lockup length for post-IPO performance from which we can get new insights into the motives behind variations in lockup length. Given that firms with voluntary lockups can use the length of lockup agreements as a signalling device of firm's quality or as a commitment device to reduce moral hazard problems, we expect that each motive will have different implications when predicting the relation between lockup length and post-IPO performance. Having reviewed the most relevant existing literature, we continue with the development of the hypotheses.

2.3 Hypothesis development

Initial returns

(i) Signaling hypothesis

IPO firms suffer from revealing their true value. There is very little information about the firm and even if the information is available, not everyone is granted access to them. Given the information constraint, IPO firms typically offer to sell their shares at discount to compensate uninformed investors for the winner's curse (Rock, 1986) or to signal the investors about the future prospect of the firm Allen and Faulhaber (1989). According to the signaling hypothesis, high-quality firms use longer lockups to communicate their quality to potential investors (Courteau, 1995). Since the all information about lockups including its length, expiration date and the percentage of shares locked-up are reported in the IPO prospectus, high-quality firms will be able to adjust its offer price upwards before the offering after investors have observed the signal in the IPO prospectus. As a result, we expect that firms with longer lockups will have lower underpricing.

Hypothesis 1:

a) *IPO firms with longer lockups will have lower underpricing compared to IPO firms with shorter lockups.*

(ii)Commitment hypothesis

In the case of moral hazard, the level of asymmetric of information concerning the actions of managers in the aftermarket should be taken into account. For instance, some managers may have strong incentive to waste free cash flow on maximizing the size of the firm (empire building) or other activities that enhance their private benefits at the expense of outside investors (Jensen and Meckling, 1976). When moral hazard incentives in the aftermarket are likely to be large (holding constant the quality of the firms), insiders will agree on longer lockups (Brav and Gompers, 2003). However, the opposite situation could also occur. Having longer lockups might actually indicate severer moral hazard problems. After all, we believe that none of these means very much for investors when they invest in IPO for the short-term, because insiders of firms with greater potential for moral hazard incentives have been "locked" for a longer period of time. Moreover, lockup agreements ensure outside investors that insiders share the same fate as earliest public investors. In other words, as formulated by Ritter and Welch (2002): "as long as insiders retain large shareholding, their incentives will be more closely aligned with those of outside equity holders". In this setting, we expect that longer lockups will not have significant impact on short-run performance.

Hypothesis 1:

b) IPO firms with longer lockups will not have significant impact on initial returns.

Long-run abnormal returns

(i)Signaling hypothesis

With respect to the theory that lockup agreements serve as a signalling device, the cost of committing to a longer lockups is high since the wealth of insiders remains illiquid for a longer period of time. As a result, only high-quality firms can afford to have such longer lockups. On the other hand, insiders of low-quality firms aware that the future of their firms is not positive and committing to a longer lockups will hurt them more than they hurt the insiders of high-quality firms. Consequently, they will be unwilling to bear the cost of committing to longer lockups. These differential consequences of using longer lockups create a separating equilibrium between high-quality firms and low-quality firms. Therefore, if a lockup period 180 days is regarded as the "benchmark", then firms with lockup periods longer than 180 days can indicate higher quality, which in turn leads to better performance in the long-run. Nevertheless, if the cost of committing to longer lockups is not high enough to prevent low-quality firms to mimic, the equilibrium will be pooling (both types of firms send the same signal regardless of the length of lockup agreements). In the same way that it will always be pooling when the cost of committing to longer lockups is too high for high-quality firms. In that case, there will be no significant difference in long-run performance between IPO firms with longer lockups and shorter lockups. These arguments lead to the following hypothesis.

Hypothesis 2:

a) IPO firms with longer lockups will have better long-run performance in the case of separating equilibrium or no significant impact on long-run performance in the case of pooling equilibrium.

(ii) Commitment hypothesis

According to commitment hypothesis, firms with greater incentives for moral hazard problems in the aftermarket are willing to accept lockup lockups (Brav and Gompers, 2003). After the lockup period expires, insiders have the chance to sell their shares and expropriate wealth from investors. Some investors may also sell the shares of firms with high moral hazard in order to avoid being expropriated, thus making a large fall in share prices. Furthermore, as insiders of firms with high moral hazard continuously cause moral hazard problems, the firm performance is deteriorated (Harris and Glegg, 2009). As a result, more investors gradually sell the shares of firms with high moral hazard. Consistent with the commitment hypothesis, we expect that firms with longer lockups, which suggest greater moral hazard incentives, to have poor performance in the long-run.

Hypothesis 2:

b) IPO firms with longer lockups perform significantly worse than firms with shorter lockups in the long-run.

Abnormal returns around lockup expiration

(i)Signaling hypothesis

According to the theory that lockup agreements serve as signaling device, managers can signal their quality to the uninformed investors by using longer lockups (Courteau, 1995). However, irrespective of the length used for signaling, managers will still have the motivation and opportunity to act in their own self-interests rather than maximize shareholder wealth. In other words, moral hazard problems are assumed the same for all firms. When the IPO lockup expires, we expect that firms with longer lockups will not have a significant impact on the abnormal returns around lockup expiration. The hypothesis is as follows.

Hypothesis 3:

a) The share price reaction around lockup expiration is not significantly sensitive to lockup length.

(ii) Commitment hypothesis

According to the theory that lockup agreements serves as a commitment device, firms that are associated with higher potential for moral hazard incentives lock-up their shares for a longer period of time (Brav and Gompers, 2003). In this way, managers will continue to exert effort, as their effort is closely linked to share price and they want to keep the share price as high as possible. At the end of lockup period, insiders of firms with greater potential for moral hazard sell their shares and thus reduce their interests in the firm, when lockup expires. As the lockup expiration date is part of the prospectus, outside investors should be capable of predicting the release of new shares and react similarly by heavily selling shares of firms with greater potential for moral hazard to prevent themselves from being expropriated by insiders. In this setting, we expect that firms with longer lockups, which suggest greater moral hazard incentives, to have a larger negative share price reaction at and around lockup expiration.

Hypothesis 3:

b) IPO firms with longer lockups will have larger negative abnormal returns at and around lockup expiration.

Table 3 present the summary of above-mentioned hypotheses.

Table 3. Summary of hypotheses

	(i)Signaling	(ii)Commitment
Initial returns	H1a: Longer lockups will have low initial returns	H1b: Longer lockups will not have significant impact on initial returns
Long-run abnormal returns	H2a: Longer lockups will have positive impact on long-run performance in the case of separating equilibrium or no significant impact on long-run performance in the case of pooling equilibrium	H2b: Longer lockups will have poor long-run performance
Abnormal returns around lockup expiration	H3a: share price reaction around lockup expiration is not significantly sensitive to lockup length	H3b:Longer lockups will have larger negative returns at and around lockup expiration

3. Methodology

This chapter discusses the methodology that has been used in the literature to evaluate post-IPO performance in the short-run, long-run and upon lockup expiration. Important to understand, the research is divided into two different parts, Firstly, this study uses ordinary least square (OLS) regression analysis to test the effect of lockup length to initial returns and long-run abnormal returns. Secondly, this paper uses event study to analyse the impacts of lockup length on the abnormal returns during lockup expiration date. Full details about these two methodologies are explained below.

3.1 OLS regression

To test the first and second hypothesis, we construct two regression models, which are differentiated by short-run or initial market performance and long-run performance. The first regression attempts to capture the impact of lockup length to initial or short-run market performance. The second regression tests the impact of lockup length to long-run performance. Each of the two regressions is estimated with a constant term and with the variables controlling. In the coming subsections, we present the explanation of the variables and the regression equations used to test the first and second hypothesis.

3.1.1 Explanation of variables

Independent variables

The main independent variable of this study is the lockup length, which is also the variable of interest in this study. It is observed using two parameters. First, Lockupdays is the predetermined amount of time (measured by calendar days) where the insiders are restricted from selling their shares during the period commencing on the offer date and ending at lockup expiration date. Second, we create a dummy variable (Lockupdummy) to capture the effect of a longer lockup period to post-IPO performance. It equals 1 if the lockup length is longer than 180 days, otherwise 0. The first parameter of this study is adopted from Nee et al. (2009), whereas the second parameter is the modification that we initiated in this study.

