Three Essays on Corporate Finance

by

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Abstract

The thesis consists of three essays on corporate finance. In the first essay, we test the hypothesis that the stock market tends to overvalue initial public offerings (IPOs), assuming that IPO issuers can value their own firms more accurately. Using the lower limit of initial file price range as issuers' reservation price, we estimate the premiums of IPO first day closing price and first month closing price over the reservation price. We find that the price premiums are positively associated with proxies for market over-optimism and uncertainty. IPOs with higher price premiums have worse stock performance in the long run. The results are robust to various economic specifications. The findings are consistent with the argument that the stock markets get over-optimistic about IPOs from time to time.

In the second essay we investigate insider selling activities for IPO firms. We find that insiders in 31.3% of IPOs sell shares prior to lock-up expiration (early sales). Consistent with the IPO over-optimism hypothesis, IPO price premium is positively correlated with early sales as well as sales following lock-up expiration (late sales), which suggests that insiders of overvalued IPOs tend to opportunistically liquidate their holdings. In addition, empirical evidences show that insiders may exploit IPO mispricing in the primary market to sell secondary shares and revise up total share offered.

In the third essay, we explore why many firms disclose internal control (IC) deterioration under section 404 of Sarbanes-Oxley Act after previously reporting effective IC. We find empirical

evidences suggesting that many of the reported IC deteriorations result from detection of previously undetected weaknesses. Restated or not, the reported deterioration in IC is associated with increase in audit fee, increase in management turnover and auditor turnover, decline in Altman Z score decile, and increase in loss. Consistent with an agency hypothesis that managers try to manipulate the IC process when firm performance declines, the reported deterioration in IC is also associated with poor stock returns in the year before disclosure. ICW disclosure is more likely when poor stock return is combined with higher sensitivity of executive compensation to stock price change.

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Chapter 1 General Introduction

The three essays in this dissertation examine issues related to market mispricing, insider trading, and corporate disclosure with an emphasis on behavioral corporate finance theories. Contrary to traditional corporate finance theories with assumptions that all of market participants are fully rational, behavioral corporate finance develops two lines of research: the first approach focuses on the irrational behavior of investors and the second one emphasizes the effect of irrational managerial behavior (Baker and Wurgler 2011).

IPO pricing is one of the most significant issues for all participants in an IPO. Price formation procedures in U.S. IPOs can be summarized as follows: first, issuers select lead underwriter; then the selected lead underwriter would be responsible for negotiating with issuer and setting up the filing range in the preliminary prospectus. The underwriter will also perform due diligence, organize the underwriting syndicate, and conduct road shows to market the shares of IPO firms with potential investors. It is noteworthy that the filing range does not establish binding constraints in the offer prices. Given the information acquired from investors and public information during the road-show period, the underwriter and the issuer will set offer price prior to the issue date. Then IPOs on average experience significantly positive returns in the first trading day. IPO price formation procedures offer a unique setting to construct an arguably less problematic measure of stock mispricing: in Chapter 2, we use the premiums of market prices over the issuers' reservation price (the lower bound price of initial filing range), to measure the degree of mispricing. Then we investigate the implications of issuers' reservation price by directly testing

the IPO over-optimism hypothesis by examining the relationship between IPO price premium and subsequent stock performance.

Going public is a big step forward for the privately held firms, and brings them many valuation-enhanced benefits. The proceeds from IPO can be used to finance profitable investment opportunities. An IPO can increase the transparency of the firm by subjecting it to the capital market regulations. Meanwhile, a public firm can easily raise additional proceeds through seasoned offerings. In addition, an IPO can provide a liquid market which allows pre-IPO corporate insiders, such as directors, officers, and large beneficial shareholders to exit their investment. Previous studies generally investigate secondary share sales at the time of IPO and IPO aftermarket insider selling activities over a short time window around the expiration of IPO lockups separately. In Chapter 3, we develop our analysis based on the assumption that rational insiders can detect the mispricing and exploit it by insider trading activities. We complement the literature by examining the incentives of IPO early sales activities prior to lock-up expiration date.

Sarbanes-Oxley Act (SOX) is one of the most important major regulation changes passed by the U.S. Congress aiming to enhance the quality of financial information disclosure in response to a number of high profile corporate fraud incidences involving companies such as Enron and Worldcom. Being effective since November 15 of 2004, Section 404 of SOX explicitly require management to assess and report on the effectiveness of internal control over financial reporting, and require external auditors of SEC reporting firms to attest management's assessment of the internal control effectiveness in their annual filings. Numerous previous studies focus on the static aspect of internal control weakness (ICW) disclosure and identify the differences between companies that report ICW and those that report effectiveness. However, little is known about why some firms report internal control weakness after reporting effectiveness in the previous year. In

Chapter 4, we make contribution to this stream of research by investigating the dynamics of deterioration in internal control reported under SOX 404. In addition to explanations suggested by the literature, we propose and examine a managerial behaviour based hypothesis to explain the internal control deterioration.

Chapter 2 IPO Issuers' Reservation Price and Market Over-optimism

2.1 Introduction

After Ritter (1991) reports poor long-run performance for initial public offering (IPO) stocks, a lot of research has been conducted to examine whether IPO stocks are overvalued (e.g., see: Loughran and Ritter 1995, Brav et al. 2000, Gompers and Lerner 2003, Purnanandam and Swaminathan 2004, and Dong et al. 2011), with no consensus emerging. In this chapter we attempt to provide new insights into the valuation of IPO stocks by using a new proxy for the intrinsic value of IPO stocks.

Before a private company goes public, the entrepreneur, or IPO issuer, usually has her own estimate about the intrinsic value of the firm as a public company. Because a significant part of the company will be sold in the IPO (30% on average), most likely the entrepreneur will not take the company public if the offer price is lower than the intrinsic value in the entrepreneur's perception. Therefore the fact that an initial public offering is conducted implies that the offer price is higher or at least equal to this perceived intrinsic value. If the markets are more optimistic than issuers in certain periods, then IPOs will be valued higher than entrepreneurs' perceived intrinsic value in those periods. In this case the markets will tend to overvalue IPOs periodically if issuers' valuation is more accurate than market prices. We call this argument the IPO over-optimism hypothesis. It is in the same spirit as the windows of opportunity theory (e.g., see Ritter 1991) and the IPO pricing model in Ljungqvist et al. (2006) but has a slightly different focus.

One way to test the IPO over-optimism hypothesis is to examine whether IPO stocks underperform. This method is always subject to the critique that the measure for "normal" return fails to control for certain omitted risk factors (e.g., see Fama 1998). Another way is to find an *ex ante* measure for the predicted overvaluation and examine the cross-sectional relation between the overvaluation measure and stock performance. The IPO over-optimism hypothesis predicts worse stock performance for IPOs that are more overvalued. Here the main challenge is to find a proxy for the intrinsic value of IPO firms.

We argue that the lower limit of the filing price range in the initial IPO prospectus is a good proxy for IPO issuers' reservation price, and the reservation price should be close to issuers' perceived intrinsic value plus a minimum profit to compensate for the risk and costs related to going public. In this case the over-optimism hypothesis suggests that the premiums of market prices over the reservation price can be used as measures of market mispricing. When market mispricing is corrected in the long run, IPO stocks with higher price premiums will underperform those with lower premiums.

Using a sample of 3,138 U.S. IPOs in the period of 1983 to 2012, we examine the validity of price premiums as a proxy for mispricing. We estimate the premiums of first day closing price (PREMIUM1, hereafter) and first month closing price (PREMIUM2, hereafter) relative to reservation price and find that the premiums are higher in over-optimistic markets, as proxied by lower market return in the following year, higher # of IPOs issued in the year, and higher turnover of IPOs issued in the previous 3 months. We also find that the premiums are higher for IPOs that are harder to value, including younger IPOs, IPOs with lower tangible assets, and IPOs with R&D expense. These results are consistent with the interpretation of the price premiums as measures of mispricing in the IPO market.

We test the IPO over-optimism hypothesis by examining the relation between IPO price premiums and subsequent stock performance. In univariate analysis, we find that generally IPOs with higher price premiums have worse stock return in the long run. For example, the mean 3-year market-adjusted abnormal return is -44% for IPOs in the highest quartile of PREMIUM1 and -28% for IPOs in the lowest quartile of PREMIUM1. The difference of 16% is statistically significant at 1% level. Similarly, IPOs in the highest quartile of PREMIUM2 experience a style adjusted 3-year buy-and-hold return of -12.7%, as compared to -1.9% for IPOs in the lowest quartile of PREMIUM2.

Then we use multivariate regressions to control for other factors such as underwriter reputation and firm age that may influence long-run performance as documented in previous literature. The regression results show that both Premium1 and Premium2 are negatively related to IPO long-run stock performance. For example, one standard deviation increase in PREMIUM1 will lead to a decrease of 6.41% for 3-year mean style adjusted buy-and-hold return, or a decrease of 12.29% for 3-year mean market adjusted buy-and-hold return. We also conduct calendar time series regressions using Fama-Frech three-factor model to determine whether the price premium effects have been accounted for by previous asset pricing factors. We find a statistically significant monthly alpha of -0.6% for IPOs in the highest PREMIUM1 quartile, compared with insignificant monthly alphas for IPOs in the other quartiles. Thus, it seems that the effect of price premium is independent from the well-documented factors that influence stock performance.

To the best of our knowledge, this chapter is the first paper to propose using IPO issuers' reservation price as a proxy for the intrinsic value of IPO stocks. We feel it may be a better measure for intrinsic value than those proposed in the literature. Specifically, compared with Purnanandam and Swaminathan (2004)'s price multiples approach, the reservation price incorporates the

expected growth of IPO firms. Compared with the valuation measures based on analyst forecasts (e.g., see: Kim and Ritter 1999 and Dong et al. 2006), the reservation price incorporates entrepreneurs' private information. Thus it will be very useful for any future research involving the intrinsic value of IPO stocks. This chapter is also the first paper to link IPO long-run stock performance with the market price premiums over IPO reservation price. The result that both PREMIUM1 and PREMIUM2 can predict long-run IPO performance has not been documented in prior studies. These results provide interesting insights into different theoretical explanations about IPO valuation and long-run performance.

The chapter proceeds as follows. In Section 2.2, we review the relevant literature and discuss IPO reservation price. In Section 2.3, we describe our data and sample characteristics. In Section 2.4 we examine the relation between IPO price premiums and proxies for market over-optimism. In Section 2.5, we investigate the relation between IPO price premiums and long-run stock performance. Section 2.6 concludes the chapter.

2.2 Related Literature and Discussion

The IPO over-optimism hypothesis relies on the assumption that the markets misprice securities from time to time. It has been well documented in the literature that mispricing in financial markets can exist and persist due to limited arbitrage. By investigating the drivers of closed-end funds mispricing, Pontiff (1996) points out that the fundamental risk about arbitrage is that perfect substitute as described by Scholes (1972) cannot be found. Wurgler and Zhuravskaya (2002) find that the effect of inclusion into S&P 500 index is more pronounced for firms that lack close substitutes. Their findings suggest that mispricing exists for securities whose cash flows are not

spanned by those of other assets. In addition to the existence of perfect substitutes, arbitrage in the financial market also requires the feasibility of short selling the over-priced securities. Some studies (Miller 1977, Morris 1996, Boehme et al. 2006) propose costly short-selling and heterogeneous beliefs among investors as an explanation for mispricing.

There are a number of additional costs and risks of arbitrage. Transaction costs, search costs, and information-gathering costs would reduce the effectiveness of arbitrage and prevent investors from exploiting mispricing. In addition to the costs mentioned above, De Long et al. (1990) highlight noise trader risk which suggests that stock price can be further pushed away from the value implied by fundamentals. Fund managers would avoid betting against irrational investors because their incentives are usually tied to the short-term fund performance and fund investors cannot distinguish between luck and skill (Lakonishok et al. 1992). Moreover, money managers often pander to investor irrationality to attract fund inflows (Han and Hirshleifer 2015). A powerful argument to support efficient market is that successful arbitrage would make money flow to smart arbitrager. As time goes by, they will dominate the market. However, Yan (2008) points out that the process of wealth flow from irrational investors to rational investors is slow and modest.

The mispricing due to limited arbitrage is probably more serious for IPOs because most IPO stocks are difficult to short sell and there is huge divergence in investor expectations (Miller 1977). The IPO over-optimism hypothesis implies that IPO issuers try to exploit the mispricing by going public when the market valuation is high. Consistent with this implication, Graham and Harvey (2001) show that roughly two thirds of CFOs highlight stock valuation as an important or very important factor to affect the equity financing decision. Empirical evidence also suggests a positive relation between equity financing and stock valuation. By examining a sample of Italian IPOs, Pagano et al. (1998) show that the likelihood of an IPO is positively correlated with the

industry's market-to-book ratio. Loughran et al. (1994) find that the volume of IPO activity goes up with the price level of the overall stock market in 14 out of 15 countries they investigate. Lowry (2003) conduct aggregate time-series regressions and find that investor optimism proxied by future market returns and closed-end fund discount is an important determinant of IPO waves in both economic and statistical terms.

Although the argument that IPO issuers will try to exploit market over-optimism is intuitive, if the overvaluation is immediately corrected after equity issuance is announced, issuers will not be able to sell the IPO shares at inflated prices. However, consistent with the theory that the mispricing caused by limited arbitrage can persist, many studies using different historical periods (e.g., see: Stigler 1964, Ritter 1991, Gompers and Lerner 2003) and different countries (McLean et al. 2009) report that IPO stocks underperform in a 3 to 5 year horizon when compared with a market index. Consistent with the IPO over-optimism hypothesis, these results suggest it is possible for issuers to sell IPO shares above their intrinsic value.

The most basic critique of IPO long-run performance studies involves the joint hypothesis problem (e.g., see: Fama 1998). Specifically, it has been argued that the asset pricing models in those studies may not properly control for various risk factors. Brav et al. (2000) show that IPO stocks do not significantly underperform seasoned stocks matched by size and book to market ratio. When IPO stock performance is measured using the calendar time portfolio approach, IPOs do not seem to underperform much either. However, Loughran and Ritter (2000) shows that the calendar time portfolio approach lacks the power to detect underperformance because of two issues: first, this approach weights each month equally; second, the factor portfolios used in this approach are partly composed of IPOs. It is also not clear whether matching by book to market ratio would bias the results if book to market ratio is correlated with mispricing. After all, a high market to book

ratio may suggest that the firm is overvalued (e.g., see: Lakonishok et al. 1994, La Porta 1996, and La Porta et al. 1997) and it is well known that market to book ratio is inversely related to future stock returns (e.g., see: Fama and French 1992, Kothari and Shanken 1997, and Pontiff and Schall 1998).

Another way to test the IPO over-optimism hypothesis is to find a measure for the mispricing of IPO stocks and test the cross-sectional relation between IPO stock return and this mispricing measure. As suggested in Baker and Wurgler (2011), this kind of method is still subject to the mispricing measurement controversy to some extent, but objections lose some steam if the cross-sectional pattern is strong.

Purnanandam and Swaminathan (2004) measure the valuation of U.S. IPOs by calculating Price/Value (P/V) ratios based on Price/Sales, Price/EBITDA, and Price/earnings (P/E) multiples. They find that the P/V ratios are significantly above one, implying that IPOs are overvalued. They also find negative cross-sectional relation between their P/V ratio and IPO long-run stock return. However, as suggested in Ritter (2011), Purnanandam and Swaminathan (2004)'s results can be interpreted as showing that IPOs are expected to have higher growth rates than the seasoned comparable firms. Consistent with this suggestion, Zheng (2007) find that the P/V ratios are not significantly different from one after controlling for growth forecast, offering proceeds, leverage, and cash. He also finds that IPO stocks do not underperform their matching seasoned firms in the long run despite having P/V ratios above one based on Purnanandam and Swaminathan (2004)'s formula.

In this chapter, we propose an arguably less problematic proxy for intrinsic value so that we can estimate measures of mispricing. We argue that an IPO provides a unique opportunity to observe the intrinsic value estimated by its insiders. Specifically, we consider the lower limit in

the initial IPO filing price range as the issuer's reservation price, i.e., the lowest price the issuer can accept for selling the shares, and use this reservation price as a proxy for the intrinsic value of the IPO shares.

Theoretically, issuers can set the lower limit in the initial IPO filing price range higher or lower than issuer's reservation price. Some issuers may not want to reveal their reservation price at all. However, in real life it is not practical to set the lower limit much lower than issuers' reservation price because in this case the ceiling will also be much lower[1] and issuers may run the risk of having to sell at a low offer price. Another problem is an artificially low filing price range may be interpreted as a negative signal about firm value. On the other hand, the literature suggests that issuers do not set the lower limit much higher than the reservation price either. Kutsuna et al. (2009) shows that if the feedbacks from the road show phase are unfavorable, that is to say, if the potential offer price is likely less than the floor of the filing range, issuers will prefer withdrawing the IPO application rather than marking down the whole filing range. Ritter (2003) reports that only a very small percentage of IPO firms have offer price below the lower limit in the initial filing price range. Therefore the lower limit of the initial filing range is likely close to issuers' reservation price. From this point on we use the two terms interchangeably until we discuss an alternative proxy of reservation price in Section 2.5.4.

The next question is how the reservation price relates to the intrinsic value of IPOs. In a typical IPO the initial price range is set before road show and marketing campaign. At this point the issuer and underwriters do not know the market demand for the IPO shares yet. Therefore the issuer has to rely on the underwriters' advice and her own estimates about the intrinsic value of

[1] As discussed in Ritter (2011), the range between the floor and ceiling is almost always $2 in the U.S.

the firm when setting her reservation price and the initial price range. It is intuitive that the issuer will not risk losing money by setting the reservation price below the IPO intrinsic value in her perception plus a minimum profit to cover the risks and costs associated with going public. The issuer may not want to set the reservation price much higher than the intrinsic value either. Even if the issuer believes that the market will overvalue the IPO, she can always revise the offer price up later after receiving confirmation about strong demand in road shows. If she sets the reservation price too high, Welch (1992) shows that the high initial price may cause a negative cascade and the IPO may fail. Underwriters also do not want the issuers to have high reservation prices and consequently set high initial filing price range. They may want to set the initial price range lower to have a lower "anchor" so that the issuer will have the psychological satisfaction when the price is revised higher later (Loughran and Ritter 2002). Underwriters will have even stronger incentive to do this if they plan to underprice (relative to market demand) the issue and use it to reward their favorite customers (Ritter 2011). So the issuer's reservation price is likely close to the intrinsic value in her perception.

The intrinsic value in the issuers' perception is not necessarily accurate. Like investors, issuers are also subject to behavioral biases and may also become over-optimistic or over-pessimistic. However, the literature (e.g., see: Meulbroek 1992, Seyhun 1988, 1992 and 2000) shows that insiders are more likely to assess their companies' share value correctly when compared with outside investors. For IPO companies, the issuers have even more information advantage given the fact that IPO companies are usually less well known to investors than public companies.

So issuers' reservation price may be closer to the intrinsic value of IPO shares than market prices[2]. Therefore we try to use issuers' reservation price to measure mispricing in the IPO market.

IPO reservation price is arguably a better proxy for intrinsic value than those previously used in the literature. Market to book ratio is probably the most common choice of mispricing. This choice assumes that book value is a proxy for the intrinsic value of equity. However, as noted in Baker and Wurgler (2011), book value is just a summary of past accounting performance, not a precise estimate of fundamental value. In addition to the criticism that market to book ratio is affected by risk and agency problems (e.g., see: Fama and French 1992), it is also well known that market to book ratio is affected by expected growth potential. Thus firms with high market to book ratio are not necessarily overvalued. They may just be expected to grow faster or have lower risks. As mentioned earlier, the P/V ratios used by Purnanandam and Swaminathan (2004) also fail to control for expected growth properly. In contrast, when IPO issuers decide the reservation price, we expect them to consider both the major risks faced by their firms and the growth potential. The measure of intrinsic value as developed in Dong et al. (2006) does control for expected growth by making use of analyst earnings forecasts. However, we expect the reservation price to be more accurate because IPO issuers can make use of the inside information they have regarding future earnings when they set the reservation price.