Dependent variables

Initial returns

To test the first hypothesis, short-run or initial stock performance is measured using the level of first-day initial return of each IPO. Initial return is calculated as the percentage change in stock price from its offering price to the closing price at first trading day. The formula is shown below.

$$IR_i = \frac{(P_{1i} - P_{0i})}{P_{0i}} \quad (1)$$

Where IR denotes the initial returns for firm i, P_i denotes the closing price on the first trading day for firm I, and P_0 denotes the offering price for firm i.

Long-run abnormal returns

As discusses in the earlier chapter, previous literature has documented a variety of methods for analysing the long-run performance of IPOs. However, two of them are most common: cumulative abnormal returns (CAR) and buy-and-hold abnormal returns (BHAR). BHAR measures long-run abnormal return by compounding daily returns for the period after the listing date and then subtract the compounded returns of a benchmark over the same period. The calculation of CAR is almost similar to BHAR, but involve summing daily abnormal returns instead of compounding. Lyon et al. (1999) argue that BHAR is more accurate than CAR as they better match investors' actual investment experience. For that reason, we use BHAR as a measure of long-run performance.

Following previous literature, one-year, two-year, and three-year BHAR are calculated to measure long-run abnormal returns. We follow Carter et al. (1998) to exclude the first 5 trading days in the calculation. This 5-day gap is meant to eliminate the effect of abnormal trading activity that generally observed on first trading day. The daily value-weighted CRSP market index is used as a benchmark. The formula for calculating BHAR is shown below.

$$BHAR_{i\mathrm{T}} = \left[\prod_{t=offerdate+6}^{\mathrm{T}}(1 + r_{it}) - \prod_{t=offerdate+6}^{\mathrm{T}}(1 + r_{mt})\right] \quad (2)$$

Where $BHAR_{it}$ is the buy-and-hold abnormal return for firm *i* during holding period T, T denotes one-year (+6, +252), two-year (+6, +504), and three-year (+6, +756) holding period, r_{it} is the daily stock returns for firm *i* during holding period t, r_{mt} is the daily CRSP value-weighted index return. A positive value for BHAR indicates that the IPO outperformed the benchmark and a negative value indicates that the IPO underperformed the benchmark. The average BHAR for each year is also calculated as the arithmetic average of abnormal returns on all IPOs in the sample of size *N*. The formula shown below.

$$\overline{BHAR} = \frac{1}{N}\sum_{1=i}^{N} BHAR_{i,T} \quad (3)$$

Control variables

In analysing the hypothesized relationship between lockup parameters and stock performance, we control for variables other than lockup parameters that have been identified in the literature as important determinants of post-IPO performance. These variables are IPO proceeds, VC-backing, and proportion of primary shares. For each variable, the rationale is given for including it in the research.

IPO Proceeds

To acknowledge the severity of information asymmetry, following Brau et al. (2005), we control for the gross proceeds raised at the IPO as proxy for firm size (Proceeds). It is widely accepted that larger firm faces less information asymmetry as there is more publicly available information on them and they attract more analyst and investors' attention. Thus, we expect initial returns to be negatively related to IPO proceeds in the first regression. In the long-run, however, larger firm is expected to yield better performance. Therefore, we expect a positive between IPO size and long-run performance in the second regression.

VC

We also include dummy variable to control for the presence of venture capital (VC). The variable equals 1 if the firm is backed by venture capitalist and 0 otherwise. It is found that VC-backing result in lower initial returns and improved long-run performance (Megginson and Weiss, 1991; Brav and Gompers, 1997). First, the involvement of VC in providing managerial and governance support as well as funding for the issuing firm serves to lower the total costs of going public. Therefore, we expect VC-backing to be negatively related with initial returns in the first regression. Second, VC may provide valuable monitoring by continuing their involvement in the firm following the IPO, which assist in better long-run performance. For that reason, we expect VC-backing to have positive relationship with long-run performance in the second regression.

Proportion of the primary shares

With respect to the source of shares in the IPO, the number of shares that firm offered are split up between "primary shares" and "secondary shares". Primary shares are newly issued shares, which proceeds from the sale go to the firm. While secondary shares refer to pre-existing shares belonging to the pre-IPO shareholders (Kim and Weisbach, 2008). A larger proportion of secondary shares are typically offered by a larger and more established firm with high internal cash generation capability (Huyghebaert and Hulle, 2006). Thus, we control for the proportion of primary shares in the total offering (Primary). With similar reasoning as for IPO proceeds, we expect that firm with a lower

proportion of primary shares (or larger proportion of secondary shares), which indicate a larger and more established firm, to have positive relationship with initial returns.

Initial returns

Additionally, Huang et al. (2010) find an evidence for the endogenous relationship between the lockup length and underpricing. To exclude the possibility that underpricing influences the long-run stock performance through lockup length, we control for initial returns as proxy for underpricing (IR) in the second regression. And no prediction is made about the sign of the coefficient.

Before the regression equations are outlined, it is best to check for possible multicollinearity between variables stated in section 3.1.1. When multicollinearity arises, the results from the regression can therefore be distorted. This test is done using Variance Inflation Factor (VIF) and tolerance level (1/VIF). Greene (2003) argues if VIF of a variable is above 4 and tolerance level is less than 0.25, then there is high multicollinearity between the variables. Results for both tests are shown in Table 4.

Table 4. Multicollinearity check

	First regression		Second regression	
Variables	VIF	Tolerance	VIF	Tolerance
IR	-	-	1.05	0.95
Lockupdays	3.17	0.32	3.18	0.31
Lockupdummy	3.22	0.31	3.22	0.31
Proceeds	1.07	0.93	1.07	0.93
VC	1.07	0.94	1.1	0.91
Primary	1.09	0.91	-	-
Mean	1.92	0.68	1.79	0.72

With the results of the VIF and tolerance level for both regressions, we can see that there is no problem of multicollinearity. However, it can be noticed that the variables Lockupdays and Lockupdummy have larger VIF than others. While this would not affect predictive strength of the models, we will have to be careful when interpreting values of these parameters.

3.1.2 Regression equations

The two regression analysis undertaken for testing first and second hypothesis are depicted as follows.

$$IR_i = \beta_0 + \beta_1 Lockupdays_i + \beta_2 Lockupdummy_i + \beta_3 Proceeds_i + \beta_4 VC_i + \beta_5 Primary_i + \varepsilon_i \quad (4)$$

$$BHAR_i = \beta_0 + \beta_1 Lockupdays_i + \beta_2 Lockupdummy_i + \beta_3 IR_i + \beta_4 Proceeds_i + \beta_5 VC_i + \varepsilon_i \quad (5)$$

Table 5. Summary of variables relationship and measurement

	Expected sign		Measurement
	First regression 1 (IR_i)	Second regression ($BHAR_i$)	
$Lockupdays_i$	Signaling hypothesis: (-) / Commitment hypothesis: (no significant impact)	Signaling hypothesis: (+) or (no significant impact) / Commitment hypothesis: (-)	Logarithm of the length of lockup in days.
$Lockupdummy_i$	Signaling hypothesis: (-) / Commitment hypothesis: (no significant impact)	Signaling hypothesis: (+) or (no significant impact) / Commitment hypothesis: (-)	A dummy variable that equals one if lockup length is longer than 180 days and zero otherwise.
$Proceeds_i$	(-)	(+)	The total number of shares offered multiplied by offer price.
VC_i	(-)	(+)	A dummy variable that equals one if the firm is venture capital-backed and zero otherwise.
$Primary_i$	(+)		The number of primary shares offered divided by total number of shares offered.
IR_i		No expected sign	The percent difference between the closing price of the first trading day and the offer price.

3.2 Event study

To test the third hypothesis, we used the event study methodology to analyse the stock performance at and around the lockup expiration. Many event study models that can be used to calculate the abnormal returns (AR) such as the market model, the mean adjusted returns model, the market adjusted returns model and the control portfolio returns model. The main difference between these models lies essentially on how expected return is estimated. This study uses the market model which assumes a linear

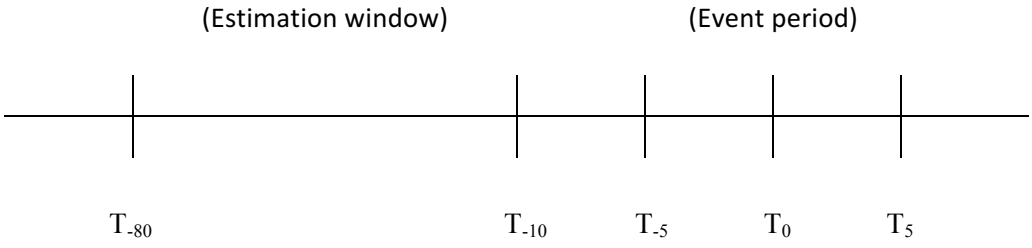
relationship between security return and market return. The regression for estimating the expected return according to the market model is depicted below.

$$E(R_{it}|X_t) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (6)$$

Where R_{it} is actual return for stock i on day t, $\hat{R}_{it} = E(R_{it}|X_t)$ is the expected return, X_t the exogenous variables used to predict the expected return. The expected return $E(R_{it}|X_t)$ is used as the benchmark return in the normal situation, considering the event would not have taken place.

The first step of the market model is to define the estimation window to estimate α and β for each firm *i* in our sample. However, since our sample consists of IPO firms with various lockup lengths, there will sometimes be no data available for the IPO with relatively short lockups. As a result, we need to restrict our estimation period. Following Bradley et al. (2004), we use an estimation period of 70-day and ending 10-days before the lockup expiration (T_{-80}, T_{-10}). The next step is to identify the event of interest to compute the event impact on security prices. In this case, lockup expiration date is identified as day zero (T_0). Our event period would go from day -5 to day 5 for a total of 11 trading days. Within this period, I will report daily AAR and CAAR for three different windows. Graphically, the timeline around the event shows in Figure 1.

Figure 1. Event timeline



The market model parameter α_i and β_i for each firm *i* is estimated by running ordinary least square (OLS) using historic stock price and market return in the estimation period. To be consistent with our first two hypotheses, we use the CRSP value-weighted market index as the proxy for the market return. Once we have these parameters estimated, we can then insert them into the market model formula to obtain the expected return of firm *i*. Finally, we calculate the daily abnormal return for each firm in the event period surrounding the expiration date. Abnormal return is calculated as the difference between the firm's actual return and its expected return. The formula is shown below.

$$AR_{it} = R_{it} - E(R_{it}|X_t) \quad (7)$$

Next, we constructed the average abnormal returns by averaging the abnormal returns across the 730 firms in the sample. This mitigates the possible outliers in the dataset, which might affect the individual firm level. In this study we report the daily AAR from day -5 to day +5 using the formula below.

$$AAR_t = \frac{1}{N} \sum_{t=i}^{N} AR_{it} \quad (8)$$

Instead of only examining the performance of the stock at the event date, this study also reports the stock performance during the period surrounding the event date. Where cumulative abnormal returns (CAR) is calculated by aggregating the sum of abnormal returns from the start of the event window period $T_{1,}$to the end of event window period T_2. The formula for calculating CAR is shown below.

$$CAR_i(T_{1,}T_2) = \sum_{t=t}^{T2} AR_{it} \quad (9)$$

Next, the mean cumulative abnormal returns (CAAR) is calculated by averaging the CAR across 730 firms in the sample. The formula for calculating CAAR is shown below.

$$CAAR = \frac{1}{N} \sum_{i=1}^{N} CAR \quad (10)$$

For better capturing the impact of the event, following Field and Hanka (2001), we place more emphasis on three-day event window (-1, +1) surrounding the lockup expiration day. According to Tuch and O'Sullivan (2007), focusing on short event window is more appropriate. Because in longer event windows, stock price behaviour can easily be distracted by other external factors. However, we also allow for broader event window of (-3, +3) and (-5, +5) for robustness check.

Significance of abnormal returns

Given the known AAR and CAAR, we test the statistical significance of these abnormal returns using the most commonly used statistical test in event studies, Patell Z-statistics (Patell, 1976), which often referred to as the standardized abnormal return test and assumes cross-sectional independence. To increase the predictive power of the empirical results, this test is performed using the Eventus software provided by WRDS. Thus, the statistical calculations should be correct. Having the research methodology outlined, we will proceed to data collection.

4. Data

This chapter describes the data selection procedure for the sample of IPO used in this thesis as well as the descriptive statistics of the sample to get a first insight into the data and draw preliminary conclusions.

4.1 Sample selection

From two sources we collected the IPO data and the historical stock prices to construct our dataset. Since this information has already been published beforehand, throughout this study we are referring to data that is publicly available (secondary data). Firstly, we use Thompson One database to identify a list of IPOs that went public from 2001 through 2011. The initial sample exists of 1140 IPOs. Next, data on the characteristics of IPO is drawn for each IPO regarding the CUSIP code, share code, lockup length, issue date, lockup expiration date, offer price, VC flag, the total number of shares offered, and the number of primary and secondary shares offered.

From the initial list of 1140 IPOs, following previous literature on this topic, only shares with share code of 10 or 11 (ordinary common shares) are included in the sample. This implies that: Real Estate investment trusts (REIT), close-end funds, unit trusts and American Depositary Receipt (ADR), certificates, and Exchange Traded Funds (EFTs) and penny stocks (issues with offer price less than $5) are excluded from the sample. These processes of elimination excluded 180 IPOs.

Secondly, we used Center for Research in Security Prices (CRSP) to obtain the information of stock returns for the list of IPO companies, where data regarding daily stock prices and daily CRSP value-weighted index, were collected. For these IPOs, we were able to calculate the initial returns. Next, calculating long-run stock performance requires IPOs whose historical stock data are recorded for at least three years (756 trading days) following the issuance. Due to this requirement, we filtered out 230 IPOs. In total, our final sample contains 730 IPOs and all of them have lockup agreements. This sample size is actually much smaller than we anticipated. However, we believe that this sample still can provide reliable outcomes.

When collecting IPO data from Thompson One, our main interest would be US IPOs with single lockup (one expiration date). However, we notice that Thompson one has started listing US IPOs with multiple lockup periods (more than one expiration date), especially after 2003. In the case of multiple lockups, Thompson one primarily employs the codes “management lockup”, “company lockup” and “selling shareholder lockup”. In deciding which lockup length to use, following Yung and Zender (2010), we convert these multiple values into a single variable using the following order of selection priority. When multiple lockup periods are reported, of which exactly one is listed as a management lockup, we use the unique value listed for “management lockup”. In the absence of a variable designated as “management

lockup", our second priority would be "company lockup" and third priority would be "selling shareholder lockup". Next, it should be noted that lockup length obtained from Thompson one is based on calendar date and stock performance obtained from WRDS is based on trading date. Therefore, if the expiration date coincides with non-trading date or holidays. We took the previous trading day.

4.2 Descriptive statistics

Table 6 presents descriptive statistics of the 730 IPO firms between 2001 and 2011. We report the average, median and standard deviation for the variables used in the regression analysis. The average of percentage of primary shares offered in the total offering is 81.84%. This suggests the majority of shares offered in this sample come from the firms rather than from pre-IPO investors. The percentage of firms backed by venture capital is 41%. The average initial return of the full sample is 11.09%, which appears to be lower than 17% reported in the earlier study of US IPOs (Banerjee et al., 2011). This value is however still comparable to those reported in other developed economies such as 6-17% reported in Australia, England and Germany (e.g. Loughran et al., 1994; Levis, 1993). The average size of the firms in our sample is about $242.91 million and the median is about $104.07 million. The last three rows of Table 6 report the average BHAR for the one-year, two-year and three-year following the IPO. These values are all positive on average. However, the median for one-year, two-year and three-year BHAR show negative values.