If we use issuers' reservation price as a proxy for intrinsic value, mispricing can be measured by the premiums of first day closing price and first month closing price over the

[2] The value of the firm as a privately held company may be lower than its value as a publicly held company. We assume that most IPO issuers will try to sell their companies in IPOs at or above the intrinsic value as public companies. We acknowledge an entrepreneur may sell her IPO company at a price that is below its value as a public company as long as the IPO price is still above its value as a private company. This makes reservation price noisier as a proxy for the intrinsic value. However, as long as our assumption holds for the majority of issuers, we expect issuers' reservation price to be a good proxy for the intrinsic value.

reservation price. The IPO over-optimism hypothesis predicts that the IPO price premiums should be higher in over-optimistic markets as proxied by worse subsequent market return (Lowry 2003), the number of IPOs in a calendar year, and high liquidity[3]. Because behavioural biases such as overconfidence have stronger effects on hard-to-value stocks (Hirshleifer 2015), mispricing is more likely when an IPO firm is hard to value. Therefore we also expect the IPO price premiums to be higher for younger IPO firms, firms with less tangible assets, and firms reporting research and development (R&D) expense[4].

The IPO over-optimism hypothesis is based on similar assumptions as Ljungqvist et al. (2006), which also assumes that issuers exploit over-optimistic investors by selling IPO shares at prices above intrinsic value. The difference is that Ljungqvist et al. (2006) also attempt to explain IPO underpricing by introducing regular IPO investors while we focus on the intrinsic value in issuers' perception. The IPO over-optimism hypothesis is compatible with not only the IPO underpricing explanation in Ljungqvist et al. (2006), but also the prospect theory explanation in Loughran & Ritter (2002). Our hypothesis is closely related to the windows of opportunity theory as discussed in Ritter (1991). However, the windows of opportunity theory is frequently also used to explain the clustering of IPOs while the IPO over-optimism hypothesis focuses on pricing only. Specifically, the windows of opportunity theory does not say much about why some IPOs are conducted in cold periods while the IPO over-optimism hypothesis suggests that an IPO can be conducted as long as the offer price is at or above the issuer's reservation price, even during cold periods. It should also be noted that the investor over-optimism about IPOs may be due to

[3] As suggested in Baker and Wurgler (2011), unusually high liquidity is symptomatic of an overvalued market dominated by irrationally optimistic investors.

[4] See Chan et al. (2001) for discussions about the relation between R&D and difficulty to value a firm.

investor's expectation about future growth. Purnanandam and Swaminathan (2004) report that the magnitude of IPO overvaluation drops after controlling for expected growth when they select matching firms. Therefore one plausible explanation for over-optimism could be that investors overvalue IPOs *ex ante* due to their perceived high growth rate. Then investors adjust their expectations downwards as the post-IPO operating performance miss their projections *ex post* (e.g., see: Jain and Kini (1994) for discussions about post-issue operating performance).

2.3 Data and Preliminary Results

2.3.1 Data and Sample

The data used in this study is collected from the sources including: (i) Securities Data Corporation (SDC) global new issue database for IPO information, (ii) COMPUSTAT for financial information, (iii) CRSP for stock information, and (iv) Professor Jay Ritter's website for underwriter ranking data.

Table 2.1 Sample Selection Procedure

This table summarizes the detailed steps in selecting our IPO sample by using Securities Data Corporation (SDC) Platinum Global New Issues, Compustat and CRSP databases.

Description	# of firms
1. U.S. IPOs in SDC Global New Issue database during the period of 1983 to 2012	9,443
2. Merging sample with CRSP and requiring firms to be listed in CRSP within 30 days since the IPO issue date	6,381
3. Sample firms after removing right issues, unit issues, unit investment issues, depositary issues, closed-end fund trust issues, and REIT issues	5,839
4. Sample firms after removing penny stocks (offer price less than 5 dollars)	5,413
5. Sample firms after removing financial firms (SIC code between 6000 and 6799 and utility firms (SIC code from 4800 to 4999)	4,811
6. Requiring firms to have low bound of original filing price available	3,210
7. Delete firms with missing or negative book value	(72)
Final sample	3,138

We obtain our initial sample of 9,443 US common stock new issues from 1983 to 2012[5] using SDC database. Then we match our sample with CRSP daily stock price database by six-digit CUSIP code. This procedure helps us collect data on shares outstanding, stock prices, and returns. We require the first appearance of the IPO firm in the CRSP database must be within one month since the issue date. After this step 6,381 IPOs remain in the sample.

Then we eliminate right issues, unit investment trusts, unit issues, depositary issues, REIT, and closed-end fund offerings by SDC flags. We exclude penny stocks with offer price less than five dollars. In addition, regulated utility firms and financial firms have also been excluded in order to avoid the effect of regulated constrains on insider trading. We then require our sample firms to

[5] We start from the year 1983 since information about original filing range is incomplete and limited before that year. The cut-off is 2012 since we need at least 3 years to calculate IPO long-run stock performance.

have low bound of original filing price and complete information available for empirical tests. Our purging procedures are consistent with previous IPO literature and yield 3,138 IPOs. Table 2.1 illustrates the sample selection procedures.

2.3.2 Summary Statistics

We construct two measures of mispricing for each IPO. First, we calculate PREMIUM1 as the difference between the lower limit of the original filing range in the preliminary prospectus and the first-day aftermarket closing price, scaled by the lower limit price. This measure is a proxy for initial mispricing in the IPO secondary market. Secondly, we define PREMIUM2 as the difference between the lower limit of the original filing range and the market closing price one month after IPO issue date, scaled by the lower limit price. We estimate PREMIUM2 because previous literature (e.g., see: Ritter 1991) document positive abnormal return for IPO stocks in the first 1-2 months after issue date, implying that it may take some time for over-optimism to be fully reflected in the price of IPO stocks. In this case PREMIUM2 may incorporate more information about market over-optimism.

Table 2.2 Frequency Distribution and Mean Price Premium by IPO Issue Year

This table depicts the frequency distribution and mean price premium of 3,138 IPOs in our sample by year. The sample selection procedures are described in Table 2.1. We measure PREMIUM1 as the difference from the lower limit of IPO original filing price range to first day aftermarket closing price scaled by the lower limit price. PREMIUM2 is defined as the difference from the lower limit of IPO original filing range to IPO first month closing price scaled by the lower limit price. The initial return is defined as first day aftermarket closing price minus offer price, divided by offer price. Reported are mean values of PREMIUM1, PREMIUM2, and initial return.

IPO Year	Freq.	PREMIUM1	PREMIUM2	Initial Return
1983	227	19.8%	21.3%	11.6%
1984	94	-1.4%	-1.2%	3.2%
1985	116	11.7%	15.8%	7.4%
1986	229	12.6%	13.9%	7.8%
1987	166	10.7%	5.9%	6.4%
1988	63	9.7%	11.3%	6.2%
1989	65	18.5%	19.9%	9.2%
1990	67	27.9%	28.4%	11.8%
1991	139	22.3%	33.0%	10.8%
1992	227	17.9%	16.7%	10.5%
1993	252	23.7%	27.3%	11.8%
1994	239	15.6%	18.0%	9.5%
1995	282	42.9%	51.3%	20.8%
1996	431	31.9%	38.5%	17.1%
1997	255	21.7%	22.3%	14.1%
1998	91	25.3%	41.6%	17.3%
1999	60	130.0%	144.0%	61.3%
2000	43	69.2%	64.0%	34.6%
2001	7	-8.1%	-18.5%	2.9%
2002	7	2.2%	6.4%	0.9%
2003	1	4.8%	2.8%	1.9%
2004	11	33.1%	21.2%	11.8%
2005	13	16.9%	14.2%	8.1%
2006	9	8.7%	-0.8%	3.6%
2007	12	15.3%	10.1%	0.1%
2009	4	63.5%	92.7%	20.3%
2010	11	8.7%	9.5%	3.2%
2011	12	18.8%	21.6%	6.2%
2012	5	12.7%	16.5%	17.0%
Total	3138	24.5%	27.9%	13.3%

Table 2.3 IPO Price Premium and Firm and IPO Offer Characteristics

This table depicts the summary statistics of firm and IPO offering characteristics. The sample includes 3,138 IPOs from 1983 to 2012 and the sample selection procedures are described in Table 2.1. We measure PREMIUM1 as the difference from the lower limit of IPO original filing price range to first day aftermarket closing price scaled by the lower limit price. PREMIUM2 is defined as the difference from the lower limit of IPO original filing range to IPO first month closing price scaled by the lower limit price. The Initial Return is defined as first day aftermarket closing price minus offer price, divided by offer price. Firm Age is the number of years between the IPO date and the company's founding date. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Offer Size is defined as the sum of primary shares and secondary shares offered scaled by post-IPO shares outstanding. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. # of IPOs are the number of IPOs in a given year, taken from Jay Ritter's website. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. Market Cap is the product of shares outstanding and first day closing price, shown in million US dollars.

Variable	Mean	Median	1st Quartile	3rd Quartile	Std. Dev.
PREMIUM1	24.50%	12.50%	-3.13%	38.04%	0.53
PREMIUM2	27.85%	13.36%	-6.94%	45.00%	0.65
Initial Return	13.29%	5.21%	0.00%	18.40%	0.24
Firm Age	15.49	8.00	4.00	17.00	20.12
Prestigious Underwriter	0.74	1.00	0.00	1.00	0.44
Offer Size	34.46%	30.70%	23.07%	39.26%	0.19
VC Backing	0.38	0.00	0.00	1.00	0.49
# of IPOs	339.05	393.00	172.00	474.00	175.34
Hi Tech	0.20	0.00	0.00	0.00	0.40
Market Cap	204.27	88.54	46.56	185.74	567.24

Table 2.2 provides yearly distribution of our sample as well as the mean PREMIUM1, PREMIUM2, and initial return of IPO issuing firms segmented by year. Our sample concentrates on the 1990s. The three years with the largest number of IPOs in our sample are the year 1996, 1993 and 1997. There is considerable variation in the magnitude of price premium and initial return for IPO firms. For example, PREMIUM1 ranges from a low of -8.1% in the year of 2001 to a high of 130% for the year of 1999. PREMIUM2 ranges from a low of -18.5% in the year of 2001 to a high of 144% in the year of 1999. The initial return also peaks at 61.3% in the year of 1999, while it decreases dramatically to merely 2.9% two years later.

Table 2.3 depicts descriptive statistics of IPO characteristics. The mean and median values of PREMIUM1 are 24.5% and 12.5%, respectively, suggesting that the distribution of PREMIUM1 is highly skewed. On average, IPOs exhibit a price premium of 27.85% from the lower limit of initial filing range to the first month closing price with a large variation. PREMIUM2 represents more than 45% of initial lower limit price for 25% of firms in the sample. The mean value of initial return is 13.29% for our sample firm. Median values for both PREMIUM1 and PREMIUM2 are around 12% to 14%. The results in Table 2.3 indicate that, on average, IPO issuing firms receive significant positive price premium in both IPO pricing stage and short-term post-IPO aftermarket stage.

Table 2.3 also reports a number of other IPO characteristics. Firm age is defined as the number of years from firm founding year to the IPO year. The mean (median) firm age for our sample is 15.49 (8.00). Underwriter ranking is collected from Professor Jay Ritter's website. The underwriter ranking data has a scale of 0 to 9 to capture the hierarchy of underwriters with 9 assigned to the top ranking underwriters. Consistent with previous literature (e.g., see: Corwin and Schultz 2005, Neupane and Thapa 2013), we use a dummy variable (prestigious underwriter) to control for underwriter quality. Prestigious underwriter is defined as one if the underwriter's ranking is equal to or larger than 7, zero otherwise. As a robustness test, we also run the regression using underwriter ranking as a dummy variable. Results are qualitatively similar. Offer size is defined as total shares offered in the IPO divided by post-IPO CRSP shares outstanding. The mean (median) ownership size offered by issuers in the post-issue firm is 34.46% (30.7%). VC backing is a dummy defined as one if an IPO is backed by venture capital (VC), zero otherwise. In our sample, 38% of firms have venture capital financing. # of IPOs is defined as the number of IPOs in a calendar year and it is used to capture heat of IPO market, as in Yung et al. (2008). The data

regarding # of IPOs comes from Jay Ritter's website. Hi Tech is a dummy for hi-tech firms. As in Loughran and Ritter (2004), hi-tech firms are those with the following SIC codes: 3571, 3572, 3575, 3577, 3578, 3661, 3663, 3669, 3674, 3812, 3823, 3825, 3826, 3827, 3829, 4899, 7370, 7371, 7372, 7374, 7375, 7378, and 7379. About 20% of firms in the sample are in the high technology industry. Overall the summary statistics for our sample as reported in Table 2.3 are in line with those reported in the previous literature.

2.4 IPO Price Premium and Proxies for Market Over-optimism

To be reasonably confident that the IPO price premiums can be used as measures of mispricing, we have to find evidence that the price premiums are correlated with other potential proxies for market over-optimism. So we run a few regressions using PREMIUM1 and PREMIUM2 as dependent variables. The independent variables include proxies for market over-optimism, proxies for difficulty to value the firm, and some control variables. The proxies for market over-optimism include Future Market Return (12-month CRSP valued weighted market return following the IPO issue date), # of IPOs (natural log of the number of IPOs in a calendar year), and Turnover. Market over-optimism is considered to be associated with worse future market returns. Turnover is the mean turnover (ratio of volume to public float) of IPOs in the previous three months prior to the IPO issue date. The proxies for difficulty to value the firm include Firm Age (measured as log (1+ firm age) as defined in Table 2.3), Tangible Assets (the ratio of net property, plant and equipment to total assets in the fiscal year end prior to IPO issue date), and R&D (a dummy variable which equals one if the firm occurs any R&D expenditure in the fiscal year end prior to IPO issue date). The control variables include Sales (log of sales for the fiscal year prior to issue date), Prestigious

Underwriter, Hi Tech, and VC Backing. Prestigious Underwriter, Hi Tech and VC Backing are defined the same way as in Table 2.3. The regression results are reported in Table 2.4.

In column (1) and column (2) of Table 2.4, we do not include Tangible Assets, R&D and Sales because some IPO observations in our sample do not have data available for these variables. PREMIUM1 is the dependent variable in column (1). This column shows that the coefficient of Future Market Return is negative and significant, suggesting that PREMIUM1 is negatively related to market return in the year following IPO. In other words, PREMIUM1 is higher in over-optimistic markets as proxied by lower future return. Colunmn (1) also shows that PREMIUM1 is positively related to average turnover of IPOs issued in the previous 3 months, again consistent with our conjecture that PREMIUM1 is higher in over-optimistic markets. The coefficient of # of IPOs is significantly positive, which suggests that price premium is higher in hot IPO markets. In column (2) PREMIUM2 is the dependent variable. The results are very similar to those in column (1). These results suggest that both PREMIUM1 and PREMIUM2 are positively related to proxies for market over-optimism.

Table 2.4 Regression Analysis of Factors Affecting IPO Price Premium

This table presents the regression analysis about factors that may affect IPO price premiums using data from 3,138 IPOs from 1983 to 2012. The dependent variables are PREMIUM1 in column (1) and (3), and PREMIUM2 in column (2) and (4). We measure PREMIUM1 as the difference from the lower limit of IPO original filing price range to first day aftermarket closing price scaled by the lower limit price. PREMIUM2 is defined as the difference from the lower limit of IPO original filing range to IPO first month closing price scaled by the lower limit price. Future Market Return is 12-month CRSP value-weighted market return following the IPO issue date and first-month market return is not included in column (2) and (4). # of IPOs is natural log of the number of IPOs in a calendar year. Turnover is the mean turnover (ratio of volume to public float) of IPOs in the previous three months prior to the IPO filing date. Firm Age is log (1+the number of years between the IPO date and the company's founding date). Tangible Assets is the ratio of net PP&E (property, plant and equipment) to total assets in the fiscal year end prior to IPO issue date. R&D is a dummy variable which equals one if the firm occurs any R&D expenditure in the fiscal year end prior to IPO issue date. Sales is log of sales for the fiscal year prior to issue date. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. VCs Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
	PREMIUM1	PREMIUM2	PREMIUM1	PREMIUM2
Future Market Return	-0.111***	-0.147***	-0.097**	-0.142**
	[-2.61]	[-2.70]	[-2.07]	[-2.42]
# of IPOs	0.060***	0.075***	0.061***	0.081***
	[5.59]	[5.49]	[4.87]	[5.09]
Turnover	0.014***	0.015***	0.014***	0.016***
	[8.19]	[7.22]	[7.30]	[6.73]
Firm Age	-0.023***	-0.023***	-0.019***	-0.024***
	[-4.47]	[-3.56]	[-3.18]	[-3.20]
Tangible Assets			-0.058**	-0.083**
			[-2.11]	[-2.45]
R&D			0.033**	0.038**
			[2.29]	[2.13]
Sales			-0.006	0.005
			[-1.48]	[0.93]
Prestigious Underwriter	0.036***	0.061***	0.045***	0.059***
	[2.92]	[4.04]	[3.07]	[3.34]
Hi Tech	0.121***	0.137***	0.109***	0.129***
	[7.23]	[6.77]	[5.80]	[5.64]
VC Backing	0.027**	0.046***	0.014	0.042**
	[2.12]	[2.95]	[0.97]	[2.40]
N	3138	3138	2713	2713
adj. R2	0.089	0.082	0.101	0.096

Column (1) and column (2) also show that the coefficient of Firm Age is negative and significant. After we add Tangible Assets, R&D, and Sales to the independent variables (and lose some observations), the coefficient of Firm Age remain negative and significant when PREMIUM1 is used as the dependent variable in column (3), implying that younger firms are more likely to be over-priced in the secondary market. The coefficient of Tangible Assets is negative and significant while the coefficient of R&D is positive and significant in column (3). These results are consistent with the prediction that the markets are more likely to overvalue the hard-to-value IPOs. In column (4) PREMIUIM2 is used as the dependent variable. The coefficients of Sales become less significant but the coefficients of R&D and Firm Age remain positive and significant, suggesting that the the hard-to-value IPOs are still more likely to be overvalued one month after trading date. The coefficients of the market over-optimism proxies remain highly significant in column (3) and column (4). Overall the results are consistent with our argument that the price premiums can be used as measures of market mispricing.

2.5 Analysis of IPO Price Premium and Aftermarket Stock Performance

If the IPO price premiums do measure market mispricing, then they will be negatively related to long-run stock performance when mispricing is corrected. Therefore we examine the long-run stock performance of IPOs in our sample in this section.

2.5.1 Univariate Analysis

Following Brau et al. (2012) and others, in empirical analysis we examine three stock performance metrics: raw buy-and-hold returns (BHRs), market adjusted BHRs, and style adjusted BHRs. We report short-term cumulative aftermarket stock returns for the periods of six months (the typical

lock-up period is 180 days in the U.S.), 1 year, 2 years, 3 years, 4 years and 5 years. For each firm, performance calculation begins from the day after issue date to a certain point (six months, one year, two years, three years, four years and five years) after IPO. First-month return is not included for stock performance measures associated with PREMIUM2. We define one month as 21 trading days. If an IPO firm is delisted based on CRSP during the five-year period, the returns are truncated at the delisting day and used for all longer-horizon returns for that IPO (Loughran and Ritter, 1995).

Table 2.5 first provides an overview of stock performance metrics across various time windows. We first take a look at market adjusted returns, where the CRSP NYSE-Amex-Nasdaq value weighted return is used as the market return and we use daily CRSP tape for calculation. Consistent with Ritter (1991), IPOs perform roughly on par with the market in the first six months (mean market adjusted BHRs at -2.5% for first six months) but underperform the market in the next few years. The average market adjusted BHRs stand at -9.6% during the first aftermarket year, -35.1% during the first three years, and -50.2% for the first five years.

Table 2.5 Univariate Analysis of PREMIUM1 and IPO Aftermarket Performance

This table reports mean values of IPO aftermarket stock performance for four portfolios, which are constructed by sorting sample firms based on the magnitude of PREMIUM1. The sample includes 3,138 IPOs from 1983 to 2012. SA is the first post-IPO six months. PREMIUM1 is defined as the difference from the lower limit of IPO original filing price range to first day aftermarket closing price scaled by the lower limit price. IPO's raw buy-and-hold returns (BHRs) are holding period total returns calculated from first-day closing prices. Market adjusted BHRs are calculated as the difference between the IPO's raw BHRs and the corresponding BHRs from the CRSP value-weighted index for certain timing periods or until the delisting date, whichever is earlier. Style adjusted BHRs are calculated as the difference between the IPO's buy-and-hold return and the corresponding BHRs from Fama-French 25 portfolio matched on size and book-to-market, for certain timing periods or until the delisting date, whichever is earlier. The empirical p values are estimated using the simulation method in Purnanandam and Swaminathan (2004).