Table 6. Descriptive statistics of the full sample

Primary shares are shares offered by issuing firm and secondary shares are shares offered by pre-IPO investors. % of primary shares offered is the number of primary shares offered divided by total number of shares offered. Venture capital backing denotes 1 if an IPO is backed by venture capital, otherwise 0. Initial returns are the difference between the first day closing price and the offering price. IPO proceeds is the total number of shares offered multiplied by offer price. BHAR defined as the difference between the realized buy-and-hold return and the normal buy-and-hold returns.

Characteristics	Median	Average	SD
No. of primary shares offered	5,933,750	9,151,257	13,670,187
No. of secondary shares offered	0	4,780,703	30,743,543
Total number of shares offered	7,500,000	13,935,681	32,934,538
% of primary shares offered	100%	81.84%	27.84%
Venture capital backing	0	0.41	0.49
Initial returns	0.075	0.1109	0.2055
IPO proceeds ($ million)	103.07	242.91	740.07
One-year BHAR (+6, +252)	-5.28%	5.60%	63.87%
Two-year BHAR (+6, +504)	-14.49%	4.98%	84.42%
Three-year BHAR (+6, +756)	-18.81%	3.47%	108.48%

Table 7 provides descriptive statistics for the subsamples. We split the full sample into three subsamples based on lockup length: Panel A contains firms with lockups shorter than 180 days; Panel B contains firms with lockups of 180 days; Panel C contains firms with lockups of more than 180 days. We find

that firms with lockups longer than 180 days offer a significantly larger proportion of primary shares than other firms. This may just reflect that firms that set their lockups longer than 180 days are usually associated with young growth firms with limited internal cash generation (Huyghebaert and Hulle, 2006). In terms of initial returns, firms with lockups longer than 180 days have significantly lower initial returns than other firms (average 0.7% and median 1.9%), whereas there is no significant difference in initial returns between firms with lockups equal to 180 days and lower than 180 days. Brav and Gompers (2003) argue that VC-backed firms tend to have short lockups because they want to exit the firm at the earliest opportunity. Table 7 partially supports their finding. VC-backing less frequently occurs in firms with lockups longer than 180 days. Nevertheless, firms with lockups shorter than 180 days have the least VC-backing. The average firm size for firms with lockups longer than 180 days is about $ 156.25 million. This value is significantly higher than firms with lockups equal to 180 days and lower than 180 days. In other words, because we use IPO proceeds as the proxy for firm size, firms with lockups longer than 180 days raise the most proceeds from IPO.

Table 7. Descriptive statistics of the subsamples

Primary shares are shares offered by issuing firm and secondary shares are shares offered by pre-IPO investors. % of primary shares offered is the number of primary shares offered divided by total number of shares offered. Venture capital backing denotes 1 if an IPO is backed by venture capital. Otherwise 0. Initial returns are the difference between the first day closing price and the offering price. IPO proceeds is the total number of shares offered multiplied by offer price.

Panel A: lockups < 180 days (N= 19)	Median	Average	SD
No. of primary shares	5,868,100	16,039,409	26,092,216
No. of secondary shares	0	2,908,576	4,847,089
% of primary shares offered	100%	76.49%	33.19%
Venture capital backing	0	0.105	0.315
Initial returns	0.141	0.156	0.186
IPO proceeds ($ million)	156.25	251.98	260.38

Panel B: lockups = 180 days (N= 672)	Median	Average	SD
No. of primary shares	6,000,000	9,159,206	13,419,069
No. of secondary shares	0	5,079,093	32,012,883
% of primary shares offered	100.00%	81.02%	27.85%
Venture capital backing	0	0.431	0.495
Initial returns	0.079	0.115	0.205
IPO proceeds ($ million)	105.58	251.4	768.31

Panel C: lockups > 180 days (N= 39)	Median	Average	SD
No. of primary shares	3,800,000.00	5,955,889.44	6,975,950.06
No. of secondary shares	0	323,570.36	1,079,432.15
% of primary shares offered	100.00%	96.04%	11.57%
Venture capital backing	0	0.205	0.409
Initial returns	0.019	0.007	0.1864
IPO proceeds ($ million)	23.22	90.03	161.73

Table 8 shows the distribution of the length of lockup period over the sample period. The average lockup length is 187 days. Interestingly, 672 firms in our sample have lockups of 180 days. This means that the "180 days" phenomenon still dominates the length and represents about 92% of the contracts in our sample firms. The 25th, 50th, and 75th percentiles of lockups are all 180 days. This is consistent with Bradley et al. (2004), they argue that 80-90% of the US IPOs in the period between 1988 and 1997 are subject to a 180 days lockups. However, our sample seems to display a more standardized lockups compared to Bradley et al. (2004). Our statistics thereby confirm the existence of the 180 days lockups equilibrium and reveal the fact that this still is a prevailing trend in the modern IPO market. Table 8 shows that IPO occurs more frequently during the period between 2004 and 2006. It seems that the crash of the dot-com bubble between 2000 and 2002 and the housing bubble burst between 2007 and 2009 had forced many firms to postpone their planned IPO. Furthermore, it has been discussed that our sample contains a number of firms with multiple lockups where some pre-IPO investors are allowed to sell their shares earlier than other insiders. The bottom part of Table 8 reports the frequency of so-called multiple lockup agreements. As shown, 10% of US IPO firms have multiple lockups. This proportion is comparable to the 11% reported by Field and Hanka (2001). Further, it can be noticed that IPOs with multiple lockups occur mostly in the period between 2004 and 2006. Interestingly, we find only less than 10 IPO firms with multiple lockups in the rest of observed period. This could be due to our sample selection which restricts IPO firms with historical stock data of less than 756 days.

Table 8. Distribution of lockup length over the sample period

This table presents the distribution of lockup period across time. The lockup length is measured by calendar days. Single lockup agreements stipulate only one date, on which all lockup expire. Multiple lockups is a lockup that has more than one lockup period.

Lockups length	90-179	180	181-270	271-365	366-730	Full sample
Full sample	19	672	10	26	3	730
% of observation	2.60	92.05	1.36	3.56	0.41	100
Mean	116.15	180	245.7	361.15	663.33	187.67
Median	90	180	270	360	720	180
Standard deviation	32.76	0	33.06	2.14	106.92	48.12
Lock period	N	25th percentile	50th percentile	75th percentile	95th percentile	Mean
Full sample	730	180	180	180	220	190
2001-2003	128	180	180	180	360	225
2004-2006	356	180	180	180	360	225
2007-2009	135	180	180	180	180	180
2010-2011	111	180	180	180	180	180

	Lockup type	
Full sample	Single	Multiple
All	659	71
2001-2003	122	6
2004-2006	292	64
2007-2009	134	1
2010-2011	111	0

5. Results

This chapter presents the results of the research methodology described in chapter 3. Section 5.1 and 5.2 present the results of the regression analysis of initial returns and long-run abnormal performance. Section 5.3 presents the results of event study around lockup expiration period. Section 5.4 presents the additional regression results on the relation between multiple lockups and post-IPO performance.

5.1 Initial returns

Hypothesis 1 consists of a set of two competing hypotheses. The signalling hypothesis (H1a) predicts that IPO firms with longer lockups will have lower underpricing compared to IPO firms with shorter lockups. The commitment hypothesis (H1b) predicts that IPO firms with longer lockups do not have significantly different initial returns compared to IPO firms with shorter lockups. To shed light on these two competing hypotheses, we regress the initial returns on lockup length with control variables. The estimated coefficients are reported in Table 9. Columns (1) and (2) of Table 9 report univariate results for lockup length (Lockupdays) and dummy variable for lockups longer than 180 days (Lockupdummy) respectively. Multivariate results for other controlling variables are reported in the remaining columns.