	SA	1 Year	2 Years	3 Years	4 Years	5 Years
Panel A: Raw BHRs for Portfolios Sorted by PREMIUM1						
All	0.039	0.053	0.102	0.173	0.242	0.289
Low	0.076	0.079	0.155	0.237	0.301	0.361
Q2	0.031	0.046	0.101	0.188	0.219	0.252
Q3	0.031	0.062	0.091	0.172	0.266	0.301
High	0.015	0.027	0.06	0.092	0.184	0.244
Low – High	0.061	0.052	0.095	0.145	0.117	0.117
Emp p value	0.004	0.038	0.013	0.006	0.018	0.050
Panel B: Market Adjusted BHRs for Portfolios Sorted by PREMIUM1						
All	-0.025	-0.096	-0.235	-0.351	-0.444	-0.502
Low	0.007	-0.076	-0.181	-0.280	-0.358	-0.412
Q2	-0.035	-0.106	-0.236	-0.348	-0.471	-0.552
Q3	-0.027	-0.081	-0.24	-0.336	-0.423	-0.484
High	-0.046	-0.119	-0.283	-0.440	-0.523	-0.557
Low - High	0.053	0.043	0.102	0.160	0.165	0.145
Emp p value	0.005	0.065	0.009	0.001	0.008	0.018
Panel C: Style Adjusted BHRs for Portfolios Sorted by PREMIUM1						
All	0.03	0.018	-0.011	-0.026	-0.044	-0.031
Low	0.054	0.031	0.019	0.008	-0.012	0.013
Q2	0.018	0.003	-0.014	-0.015	-0.074	-0.085
Q3	0.029	0.033	-0.014	-0.017	-0.023	-0.025
High	0.018	0.008	-0.037	-0.079	-0.067	-0.027
Low - High	0.036	0.023	0.056	0.087	0.055	0.040
Emp p value	0.028	0.197	0.023	0.049	0.198	0.285

The risk profile of IPO firms could be notably different from market index which heavily concentrates on large and established firms. Therefore, market adjusted returns may not be a good measure of IPO aftermarket performance. Fama and French (1992) suggest that two factors, namely firm size and book-to-market ratio, are closely associated with the risk characteristics of firms. Therefore, we calculate style adjusted BHRs for IPO firms in the sample to control for the size effect and value effect. The style adjusted BHRs are defined as the difference between raw BHRs of IPO firms and the corresponding return of the benchmark portfolio over the same time period. Specifically, we sort each firm into one of Fama and Frech 25 benchmark portfolios constructed by market capitalization (size) and book-to-market ratio. The selection of benchmark portfolio is as follows: We first obtain each IPO firms' book equity using data on the IPO year, and then calculate market capitalization as the product of first-day aftermarket closing price and post-IPO shares outstanding. We then obtain the market capitalization and book-to-market ratio breakpoints from Kenneth French's website and use them as benchmark cut-offs.[6] We further sort each IPO firm into one of the 25 size and book-to-market portfolios based on these cut-offs.

As documented in the previous literature (for example, see: Brav and Gompers 1997, Ritter and Welch 2002), the extent of IPO stock underperformance decreases dramatically after controlling for size and value effects. One implication from their studies is that firms may have abilities to time their IPOs for periods when future returns on small growth firms are low. The results regarding style adjusted returns reported in Table 2.5 is similar to those reported in previous studies. For example, in our sample, we find that mean 3-year style-adjusted buy-and-hold return

[6] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Breakpoints

is -2.6%, which is close to the mean 3-year style adjust return of -5.5% reported in Brau et al. (2012).

To examine how PREMIUM1 and PREMIUM2 relate to the long run performance of IPO stocks, we first sort the IPOs into four approximately equal groups based on PREMIUM1, then we redo the sorting based on PREMIUM2. For each group, we calculate the mean returns and report them over the same time periods for ease of comparison. We report raw buy-and-hold returns (BHRs), market adjusted BHRs, and style adjusted BHRs for IPO firms. To deal with misspecification issues in long-run stock performance studies, in addition to typical p values, we estimate empirical p values by using a randomization sampling procedure as documented in Purnandam and Swaminathan (2004).

Table 2.5 presents the comparisons of post-IPO stock performance using PREMIUM1 as the sorting criteria. Across all three panels, IPO firms show a pattern of short-term momentum and long-run reversal with regards to the relation between price premium and post-IPO stock performance. As shown in Panel A, high price premium IPOs merely exhibit a mean six-month raw buy-and-hold return of 1.5%, whereas low price premium group gets a statistically significantly higher stock performance with a mean six-month raw BHRs of 7.6%. The results are similar for other time periods. For example, high PREMIUM1 IPOs obtain a mean 3-year raw BHRs of 9.2%, whereas low PREMIUM1 group achieves a much higher return of 23.7% during the same time period. The differences in returns are statistically significant at 1% level for time periods of 6 months and 3 years, and at 5% level for time periods of 1 year, 2 years, 4 years and 5 years. Reinforcing the conclusion, we also find similar results for the measure of market adjusted BHRs as shown in panel B, where low price premium IPOs have worse short-term aftermarket stock return over first post-IPO month but better long-run stock performance than high price

premium IPOs. The results discussed above hold when we use stock performance measures based on style adjusted BHRs. Consistent with the results reported in Table 2.4, on average IPOs exhibit slight underperformance in the long run compared with size and book-to-market adjusted benchmark. The stock performance difference between high PREMIUM1 group and low PREMIUM1 group is statistically and economically significant. For example, the mean value of 3-year style adjusted return for IPOs in the low PREMIUM1 group is 8.7% higher than the mean style adjusted BHRs for IPOs in the high PREMIUM1 group.

Table 2.6 Univariate Analysis of PREMIUM2 and IPO Aftermarket Performance

This table reports mean values of IPO aftermarket stock performance for four portfolios, which are constructed by sorting sample firms based on the magnitude of PREMIUM2. The sample includes 3,138 IPOs from 1983 to 2012. We define PREMIUM2 as the difference from the lower limit of IPO original filing price range to first month aftermarket closing price scaled by the lower limit price. First-month return is not included in the stock performance. SA is the first post-IPO six months. IPO's raw buy-and-hold returns (BHRs) are holding period total returns calculated from first-day closing prices. Market adjusted BHRs are calculated as the difference between the IPO's raw BHRs and the corresponding BHRs from the CRSP value-weighted index for certain timing periods or until the delisting date, whichever is earlier. Style adjusted BHRs are calculated as the difference between the IPO's buy-and-hold return and the corresponding BHRs from Fama-French 25 portfolio matched on size and book-to-market, for certain timing periods or until the delisting date, whichever is earlier. The empirical p values are estimated using the simulation method in Purnanandam and Swaminathan (2004).

	SA	1 Year	2 Years	3 Years	4 Years	5 Years
Panel A: Raw BHRs for Portfolios Sorted by PREMIUM2						
All	0.022	0.034	0.084	0.153	0.222	0.266
Low	0.039	0.048	0.106	0.187	0.236	0.275
Q2	0.033	0.041	0.11	0.198	0.261	0.305
Q3	0.019	0.04	0.1	0.183	0.274	0.306
High	-0.003	0.007	0.018	0.042	0.116	0.174
Low – High	0.042	0.041	0.088	0.145	0.12	0.101
Emp p value	0.015	0.056	0.008	0.001	0.018	0.066
Panel B: Market Adjusted BHRs for Portfolios Sorted by PREMIUM2						
All	-0.034	-0.104	-0.243	-0.363	-0.457	-0.513
Low	-0.021	-0.096	-0.213	-0.309	-0.401	-0.472
Q2	-0.027	-0.099	-0.216	-0.327	-0.418	-0.486
Q3	-0.032	-0.095	-0.227	-0.333	-0.424	-0.484
High	-0.057	-0.128	-0.316	-0.484	-0.587	-0.612
Low - High	0.036	0.032	0.103	0.175	0.186	0.14
Emp p value	0.021	0.100	0.003	0.001	0.001	0.009
Panel C: Style Adjusted BHRs for Portfolios Sorted by PREMIUM2						
All	0.011	-0.001	-0.027	-0.044	-0.066	-0.063
Low	0.019	-0.001	-0.018	-0.019	-0.056	-0.063
Q2	0.014	0.002	-0.009	-0.022	-0.046	-0.046
Q3	0.015	0.009	-0.006	-0.01	-0.011	-0.02
High	-0.005	-0.014	-0.078	-0.127	-0.154	-0.122
Low - High	0.024	0.013	0.06	0.108	0.098	0.059
Emp p value	0.065	0.306	0.007	0.008	0.039	0.178

In Table 2.6, we examine the relation between PREMIUM2 and IPO aftermarket performance. First-month return is not included in the stock performance. With regards to raw BHRs as shown in Panel A, the mean three-year raw returns for low premium IPOs is 14.5% higher than that for high price premium IPOs and the difference is statistically significant at 1% level. The results for market adjusted BHRs in Panel B are similar to those based on raw BHRs. Specifically, the mean three-year market-adjusted return for high price premium IPOs is 19.7% lower than that for low price premium IPOs. For style adjusted returns reported in Panel C, high price premium portfolio yields 10.8% lower returns than low price premium group. The results combined suggest that our conclusion is not sensitive to the different measurements of price premium and stock performance.

2.5.2 Cross-sectional Regressions

The univariate tests in Table 2.5 and Table 2.6 do not control for many factors known to affect IPO long-run performance. In this section, we use the following regression model to assess the impact of IPO price premiums on long-run stock performance after controlling for IPO offering characteristics:

$$Long\ run\ performance_i = \beta_0 + \beta_1 * Price\ Premium + \beta_2 * Prestigious\ Underwriter + \beta_3 * VC\ backing + \beta_4 * Bubble + \beta_5 * Hi\ Tech + \beta_6 * Ln(Market\ Cap) + \beta_7 * Firm\ Age + \beta_8 * Offer\ Size + \beta_9 * Ln\left(\frac{P}{B}\right) + \varepsilon_i \quad (1)$$

In this regression model Price Premium is either PREMIUM1 or PREMIUM2. Previous research indicates that firm age should be considered as a proxy for risk (Ritter 1984). Thus, we include Firm Age as a control variable. Prior studies (e.g., see: Carter et al. 1998, and Dong et al.

2011) find that prestigious underwriter could play a positive role in IPO stock performance through marketing, certification and screening channels. Therefore we include the dummy variable Prestigious Underwriter to capture underwriter reputation. Brav and Gompers (1997) identify backing by venture capitalist as another determinant of IPO aftermarket returns. We control for this effect by the dummy variable of VC Backing. We include # of IPOs to control for the effect of hot IPO markets and the dummy of Hi Tech to control for industry effects. These variables above are all defined in the same way as in Table 2.4. We include Market Cap, which is equal to log (shares outstanding * first day closing price), to control for any possible size effects. Bradley and Jordan (2002) link IPO underpricing with pre-IPO owner's share retention and share overhang. So we include Offer Size, the number of shares offered scaled by post-IPO shares outstanding, as a control variable.

We report the regression results in Table 2.7. In columns (1) and (2), we test the relation between PREMIUM1 and post-IPO stock performance, while in columns (3) and (4) we test the relation between PREMIUM2 and stock performance. In columns (1) and (3) we use 3-year style adjusted BHR to measure stock performance. In columns (2) and (4) market adjusted BHR is used to measure stock performance.

Table 2.7 Regression Analysis of IPO Price Premium and Long-run Stock Performance

This table presents the regression estimates of the effects of IPO price premium on long-run stock performance using data from 3,138 IPOs from 1983 to 2012. The dependent variables are 3-year style adjusted buy-and-hold returns (BHRs) in column (1) and (3), and 3-year market adjusted buy-and-hold returns (BHRs) in column (2) and (4). First-month stock return is not included in column (2) and (4).We measure PREMIUM1 as the difference from the lower limit of IPO original filing price range to first day aftermarket closing price scaled by the lower limit price. PREMIUM2 is defined as the difference from the lower limit of IPO original filing range to IPO first month closing price scaled by the lower limit price. Firm Age is log (number of years between the IPO date and the company's founding date). Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. # of IPOs is natural log of the number of IPOs in a calendar year. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. Market Cap is log (shares outstanding * first day closing price). Offer Size is defined as the number of shares offered scaled by post-IPO shares outstanding. Log (P/B) is natural log of price to book ratio in which price is based on IPO reservation price. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
PREMIUM1	-0.121***	-0.232***		
	[-2.63]	[-4.99]		
PREMIUM2			-0.087**	-0.181***
			[-2.37]	[-4.91]
Firm Age	0.041**	0.052***	0.043***	0.055***
	[2.38]	[2.99]	[2.60]	[3.34]
Prestigious Underwriter	0.196***	0.117**	0.183***	0.111**
	[4.09]	[2.41]	[3.90]	[2.36]
VC Backing	0.096**	0.100**	0.083**	0.088**
	[2.43]	[2.47]	[2.17]	[2.26]
# of IPOs	-0.039	-0.193***	-0.045	-0.196***
	[-1.09]	[-5.23]	[-1.28]	[-5.52]
Hi Tech	0.159***	0.162***	0.141***	0.138***
	[3.11]	[3.09]	[2.86]	[2.75]
Market Cap	-0.040**	0.073***	-0.047**	0.061***
	[-2.01]	[3.67]	[-2.44]	[3.17]
Offer Size	-0.264**	-0.017	-0.201*	0.039
	[-2.34]	[-0.15]	[-1.82]	[0.35]
Log (P/B)	-0.018	-0.130***	-0.001	-0.107***
	[-0.52]	[-3.56]	[-0.04]	[-3.07]
N	3138	3138	3138	3138
adj. R^2	0.016	0.033	0.014	0.032

Table 2.7 shows that the coefficients of PREMIUM1 are negative and significant in both column (1) and column (2) regardless of whether the dependent variable is 3-year market adjusted BHR or style adjusted BHR. Similarly, the coefficients of PREMIUM2 are negative and significant in columns (3) and (4). Therefore, both the market adjusted BHR model and the style adjusted BHR model show that IPO stocks with higher PREMIUM1 or PREMIUM2 have lower long-run stock performance. The results are consistent with the IPO over-optimism hypothesis and support our argument that the lower limit of initial IPO filing range is a good proxy for the intrinsic value of IPO shares.

For control variables, the coefficients of prestigious underwriter and firm age are positive and significant in all four models while the coefficient of market capitalization is significantly positive in only one of the four models. The coefficient of VCs backing is positive and significant in all but one of the four models. We do not identify a significant relation between offering size and post-IPO stock performance.

2.5.3 Calendar Time Regressions

We also use the Fama and French (1993) three-factor model (MKRF, SMB, HML) as well as a four factor model (MKRF, SMB, HML, MOM) as alternative methods to examine the relation between price premium and post-IPO long-run stock performance. Specifically, we sort our sample firms into four calendar time portfolios based on either PREMIUM1 or PREMIUM2. The IPOs stay in their respective portfolios for 36 months starting from the month after they go public. Every time a new IPO joins or an old IPO leaves, the portfolios are rebalanced. Based on the monthly returns of the IPOs, we calculate the equal-weighted monthly returns of each portfolio from March 1983 to December 2015. Then we estimate the Fama-French three-factor model and the four factor model for the whole IPO sample and each of the price premium portfolios:

$$R_{pt} - R_{ft} = \alpha_p + b_p * (R_{mt} - R_{ft}) + s_p * SMB_t + h_p * HML_t + u_t \quad (2)$$

$$R_{pt} - R_{ft} = \alpha_p + b_p * (R_{mt} - R_{ft}) + s_p * SMB_t + h_p * HML_t + m_p * MOM_t + u_t \quad (3)$$

where R_{pt} is the monthly return for the portfolios, R_{ft} is the one-month T-bill return, R_{mt} is the monthly return on the NYSE-Amex-Nasdaq value-weighted index, SMB is the monthly return on the portfolio of small firms minus the return on large firm portfolio, HML is the monthly return on high book-to-market stocks minus the return on low book-to-market stocks, and MOM is defined as the monthly excess return of past winner portfolio over that of past loser portfolio. α_p is the monthly risk-adjusted abnormal return. b_p, s_p, h_p, and m_p are factor loadings. We report the intercept of calendar time regression models in Table 2.8.

Panel A of Table 2.8 reports the intercepts estimated using Fama-French three factor model. Consistent with extant IPO literature, the intercept is negative but insignificant when the whole IPO sample is used. For the price premium portfolios, the intercepts are negative and significant only for the high price premium groups. For portfolios based on PREMIUM2, monthly return of negative 0.7% for high premium. In Panel B, after momentum factor is added into the calendar time regressions, the intercept for high PREMIUM1 group is -0.5% per month although it is not statistically significant. Overall the results are weaker than those based on BHRs in Tables 2.5, 2.6, and 2.7. This is not surprising given our earlier discussion that calendar time regressions lack the power to detect abnormal returns that tend to concentrate over certain periods (Loughran and Ritter 2000).

Table 2.8 Regression on Calendar-time Portfolios sorted by IPO Price Premium

This table reports the intercepts of regressions using Fama and French (1993) three-factor (MKRF, SMB, HML) model and four-factor (MKRF, SMB, HML, MOM) model involving equal-weighted monthly calendar time returns of IPO portfolios sorted by either PREMIUM1 or PREMIUM2. There are 3,138 IPO firms in the sample. The IPOs stay in their respective portfolios for up to 36 months starting the month after they go public. First month return has been excluded for IPOs sorted by PREMIUM2. The period is from March 1983 to December 2015. MKRF is the monthly excess return on the NYSE-Amex-Nasdaq value-weighted index. SMB is the monthly return on small firms minus the return on large firms, HML is the monthly return on high book-to-market stocks minus the return on low book-to-market stocks, and MOM is momentum factor, which is defined as the monthly return of past winner stocks minus that of past loser stocks. The data about MKRF, SMB, HML, and MOM is taken from Dr. French's website. *, **, *** denote statistical significance at 1%, 5%, and 10% level, respectively, and t-statistics are in brackets.

	PREMIUM1	PREMIUM2
Panel A: Fama-French 3 Factor Model (MKRF, SMB, HML)		
All IPOs	-0.2%	-0.2%
	[-1.27]	[-1.20]
Low Premium	-0.3%	-0.4%
	[-1.27]	[-1.42]
Q2	-0.4%	-0.3%
	[-1.39]	[-1.43]
Q3	-0.1%	-0.3%
	[-0.66]	[-1.46]
High Premium	-0.6%**	-0.7%*
	[-2.07]	[-1.84]
Panel B: 4 Factor Model (MKRF, SMB, HML, MOM)		
All IPOs	-0.1%	-0.1%
	[-0.44]	[-0.36]
Low Premium	-0.3%	-0.3%
	[-1.08]	[-1.39]
Q2	-0.2%	-0.3%
	[-0.57]	[-1.16]
Q3	-0.1%	-0.2%
	[-0.35]	[-1.11]
High Premium	-0.5%	-0.5%
	[-1.53]	[-1.28]

2.5.4 Robustness Test

Up to now we have been assuming that the lower limit of the initial filing range is a proper proxy for the issuers' reservation price. This seems to be the case for majority of the IPOs in our sample.

However, as shown in Table 2.2 and Table 2.3, there are some IPOs with offer price or even closing price below the lower limit of the initial filing range. One possible explanation is that some issuers try to hide their inside information by setting the lower limit of the initial filing range above their reservation price. Another possible explanation is that some issuers are not confident about their own initial valuation and choose to adjust their reservation price down. In both cases the offer price will be closer to issuers' reservation price than the lower limit of the initial filing range. Therefore for those IPOs with offer price less than the floor price in the original filing range, we do a robustness check by using the offer price as the proxy for reservation price and re-estimate PREMIUM1. Then we replace the PREMIUM1 in regressions with this revised closing premium and re-estimate the regressions. Consistent with the IPO over-optimism hypothesis, we get very similar results[7]. The coefficient of the revised price premium is still negative and significant, suggesting that the market overvalues those IPOs with high price premiums. In addition, we also perform robustness check by using the midpoint of the filing range as the reservation price. As expected, this alternative measure yield quantitatively similar results since the range between the floor and ceiling is almost always $2 in the U.S (Ritter 2011).

2.6 Conclusions

In this chapter we propose that the lower limit of the initial IPO filing price range can be used as a proxy for the intrinsic value of IPO shares. We estimate IPO price premiums based on this proxy and find that the price premiums are positively related to proxies for market over-optimism. The price premiums are also higher for hard to value IPOs. These results are consistent with our

[7] The results are available upon request.

argument that the IPO price premiums can be used to measure mispricing in the IPO market. In addition, the aftermarket performance of IPO stocks is negatively related to the price premiums, suggesting that those IPOs with high price premiums are more likely to be overvalued. These results are consistent with the hypothesis that the IPO markets are over-optimistic from time to time. Future studies can be built on this arguably less problematic mispricing measure to investigate other important issues in the IPO settings. For example, will the IPO price premium be correlated with IPO quality? Will the IPO price premium predict underwriter switching in the SEOs?

It should be noted that although we argue that the lower limit of the initial IPO filing price range is a good proxy for IPO issuers' reservation price and the reservation price is a good proxy for the intrinsic value of IPO shares, the fact that some IPOs are sold below the lower limit suggests that the actual reservation price may be lower in some occasions. Therefore the intrinsic value of IPO shares in issuers' perception may be lower than the value of our proxy. In other words, IPOs may be more overvalued than what the price premiums suggest. This explains why the IPOs in the low price premium group also underperform the market. It is likely caused by some IPO issuers' effort to either hide their inside information or to take advantage of market over-optimism. In any case, the difference between the intrinsic value in issuers' perception and our proxy increases the noise in our measure of mispricing. However, we still find negative and significant relation between IPO long-run stock performance and IPO price premiums. This implies that IPO issuers' own valuation is probably even more accurate than what our results suggest.

Chapter 3 Insider Selling and IPO Price Premium

3.1 Introduction

Going public brings many valuation-enhanced benefits to privately held firms (Pagano et al. 1998). The proceeds from IPO can be used to finance profitable investment opportunities. An IPO can increase the transparency of the firm by subjecting it to capital market regulations. Meanwhile, a public firm can easily raise additional proceeds through seasoned offerings. In addition, an IPO can provide a liquid market which allows pre-IPO corporate insiders[8], such as directors, officers, and large beneficial shareholders, to exit their investments, either to diversify or to take advantage of over-optimistic valuations. In this chapter we focus on insiders' opportunistic behaviour to sell into over-optimistic markets.

The IPO over-optimism hypothesis in Chapter 2 suggests that markets tend to overvalue IPOs from time to time and insiders are aware of the overvaluation. This implies that insiders in overvalued IPO firms may want to sell their holdings as early as possible before the overvaluation is corrected, as evidenced by the poor long run performance of IPO stocks (e.g., see: Ritter 1991). The literature does show that insiders significantly reduce their shareholdings after IPO (Aggarwal et al. 2002, Helwege et al. 2007). The question is when and how they reduce their shareholdings.

[8] According to the filing requirements of Section 16 of the Exchange Act of 1934 and Section 403 of the Sarbanes-Oxley Act of 2002, insiders are defined as a company's directors, officers, and any beneficial owners of more than 10% of a class of the company's equity securities. In this chapter, we use insiders and owner-manager interchangeably for IPO firms.

The first opportunity is to sell their shares as secondary shares at the time of IPO. Therefore the IPO over-optimism hypothesis predicts that the likelihood and magnitude of secondary shares sales are positively related to the extent of overvaluation.

However, many insiders may choose not to sell secondary shares in IPOs even when their IPOs are overvalued because doing so could draw too much attention from outside investors and send a negative signal to the market about IPO valuation (Ang and Brau 2003). The well-known fact that on average IPO offer price is more than 10% lower than aftermarket price also reduces the incentive for insiders to offer secondary shares in IPOs. They can hold on to their shares a little longer and expect to sell in the aftermarket at a better price. To send a positive signal to the market, most insiders even commit to not selling their shares for a certain period by agreeing to a lockup provision (Ang and Brau 2003). However, Karpoff et al. (2013) and Keasler (2001) show that lockup is not 100% binding and early release from lockup is frequently granted to insiders. If insiders in overvalued IPO firms want to sell their shareholdings in the aftermarket as early as possible, as predicted by the IPO over-optimism hypothesis, then they are more likely to seek early release to sell their shareholdings early in the aftermarket. If for some reason these insiders cannot sell before lockup expiration, they will be more likely to sell shortly after lockup expiration. The IPO over-optimism hypothesis also predicts that insiders in overvalued IPO firms will sell more shares in the aftermarket.

Using a sample of 1,868 IPOs with lockup provision and issued between 1988 and 2012, we estimate the premiums of offer price and first day closing price over the lower limit of the filing price range in the initial IPO prospectus and measure overvaluation by the two price premiums. We find that higher offer price premium is associated with more upward revision in the total number of shares offered. In addition, the probability of offering secondary shares and the

proportion of secondary shares offered also increase with offer price premium. Consistent with the IPO over-optimism hypothesis, these results suggest that when the market values the IPO shares higher relative to insiders' reservation price, insiders are more likely to issue secondary shares in IPOs and they issue more secondary shares on average.

Next we examine aftermarket insider sale before lockup expiration (early sale). We find that insiders in 31.3% of our IPO sample firms do early sale. Consistent with the IPO over-optimism hypothesis, the probability of early sale increases with first day closing price premium. It seems insiders of overvalued IPOs are more likely to seek early release from lockup so that they can reduce their shareholdings in the aftermarket as early as possible. In addition, the size of insider early sale also increases with first day closing price premium.

We also look into insider sale in the year after lockup expiration (late sale). We find that insiders in 64.2% of our IPO sample firms conduct late sale. Both the probability and the size of late sale increase with first day closing price premium. Consistent with the IPO over-optimism hypothesis, these results suggest that IPO insiders' have more incentives to reduce their shareholdings after lockup expiration if the IPO is overvalued.

The results in this chapter help us gain more insights about the incentives and behaviours of insiders in IPO firms. A lot of research focuses on insiders' desire to diversify their portfolios or to meet their liquidity needs. For example, Pagano (1993) and Pagano et al. (1998) cite portfolio diversification as an important motive in the decision to go public; Bodnaruk et al. (2008) find that firms held by less diversified controlling shareholders are more likely to go public; Chua and Nasser (2016) focus on insiders' liquidity needs as a motivation for secondary sales in IPOs. In contrast, this chapter examines insiders' opportunistic behaviour by investigating the relation between insider sales and IPOs valuation. In the literature, Chen et al. (2012) is probably closest

to this study. They find that IPO long run returns after lockup expiration are negatively associated with abnormal selling by senior executives and suggest that the selling is motivated in part by private information. However, Chen et al. (2012) did not examine the nature of the private information. This chapter suggests that the private information may be related to the initial valuation of IPOs. Specifically, consistent with the IPO over-optimism hypothesis, we find that insiders tend to sell more shares before and after lockup expiration if the market values the IPO higher relative to insiders' reservation price. As far as we know, this is the first comprehensive study about this relation and the results suggest that insiders are quite opportunistic in the IPO process.

The chapter proceeds as follows. In Section 3.2, we first review related literature and then propose testable hypotheses. In Section 3.3, we describe data, sample, and variable measures. In Section 3.4, we present empirical results regarding insider secondary share sales and offering size revision. In Section 3.5 and 3.6, we examine insider sales prior to and following lockup expiration, respectively. Section 3.7 concludes the chapter.

3.2 Related Literature and Hypothesis Developments

Insiders play important roles in the IPO process, making decisions regarding the timing, pricing, size, and other aspects of IPO. Therefore it is important to understand the incentives and behaviors of insiders in IPO firms. For insiders, one of the most important benefits of going public is the access to a liquid equity market where they can cash out (e.g., see: Booth and Chua 1996, Ritter and Welch 2002). It has been documented that insiders significantly reduce their shareholdings after IPO (Aggarwal et al. 2002, Helwege et al. 2007). For the venture capitalists among insiders,

exiting after a company goes public seems to be a natural decision. After all, they specialize in private start-up companies. The question is: why do other insiders want to cash out?

Modern portfolio theory suggests a simple reason: insiders need to diversify their investment to reduce the risks they face. Many IPO insiders have a highly undiversified personal portfolio with concentrated investment in their IPO companies. Going public makes it much easier for these insiders to rebalance their portfolios. Many studies, such as Pagano (1993), Zingales (1995), and Pagano et al. (1998), refer to the diversification benefit IPOs bring to insiders. In Brau and Fawcett (2006), more than 44% of the CFOs surveyed agree that one of the motivations for IPOs is to allow insiders to diversify personal holdings. Although Pagano et al. (1998) find little evidence that portfolio diversification is important in the decision to go public using Italian data, Bodnaruk et al. (2008) show that the less diversified individual shareholders sell more of their shares at the IPO using information on the portfolio composition of shareholders in private and public firms from Sweden. They also show that firms held by less diversified controlling shareholders are more likely to go public.

Insiders' liquidity needs may also affect insiders' behaviors. Chua and Nasser (2016) find that lower levels of pre-IPO cash holdings in the company lead to lower levels of executive compensation, and the smaller cash-pay results in greater levels of insider secondary share sales in IPOs. In other words, insiders with liquidity shortage are more likely to cash out.

The focus of this paper is another factor that may affect insiders' behaviors: market valuation. Seyhun (1992) shows that insiders are more likely to sell (purchase) shares following periods of significant price appreciation (declines), consistent with insiders trying to buy when market valuation is low and sell when market valuation is high. Rozeff and Zaman (1998) show that insiders predominantly buy (sell) shares in value (glamour) firms and interpret this as evidence

of insiders trading against market misvaluation. Piotroski and Roulstone (2005) also find that insider purchases are positively related to proxies for security undervaluation. These results imply that IPO insiders may also trade based on market valuation.

The IPO literature also supports the idea that market valuation affect IPO insiders' behaviors. In Zingales (1995), entrepreneurs will sell their companies through public offerings only when the market value the companies higher than the entrepreneurs do. Zingales (1995) assumes that the different valuation is caused by different discount rates and does not consider the possibility that the market may overvalue IPO firms. However, as summarized in Chapter 2, there are a lot of factors that may cause the market to overvalue IPO firms. Chapter 2 also documents many studies with results suggesting that IPO firms are overvalued on average. Therefore the windows of opportunity hypothesis (Ritter 1991) and the IPO price model in Ljungqvist et al. (2006) both assume that IPOs are conducted to take advantage of the overvaluation. In the IPO over-optimism hypothesis proposed in Chapter 2, entrepreneurs (insiders) are aware of the overvaluation because the market price is higher than the intrinsic value in their own perception. They are also aware of the fact that overvaluation will be corrected sooner or later, as evidenced by the poor long run performance of IPO stocks. Therefore IPO insiders will have more incentives to sell their shareholdings as soon as possible if they believe their firms are overvalued.

The first chance for IPO insiders to cash out is during the IPO. In addition to the new/primary shares offered by the IPO firm, insiders can also sell their shares as part of IPO in the form of secondary share issuance. Based on the IPO over-optimism hypothesis, if insiders believe an IPO is overvalued, they will be more likely to sell more secondary shares during the IPO.

However, many insiders do not sell secondary shares in IPOs (in our sample, less than half of IPOs include secondary shares). One possible reason is the sale of secondary share has long

been considered a negative signal (Leland and Pyle 1977), which will reduce IPO valuation as well as the wealth of insiders. Ang and Brau (2003) find that insiders try to reduce the negative signal by manipulating the number of shares filed and amended. These results imply that the wealth loss from the negative signal is significant for insiders. Another reason may be the fact that when insiders sell secondary shares in IPOs, the price they receive will be IPO offer price minus price spread and fees charged by underwriters. The price spread is on average 7% of the offer price. In addition, it is well known that IPOs are underpriced, meaning that offer price is more than 10% lower than first day market closing price on average. Considering the factors above, many insiders may decide to sell their shares in the aftermarket and expect to get a better price than issuing secondary shares in IPOs.

Insiders' sale in the aftermarket is subject to various institutional constraints. They are subject to insider trading rules and Securities and Exchange Commission (SEC) Rule 144, which regulates the sale of restricted stocks. Many IPOs involve lockup provision, which prevents insiders from selling shares in the aftermarket for a certain period (usually 180 days). Lockup is usually considered a positive signal (Ang and Brau 2003) and its use may improve the price that insiders can get from selling their shares. At the same time, IPO lockup also increases the price risk insiders face because the overvaluation may be corrected during the lockup period. Interestingly, lockup is not necessarily binding. Karpoff et al. (2013) and Keasler (2001) find that insiders can frequently get lockup early release, which allows insiders to sell their shares before lockup period expires. This feature provides us another way to test the IPO over-optimism hypothesis. Specifically, the IPO over-optimism hypothesis predicts that the more overvalued an IPO is, the more eager insiders are to seek early release so that they can sell their shares early. It also predicts that the size of insider early sell is positively related to the extent of overvaluation.

In many cases insiders are not granted early release from lockup and have to wait until lockup expiration to sell their shares. The rationale of IPO over-optimism hypothesis is still applicable here and predicts that insiders in overvalued IPOs are more likely to sell their shares after lockup expiration. Chen et al. (2012) examine IPO long run returns subsequent to lockup expiration. They find that the returns are negatively associated with abnormal selling by senior executives. These results suggest that insider sales after lockup expiration may still be motivated in part by private information. Because in Chapter 2 we find that IPO long run return is also negatively related to our proxy for IPO overvaluation, it is possible that the private information is related to the overvaluation suggested in the IPO over-optimism hypothesis.

3.3 Data, Variables and Preliminary Results

3.3.1 Data

The data used in this study are collected from the sources including: (i) Securities Data Corporation (SDC) global new issue database for IPO information, (ii) Thomson Reuters Insider Filing Data Feed (IFDF) for insider trading data, (iii) COMPUSTAT for financial information, (iv) CRSP for stock information, and (v) Professor Jay Ritter's website for underwriter ranking data.

We obtain our initial US common stock new issues sample from 1988[9] to 2012 using SDC database. Then we match our sample with CRSP daily stock price database by six-digit CUSIP code. This procedure helps us to collect data on shares outstanding, stock prices, and returns. We require the first appearance of the IPO firm in the CRSP database must be within one month since the issue date. We have 5,167 IPOs remaining. Then we eliminate right issues, unit investment

[9] Securities Data Corporation (SDC) starts collecting lock-up information since 1988.

trusts, unit issues, depositary issues, REIT, and closed-end fund offerings by SDC flags. We also exclude issues with offer price less than 5 dollars. In addition, regulated utility firms and financial firms have also been excluded in order to avoid the effect of regulatory constraints on insider trading. For the purpose of empirical analysis, we require firms to have lower limit of original filing range available. We then merge our sample with Compustat and require firms to have positive book value. Our purging procedures are consistent with previous IPO literature and yield 2,306 IPOs. Over the period of 25 years, 1,868, or 81%, of the 2,306 IPOs are subject to lock-up agreement between issuers and underwriters. With regards to time-series trend, we find that the proportion of lock-up IPOs are relatively stable and we control for the time effect by including year dummies in regression analysis. The 1,868 IPOs would be used as the sample for the following empirical analysis. Table 3.1 illustrates the sample selection procedures.

Table 3.1 Sample Selection Procedure

This table summarizes the detailed steps in selecting our IPO sample by using Securities Data Corporation (SDC) Platinum Global New Issues, Compustat and CRSP databases.

Description	# of firms
1. U.S. IPOs in SDC Global New Issue database during the period of 1988 to 2012	7,304
2. Merging sample with CRSP and requiring firms to be listed in CRSP within 30 days since the IPO issue date	5,167
3. Sample firms after removing right issues, unit issues, unit investment issues, depositary issues, closed-end fund trust issues, and REIT issues	4,654
4. Sample firms after removing penny stocks (offer price less than 5 dollars)	4,377
5. Sample firms after removing financial firms (SIC code between 6000 and 6799) and utility firms (SIC code from 4800 to 4999)	3,914
6. Requiring firms to have lower limit of original filing price available	2,358
7. Delete firms with missing or negative book value	(52)
# of IPOs	2,306
# of IPOs with lock-up provision (sample for empirical analysis)	1,868

3.3.2 Price Premiums

As discussed in Chapter 2, insiders may be able to value IPOs more accurately than the market. Therefore we can use insiders' reservation price in IPOs as a proxy for the intrinsic value of IPO shares. Using the lower limit of the filing price range in the original prospectus as insiders' reservation price, we construct two measures of mispricing for each IPO. First, we define Offer Price Premium as the difference between the lower limit of the original filing price range and IPO offer price, scaled by the lower limit price. We use Offer Price Premium as a proxy for mispricing in the IPO primary market and examine how it affects offering of secondary shares. To investigate how mispricing affects insiders' activities in the aftermarket, we construct the second measure, Closing Price Premium, as the difference between the lower limit of the original filing price range and first day stock closing price, scaled by lower limit of the original filing range. It is defined the same way as PREMIUM1 in Chapter 2.

3.3.3 Secondary Share Offering and Offering Size Revision

We include a few measures to investigate the effect of market over-optimism on share offering in the primary market. We obtain information about secondary share offering and offering size revision in the process of IPO from SDC database. We construct the following measures in our empirical analysis: SECD (a dummy variable which equals one if any secondary shares are sold during IPO, and zero otherwise), and SECR (A proportion which is measured as the ratio of secondary shares sold in the process of IPO to total shares offered in the process of IPO). We also include offering size revision, REVR (a proportion which is measured as the ratio of (total shares offered minus total shares filed in the initial prospectus to total shares filed), to measure insiders' reaction in the primary market to valuation assigned by the market. The related information comes from SDC database.

3.3.4 Insider Trading Data

We obtain the insider trading data from Thomson Reuters Insider Filing Data Feed (IFDF), which is designed to capture all U.S. insider activity as reported on Securities and Exchange Commission (SEC) Forms 3, 4, 5, and 144 in line-by-line detail since January 1986. We use the Table One file of this database, which contains all Table I non-derivative transaction and holdings information filed on Forms 3, 4, and 5 since 1986. Corporate insiders are defined broadly to include a company's officers and directors, and any beneficial owners of more than ten percent of a class of the company's equity securities registered under Section 12 of the Securities Exchange Act of 1934. These insiders are required to file SEC form 3, 4, and 5 when they trade in their companies stock.

To investigate insider trading behaviour, we set two periods as our main research windows for insider trading activities in IPO firms and then merge our SDC/CRSP IPO sample with IFDF. The first period ranges from IPO issue date to IPO lock-up expiration date. We exclude the

containment of secondary shares sold by insiders by eliminating shares sold at offer price within one week since the issue date. The second period covers one-year time window since IPO lock-up expiration date. There are a few reasons for this setting. First, the one-year window can well incorporate the insider trading activities after this expiration date. Secondly, the purpose of this study is to analyze the impacts of various IPO characteristics on subsequent insider trading activities. One-year window can avoid the containment of other major corporate events, such as M&A and SEOs to a large extent.

For each firm in our sample, we obtain all open market purchases (transaction code "P") and open market sales (transaction code "S") records from Thomson Reuters Insider Filing Data Feed (IFDF). Following Brochet (2010), we only include trades from all insiders, but exclude those trades that were duplicate, amended, dealt with a transaction price less than 2 dollars execution price or less than 100 shares. We require every transaction must have transaction date, transaction price and transaction shares available. We construct the following aftermarket insider trading measures:

1) Early sales: we define early sales (labeled as EARLY) as a dummy variable which equals one if insiders in an IPO sell any shares in the open market prior to lock-up expiration date, zero otherwise.
2) Late sales: we define late sales (labeled as LATE) as a dummy variable which equals one if insiders in an IPO sell any shares in the open market over one-year period following lock-up expiration date, zero otherwise.
3) Frequency: we calculate the number of trades of disposing/buying shares prior to and following IPO lock-up expiration date.
4) Size: selling/purchasing size is measured as the sum of shares sold/purchased by corporate

insiders scaled by post-IPO shares outstanding.

3.3.5 Discretionary Accruals

To measure insider's opportunistic earnings management behaviour, we estimate discretionary accruals (DAC) by following mainstream method in the literature (e.g., see: Teoh et al. 1998, Xie 2001, Sawicki et al. 2014 among others). We start from total accruals (ACC) which is defined as net income before extraordinary items minus cash flow from operation activities. Then we form industry-year groups for all COMPUSTAT firms based on two-digit SIC codes. Then, for each group, we run the following cross-sectional regressions for all firms i in industry j in year t to get estimates of coefficients:

$$ACC_{i,j,t}/TA_{i,j,t-1} = \propto_{0\ j,t} + \propto_{j,t} \left(1/TA_{i,j,t-1}\right) + \beta_{j,t} \left(\Delta REV_{i,j,t}/TA_{i,j,t-1}\right) + \gamma_{j,t} \left(PPE_{i,j,t}/TA_{i,j,t-1}\right) + \varepsilon_{i,j,t} \quad (1)$$

Where ACC is total accruals, TA is total assets, ΔREV refers to change in net sales, and PPE refers to gross property, plant and equipment.