In regression model (1), the coefficient of lockup length (Lockupdays) is negative and statistically significant at 1%. This suggests that initial returns are significantly lower for firms that lock-up their shares for a longer period of time. Looking at regression model (2), as we anticipated, it is clear that the Independent variables Lockupdays and Lockupdummy suffer from multicollinearity. The two variables come up marginally significant at 10% in regression model (2). But become highly significant when both are put separately in regression (3) and (4) (at 1% and 1% respectively). One possible interpretation could be that multicollinearity shows that the effects of Lockupdays and Lockupdummy on the initial returns strengthen each other. Meaning, the effect of lockup length to initial returns is more negative when the lockups is more than 180 days. These results are consistent with the results found in Table 7. And therefore, clearly support the signalling hypothesis, which predicts that IPO firms with longer lockups will have lower initial returns.

In regards to the control variables, VC-backing (VC) appears to affect initial returns both positively and significantly (at 1%), implying that for VC-backed firms exhibit higher initial returns. This result is however not in line with our expectation. One possible explanation for positive correlation between VC-backing and initial returns is the “grandstanding hypothesis”, which is put forward by Lee and Wahal (2004). This theory argues that VC-backed firms may issue underpriced shares as a response to greater information asymmetry inherent in the young firms being brought public. The IPO proceeds (Proceeds), used as proxy for firm size, have a decreasing effect on initial returns. This is in line with previous

studies (Brau et al., 2005). However, the effect is not significant. The proportion of primary shares in the total offering (Primary) has a negative and statistically significant effect on initial returns. Our finding is again not in line with our expectation. To the best of our knowledge, such negative relationship between the proportions of primary shares and initial returns has not yet been investigated.

Table 9. Initial returns and lockup length

This table presents the OLS regression results where the dependent variable is initial returns (IR), which is The percent difference between the closing price of the first trading day and the offer price. Independent variables include Lockupdays, which is the logarithm of the length of lockup in days. Lockupdummy, which indicates 1 if lockup period is longer than 180 days. Otherwise 0. The rest are the controlling variables as described in chapter 3. All regressions are run with an intercept. P-values (reported in parentheses) are based on robust standard errors. The adjusted R-squared gives the explanatory power of regression equation. The symbols *, ** and *** denote statistical significance at 10%, 5%, and 1% respectively. The regression is depicted as follows:

$$IR_i = \beta_0 + \beta_1 Lockupdays_i + Lockupdummy_i + \beta_3 Proceeds_i + \beta_4 VC_i + \beta_5 Primary_i + \varepsilon_i$$

Variables	Initial Returns (IR) in percentage %				
	(1)	(2)	(3)	(4)	(5)
Lockupdays	-0.052***	-0.024*	-0.044***		-0.032**
	(0.000)	(0.056)	(0.001)		(0.027)
Lockupdummy		-7.236*		-9.009***	-3.231
		(0.055)		(0.006)	(0.428)
Primary			-0.079***	-0.078***	-0.078***
			(0.001)	(0.001)	(0.001)
Proceeds			-0.003	-0.004	-0.004
			(0.418)	(0.377)	(0.396)
VC			7.213***	6.978***	7.105***
			(0.000)	(0.000)	(0.000)
Intercept	21.018***	16.147***	23.158***	15.234***	20.970***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	730	730	730	730	730
Adjusted R-squared	1.53%	1.62%	5.02%	4.89%	5.07%

5.2 Long-run abnormal returns

Hypothesis 2 consists of a set of two competing hypotheses. Signalling hypothesis (H2a) predicts that IPO firms with longer lockups will have better long-run performance in the case of separating equilibrium or no significant impact on long-run performance in the case of pooling equilibrium. Commitment hypothesis (H2b) predicts that IPO firms with longer lockups perform significantly worse than those firms with shorter lockups in the long-run. To shed light on these two competing hypotheses, buy-and-abnormal return (BHAR) is used to measure long-run performance. The benchmark used for

calculating the BHAR is the CRSP value-weighted market index. The results for one-year, two-year and three-year BHAR for the full sample and subsamples are presented in Panel A of Table 10.

In the full sample, it is evident that US IPOs do not underperform in the long-run. The one-year, two-year, and, three-year BHAR are all positive (5.39%, 4.70%, and 3.15% respectively). These results are quite surprising given that US studies have constantly documented long-run underperformance of IPOs (Aggarwal and Rivoli, 1990; Ritter, 1991; Loughran and Ritter, 1995). As discussed in the earlier section, the absence of long-run underperformance in our full sample could be influenced by the sample period we investigate. Another possible explanation is that those poorly performing IPOs that do not survive or are listed for less than three years after the issue are excluded from the sample and leave the remaining well-performing IPOs to be kept in the sample. However, when the full sample is divided into subsamples according to lockup length, a different pattern emerges.

Focusing to specific results for our three subsamples, we find that firms with lockups longer than 180 days underperform in the long-run. Specifically, the average BHAR for one-year, two-year and three-year for firms with lockups longer than 180 days are all negative (-1.41%, -9.14%, and 3.15% respectively). Meanwhile, other firms with lockups of 180 days and shorter than 180 days do not underperform (the one-year, two-year, three-year BHAR are all positive). Besides, the magnitude of outperformance is greater for firms with lockups shorter than 180 days than firms with lockups of 180 days. These results are in line with the expectation of commitment hypothesis that firms with longer lockups perform worse than firms with shorter lockups in the long-run.

However, given that our sample sizes are not equal across comparison groups (92% of firms in the sample have lockups of 180 days), it is important to test whether the above findings are "statistically significant". We run Kruskal Wallis non-parametric test to identify statistical differences in average BHAR between subsamples. This test is appropriate as it allows for severe departures from normally and unequal sample sizes. The results of the Kruskal Wallis test are reported in Panel B of Table 10, for the one-year and two-year and three year BHAR, only the pair test for difference between IPO firms with lockups longer than 180 days and equal to 180 days are statistically significant. For this group, the mean differences for one-year, two-year, and three-year BHAR are significant at 5%, 1%, and 5% respectively. In addition to Kruskal-Wallis test, we performed Mann-Whitney non-parametric test to verify if the results are consistent. As shown in Panel B, the results of the Mann-Whitney show qualitatively similar to what Kruskal-Wallis test predicts. The results of both non-parametric test give strong evidence to support the commitment hypothesis.

Although the comparison of means among subsamples gives us some evidence to support commitment hypothesis, many more variables have their influence at the same time. To come to meaningful

conclusions about the impact of lockup length on long-run performance of IPOs, we regress the estimated BHAR on the lockup length and other controlling variables. The estimated coefficients are reported in Table 11. Columns (1) and (2) of Table 11 reports univariate results for lockup length (Lockupdays) and dummy variable for lockups longer than 180 days (Lockupdummy) respectively. Multivariate results for other controlling variables are reported in remaining columns.

Regression model (1) shows that the coefficient of lockup length (Lockupdays) is negative, but not statistically significant. Moreover, the inclusion of control variables does not affect the significance level in regression model (3). Since most lockups in our sample are concentrated at 180 days, the relationship between lockup length and long-run stock performance cannot be linear over the full sample. Focusing on the regression model (2), the dummy variable for lockups longer than 180 days has a negative and significant effect on one-year, two-year, and three-year BHAR (at 5%, 10%, and 10% respectively), indicating that firms with lockups longer than 180 days are associated with poor long-run performance. We therefore reaffirm our earlier findings in panel A and Panel B of Table 10. However, the significance appears to be sensitive to the inclusion of the control variables. As can be seen in regression model (4), the coefficient of lockup dummy become insignificant after including the rest of variables.

In regard to the the control variables, the coefficients of VC-backing (VC) are negative and significant, indicating that VC-backing does not lead to better long-run performance. This finding contradicts the result from Brav and Gompers (1997), who find that VC-backed firms have better long-run performance than non-VC-backed firms. The alternative explanation for the negative association between VC-backed firms and long-run performance is put forward by Brown (2005). VC typically have complete control over the future direction of the firm. And in such cases, the owner's incentive may no longer be aligned with the success of the firm, and firm performance may deteriorate. Finally, the coefficients of firm size (Proceeds) and underpricing (IR) are not significant in all regression models, indicating that they do not play a role in explaining long-run performance.