Next we estimate the non-discretionary part of total accruals by utilizing coefficient estimates that come from the regression (1):

$$NDAC_{i,j,t} = \propto_{0\ j,t} + \propto_{j,t} \left(1/TA_{i,j,t-1}\right) + \beta_{j,t} \left((\Delta REV_{i,j,t} - \Delta AR_{i,j,t})/TA_{i,j,t-1}\right) + \gamma_{j,t} \left(PPE_{i,j,t}/TA_{i,j,t-1}\right) \quad (2)$$

In which α, β, γ are estimated from regression (1). We adjust change in revenue (REV) by change in accounts receivable (AR) to account for the effect of credit sales. Lastly, we estimate discretionary accruals (DAC) as difference between total accruals and non-discretionary accruals by the following equation. DAC can be interpreted as a proportion of lagged total assets:

$$DAC_{i,j,t} = ACC_{i,j,t}/TA_{i,j,t-1} - NDAC_{i,j,t} \quad (3)$$

3.3.6 Other Variables

Following Brau et al. (2005), we consider three measures to proxy for firm transparency: size, high-tech industry dummy, as well as investment bank prestige. We use total assets and total sales as our proxies for firm size. Firm size is considered to be positively correlated with information asymmetry, thus could be negatively correlated with the occurrence of early sales based on Brau et al. (2005). Hi-tech firms may have hard-to-value assets and thus there exists high information asymmetry in hi-tech industry for outside insiders. As in Loughran and Ritter (2004), Hi-tech firms are those with the following SIC codes: 3571, 3572, 3575, 3577, 3578, 3661, 3663, 3669, 3674, 3812, 3823, 3825, 3826, 3827, 3829, 4899, 7370, 7371, 7372, 7374, 7375, 7378, and 7379. Brau et al. (2005) expects that IPOs in hi-tech industries are less likely to be involved in insider early sales.

Underwriters also play an important role in the IPO process. Prestigious underwriters do a better job in the information communication between issuers and investors. Previous literature shows that the certification, marketing, and screening roles of high quality investment banks could result in a more accurately priced IPO and reduced information asymmetry between insiders and outsiders (e.g., see: Carter et al. 1998, Corwin and Schultz 2005, Dong et al. 2011). For example, Dong et al. (2011) find that underwriter quality is positively related to IPO long-run performance. Corwin and Schultz (2005) find that more underwriters result in higher probability of offer price revision, more analyst coverage, and additional market markers following IPOs. An additional implication for underwriter reputation theory would be that high quality underwriters imply a higher probability that firm insiders will sell shares in the early date. The reason is that analyst coverage and other marketing services provided by high quality underwriters may help insiders to reduce information asymmetries between issuers and outside investors. Thus, we therefore expect that high quality underwriter is associated with higher profitability of insider early sales.

Prestigious Underwriter is used to measure the quality of IPO underwriter. First, we gather up-to-date underwriter ranking data information from Professor Jay Ritter's website. Underwriter ranking is a measure with a scale of 0 to 9 to capture the hierarchy of underwriters, which is initially defined by Carter and Manaster (1990), and then updated by Loughran and Ritter (2004). 9 is assigned to the top ranking underwriters. Then, we define underwriter quality *Prestigious Underwriter* as a dummy variable which would be equal to one if the underwriter's ranking is equal to or larger than 7, and zero otherwise.

Venture capitalists (VCs) usually sit on the board, thus they are insiders according to SEC regulation and are required to report their trading activities. Previous literature documents that VCs usually liquidate their positions in a short window after the IPO (Bradley et al. 2001). Thus, we expect a positive relation between VCs backing and the probability of IPO insider sales. Previous studies also show that VCs, as financial intermediaries, can help to certify the quality of newly issued IPOs (Megginson and Weiss et al. 1991). More reputable VCs can improve the financial reporting quality in IPOs (Lee and Masulis 2011). Collectively, finance theory suggests that VCs can help to mitigate the information asymmetry and therefore boost insider sales. We test whether relation exists in our broader empirical setting. *VC backing* is defined as a dummy variable which equals one if an IPO is backed by any venture capitalists, zero otherwise. The information is based on the SDC flag.

Our next variable of interest is post-IPO insider ownership. It is difficult to obtain insider ownership at the time of IPO, because SDC include little information about insiders. The blockholder's ownership can only be updated at the end of each quarter which means it may take up to 3 months for an IPO appearing in the Thomson Reuters database. We use shares Retention rate to proxy for the initial insider ownership. Following Field and Hanka (2001), shares Retention

is defined as the ratio of the shares not sold in IPO to CRSP post-IPO shares outstanding. It is a reasonable assumption that for privately held firms, most of the pre-IPO shares are owned by corporate insiders, i.e., directors, officers and large beneficial shareholders. It is noteworthy that our Retention measure is a transformation of Shares Overhang, which has been included in Chua and Nasser (2016).

We also include a group of variables to control for offer and firm characteristics in the empirical analysis by following Chua and Nasser (2016). We include pre-IPO Cash holdings, since Chua and Nasser (2016) suggest that cash holding is related to insiders' liquidity needs. Firm Age (the number of years between the IPO date and the company's founding date) is included since mature firms suffer less from information asymmetry and therefore insiders of those mature IPOs could be more likely to get involved in insider sales. We use Sales and ROA (return on assets, defined as net income/total assets) as proxies for accounting performance. We include Total Assets for the size effect and Leverage as a proxy of access to capital market. Leverage is defined as debt (Compustat items: DLCC+DLT) to equity. In addition, we include Return Volatility as a control variable for firms' risk in regressions of post-IPO insider trading activities. It is expected that Return Volatility is positively correlated with insider early sales since insiders in the high-risk IPOs are more likely to sell their holdings faster. Following Boulton et al. (2010), we use 30 days of post-IPO trading data to calculate stock return volatility (standard deviation) for each IPO.

3.3.7 Sample Characteristics

Table 3.2 reports the distribution of sample IPOs by lock-up period. In our sample, 78.9% of all IPOs have lock-up agreement to restrict insiders from selling their holdings within 180 days since the IPO offer date, which is consistent with previous results reported by Bradley et al. (2001). Next, 8.9% of IPOs have a lock-up period within the range of 180 days to 366 days. The third dominant

lock-up period is one from 90 days to 180 days. 109 IPOs, or 5.8% of our sample, have lock-up agreement in this range.

Table 3.2 Sample Distribution by Year and by Lock-up Period

This table describes the distribution of sample IPOs by lock-up period. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1.

Lock-up period	Number of IPOs	% in Lock-up IPOs
Lock-up<=90 days	53	2.8%
90 days<Lock-up<180 days	109	5.8%
Lock-up=180 days	1,473	78.9%
180 days<Lock-up<=366 days	166	8.9%
Lock-up>366 days	67	3.6%
Total	1,868	100%

In Table 3.3, we first present mean, median values, and standard deviation of proxies for mispricing. IPOs on average have an offer price premium of 7.8% and closing price premium of 24.2%. In panel B, we report summary statistics for share offering and insider trading measures. 44.5% of our sample IPOs sell secondary shares and the average secondary share selling size is 12.4% of total shares offered. On average IPOs increase their total shares offering by 1.8% relative to the shares initially filed in the prospectus.

The mean and median lock-up periods are 201 days and 180 days, respectively. 31.3% of sample IPOs report insider sales prior to lock-up expiration date. In other words, insiders are released from the mutual agreement by underwriters earlier. The proportion is economically significant and quantitatively similar with the empirical evidence in firms issuing seasoned equity (Karpoff et al. 2013). As for trading magnitude, insiders on average sell 2.5% of post-IPO shares outstanding, which is economically significant. It is also noteworthy that the distribution of early selling size is highly skewed with a median value of zero. For our measure of insider sales following lock-up expiration, we find that more than half of all IPOs report insider sales within a

year. This is consistent with the argument that pre-IPO owners utilize secondary market to dilute their holdings in the IPO firms. More importantly, on average insiders sell approximately 6.2% of post-IPO shares outstanding, which is much larger than early selling size. As for the trading frequencies, late selling frequency is nearly seven times as large as early selling frequency. This pattern suggests that insider sale following lock-up expiration is still one of main channels to reduce insider's holdings.

We reveal mean and median values of several key variables in firm and issue related characteristics for our whole sample in panel C. On average our sample firms have a P/B ratio of 2.854 based on reservation price, total assets of $160 million, and a firm age of 14.23 years. 43.2% and 72.9% of sample firms are supported by venture capitals (VCs) or with a reputable underwriter, respectively. Meanwhile, 22.4% of sample firms belong to high technology industry. The mean discretionary accruals is 0.053, which is significantly different from zero. The result suggests that on average IPO firms get involved in earnings management activities. The average return volatility stands at 3.7% for sample IPO firms. Our aggregate estimate of discretionary accruals is 5.3% of total assets for IPO firms, which is in line with the estimate as reported by previous earnings management studies in IPO area (e.g., see: Teoh et al. 1998).

Table 3.3 Summary Statistics

This table describes mean, median values, and standard deviation of various variables for 1,868 IPOs with lock-up provisions from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. Offer Price Premium is defined as the difference from the lower limit of IPO original filing price range (reservation price) to offer price scaled by reservation price. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. SECD is a dummy variable which equals one if any secondary shares are sold in the process of IPO, zero otherwise. SECR is a proportion which is measured as the ratio of secondary shares sold in the process of IPO to total shares offered in the process of IPO. REVR is a proportion which is the ratio of (total shares offered minus total shares filed) to total shares filed in the initial prospectus. EARLY equals one if insiders sell any shares prior to lock-up expiration date, zero otherwise. LATE equals one if insiders sell any shares within 365 days since lock-up expiration date, zero otherwise. Early Selling Size is measured as the ratio of aggregate shares sold by corporate insiders over the period prior to lock-up expiration date to CRSP shares outstanding. Early Selling Frequency is defined as the number of insiders' selling trades over the same period. Late Selling Size is measured as the ratio of aggregate shares sold by corporate insiders over one-year period following lock-up expiration date to CRSP shares outstanding. Late Selling Frequency is defined as the number of insiders' selling trades over the same post lock-up period. Definitions for other variables are shown in Table 3.14.

	Mean	Median	SD
Panel A: Price Premium			
Offer Price Premium	7.8%	7.7%	18.7%
Closing Price Premium	24.2%	15.4%	37.6%
Panel B: Share Offering and Aftermarket Insider Trading			
SECD	0.445	0	0.497
Secondary Share Selling Size (SECR)	12.4%	0.0%	18.9%
Offering Size Revision (REVR)	1.8%	0.0%	12.2%
Lock-up Days	201.108	180.000	88.897
EARLY	0.313	0.000	0.464
LATE	0.642	1.000	0.479
Early Selling Size (SPCT1)	2.5%	0.0%	14.5%
Late Selling Size (SPCT2)	6.2%	0.5%	18.1%
Early Selling Frequency	2.362	0.000	6.680
Late Selling Frequency	15.507	4.000	29.594
Panel C: Firm and Offering Characteristics			
P/B Ratio	2.854	2.479	1.529
Retention Rate	65.4%	68.3%	15.0%
VC backing	0.432	0.000	0.495
Prestigious Underwriter	0.729	1.000	0.445
Age	14.231	8.000	18.155

Hi Tech	0.224	0.000	0.417
Cash	4.389	1.666	7.078
Leverage	0.326	0.286	0.272
ROA	-6.2%	4.5%	32.4%
Log(Total Assets)	3.038	2.987	1.450
Log(Sales)	3.294	3.394	1.729
Discretionary Accruals	0.053	0.033	0.217
Return Volatility	0.037	0.035	0.015

3.4 Secondary Share Offering and Offering Size Revision

3.4.1 Univariate Analysis

We examine the impact of offer price premium on secondary share offering and offering size revision of IPO firms in Table 3.4. We divide the whole sample into four subgroups based on the magnitude of percentage change from reservation price to IPO offer price. We find that on average, the probability of secondary share sales is 20.9% lower for low premium IPOs relative to high premium IPOs, and the difference is significant at 1% level. The comparison between low premium IPOs and high premium IPOs for secondary share selling size reveals the similar pattern. In details, 15.7% of total shares offered by high premium IPOs come from pre-IPO owners; in contrast, the number is 9.1% only for low premium IPOs. We also report the mean values of offering size revision (REVR) across four subgroups. We find that low premium group actually revise down their offering size by 3.7%. In contrast, those IPOs that received favorable market reactions (high premium IPOs) revise up their offering size by 10.3%. Putting the evidences together, it seems that high premium IPOs are more likely to adjust shares offering more aggressively, and to sell more secondary shares. The results from univariate analysis lend support to the IPO over-optimism hypothesis.

Table 3.4 Offer Price Premium, Secondary Share Offering and Offering Size Revision

This table reports mean values of share offering measures in the process of IPO for four groups, which are constructed by sorting sample firms based on the quartiles of closing price premium. The sample includes 1,868 IPOs with lock-up provisions from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. Offer Price Premium is measured as the difference from reservation price to offer price scaled by reservation price. SECD is a dummy variable which equals one if any secondary shares are sold in the process of IPO, zero otherwise. SECR is a proportion which is measured as the ratio of secondary shares sold in the process of IPO to total shares offered in the process of IPO. REVR is offering size revision rate, which is defined as a proportion which is the ratio of (total shares offered minus total shares filed) to total shares filed in the initial prospectus.

Variable	Total	Low	Q2	Q3	High	H - L	p value
SECD	44.5%	35.6%	39.6%	47.2%	56.5%	20.9%	0.001
SECR	12.4%	9.1%	11.7%	13.6%	15.7%	6.6%	0.001
REVR	1.7%	-3.7%	1.0%	5.5%	10.3%	14.0%	0.001

3.4.2 Multivariate Analysis

We formally test whether offer price premium is positively correlated with insiders' share offering decision in this section. Our regression follows that of Chua and Nasser (2016), but includes offer price premium as an explanatory variable. We use the occurrence of secondary share sales (SECD) as the dependent variable. We report the Probit regression results in Table 3.5 since SECD is a binary variable. We regress SECD on Offer Price Premium, P/B ratio, VC Backing, Prestigious Underwriter, and Log (Age) in column (1). We add Hi Tech to control for industry effect and year dummies to control for year effect in column (2). In column (3), we further include Cash, Leverage, ROA, Log (Total Assets), Log (Sales), and discretionary accruals into our regression and our sample size reduces to 1,523 IPOs due to data availability.

Table 3.5 Probit Analysis of Secondary Share Sales and Offering Price Premium

This table presents the Probit regression estimates of secondary share offering decision using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (SECD) equals one if any secondary shares are sold in the process of IPO, zero otherwise. Offer Price Premium is measured as the difference from reservation price to offer price scaled by reservation price. P/B is price to book ratio in which price is based on IPO reservation price. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. Cash is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) SECD	(2) SECD	(3) SECD
Offer Price Premium	1.146***	1.121***	0.990***
	[6.832]	[6.279]	[4.702]
P/B ratio	0	0.002	0.063**
	[0.012]	[0.097]	[2.343]
VC Backing	0.160**	0.1	0.317***
	[2.554]	[1.535]	[3.933]
Prestigious Underwriter	0.461***	0.470***	0.530***
	[6.477]	[6.355]	[5.635]
Log(Age)	0.213***	0.234***	0.117***
	[6.714]	[7.098]	[2.904]
Hi Tech		0.419***	0.339***
		[5.292]	[3.538]
Cash			-0.014**
			[-2.210]
Leverage			-0.630***
			[-3.998]
ROA			1.030***
			[5.827]
Log(Total Assets)			-0.229***
			[-3.593]
Log(Sales)			0.286***

			[5.567]
Discretionary Accruals			0.199
			[1.122]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.065	0.118	0.2

As shown in Table 3.5, the coefficient of offer price premium is positively significant in all columns, indicating that the valuation of an IPO is positively correlated with the occurrence of shares sold by pre-IPO owners. For example, column (3) shows that one standard deviation increase in offer price premium will lead to an increase of 18% in the probability of secondary share sales after controlling for other firm and offer characteristics. A few takeaways come from the coefficients of controlling variables. Overall, we are able to find that IPOs with less information asymmetry (e.g., older firms, firms with VCs and reputable underwriters) are more likely to get involved in secondary share sales. The results are consistent with IPO literature (e.g., see: Megginson and Weiss 1991, Aggrawal et al. 2002). We also find that pre-IPO owners from larger firms (proxied by total assets), cash rich firms, and firms with higher leverage are less likely to be involved in secondary share sales. One plausible reason is that these firms have better access to capital market and/or have more cash at hand, and therefore are able to compensate their insiders appropriately. Consequently, insiders in these firms may have less incentive to sell their shares (Chua and Nasser, 2016). Next we examine the relation between offer price premium and the magnitude of secondary share sales while controlling for all other influential factors. We run Tobit regressions since our dependent variable, SECR, stays within the range of 0 to 1. According to column (1) to (3), the offer price premium is also significantly related to the selling size.

Table 3.6 Tobit Analysis of Secondary Share Selling Size and Offering Price Premium

This table presents the Tobit regression estimates of secondary share selling size using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (SECR) is a proportion which is measured as the ratio of secondary shares sold in the process of IPO to total shares offered in the process of IPO. Offer Price Premium is measured as the difference from reservation price to offer price scaled by reservation price. P/B is price to book ratio in which price is based on IPO reservation price. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. CASH is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) SECR	(2) SECR	(3) SECR
Offer Price Premium	0.359***	0.339***	0.269***
	[6.912]	[6.452]	[4.952]
P/B ratio	0.012*	0.013**	0.031***
	[1.854]	[2.101]	[4.530]
VC Backing	0.026	0.009	0.059***
	[1.370]	[0.453]	[2.838]
Prestigious Underwriter	0.132***	0.130***	0.095***
	[5.790]	[5.702]	[3.787]
Log(Age)	0.078***	0.080***	0.034***
	[7.780]	[8.058]	[3.189]
Hi Tech		0.090***	0.053**
		[4.001]	[2.225]
Cash			-0.001
			[-0.544]
Leverage			-0.263***
			[-6.178]
ROA			0.267***
			[5.588]
Log(Total Assets)			-0.051***
			[-2.920]
Log(Sales)			0.095***

			[6.662]
Discretionary Accruals			0.01
			[0.223]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.078	0.136	0.257

In Table 3.7, we formally test whether high (low) offering size premium will coincidence with an upward (downward) revision in total shares offered relative to shares filed initially in the prospectus. Our hypothesis predicts that insiders will opportunistically adjust share offerings to exploit market mispricing. The coefficients of offer price premium are significantly positive at the 1% level in all three specifications. In contrast with the result in Table 3.5 and Table 3.6, we find that a majority of explanatory variables such as VC Backing, Prestigious Underwriter, and pre-IPO cash holding are not related with offering size revision, indicating information asymmetry and insiders' liquidation needs may not have a major impact on the decision of share offering revision. These results lend further support to our IPO over-optimism hypothesis.

Table 3.7 Regression Analysis of Offering Size Revision and Offering Price Premium

This table presents the OLS regression estimates of secondary share selling size using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (REVR) is a proportion which is the ratio of (total shares offered minus total shares filed) to total shares filed in the initial prospectus Offer Price Premium is measured as the difference from reservation price to offer price scaled by reservation price. P/B is price to book ratio in which price is based on IPO reservation price. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. Cash is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
	REVR	REVR	REVR
Offer Price Premium	0.199***	0.201***	0.205***
	[11.766]	[11.240]	[10.558]
P/B ratio	-0.004**	-0.003	-0.003
	[-2.078]	[-1.604]	[-1.410]
VC Backing	-0.002	0	0.002
	[-0.271]	[0.025]	[0.335]
Prestigious Underwriter	-0.004	-0.005	-0.004
	[-0.668]	[-0.758]	[-0.464]
Log(Age)	-0.005*	-0.006**	-0.003
	[-1.875]	[-1.979]	[-1.018]
Hi Tech		-0.008	-0.001
		[-1.161]	[-0.101]
Cash			0
			[0.402]
Leverage			0.034***
			[2.600]
ROA			0.018
			[1.321]
Log(total assets)			0.008
			[1.457]
Log(Sales)			-0.009**

			[-2.320]
Discretionary Accruals			0.015
			[1.089]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
adj. R^2	0.104	0.113	0.125

3.5 Insider Early Sales in IPO Firms

3.5.1 Univariate Analysis

In Table 3.8, we examine insider trading activities of IPO firms based on the percentage change from reservation price to 1st day closing price. We divide the whole sample into four subgroups measured by the magnitude of closing price premiums.

Table 3.8 documents the prominent role of closing price premium in the occurrence of insider early sales as well as the amount of shares sold by insiders within our IPO sample. For our primary measure (EARLY), we identify a clear monotonically positive relation between the magnitude of closing price premium and the early sales likelihood. We find that the chance of early sales in the quartile with highest price premium could be more than 60% larger than the chance in the quartile with lowest price premium (41.3% for 4th Quartile vs. 25.3% for 1st quartile).

With regards to the magnitude of insider trading, the dollar value of insider early sales prior to lock-up expiration date is $6.87 million for IPOs within the group of highest closing price premium (1st quartile) while IPOs with the bottom 25% of price premium witnesses only $1.35 million of early sales, which is consistent with the evidences provided by our primary measure. We do not find any clear pattern for the relation between insider purchasing behaviour and price premium, which suggests that insider purchases could be driven by other variables. To verify the

relation between insider selling and price premium, we also construct net selling measures by subtracting off insider buying amounts. Insiders within the highest premium group sell shares net worth of $6.37 million on average while insiders in the lowest quartile only sell shares net worth of $1 million. The results are consistent with the over-optimism hypothesis.

Table 3.8 Closing Price Premium and Insider Trading Prior to Lock-up Expiration

This table reports mean values of insider trading measures for four groups, which are constructed by sorting sample firms based on the quartiles of closing price premium. The sample includes 1,868 IPOs with lock-up provisions from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. EARLY equals one if insiders sell any shares prior to lock-up expiration date, zero otherwise. Dollar Value of Insider Sales/Buys is defined as the aggregate dollar amount of insider sales/buys over the period prior to lock-up expiration date. Early Selling/Buying Size is measured as the ratio of aggregate shares sold/bought by corporate insiders over the period prior to lock-up expiration date to CRSP shares outstanding. Early Selling/Buying Frequency is defined as the number of insiders' selling/buying trades over the same period. Early Net Selling Size is defined as early selling size minus early buying size. Early Net Selling Frequency is defined as early selling frequency minus early buying frequency.

Variable	Total	Low	Q2	Q3	High	H - L	p value
EARLY	0.313	0.253	0.254	0.31	0.413	0.16	0.001
Early Insider Sales ($millions)	3.50	1.35	2.45	2.74	6.87	5.52	0.001
Early Insider Buys ($millions)	0.30	0.35	0.18	0.12	0.51	0.159	0.464
Early Net Sales ($millions)	3.20	1.00	2.27	2.62	6.37	5.371	0.001
Early Selling Size	2.5%	1.6%	2.7%	2.2%	3.4%	0.018	0.008
Early Buying Size	0.3%	0.5%	0.3%	0.2%	0.3%	-0.002	0.422
Early Net Selling Size	2.2%	1.1%	2.4%	2.0%	3.0%	0.019	0.005
Early Selling Frequency	2.362	1.42	1.708	2.255	3.794	2.374	0.001
Early Buying Frequency	1.914	2.394	2.19	1.648	1.506	-0.888	0.006
Early Net Selling Frequency	0.448	-0.974	-0.482	0.607	2.289	3.263	0.001

Similar patterns appear for mean values of early selling size, which is defined as the ratio of shares sold by insiders prior to lock-up expiration to post-IPO shares outstanding. Overall speaking, a positive relation exists for price premium and early selling size. For instance, 3.4% of

shares outstanding have been sold by insiders in the highest quartile of price premium prior to lock-up expiration, compared with 1.6% for insiders in the lowest quartile. The difference is statistically significant at 1% level. Consistent with the view that insider buying activities are little or uncommon, insiders in our sample purchase a tiny amount of shares in the open market. Insiders on average sell 2.5% of shares outstanding, which is around 8 times as much as the average 0.3% for insider purchases. Statistics about trading frequencies also confirm our findings: the selling frequency for insiders in the 4th quartile could be nearly 3 times as many as that for insiders in the 1st quartile. There appears an inverse relation between price premium and purchasing frequencies.

3.5.2 Multivariate Analysis of Insider Early Sales

To control for various factors that may affect insider early sales, we use the cross-sectional regression model to formally examine the predictions of IPO over-optimism hypothesis on insider early sales decision.

Table 3.9 Probit Analysis of Insider Early Sales and Closing Price Premium

This table presents the Probit regression estimates of insider early sale decision using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (EARLY) equals one if insiders sell shares prior to lock-up expiration date, zero otherwise. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. P/B is price to book ratio in which price is based on IPO reservation price. Retention is defined as the ratio of (CRSP post-IPO shares outstanding minus total shares offered in IPO) to CRSP post-IPO shares outstanding. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious Underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. CASH is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Return volatility is defined as the standard deviation of daily returns over 30 days following the offering. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) EARLY	(2) EARLY	(3) EARLY
Closing Price Premium	0.483***	0.445***	0.369***
	[5.679]	[4.946]	[3.478]
P/B ratio	-0.004	-0.012	-0.017
	[-0.187]	[-0.484]	[-0.590]
Retention	0.165	0.176	0.184
	[0.694]	[0.705]	[0.631]
VC Backing	0.323***	0.286***	0.394***
	[5.000]	[4.292]	[4.948]
Prestigious Underwriter	-0.108	-0.112	-0.074
	[-1.497]	[-1.506]	[-0.796]
Log(Age)	0.046	0.045	0.020
	[1.396]	[1.337]	[0.491]
Hi Tech		0.221***	0.172*
		[2.829]	[1.883]
Cash			-0.009
			[-1.321]
Leverage			0.156
			[0.981]
ROA			0.511***

			[3.135]
Log(Total Assets)			-0.199***
			[-3.144]
Log(Sales)			0.150***
			[3.063]
Discretionary Accruals			-0.222
			[-1.307]
Return Volatility			6.239**
			[2.180]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.029	0.068	0.100

Table 3.9 report the results of Probit regressions with EARLY as the dependent variable. In the first column, we include the closing price premium to proxy for mispricing, a number of variables to measure transparency, a VC Backing dummy, as well as retention rate. We include a number of year dummies as well as Hi Tech to control for time and industry effects in column (2). We add the variables of Cash, Leverage, ROA, Log (Total Assets), Log (Sales), Discretionary Accruals and Return Volatility in column (3) since this addition would reduce our sample size to 1,523 due to data availability to calculate accruals.

As shown in all the columns, closing price premium is significantly and positively related to the occurrence of early sales. This indicates that insiders are more likely to start selling their holdings earlier if the market overvalues their firms in the secondary market: overvalued IPOs are proxied by high price premium. In addition, there seems no significant difference between initial valuations at primary market and early sales decision as shown by the coefficients for P/B ratio.

Additionally, in accordance with the findings of Bradley et al. (2001), VC backing has a significant positive effect on the insider early sales of IPO firms. It is no surprise that firms with venture capitalist backing subsequently demonstrate greater probability of early sales prior to IPO

lockup expiration than others as VCs usually have a relatively short time horizon of investment and they intend to liquidate their holdings as soon as possible in the secondary market. In addition, although the coefficient for retention is positive, the relation is not statistically significant. Why is retention rate not a driver of insider early sales? One possibility is that early insider sales from concentrated owners may convey a negative signal to the public and this consideration weaken the positive relation that should be observed. If this argument holds, we should observe a more significantly positive relation between retention rate and insider late sales. The coefficients for prestigious underwriter are not significant in all columns. As expected, insiders from high risky IPOs (proxied by Return Volatility) are more likely to get involved in early sales behavior.

Table 3.10 Tobit Analysis of Insider Early Selling Size and Closing Price Premium

This table presents the Tobit regression estimates of insider early sale decision using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. . The dependent variable (SPCT1) is a proportion which is measured as the ratio of aggregate shares sold by corporate insiders over the period prior to lock-up expiration date to CRSP shares outstanding. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. P/B is price to book ratio in which price is based on IPO reservation price. Retention is defined as the ratio of (CRSP post-IPO shares outstanding minus total shares offered in IPO) to CRSP post-IPO shares outstanding. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. CASH is cash holding, which is composed of cash and cash equivalents. Leverage is debt (compustat items: dlc+dltt) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Return volatility is defined as the standard deviation of daily returns over 30 days following the offering. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
	SPCT1	SPCT1	SPCT1
Closing Price Premium	0.071***	0.060***	0.048***
	[5.030]	[4.219]	[2.965]
P/B ratio	-0.002	-0.002	-0.002
	[-0.507]	[-0.551]	[-0.487]
Retention	-0.036	-0.039	-0.033
	[-0.895]	[-0.958]	[-0.738]
VC Backing	0.047***	0.038***	0.052***
	[4.314]	[3.550]	[4.211]
Prestigious Underwriter	-0.007	-0.008	0.003
	[-0.542]	[-0.624]	[0.217]
Log(Age)	0.008	0.008	0.003
	[1.455]	[1.522]	[0.483]
Hi Tech		0.025**	0.011
		[2.032]	[0.793]
Cash			-0.002**
			[-2.167]
Leverage			0.036
			[1.448]
ROA			0.065**
			[2.559]
Log(Total Assets)			-0.032***
			[-3.177]

Log(Sales)			0.028***
			[3.612]
Discretionary Accruals			-0.062**
			[-2.379]
Return Volatility			0.807*
			[1.819]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.061	0.158	0.253

To investigate factors affecting the magnitude of early sales, we use insider early selling size (SPCT1) as the dependent variable in Table 3.10. Since SPCT1 is a proportion which has values that fall between zero and one, we run Tobit regressions in this section. For robustness check, we also utilize a generalized linear model (GLM) with a logit link and the binomial family with robust option in case of mis-specified model. GLM regressions yield quantitatively and qualitatively constant results although the results are not reported for brevity.

Closing price premium is positively correlated with the size of insider early sales as shown in all columns. The evidence is consistent with the results in Table 3.9. This supports the argument that IPO firms whose insiders engage in early sales prior to the lockup expiration tend to be overvalued by the market at the time of IPO. Table 3.10 also confirms that financial intermediaries, in addition to those of major interest, exhibit mixed power in explaining the insider early sales decision in IPO firms. On one hand, IPOs backed by venture capitalists have higher probability of early sales. This result is consistent with the argument that venture capitalists desire to liquidate their holdings. On the other hand, there exists no significant relation between underwriter reputation and early selling size, which contrasts with the prediction of Brau et al. (2005). As for the relation between retention and early sales, our findings suggest that although IPOs with high retention are more likely to have early sales as shown in Table 3.9, the relation reverses when we turn to the magnitude of selling size.

3.6 Insider Sales following IPO Lock-up Expiration

3.6.1 Univariate Analysis

After sorting sample firms into four groups based on quartiles of closing price premium, we start analyzing insider selling activities following lock-up expiration (late insider sales) by providing some univariate comparisons of variables of interest for firms with high closing price premium (4th quartile) and those with low premium (1st quartile).

As shown in Table 3.11, the mean value of LATE is 0.777 for firms with high premium and 0.57 for firms with low premium, indicating a positive relation between the price move from reservation price to 1st day closing price and the occurrence of insider sales over one-year window following IPO lock-up expiration date. We find that the dollar value of insider sales is $12.7 million for firms with high premium, compared to $4.39 million for firms with closing price premium. These results are statistically significant and consistent with over-optimism hypothesis.

Table 3.11 also reports insider trading frequency and trading size following lock-up expiration. Our sample firms on average have selling size of 6.2% relative to shares outstanding and buying size of 1.1%, which implies the heavy dilution of initial ownership and roughly in line with IPO literature. For both measures of insider sales, IPOs with high premium have significantly higher selling frequencies and selling size compared with IPOs with low premium. The net selling size during one year following lock-up expiration are 3.8% for IPOs in the lowest quartile of premium and 8.3% for IPOs in the highest quartile. The difference of 4.5% is statistically significant at 1% level. The results are consistent with IPO over-optimism hypothesis.

Table 3.11 Closing Price Premium and Insider Trading Following Lock-up Expiration

This table reports mean values of insider trading measures for four groups, which are constructed by sorting sample firms based on the quartiles of offer price premium. The sample includes 1,868 IPOs with lock-up provisions from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. Closing Price Premium is measured as the difference from reservation price to the first day closing price scaled by reservation price. LATE equals one if insiders sell any shares over one-year period following lock-up expiration date, zero otherwise. Dollar Value of Insider Sales/Buys is defined as the aggregate dollar amount of insider sales/buys over the same period. Late Selling/Buying Size is measured as the ratio of aggregate shares sold/bought by corporate insiders over the same period. Late Selling/Buying Frequency is defined as the number of insiders' selling/buying trades over the same period. Late Net Selling Size is defined as late selling size minus late buying size. Late Net Selling Frequency is defined as late selling frequency minus late buying frequency.

Variable	Total	Low	Q2	Q3	High	H - L	p value
LATE	0.642	0.57	0.569	0.659	0.777	0.207	0.001
Late Insider Sales ($millions)	7.21	4.39	5.53	6.43	12.7	8.31	0.001
Late Insider Buys ($millions)	0.211	0.227	0.197	0.204	0.214	-0.013	0.69
Late Net Sales ($millions)	6.78	4.06	5.1	5.93	12.2	8.14	0.001
Late Selling Size	6.2%	5.2%	5.5%	5.2%	8.9%	0.037	0.001
Late Buying Size	1.1%	1.4%	1.1%	1.4%	0.5%	-0.009	0.981
Late Net Selling Size	5.0%	3.8%	4.4%	3.8%	8.3%	0.045	0.001
Late Selling Frequency	15.507	9.938	10.752	13.927	27.818	17.88	0.005
Late Buying Frequency	4.236	4.058	4.891	3.974	4.033	-0.025	0.335
Late Net Selling Frequency	11.272	5.881	5.861	9.953	23.786	17.905	0.001

3.6.2 Multivariate Analysis

In this section, we use cross-sectional regression analyses in order to determine which factors may have been responsible for insider selling activities of IPO firms over one-year period following lock-up expiration. Table 3.12 presents a set of cross-sectional regressions to examine the determinants of the occurrence of insider late sales in IPO firms. The dependent variable is LATE, which is a dummy variable equal to one if insiders in IPOs sell any shares within one-year period since lock-up provision expires and zero otherwise. The primary independent variable of interest is closing price premium. We add Stock Return in our regression to control for post-IPO stock

performance from second trading day to lock-up expiration date. Other independent variables included are the same as in Table 3.9.

We would like to point out that insider late sales decision in IPO firms are significantly related to closing price premium across all regression models. The positive coefficients are consistent with the results in the univariate analysis reported in Table 3.11, confirming that mispricing is the primary driver of insider sales. In contrast with the results in Table 3.9, now both share retention rate and underwriter reputation are positively related to the occurrence of late insider sales and the relations are statistically significant at 1% level across all regressions. The plausible explanation is that compared with early sales, the market may view insider sales after lock-up expiration as a normal diversification behaviour for insiders. Therefore, concentrated owners do not need to keep holding their shares. In addition, reputable underwriters can play a significant role in marketing the IPO firm to facilitate insider sales. For other variables, since the results are quite similar with comparable regressions in Table 3.9, we do not elaborate them here.

Table 3.13 reports Tobit regression estimates of insider selling size following lock-up expiration. The dependent variable (SPCT2) is a proportion which is measured as the ratio of aggregate shares sold by corporate insiders over the one-year period following lock-up expiration date to CRSP shares outstanding. The coefficient for VC backing is consistent with the notion that VCs tend to quickly liquidate their holdings. In addition, the coefficient for share retention contrasts that in Table 3.12, which presents an interesting pattern. We find that underwriter reputation is positively related to the incidence of insider late sales decision. Overall, the results in Table 3.12 and 3.13 lend support to mispricing hypothesis.

Table 3.12 Probit Analysis of Insider Sales Following Lock-up Expiration and Closing Price Premium

This table presents the Probit regression estimates of insider sales following lock-up expiration using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (LATE) equals one if insiders sell shares prior to lock-up expiration date, zero otherwise. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. Stock return is post-IPO stock performance from second trading day to lock-up expiration date. P/B is price to book ratio in which price is based on IPO reservation price. Retention is defined as the ratio of (CRSP post-IPO shares outstanding minus total shares offered in IPO) to CRSP post-IPO shares outstanding. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. CASH is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Return volatility is defined as the standard deviation of daily returns over 30 days following the offering. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) LATE	(2) LATE	(3) LATE
Closing Price Premium	0.701***	0.736***	0.591***
	[7.127]	[6.875]	[4.778]
Stock Return	0.992***	1.030***	0.967***
	[11.511]	[11.191]	[9.506]
P/B ratio	-0.042*	-0.057**	-0.052*
	[-1.817]	[-2.316]	[-1.781]
Retention	0.829***	1.003***	0.897***
	[3.585]	[4.093]	[3.186]
VC Backing	0.744***	0.721***	0.722***
	[10.654]	[9.942]	[8.358]
Prestigious Underwriter	0.289***	0.251***	0.255***
	[4.004]	[3.341]	[2.724]
Log(Age)	0.074**	0.080**	0.087**
	[2.289]	[2.360]	[2.120]
Hi Tech		0.048	-0.011
		[0.550]	[-0.106]
Cash			0.005
			[0.747]
Leverage			-0.273*
			[-1.696]

ROA			0.086
			[0.501]
Log(Total Assets)			-0.093
			[-1.491]
Log(Sales)			0.034
			[0.731]
Discretionary Accruals			0.131
			[0.716]
Return Volatility			2.820
			[0.943]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.168	0.212	0.206

Table 3.13 Tobit Analysis of Insider Selling Size Following Lock-up Expiration and Closing Price Premium

This table presents the Tobit regression estimates of insider sales following lock-up expiration using data from 1,868 IPOs from 1988 to 2012. The IPOs are for U.S. common stocks and excludes: right issues, unit investment trusts, unit issues, depositary issues, REIT, closed-end fund offerings, regulated utility firms, and financial firms. The sample selection procedure is reported in Table 3.1. The dependent variable (SPCT2) is a proportion which is measured as the ratio of aggregate shares sold by corporate insiders over the period following lock-up expiration date to CRSP shares outstanding. Closing Price Premium is measured as the difference from reservation price to 1st day closing price scaled by reservation price. Stock return is post-IPO stock performance from second trading day to lock-up expiration date. P/B is price to book ratio in which price is based on IPO reservation price. Retention is defined as the ratio of (CRSP post-IPO shares outstanding minus total shares offered in IPO) to CRSP post-IPO shares outstanding. VC Backing is a dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise. Prestigious underwriter is a dummy variable which equals one for IPOs with high rated underwriter, zero otherwise. Age is the number of years between the IPO date and the company's founding date. Hi Tech is a dummy variable which equals one if the firm is in high tech industry, zero otherwise. CASH is cash holding, which is composed of cash and cash equivalents. Leverage is debt (Compustat items: DLC+DLTT) to equity ratio. ROA is the ratio of net income to total assets. Discretionary accruals are estimated by following Teoh et al. (1998) and Xie (2001). Return volatility is defined as the standard deviation of daily returns over 30 days following the offering. Constant item is included but not reported. Associated t-statics are reported in brackets and are corrected for heteroskedasticity, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) SPCT2	(2) SPCT2	(3) SPCT2
Closing Price Premium	0.080***	0.080***	0.078***
	[6.038]	[5.815]	[4.787]
Stock Return	0.128***	0.125***	0.122***
	[10.739]	[10.280]	[8.882]
P/B ratio	-0.002	-0.002	-0.000
	[-0.445]	[-0.663]	[-0.063]
Retention	-0.051	-0.049	-0.068
	[-1.411]	[-1.344]	[-1.578]
VC Backing	0.074***	0.067***	0.077***
	[7.361]	[6.714]	[6.360]
Prestigious Underwriter	0.042***	0.039***	0.043***
	[3.601]	[3.382]	[3.014]
Log(Age)	0.024***	0.025***	0.019***
	[4.740]	[4.934]	[2.997]
Hi Tech		0.002	-0.003
		[0.148]	[-0.207]
Cash			0.001
			[1.427]
Leverage			0.006

			[0.258]
ROA			0.016
			[0.657]
Log(Total Assets)			-0.022**
			[-2.330]
Log(Sales)			0.015**
			[2.213]
Discretionary Accruals			0.039
			[1.516]
Return Volatility			-0.183
			[-0.426]
Constant	Yes	Yes	Yes
Year	No	Yes	Yes
N	1868	1868	1523
pseudo R^2	0.488	0.654	0.574

3.7 Conclusion

Corporate insiders from IPO firms have strong incentives to liquidate their shares in the aftermarket. Although there are numerous studies about insider trading around IPO lock-up expiration date, little is known about insider sales before the lock-up expiration date in IPO firms. We address this issue and investigate the impact of market over-optimism on share offering in the process of IPO, and post-IPO open market insider sales prior to and following lock-up expiration date by using insider trading data from IFDF on a sample of 1,868 U.S. IPO firms between 1988 through 2012.