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Table 10. Buy-and-hold abnormal returns across subsamples

This table reports the long-run performance as measured by buy-and-hold returns across subsamples.

$$BHAR_{it} = \left[\prod_{t=offerdate+6}^{T}(1+r_{it}) - \prod_{t=offerdate+6}^{T}(1+r_{mt})\right]$$

Where $BHAR_{it}$ is the buy-and-hold abnormal returns of firm *i* on time period T, r_{it} is the daily absolute stock return, r_{mt} is the CRSP daily value-weighted market index return. T denotes 252, 504 and 756 respectively for one-year holding period (+6, +252), two-year period (+6, +504), and three-year holding period (+6, +756). Lockup period is measured in calendar days. The symbols *, ** and *** denote statistical significance at 10%, 5%, and 1% respectively.

Panel A Long-run abnormal returns

	One-year BHAR (+6, +252)				**Two-year BHAR (+6, +504)**				**Three-year BHAR (+6, +756)**			
Lockup length	N	Median	Mean	SD	N	Median	Mean	SD	N	Median	Mean	SD
1-179	19	9.33%	12.36%	80.45%	19	-11.49%	13.25%	93.86%	19	-29.10%	3.37%	99.74%
180	672	-4.25%	5.59%	61.80%	672	-12.32%	5.26%	82.03%	672	-15.97%	3.77%	106.58%
180-730	39	-28.21%	-1.41%	87.75%	39	-40.51%	-9.14%	116.11%	39	-43.99%	-7.50%	142.72%
Full sample	730	-5.28%	5.39%	63.87%	730	-14.49%	4.70%	84.42%	730	-0.18805	3.15%	108.48%

Panel B Test statistics for difference in subsamples

Difference in groups	Mann-Whitney Test	Kruskal-Wallis Test	Mann-Whitney Test	Kruskal-Wallis Test	Mann-Whitney	Kruskal-Wallis Test
<180 and 180	0.199	0.04	0.028	0.001	0.066	0.004
>180 and 180	2.528**	6.389**	2.698***	7.277***	1.999**	3.997**

Table 11. Long-run abnormal returns and lockup length

This table presents the OLS regression results where the dependent variables are the one-year, two-year, and three-year buy-and-hold abnormal returns (BHAR). Independent variables include Lockupdays which is the logarithm of the length of the lockup in days. Lockupdummy which indicates 1 if lockup period is longer than 180 days. Otherwise 0. The rest are the controlling variables as described in chapter 3. The benchmark used for calculating the BHAR is the CRSP value-weighted market index. All regressions are run with an intercept. P-values (reported in parentheses) are based on robust standard errors. The adjusted R-squared gives the explanatory power of regression equation. The symbols *, **and *** denote statistical significance at 10%, 5%, and 1% respectively. The regression is depicted as follows:

$$BHAR_i = \beta_0 + \beta_1 Lockupdays_i + Lockupdummy_i + \beta_3 IR_i + \beta_4 Proceeds_i + VC_i + \varepsilon_i$$

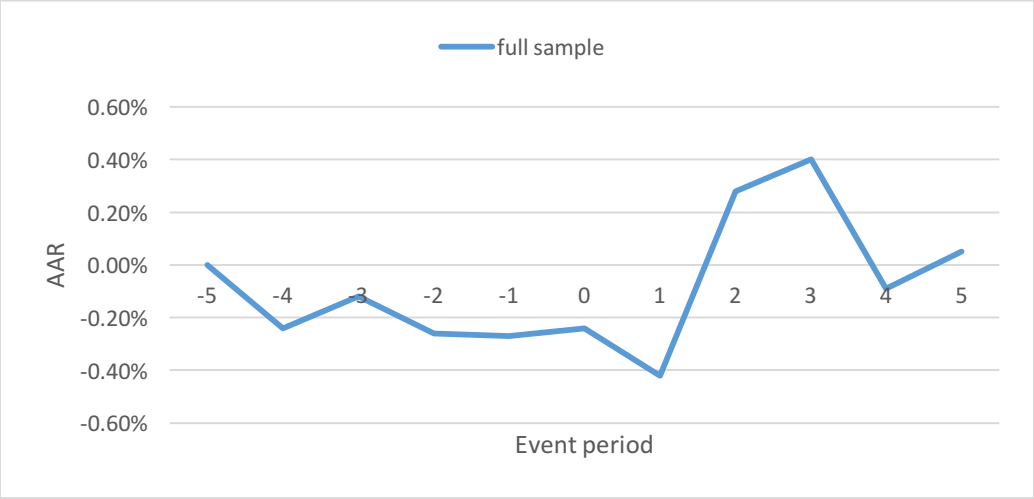
Variables	**One-year BHAR (+6, +252)**				**Two-year BHAR (+6, +504)**				**Three-year BHAR (+6, +756)**			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Lockupdays	-0.017		-0.024	-0.042	-0.067		-0.069	-0.019	-0.056		-0.066	-0.021
	(0.545)		(0.636)	(0.607)	(0.354)		(0.331)	(0.850)	(0.532)		(0.460)	(0.852)
Lockupdummy		-7.192*		-11.259		-14.622**		-12.983		-11.263**		-11.684
		(0.067)		(0.085)		(0.043)		(0.064)		(0.048)		(0.071)
IR			-0.054	-0.057			-0.031	-0.029			-0.0735	-0.075
			(0.602)	(0.582)			(0.839)	(0.850)			(0.637)	(0.628)
Proceeds			0.090	0.022			0.020	0.019			0.026	0.025
			(0.230)	(0.120)			(0.350)	(0.664)			(0.554)	(0.565)
VC			-8.338*	-8.852*			-10.700*	-11.088*			-17.033**	-17.381**
			(0.096)	(0.074)			(0.098)	(0.085)			(0.036)	(0.033)
Intercept	8.693	5.779**	14.004	2.753	17.339	5.481	21.249	12.786	13.812	3.756	22.824	15.207
	(0.463)	(0.015)	(0.237)	(0.855)	(0.203)	(0.081)*	(0.109)	(0.493)	(0.418)	(0.353)	(0.184)	(0.471)
Adjusted R-squared	0.02%	0.06%	0.49%	0.61%	0.15%	0.15%	0.59%	0.63%	0.06%	0.05%	0.79%	0.81%

5.3 Abnormal returns around lockup expiration

Hypothesis 3 consist a set of two competing hypothesis. Signalling hypothesis (H3a) predicts that the stock price reaction around lockup expiration is not significantly sensitive to lockup length. Commitment hypothesis (H3b) predicts that IPO firms with longer lockups will have larger negative abnormal returns at or around lockup expiration. To shed light on these two competing hypotheses, we run event study to explore the stock price reaction at and around lockup expiration. The market model is used to estimate abnormal returns where the CRSP value-weighted market index is used as the benchmark. The results from the market model event study are presented in Table 12.

In the full sample, we find significant negative AAR from day -4 to day +1 of the event period with exception of day -3, where we do not find AAR on this day to be significant. The most negative AAR is -0.42% on day +1. However, from day +2 onwards, returns appear to reverse its direction. The temporary price changes are consistent with the price pressure theory and represent a violation of efficient market theory. In panel B, which captures market reaction around the lockup expiration date, the CAAR for three-day centered on the expiration date (-1, +1) amounts to -0.96% and highly significant at 1%. Moreover, the CAAR over longer event windows of (-3, +3) and (-5, +5) appears to be significant and equals to -0.74% and -1.10% respectively. Figure 2 illustrates the build-up of the AAR for the full sample.