We develop a hypothesis in which insiders in IPOs exploit market mispricing to accelerate their selling behavior. We use the lower bound of initial filing price range as issuer's reservation price then we use offer/closing price premium relative to reservation price as a proxy for market mispricing. We find that offer price premium is positively correlated with the occurrence and the magnitude of secondary share sales and share offering revision, indicating that insiders seize their first opportunity to sell shares conditional on the market mispricing. Empirical evidences also show that closing price premium is positively correlated with early release from lock-up agreement and insider selling activities prior to and following lock-up expiration date. Our study also provides several lucrative opportunities for future research. Most of all, since a large number of IPOs are relatively small in the size and have concentrated ownership structure, how to disentangle diversification motive of insider trading from opportunistic selling behavior based on mispricing is an important topic. This direction may provide more precise understanding on insiders' behavior. Investigating the effect of price premium on the aggregate insider trading behavior may be another interesting direction.

Table 3.14 Variable Definition

Variable	Definition
Age	The number of years between the IPO date and the company's founding date
Cash	Cash holding, which is composed of cash and cash equivalents.
Closing Price Premium	The difference from reservation price to 1st day closing price scaled by reservation price
Discretionary Accruals	Accruals are estimated at the first fiscal year end after the IPO date by following methods suggested by Teoh et al. (1998) and Xie (2001).
EARLY	One if insiders sell any shares prior to lock-up expiration date, zero otherwise.
Early Selling Frequency	Defined as the number of insiders' selling trades over the same period.
Early Selling Size	The ratio of aggregate shares sold by corporate insiders over the period prior to lock-up expiration date to CRSP shares outstanding.
Hi Tech	A dummy variable which equals one if the firm is in high tech industry, zero otherwise. Log (Size) is natural log of total assets.
LATE	One if insiders sell any shares within 365 days since lock-up expiration date, zero otherwise.
Late Selling Frequency	The number of insiders' selling trades over the same post lock-up period.
Late Selling Size	The ratio of aggregate shares sold by corporate insiders over one-year period following lock-up expiration date to CRSP shares outstanding.
Leverage	The ratio of debt (Compustat items: DLC+DLTT) to equity.
Offer Price Premium	The difference from reservation price to offer price scaled by reservation price.
P/B	Price to book ratio in which price is based on IPO reservation price.
Prestigious Underwriter	A dummy variable which equals one for IPOs with high rated underwriter, zero otherwise.
Retention	Defined as the ratio of (CRSP post-IPO shares outstanding minus total shares offered in IPO) to CRSP post-IPO shares outstanding
Return Volatility	Return volatility is defined as the standard deviation of daily returns over 30 days following the offering.
REVR	A proportion which is the ratio of (total shares offered minus total shares filed) to total shares filed in the initial prospectus.
ROA	The ratio of net income to total assets.
SECD	A dummy variable which equals one if any secondary shares are sold in the process of IPO, zero otherwise.
SECR	A proportion which is measured as the ratio of secondary shares sold in the process of IPO to total shares offered in the process of IPO.

SPCT1	A proportion which is measured as the ratio of aggregate shares sold by corporate insiders over the period prior to lock-up expiration date to CRSP shares outstanding.
SPCT2	A proportion which is measured as the ratio of aggregate shares sold by corporate insiders over the period following lock-up expiration date to CRSP shares outstanding.
Stock Return	Post-IPO stock performance from second trading day to lock-up expiration date.
VC Backing	A dummy variable which equals one if the IPO is backed by venture capitalists, zero otherwise.

Chapter 4 The Dynamics of Deterioration in Internal Control Reported under SOX 404

4.1 Introduction

Numerous prior studies (e.g., see: Doyle et al. 2007b and Ashbaugh-Skaife et al. 2007) examine the determinants of internal control weaknesses (hereafter ICW) disclosure. They find that companies with certain characteristics are more likely to disclose ICW than other firms. Their approach focuses on the static aspect of ICW disclosure and identifies the differences between companies with ICW disclosure and those without. However, many of the ICW companies previously reported effective internal control (hereafter IC)[10]. So their ICW disclosures suggest deteriorations in IC in these companies. What has changed to cause the reported deterioration? We have not seen any extensive study about this dynamic aspect of ICW disclosure and this chapter is an attempt in this direction.

The reported deteriorations in IC may result from either the detection of previously undetected/unreported ICW or the reporting of recent deterioration in IC conditions. Because the determinants of ICW disclosure as identified in prior studies also involve the occurrence and detection of ICW, a good starting point is to assume that the reported deteriorations are caused by changes in these determinants. However, some of these determinants, such as whether a firm pays

[10] In our sample, 1,223 of 1,580 ICW companies previously reported effective IC.

dividend, usually do not change much from one year to the next. Some other determinants, such as firm age, actually change in a direction that may reduce the likelihood of ICW disclosure based on the literature. Therefore, it is worthwhile to find out which of the known determinants change and contribute to the reported deterioration.

In addition, there may be other factors that cause IC conditions to deteriorate. Managers may intentionally weaken IC to benefit themselves. Degorge et al. (1999) show that managers have strong incentives to manage earnings to meet investors' expectations. Because poor stock return likely reflects investors' disappointment with earnings, managers have more incentives to manipulate earnings when stock return is poor. As suggested in Doyle et al. (2007a) and Chan et al. (2008), a weak IC system gives managers more room to manipulate earnings, especially when the weaknesses are linked to entity-level control problems. Therefore managers may have the incentive to weaken the IC system when stock return is poor. This pattern will be more likely to hold for entity-level ICW and will be stronger when managerial compensation is more tightly linked to stock performance. We call this conjecture the *agency hypothesis*.

We investigate 708 firms disclosing material ICW under Section 404 of Sarbanes-Oxley Act (SOX) between 2004 and 2013 after previously reporting effective IC. In our univariate tests, we find that more than 51% of the reported IC deteriorations occur after financial restatements. The probability of reporting IC deterioration increases from 2.78% for firms with no restatement to 32.72% for firms with restatement. If we accept that most of the restatements are direct evidence of IC weakness as suggested by Rice and Weber (2012), then a large portion of the reported deteriorations in IC result from detection of previously unreported weaknesses. Multivariate Probit analysis confirms that increase in restatement is the most significant predictor for reported IC deterioration. Our analysis also reveals that these ICW firms pay higher audit fees, have higher

frequency of management turnover and auditor turnover, less financing need, lower Altman Z-score deciles, and suffer more losses when compared to the previous year. In Probit regressions these changes all contribute to higher probability of reported deterioration in IC.

We find that the firms reporting IC deterioration have significant decline in stock returns in the year before disclosure when compared with the previous year. The decline in stock return is associated with higher probability of reporting IC deterioration in Probit regressions. This relation is driven by IC deterioration at entity level rather than deterioration at account-level. In addition, ICW disclosure is more likely when poor stock return is combined with higher sensitivity of executive compensation to stock price change. These results are consistent with the agency hypothesis.

This chapter advances the existing literature in two ways. First, we show that among the major ICW disclosure determinants, only a few of them change in a way that contributes to the reported deterioration in IC. Three of these contributors are related to the effort of auditors (changes in financial restatement, auditor turnover, and audit fee), suggesting that the effort of auditors is among the most important determinants of ICW reporting. Among the other ICW determinants documented in the literature, some of them change in directions that theoretically reduce the likelihood of ICW disclosure. For example, although the literature suggests that the probability of ICW disclosure is higher for smaller firms, we find that the firms reporting IC deterioration experience increase in firm size. Many other known determinants of ICW disclosure, including non-auditor fees, prestigious auditor, sales growth rate, # of segments, R&D intensity, and dividend payer, either do not change significantly or are not statistically significant in probit regressions. These results are useful for both academia and practitioners in finding ways to improving IC disclosure.

Second, we propose and test the agency hypothesis about the reported deteriorations in IC. The agency hypothesis suggests interactions between managers' incentives and the maintenance of proper IC, thus providing a new angle to examine IC issues. In contrast, prior studies in the literature seem to focus on the effects of managerial incentives on the detection and disclosure of IC problems. Given the evidence in this chapter that seems to support the agency hypothesis, both researchers and practitioners may want to pay more attention to the effects of agency problems on IC systems.

The remainder of the chapter is organized as follows: Section 4.2 reviews the relevant literature and presents our hypothesis. Section 4.3 describes data, sample and variables. Section 4.4 reveals the empirical settings and results. Section 4.5 concludes the chapter.

4.2 Literature and Hypothesis Development

Because the ICW disclosure determinants identified in prior studies may also contribute to the reported deteriorations in IC, we first review the literature about the cross-sectional determinants. Then we develop the agency hypothesis about IC deterioration.

4.2.1 Literature about the Determinants of ICW Disclosure

The determinants of ICW disclosure are related to both the existence and detection of ICW. Because building and maintaining a strong IC system requires investments, companies that cannot or do not make enough investments in IC are more likely to have IC problems. Specifically, small firms, young firms, and firms in financial trouble have limited resources to invest in IC; Companies with higher business complexity require more resources to avoid IC problems; Companies with weaker management and weaker corporate governance tend to invest less in internal control.

Consequently, they are more likely to experience internal control weaknesses. These companies are more likely to have ICW. Detection of ICW involves the quality, incentives and efforts of auditors and managers. It can be argued that Big 6 auditor, auditor turnover, higher audit fees, and management turnover are associated with a higher probability of detecting ICW. The evidence in the literature is generally consistent with the arguments above (e.g., see: Ashbaugh-Skaife et al. 2007, Rice and Weber 2012).

Early work by Ge and McVay (2005) focus on a sample of 261 firms that disclosed material ICW after the implementation of the SOX Act of 2002, and find that material ICW is positively related to business complexity and the appointment of a Big 6 auditor, and negatively related to firm size and return on assets. Ashbaugh-Skaife et al. (2007) examines 326 firms that disclose ICW under SOX Section 302 before the implementation of Section 404 of SOX. They document that the disclosure of ICW is positively related with: (i) the complexity of the firm's operations, (ii) the resource constraint for firms to maintain proper IC environment, and (iii) greater reporting incentives. Doyle et al. (2007b) examine the determinants of ICW under both SOX Section 302 and 404 disclosures from 2002 to 2005. They highlight the lack of resources, complex business and accounting environment as predictors for ICW. They also decompose ICW into firm level and account-specific level depending on the severity. They find that firms that report account-level weaknesses tend to have more resources, financially healthier and have more complex business operations than firms that report firm-level weaknesses. Ogneva et al. (2007) also find results similar to those in Ashbaught-Sakife et al. (2007) and Doyle et al. (2007b).

Some other studies focus on the auditing/governance aspect of IC. Krishnan (2005) examines 128 IC deficiencies reported in the 8-Ks during the period of 1994 to 2000 by firms that

change their auditors. She finds that audit committee quality is positively related with IC quality. Zhang et al. (2007) shows that the financial expertise of the audit committee is negatively related to the disclosure of ICW. Krishnan and Visvanathan (2007) find evidence that the disclosure of ICW is positively related to the number of audit committee meetings and negatively related to the proportion of audit committee financial experts. Naiker and Sharma (2009) find that the presence of former audit partners on the audit committee is negatively related to ICW disclosure under SOX 404. Li et al. (2010) find that companies with less qualified CFOs are more likely to have SOX 404 ICW disclosure. Hoitash et al. (2009) provide evidence that ICW disclosure under SOX 404 is negatively related to corporate governance attributes.

Rice and Weber (2012) focus on the detection and reporting of ICW. They examine 488 restating firms whose misstatements are believed to be linked to ineffective IC and investigate whether these firms report control weaknesses. By this way, they distinguish the reporting issues of ICW from the existence of ICW. They show that only 32.4% of sample firms report control weaknesses during the misstatement period. Their further empirical tests indicate that managers' and auditors' incentives to detect and report ICW are important determinants of whether or not the control weaknesses are disclosed under SOX 404.

4.2.2 The Agency Hypothesis about IC Deterioration

To a large extent, the studies above use a static approach to examine IC. However, the fact that many companies report deterioration in IC, and the fact that most ICW companies later report remediation[11], suggest that IC should also be considered as a dynamic process. The agency

[11] See, for example, Goh (2009).

hypothesis in this chapter attempts to describe part of the dynamics and further explores management incentives and motivations.

As argued by Degorge et al. (1999), managers are under strong pressures from investors, directors, customers, and suppliers. Because earnings provide important information about the company's performance, the manager has incentives to manipulate earnings to meet investors' expectations. When a company's performance misses investors' expectations, disappointed investors may dump the stock and push down stock price. The decline in stock return will send the manager a signal about investors' dissatisfaction and give the manager more incentives to manipulate earnings. This incentive will be even stronger if managerial compensation is linked to stock performance.

Whether managers can easily manipulate earnings depends on the strength of IC. Chan et al. (2008) find that material ICW firms under SOX Section 404 have more positive and absolute discretionary accruals than firms with effective IC. Doyle et al. (2007a) find that ICW is generally associated with poorly estimated accruals that are not realized as cash flows. Further, this relation between ICW and lower accruals quality is driven by weakness disclosures that relate to overall company-level controls, which may be more difficult to "audit around." These results suggest that weak IC systems, especially those with entity-level weaknesses, give managers more room to manipulate earnings. Therefore when stock return is poor, managers will have the incentive to weaken IC so that it becomes easier for them to manage earnings to meet investors' expectations. At least some of the effort to weaken the IC will be caught by auditors. So auditors' opinion in corporate disclosure is likely to show deterioration in IC after poor stock return. We call this argument the agency hypothesis because it is based on the agency problem between managers and investors.

Given the evidence in Doyle et al. (2007a) that entity-level ICW is more "useful" for managers seeking to manipulate earnings, we expect the agency hypothesis to be more applicable to ICW at entity level. Considering the stronger incentive for managers to manipulate earnings when their compensation is linked to stock performance, we expect the relation predicted in the agency hypothesis to be stronger when managerial compensation is more sensitive to stock return.

It should be noted that the rationale of the agency hypothesis is also applicable to factors other than stock return. For example, Degorge et al. (1999) find that one of the thresholds that earnings management try to reach is positive profit. In this case managers may have more incentive to weaken IC when earnings are negative. This argument provides an alternative explanation for the positive relation between ICW disclosure and operating loss as documented in the literature.

4.3 Sample and Data

4.3.1 Sample

We first collect all firms that report their auditor's attestation under SOX 404 from Audit Analytics database for the period between 2004 and 2013. We limit our sample to auditor's opinions as opposed to management disclosures as shown under SOX 302 and SOX 404 management opinions because auditor's detection is considered as a more effective and accurate channel to identify and report material ICW within a firm (e.g., see: Bedard and Graham 2011, Donelson et al. 2014).

We start from 2004 because the SOX 404 disclosure requirements for all SEC registrants became effective since November 2004. The objective of our study is to investigate why internal control deteriorates as reported under SOX 404. Thus for the IC deterioration observations we identify only those firms who report at least one initial material ICW under SOX 404 (i.e., we

delete duplicate SOX 404 ICW disclosures) without prior ICW disclosures under SOX 404 or SOX 302. For the non-ICW observations, we identify firms with clean history in both SOX 302 and 404 up to the corresponding filing date. The preceding procedures yield 30,244 firm-year observations among which 1,223 firms report IC deteriorations.

Table 4.1 Sample Selection Procedure

Table 4.1 summarizes the detailed steps in selecting ICW and matching non-ICW firms using Audit Analytics, Compustat, ExecuComp, and CRSP and I/B/E/S databases. We merge Audit Analytics with Compustat, ExecuComp and I/B/E/S using CIK identifier, and then we merge the data with CRSP using six-digit CUSIP code.

Description	**Firm-year obs**
1. SOX 404 audited disclosures in Audit Analytics database during the period of 2004/11–2013/12	
A. Firm-year observations with SOX 404 ICW disclosures	2,432
Deleting duplicate ICW reports	(852)
Deleting firms not reporting effective IC in the previous year	(357)
Initial SOX 404 ICW disclosures with prior clean internal control disclosures	1,223
B. Identifying firms with clean history in both SOX 302 and 404 up to the corresponding filing date (non-ICW firms, thereafter)	29,021
2. Merging initial sample with Compustat, ExecuComp, CRSP, I/B/E/S and requiring firms to have complete information for empirical tests	
A. ICW firms	708
B. non-ICW firm-year observations	16,171
Final sample (including ICW and non-ICW firms)	16,879

Then we merge our Audit Analytics sample with the Compustat and ExecuComp databases to obtain company's financial information and executive compensation information. Stock price and return data are retrieved from Center for Research in Security Prices (CRSP) database. We keep only observations with complete information available from Compustat and CRSP. Our final sample consists of 16,879 firm-year observations (708 IC deterioration observations and 16,171 non-ICW firm-year observations).

4.3.2 Material Weakness and Its Classification

The primary dependent variable we investigate is *ICW*, which is an indicator variable that equals one for all firms with disclosure of material weakness observations and zero for all non-ICW firm-year observations. Following previous literature (e.g., Doyle et al. 2007a), we also examine two levels of IC deterioration, namely, entity level and account level. We define entity level IC deterioration based on the classification suggested by Donelson et al. (2014). Specifically, an IC deterioration observation will be categorized as *ENTITY* if there is at least one entity-level IC material weakness reported. Entity level material weaknesses are those in which Audit Analytics identifies as (1) non-routine transaction control issues (Audit Analytics code 77); (2) journal entry control issues (code 76); (3) foreign, related party, affiliated or subsidiary issues (code 38); (4) an ineffective, non-existent, or understaffed audit committee (code 11); (5) senior management competency, tone, or reliability issues (code 13); (6) an insufficient or non-existent internal audit function (code 18); (7) ethical or compliance issues with personnel (code 21); or (8) accounting personnel resources, competency, or training issues (code 44). The remaining IC deterioration observations are categorized as account level. Account level material weaknesses are usually less severe and are related to control problems over specific account items. Firm level material

weaknesses, on the other hand, are considered as related to the firm's macro control environment and the overall financial reporting process.

4.3.3 Potential Determinants of Reported Deterioration in IC

Following prior literature, we use the common determinants to test internal control deterioration. We focus on variables available from the databases of Audit Analytics, Compustat, CRSP, and ExecuComp. Detailed variable descriptions for these variables above are provided in Table 4.9. The discussions below describe the motivations for considering them.

Two variables are related to the fees charged by auditors. We examine *AUDIT FEES*, which is used to measure auditor's efforts and is defined as audit related fees paid (obtained from Audit Analytics) scaled by the square root of total assets (Simunic 1980) in the recent fiscal year. The scaling can linearize the relation and reduce the heterogeneity of variances related to size. We also examine the effects of non-audit services on the reported deterioration in IC. *NON-AUDIT FEES* is defined as non-audit fees paid to auditors scaled by the square root of total assets in the recent fiscal year. Rice and Weber (2012) provide evidence that auditors with higher audit service revenues make more efforts to detect and report ICW. Therefore the reported IC deterioration may be related to the increased efforts (and audit fees charged) by auditors.

We also investigate auditor quality. The literature reports mixed evidence about the relation between auditor quality and ICW disclosure. Ge and McVay (2005) and Ashbaugh-Skaife et al. (2007) find a positive relation between auditor quality and ICW disclosure while Rice and Weber (2012) find the opposite. So it is not clear how the change in auditor quality may affect the reported deterioration in IC. We measure auditor quality by a dummy variable termed *BIG 4* which equals one if a firm ever receives the auditor opinion under SOX 404 from any of the four largest

accounting firms (PWC, KPMG, Deloitte, and E&Y) in the recent two fiscal years, and zero otherwise.