Figure 2. Average abnormal returns for full sample (-5, +5)



The results in full sample show that US IPO firms are, on average associated with negative abnormal returns at and around lockup expiration. Although we observe highly significant price reaction, a price decline of less than 1% is smaller than 1.5%-5% reported by previous US studies (e.g. Ofek and Richardson, 2000; Brav and Gompers, 2000; Field and Hanka, 2001). These negative returns suggest

that the market failed to incorporate the event of lockup expiration into stock prices. This is interesting, considering that lockup expiration date is public information and should be anticipated by investors from the first day of trading. However, given the significant negative abnormal returns are already visible during the days before the lockup expiration, the drop in stock prices cannot be attributed to the insider selling after lockup expiration. Figure 2 illustrates the build-up of the AAR for the full sample.

Turning to specific results for our three subsamples, our goal here is to investigate the effect of different lockup lengths to the market price reaction during lockup expiration. In Table 12, we divide our full sample into three subsamples based on lockup length. As shown, it is evident that firms with lockups longer than 180 days experience positive AAR from day -4 to day 2. Interestingly, the positive AAR are not statistically significant for any days surrounding the event date, except for the lockup expiration day itself. The AAR on day 0 is 2.67% which is significant at 5%. Furthermore, the CAAR are also positive and significant with magnitudes of 3% and 5.11% for (-1, +1) and (-5, +5) event windows respectively. The persistent positive price reaction to lockup expiration appear to contradict previous US studies where the negative abnormal returns surrounding the lockup expiration date are widely documented. To our knowledge, no studies have investigated positive abnormal returns around lockup expiration. The fact that abnormal returns seem to rise in the days surrounding the event leads us to believe that investors will be more attracted to IPOs with long lockup periods after a potential negative catalyst has ended (i.e. lockup expiration). In contrast to the other firms with lockups of 180 days and shorter than 180 days are, on average associated with negative abnormal returns during the period surrounding the lockup expiration. However, the magnitude is smaller for the former than for the latter. Figure 2 illustrates the build-up of the AAR among the firms with lockups longer than 180 days, equal to 180 days and shorter than 180 days.

Figure 3. Average abnormal returns for subsamples (-5, +5)

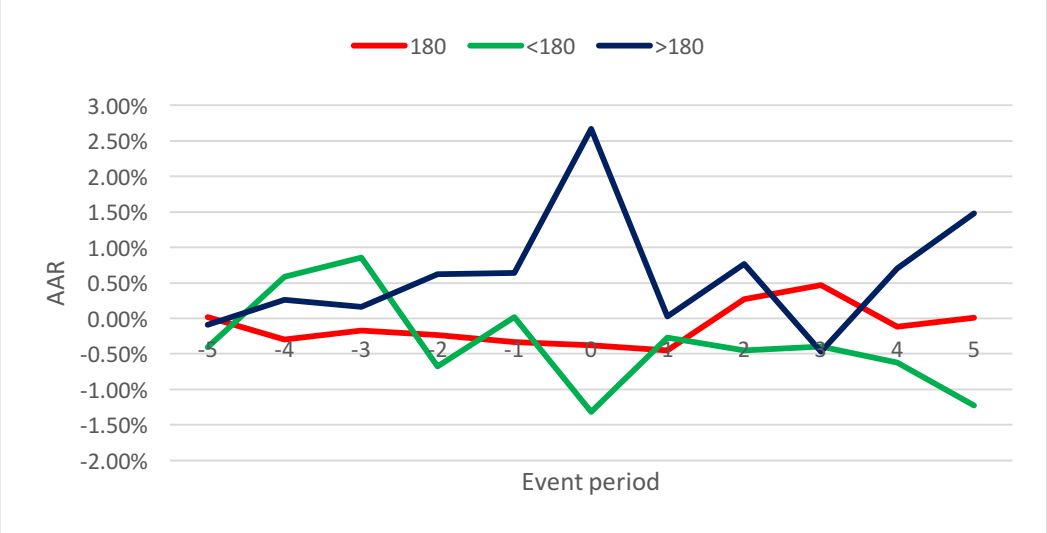


Table 12. Abnormal returns around lockup expiration and lockup length

This table reports the event study results for the full sample and the subsamples grouped by lockup length. The market model is used to estimate abnormal return with the model parameters estimated over the period day -80 to day -10, where returns to the CRSP equally-weighted index are used for R_{mt}. Panel A reports the report the average abnormal return (AAR) for 11 days surrounding the lockup expiration date. Panel B reports the cumulative average abnormal return (CAAR) of different event windows surrounding the lockup expiration date. The AAR and CAAR are calculated as shown in section 3.2. The symbols *, **, *** denote statistical significance at 10%, 5%, and 1% respectively.

	<180 (19 IPOs)		180 (672 IPOs)		>180(39 IPOs)		Total (730 IPOs)	
Panel A: Event day	AAR	Z-Statistic	AAR	Z-Statistic	AAR	Z-Statistic	AAR	Z-Statistic
-5	-0.41%	-0.708	0.02%	0.192	-0.09%	0.073	0.00%	0.086
-4	0.59%	1.329	-0.30%	-2.874**	0.26%	0.031	-0.24%	-2.536*
-3	0.86%	1.323	-0.17%	-1.338	0.16%	1.069	-0.12%	-0.823
-2	-0.68%	-1.427	-0.23%	-1.813	0.62%	0.929	-0.26%	-2.184*
-1	0.02%	0.156	-0.33%	-3.131**	0.64%	0.939	-0.27%	-2.762**
0	-1.32%	-1.678	-0.38%	-2.534*	2.67%	3.052**	-0.24%	-1.996*
1	-0.27%	-0.196	-0.45%	-3.221**	0.03%	0.316	-0.42%	-3.049**
2	-0.45%	-0.9	0.27%	2.460*	0.77%	1.298	0.28%	2.515*
3	-0.40%	-0.538	0.47%	3.423***	-0.47%	-1.587	0.40%	2.830**
4	-0.62%	-0.6	-0.12%	-0.944	0.70%	1.407	-0.09%	-0.677
5	-1.23%	-2.147*	0.01%	0.237	1.48%	1.801	0.05%	0.297
Panel B: Event windows	CAAR	Z-Statistic	CAAR	Z-Statistic	CAAR	Z-Statistic	CAAR	Z-Statistic
(-1, +1)	-1.53%	-0.992	-1.17%	-5.130***	3.00%	2.487*	-0.96%	-4.507***
(-3, +3)	-2.16%	-1.232	-0.88%	-2.326*	2.51%	1.571	-0.74%	-2.067*
(-5, +5)	-3.71%	-1.624	-1.39%	-2.877**	5.11%	2.252*	-1.10%	-2.502*

In summary, Table 12 shows that IPO firms with lockups longer than 180 days have significant return reaction at and around the lockup expiration date. This significant abnormal return can be interpreted as a support for the commitment hypothesis. However, the direction of the price reaction is not in line with commitment hypothesis. The abnormal returns at and around the lockup expiration should be negative. As a result, we do not have enough support to confirm commitment hypothesis.

5.3.1 Robustness check

Given the results previously presented in Table 12 do not provide sufficient evidence to confirm commitment hypothesis, one has to be sceptical about the results presented in Table 12. Because sometimes the results can be very sensitive to the choice of benchmark. To asses the robustness of the results in Table 12, we re-estimate the abnormal returns for firms with lockups longer than 180 days using alternative benchmarks other than CRSP value-weighted index. Table 13 presents event study results using CRSP value-weighted versus CRSP equally-weighted and S&P 500.

Table 13. Robustness check

This table reports the event study results for firms with lockups longer than 180 days. The market model is used to estimate abnormal returns with the model parameters estimated over the period day -80 to day -10. Three indices used to compute the abnormal returns are CRSP value-weighted index (CRSP VW), CRSP equally-weighted (CRSP EW), and S&P 500. Panel A reports the report the average abnormal return (AAR) for 11 days surrounding the lockup expiration date. Panel B reports the cumulative average abnormal return (CAAR) of different event windows surrounding the lockup expiration date. The AAR and CAAR are calculated as shown in section 3.2. The symbols *, **, *** denote statistical significance at 10%, 5%, and 1% respectively.

>180(39 IPOs)	CRSP VW		CRSP EW		S&P 500	
Panel A: Event period	AAR	Z- Statistic	AAR	Z- Statistic	AAR	Z- Statistic
-5	-0.09%	0.073	-0.10%	0.097	-0.13%	-0.171
-4	0.26%	0.031	0.25%	0.004	0.25%	0.323
-3	0.16%	1.069	0.19%	1.223	0.15%	0.2
-2	0.62%	-0.929	0.56%	-0.873	0.65%	-0.839
-1	0.64%	0.939	0.61%	0.881	0.64%	0.832
0	2.67%	3.052**	2.64%	3.052**	2.69%	3.494***
1	0.03%	0.316	0.05%	0.298	0.03%	0.043
2	0.77%	1.298	0.81%	1.445	0.75%	0.976
3	-0.47%	-1.587	-0.36%	-1.413	-0.51%	-0.663
4	0.70%	1.407	0.74%	1.461	0.67%	0.875
5	1.48%	1.801	1.56%	1.968*	1.46%	1.897$
Panel B: Event windows	CAAR	Z- Statistic	CAAR	Z- Statistic	CAAR	Z- Statistic
(-1,+1)	3.00%	2.487*	3.30%	2.443*	3.36%	2.522*
(-3,+3)	2.51%	1.571	3.38%	1.744	3.11%	1.528
(-5,+5)	5.11%	2.252*	5.83%	2.455*	5.36%	2.101*

As shown in Table 12, the abnormal returns estimated using both CRSP equally-weighted and S&P 500 are qualitatively similar to those reported in Table 12. With the results being robust to the choice of benchmark, this paper again arrive at same conclusion that we do not have sufficient evidence to show that hypothesis 3b is true and we do not conclude that hypothesis 3a is true.

5.4 Multiple lockups

So far we have covered the implication of single lockup length for post-IPO performance. However, as previously shown in Table 8, some IPOs in our sample have multiple lockups where some pre-IPO investors are allowed to sell their shares earlier than others. For instance, the venture capitalists, can sell their holdings earlier than management. This can have its influence on post-IPO performance. To maximize the utilization of our findings, we provide additional regression results on the relation between multiple lockups and post-IPO performance. The estimated coefficients are reported in Table 14.

As shown, we included a dummy variable (multiple dummy) which equal 1 if the firm has multiple lockups and 0 if the firm has single lockups. The coefficients of multiple dummy are not significant in

both initial returns and buy-and-hold abnormal returns model. The insignificance of these coefficients do not suggest any compelling motives for the choice of multiple lockups. However, because the data available for multiple lockups on the US market is still limited, one has to be sceptical about the results presented in Table 14. Therefore, this is a direction of research that needs to be further investigated when sufficient data is available.

Table 14. Post-IPO performance and multiple lockups

The table reports OLS regression results where the variable of interest is Multipledummy which indicates 1 if the firm has multiple lockups and 0 if the firm has single lockups. The rest are the variables as described in chapter 3. All regressions are run with an intercept. P-values (reported in parentheses) are based on robust standard errors. The adjusted R-squared gives the explanatory power of regression equation. The symbols *, **, and *** denote statistical significance at 10%, 5%, and 1% respectively.

Variables	**IR**	**BHAR**		
		One-year	**Two-year**	**Three-year**
Multipledummy	2.933	8.466	19.456	-2.911
	(0.244)	(0.311)	(0.171)	(0.817)
Lockupdays	-0.049***	-0.036	-0.097	-0.062
	(0.001)	(0.565)	(0.188)	(0.489)
IR		-0.060	0.018	-0.071
		(0.565)	(0.903)	(0.647)
Primary	-0.078***			
	(0.001)			
Proceeds	-0.003	-0.001	0.002	0.002
	(0.463)	(0.995)	(0.624)	(0.559)
VC	7.163***	-8.422	-10.894	-17.004
	(0.000)	(0.093)	(0.091)	(0.036)
Intercept	23.581***	15.533	24.763	22.298
	(0.000)	(0.188)	(0.067)	(0.190)
Observations	730	730	730	730
Adjusted R-squared	4.54%	0.64%	1.03%	0.79%

6. Conclusions and recommendations

This chapter will summarize the overall conclusions from the theory and the methodology. Section 6.1 summarizes the main findings of our study. Section 6.2 presents the limitations of the study and recommendations for future research.

6.1. Conclusions

This paper presents a comprehensive study of the implication of lockup length for the post-IPO performance of 730 IPOs that went public between 2001 and 2011. Given the US trend towards standardized lockup periods of 180 days, I examined how the departure from 180 days market trend can affect the post-IPO performance. Specifically, we examined post-IPO performance over three periods: (1) initial returns, (2) long-run abnormal returns, and (3) abnormal returns around lockup expiration date. Further, lockup are studied and tested using two theoretical inputs of two hypotheses - the signalling hypothesis based on information asymmetry and the commitment hypothesis based on moral hazard.

The main results of this study can be summarized as follows. First, we used OLS regression to test the effect of lockup length on initial returns and long-run abnormal returns. We find that IPO firms with lockups longer than 180 days have a significantly negative impact on initial returns (underpricing) and significantly worse performance in the one-year, two-year, and three-year holding returns. The former is in line with the prediction of signalling hypothesis, which claims that IPO firms with longer lockups will have lower underpricing compared to IPO firms with shorter lockups. The latter is in line with the prediction of commitment hypothesis, which claims that IPO firms with longer lockups perform significantly worse than those firms with shorter lockups in the long-run.

Second, we used event study methodology to test the effect of lockup length on the share price reaction around lockup expiration date. We document significant positive abnormal returns around lockup expiration at and around. Furthermore, the results are robust to a different benchmark. Even though we observe significant price reaction at and around the lockup expiration, the direction of the price reaction is not in line with what commitment hypothesis predicts. For that reason, we do not have enough evidence to support commitment hypothesis. Additionally, we also attempt to explain the influence of multiple lockups on post-IPO performance. However, no significant impact on post-IPO performance is identified.

Overall, our empirical results uncover a new anomaly in post-IPO performance that is linked to the length of lockup agreements: (1) the longer the lockup period - the lower the initial returns, (2) the

longer the lockup period - the worse its stock performs in the long-run, and (3) the longer the lockup period - the more positive its price reaction around lockup expiration. In addition, given the pattern of the results, we can not shed light on the mixed motives behind the lockup agreements. The evidence on initial market performance supports the notion that lockup agreements serve as a signalling device. On the other hand, the evidence on long-run performance supports the notion that lockup agreements serve as a commitment device. Therefore, we cannot conclude which of the two motives is considered dominant, since they both are observationally equivalent.

6.2 Limitations and recommendations

As with all forms of research, there are some limitations inherent in this study. The first is the issue of omitted variable bias. The underwriter reputation has been employed in previous studies as a proxy to judge the degree of information asymmetry. However, due to time constraints, this paper does not include underwriter reputation into control variables. Even though the IPO firm size (Proceeds) has been included as a proxy for information asymmetry, the absence of underwriter reputation leads to less accurate regression estimates. It is straight forward for further research to incorporate underwriter reputation in the model to gain better results. Second, the data used in this study lacked a lot of information. There are only 39 IPOs who set their lockups longer than 180 days and 19 IPOs who set their lockups lower than 180 days, it was not possible to obtain more data, due to time constraint and lack of information in Thompson One database. Should this research be conducted on a larger sample, findings will probably be more clarifying.

One point of our event study results we need to clarify is the significant positive abnormal returns around lockup expiration for firms with lockups longer than 180 days, which undoubtedly contradicts many studies that documented strong negative abnormal returns around lockup expiration (Ofek and Richardson, 2000; Brav and Gompers, 2000; Field and Hanka, 2001). However, the above-mentioned studies are old studies and the sample period in this research is relatively recent. And during the time period, the market experienced different conditions which may have different effects on the results. However, this is a direction of research that needs to be further investigated before this claim can be made.

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