The next set of variables gauge shocks to the firm's IC environment. The first variable we analyze is *AUDITOR TURNOVER,* which is defined as an indicator variable that is equal to one if the firm experienced an auditor turnover during the recent two years. The second variable is *MANAGEMENT TURNOVER,* which is defined as an indicator variable that is equal to one if the firm's CEO or CFO changes during the recent two years. Rice and Weber (2012) report that auditor and management turnovers are positively related to the probability of reporting existing ICW. In this case the reported deterioration in IC may be caused by increases in auditor turnover and management turnover (e.g., see: Campbell et al. forthcoming).

Rice and Weber (2012) suggests that the prior restatement has a strong effect on the odds of reporting existing ICW. Therefore we include accounting restatement to control for this effect. The measure, termed *RESTATEMENT,* is defined as a dummy variable which equals one if the firm restates their financial statement in the recent two years. The positive relation between ICW disclosure and restatement as documented in the literature (e.g., see: Ashbaugh-Skaife et al. 2007) implies that the reported deterioration in IC may be related to increase in restatement.

Previous studies report that ICW disclosure is positively related to sales growth (e.g., see: Ashbaugh-Skaife et al. 2007). This implies that the reported deterioration in IC may be caused by increase in sales growth rate. So we consider the changes in *SALES GROWTH RATE* among the potential determinants of reported deterioration.

The literature shows that firms with financial distress are more likely to report ICW. We consider two variables related to financial distress. One variable is *ALTMAN-Z DECILE* (the decile

of Altman Z-score value estimated using Compustat data in the recent fiscal year). Higher *ALTMAN-Z DECILE* means lower probability of going bankruptcy. The other variable is a dummy variable, *LOSS*, which equals one for firms with negative net income in the recent fiscal year and zero otherwise. The reported deterioration may be caused by decrease in is *ALTMAN-Z DECILE* and/or increase in *LOSS*.

Rice and Weber (2012) find that managers in firms with high net financing activities are less likely to report existing ICW. So we examine whether the change in a firm's financing need is associated with IC deterioration. We model the variable *NET FINANCING* as the sum of net new equity issues plus net new debt issues (Compustat item: SSTK+DLTIS-PRSTKC-DLTR) scaled by total assets in the recent fiscal year. This variable measures the overall financing activities.

Following previous studies about the determinants of ICW disclosure (e.g., see: Rice and Weber 2012 and Doyle et al. 2007b), we also include a group of firm characteristic variables. These variables are *FIRM SIZE* (total assets in the recent fiscal year), *R&D INTENSITY* (research and development expenses scaled by sales in the recent fiscal year), *# OF SEGMENTS* (the number of segments in the recent fiscal year), and *DIVIDEND PAYER* (a dummy variable which equals one if the firm pays dividends in the recent year, zero otherwise).

To test the agency hypothesis, we need a measure for stock return. Prior studies (e.g., see: Beneish et al., 2008; Ashbaugh-Skaife et al., 2009; Kim and Park, 2009) usually focus on a short time window around ICW disclosure date to calculate market reaction to the announcement. This method is considered inappropriate in our research setting since we are investigating the incentives for ICW detection and reporting and therefore are more interested in a relatively long time period before the disclosure. Following the conventions in the existing literature about stock performance

(e.g., see: Grinblatt and Moskowitz 2004, Faulkender and Wang 2006), we use *STYLE ADJUSTED RETURN* to capture the risk-adjusted stock performance, which is defined as the difference between the buy-and-hold return of a firm and the corresponding return of its benchmark portfolio controlling for style effects (size and book-to-market). The benchmark portfolios are the 25 Fama and French portfolios based on firm size and book-to-market ratio. They are constructed as follows: We match every firm year in our sample with one of the 25 size and BE/ME (book-to-market ratio) portfolios based on the breakpoints taken from Kenneth French's website. Then we estimate the benchmark adjusted returns for the year prior to SOX 404 disclosure and the year before. The agency hypothesis predicts that decline in stock return is associated with the reported deterioration in IC.

The agency hypothesis suggests that the portion of managers' compensation that is closely tied to the stock performance can play a role in the relation between stock performance and IC deterioration. Thus we construct *INCENTIVE* to measure the sensitivity of executive compensation to stock price change using the method suggested by Bergstresser and Philippon (2006). First, using data from Execucomp, we calculate the dollar change in the value of CEO's stock and option holdings coming from a one percent change in the firm's stock price, *ONEPCT*, as 0.01**PRICE*(SHARES+OPTIONS)*, where *PRICE* is the stock price while *SHARES* and *OPTIONS* are the number of shares and options held by CEO as of the recent fiscal year-end. Then we calculate *INCENTIVE* as *ONEPCT/(ONEPCT+SALARY+BONUS)*, to capture the change in CEO's total compensation that comes from a one percent change in the value of his or her equity in the company.

4.4 Empirical analysis

4.4.1 Summary Statistics

Table 4.2 presents summary statistics of the variables related to the potential determinants for the reported deterioration in IC for both the IC deterioration firms and the non-ICW firms in our sample. The variable values are calculated for Year T (the year immediately before IC disclosure). We also calculate the differences in mean value between the two groups and estimate the statistical significance of the differences.

Compared with non-ICW firms, the IC deterioration firms in our sample pay more audit and non-audit fees and are less likely to use Big 4 auditors. They experience more changes in auditors and management. The difference in restatement is very large. About 51.3% of the IC deterioration firms restate their financial statements in the year prior to the SOX 404 disclosure while the comparable number for non-ICW firms is only 7.4%. The IC deterioration firms have higher sales growth rate but lower Altman Z-score decile. They are more likely to suffer a loss and they raise more external financing. The IC deterioration firms are smaller than non-ICW firms[12]. Their R&D intensity and number of segments are similar to those of non-ICW firms. They are much less likely to be dividend payers. These results are generally consistent with those in the literature.

Consistent with the agency hypothesis, the IC deterioration firms have very poor stock performance in the year before IC deterioration is reported. The style adjusted return for the IC deterioration firms has mean of -12% and median of -18.4%. In contrast, the same measure for non-ICW firms has mean of 1.3% and median of -3.5%. The IC deterioration firms underperform the non-ICW firms by 13.3%.

[12] Although not reported in Table 4.2, the IC deterioration firms are also younger than non-ICW firms.

Table 4.2 Descriptive Statistics of Key Variables for IC Deterioration firms versus Non-ICW Firm Years

Table 4.2 reports descriptive statistics of key variables for ICW and non-ICW firms. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-sample parametric t-tests. Continuous variables are winsorized at the 1% and 99% tail to mitigate outliers, and are defined as in the Table 4.9.

	ICW firm-years			Non-ICW firm years			ICW minus non-ICW		
Variable	N	Mean	Median	N	Mean	Median	Diff. in mean	p-value	t statistics
AUDIT FEES	708	72.027	61.229	16171	41.747	36.587	30.280	0.001	27.64
NON-AUDIT FEES	708	11.731	6.11	16171	8.988	5.184	2.743	0.001	6.01
BIG 4	708	0.832	1	16171	0.899	1	-0.067	0.001	-5.69
AUDITOR TURNOVER	708	0.168	0	16171	0.075	0	0.093	0.001	9.01
MANAGEMENT TURNOVER	708	0.425	0	16171	0.320	0	0.105	0.001	5.84
RESTATEMENT	708	0.513	0	16171	0.074	0	0.439	0.001	41.52
SALES GROWTH RATE	708	0.208	0.115	16171	0.175	0.098	0.033	0.065	1.85
ALTMAN Z DECILE	708	6.054	6	16171	6.362	6	-0.308	0.001	-3.48
LOSS	708	0.405	0	16171	0.225	0	0.180	0.001	11.15
NET FINANCING	708	0.048	0.007	16171	0.033	0.002	0.015	0.008	2.65
FIRM SIZE	708	6.249	6.061	16171	7.152	7.091	-0.903	0.001	-12.35
R&D INTENSITY	708	0.199	0.005	16171	0.237	0	-0.038	0.411	-0.82
# OF SEGMENTS	708	2.240	2.398	16171	2.191	2.398	0.049	0.185	1.33
DIVIDEND PAYER	708	0.257	0	16171	0.496	0	-0.239	0.001	-12.52
STYLE ADJUSTED RETURN	708	-0.120	-0.184	16171	0.013	-0.035	-0.133	0.001	-6.59
INCENTIVE	237	0.183	0.081	7859	0.203	0.116	-0.020	0.174	-1.36

To find the cause of the reported IC deterioration, we have to find out which potential determinant changed in the year before ICW disclosure. So we report the statistics for both Year T and Year T-1 (the year before Year T) in Table 4.3. Only the statistics for IC deterioration firms are reported.

Table 4.3 shows the dynamic changes of ICW firms. Specifically, the IC deterioration firms pay more audit fees but less non-audit fees than before. They experience more management turnovers. The frequency of restatement increases to 2.67 times the level in the previous year. Table 4.3 shows that the sales growth rate and Altman Z-score decile of IC deterioration firms decline and more firms have losses. The amount of net financing declines while firm size increases. At the same time the number of segments decreases significantly.

Table 4.3 suggests that many of the ICW disclosure determinants documented in the literature do not seem to contribute to the dynamics of IC deterioration. There are no significant changes in auditor quality (as measured by BIG 4), auditor turnover, R&D intensity, and the proportion of dividend payers. The declines in sales growth rate and the amount of net financing, the increase in firm size, and the decrease in number of segments are actually supposed to reduce the likelihood of ICW disclosure based on the literature. Only audit fees, management turnover, restatement, Altman Z-score decile and earnings loss change in directions that are predicted to increase the probability of ICW disclosure.

Consistent with the agency hypothesis, IC deterioration firms have much worse stock performance than in the previous year. The average style adjusted return in the year before ICW disclosure is -12%, which is 17.2% lower than the return in the previous year. We do not see significant change in the sensitivity of executive compensation to stock price change.

Table 4.3 Descriptive Statistics of Key Variables for IC Deterioration Firms

Table 4.3 reports descriptive statistics of key variables for ICW firms at the ICW announcement years versus years prior to announcement years. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-sample parametric t-tests. Continuous variables are winsorized at the 1% and 99% tail to mitigate outliers, and are defined as in the Table 4.9.

	ICW year (T)			Previous year (T-1)			Year T minus Year T-1		
Variable	N	Mean	Median	N	Mean	Median	Mean	p value	t statistic
AUDIT FEES	708	72.027	61.229	708	49.289	37.481	22.738	0.001	9.56
NON-AUDIT FEES	708	11.731	6.11	708	13.811	7.779	-2.080	0.003	-2.98
BIG 4	708	0.832	1	708	0.840	1	-0.008	0.257	-1.13
AUDITOR TURNOVER	708	0.168	0	708	0.177	0	-0.009	0.553	-0.59
MANAGEMENT TURNOVER	708	0.425	0	708	0.219	0	0.206	0.001	11.92
RESTATEMENT	708	0.513	0	708	0.192	0	0.321	0.001	15.95
SALES GROWTH RATE	708	0.208	0.115	708	0.307	0.137	-0.099	0.001	-4.05
ALTMAN Z DECILE	708	6.054	6	708	6.506	7	-0.452	0.001	-8.26
LOSS	708	0.405	0	708	0.312	0	0.093	0.001	4.86
NET FINANCING	708	0.048	0.007	708	0.072	0.015	-0.024	0.001	-3.23
FIRM SIZE	708	6.249	6.061	708	6.120	5.912	0.129	0.001	9.81
R&D INTENSITY	708	0.199	0.005	708	0.162	0.003	0.037	0.200	1.28
# OF SEGMENTS	708	2.240	2.398	708	2.365	2.565	-0.125	0.001	-6.51
DIVIDEND PAYER	708	0.257	0	708	0.247	0	0.010	0.209	1.26
STYLE ADJUSTED RETURN	708	-0.120	-0.184	708	0.052	-0.095	-0.172	0.001	-4.76
INCENTIVE	237	0.183	0.081	221	0.171	0.067	0.012	0.788	0.27

4.4.2 Conditional Probabilities of IC Deterioration

As discussed in section 4.3.3, IC deterioration may be caused by the changes in the variables reported in Table 4.3. To find out whether those changes contribute to higher probability of reporting IC deterioration, for each variable, we classify all the firms in our sample (both IC deterioration and non-ICW firms) into 3 sub-samples based on the changes in those variables from Year T-1 to Year T. For continuous variables the observations with changes in the lowest 33.3% percentile are placed in the LOW sub-sample and those with changes in the highest 33.3% percentile are placed in the HIGH sub-sample. The rest are put in the MIDDLE sub-samples. For dummy variables, because the changes take one of three values (-1, 0, and 1), we form 3 sub-samples (MINUS, ZERO, and PLUS) based on the three values. For example, for a firm with auditor turnover in the 2-year window before Year T-1 but not in the 2-year window before Year T, the change in AUDITOR TURNOVER takes the value of -1. These firms are put into the MINUS sub-sample. Therefore for all dummy variables the firms in the MINUS sub-samples experience decrease in the variables respectively from Year T-1 to Year T. Firms with no changes in dummy variables are in the ZERO sub-samples. Firms with increases in dummy variables are put into the PLUS sub-samples. Then we find the probability of reported IC deterioration for each sub-sample. These conditional probabilities are reported in Table 4.4.

Table 4.4 Conditional Probabilities of IC Deterioration for Different Groups

Table 4.4 reports the probabilities of reporting IC deterioration for sub-samples classified based on changes in different variables from Year T-1 to Year T. All variable are defined in Table 4.9. P values and t statistics are based on the two-tailed t-tests.

Panel A. Probabilities for sub-samples based on changes in continuous variables					
	Sub-sample probability			LOW vs. HIGH	
Changes in	LOW	MIDDLE	HIGH	t stat.	p value
AUDIT FEES	2.22%	1.78%	8.59%	15.08	0.000
NON-AUDIT FEES	4.90%	3.23%	4.44%	1.16	0.247
SALES GROWTH RATE	4.62%	3.54%	4.43%	0.50	0.619
ALTMAN Z DECILE	6.66%	3.39%	3.39%	6.38	0.001
NET FINANCING	4.57%	3.82%	4.19%	0.97	0.335
FIRM SIZE	4.35%	3.61%	4.62%	-0.69	0.493
R&D INTENSITY	4.59%	3.62%	5.16%	-1.18	0.240
# OF SEGMENTS	4.68%	3.93%	3.99%	1.63	0.102
STYLE ADJUSTED RETURN	4.99%	3.47%	4.12%	2.21	0.027

Panel B. Probabilities for sub-samples based on changes in dummy variables							
	Sub-sample probability			MINUS vs. PLUS		ZERO vs. PLUS	
Changes in	MINUS	ZERO	PLUS	t stat.	p value	t stat.	p value
BIG 4	10.63%	4.08%	16.42%	-1.21	0.228	-5.07	0.001
AUDITOR TURNOVER	5.65%	3.95%	8.38%	-2.07	0.039	-5.25	0.001
MANAGEMENT TURNOVER	1.40%	3.93%	7.29%	-7.51	0.001	-7.17	0.001
RESTATEMENT	4.26%	2.78%	32.72%	-13.51	0.001	-42.57	0.001
LOSS	4.87%	3.63%	9.57%	-4.64	0.001	-10.46	0.001
DIVIDEND PAYER	4.78%	4.19%	4.12%	0.41	0.681	0.07	0.944

Panel A of Table 4.4 reports the probabilities for sub-samples based on changes in continuous variables. It shows that the probability of reporting IC deterioration increases from 2.22% for the firms with low audit fee increases (some of these firms see decrease in audit fees) to 8.59% for the firms with high audit fee increases. Firms with low increases (or large decreases) in Altman Z score decile see their probability of reporting IC deterioration at 6.66%, which is almost double the probability for those in the high increase sub-sample. For firms with large decline in stock return (the LOW sub-sample based on increase in STYLE ADJUSTED RETURN) the probability of reporting IC deterioration is 4.99%, which is significantly higher than that for firms in the HIGH sub-sample. This is consistent with the agency hypothesis. For the other continuous variables, the probability differences between LOW and HIGH sub-samples are not statistically significant.

Panel B of Table 4.4 reports the probabilities of reporting IC deterioration for sub-samples based on changes in dummy variables. Because more than half of the observations are in the ZERO subsample for all dummy variables, we estimate the statistical significance of not only the differences between the MINUS and PLUS sub-samples, but also the differences between ZERO and PLUS sub-samples. For sub-samples based on change in MANAGEMENT TUROVER, we see a monotonic increase in the probability from 1.4% for the MINUS sub-sample to 3.93% for the ZERO sub-sample to 7.29% for the PLUS sub-sample. For other dummy variables we see a slight U shape change in the probability of reporting IC deterioration from the MINUS sub-sample to the ZERO sub-sample. However, with the exception of DIVIDEND PAYER and BIG 4, for all other dummy variables the probabilities of reporting IC deterioration are the highest in the PLUS sub-sample. These results suggest that the firms with increase in auditor turnover, increase in management turnover, increase in restatement, and increase in earnings loss are more likely to

report IC deterioration. Change in RESTATEMENT has the most significant effect. For companies with no change (the ZERO sub-sample) in RESTATEMENT, the probability of reporting IC deterioration is only 2.78%. For companies in the PLUS sub-sample, the probability increases more than 10 times to 32.72%, which is also more than 6 times higher than the probability for the MINUS group.

4.4.3 Regression Analysis: ICW in general

To do a comprehensive examination of the determinants of the reported deterioration in IC, we regress *ICW* on the potential determinants of IC deterioration as discussed in sections 4.3.3 and 4.4.2. We estimate Probit model (1) below to find the effects of changes in various factors on ICW:

$$ICW_i = \alpha_0 + f\,(changes\ in\ potential\ determinants\ of\ reported\ IC\ deterioration)_i + f\,(lagged\ potential\ determinants\ of\ reported\ IC\ deterioration)_i + year\ and\ industry\ dummies + \varepsilon_i \qquad (1)$$

As mentioned earlier, *ICW* is a dummy variable that takes the value of one for IC deterioration observations and the value of zero for non-ICW firm-year observations. We include two groups of explanatory variables: the dynamic changes in potential determinants from Year T-1 to Year T, as reported in the last three columns of Table 4.3, and lagged potential determinants in Year T-1, as shown in the middle of Table 4.3. Our primary focus is in the dynamic change group while lagged group is used as controlling variables.

Table 4.5 Probit Regressions Examining the Determinants of ICW Deterioration

Table 4.5 reports the Probit regression results in which the dependent variable is equal to one if the firm reports ICW under SOX 404, zero otherwise. All variable are defined in Table 4.9. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-tailed t-tests. Continuous variables are winsorized at the 1% and 99% tail to mitigate outliers.

	(1) ICW		(2) ICW	
ΔAUDIT FEES	0.011***	[15.017]	0.010***	[12.788]
ΔNON-AUDIT FEES	-0.001	[-0.769]	-0.002	[-0.986]
ΔBIG 4	0.025	[0.175]	0.056	[0.375]
ΔAUDITOR TURNOVER	0.209***	[2.951]	0.212***	[2.964]
ΔMANAGEMENT	0.180***	[3.993]	0.116**	[2.434]
ΔRESTATEMENT	1.349***	[25.378]	1.324***	[23.916]
ΔSALES GROWTH RATE	0.008	[0.153]	-0.019	[-0.341]
ΔALTMAN Z DECILE	-0.075***	[-4.280]	-0.070***	[-3.785]
ΔLOSS	0.237***	[4.124]	0.288***	[4.788]
ΔNET FINANCING	-0.517***	[-2.890]	-0.553***	[-2.962]
ΔFIRM SIZE	0.421***	[4.870]	0.391***	[4.303]
ΔR&D INTENSITY	0.024	[0.622]	0.018	[0.471]
Δ# OF SEGMENTS	-0.087**	[-2.072]	-0.048	[-1.015]
ΔDIVIDEND PAYER	-0.096	[-0.929]	-0.13	[-1.210]
AUDIT FEES	0.009***	[12.130]	0.009***	[11.945]
NON-AUDIT FEES	-0.001	[-0.732]	-0.003*	[-1.825]
BIG 4	-0.284***	[-4.317]	-0.384***	[-5.520]
AUDITOR TURNOVER	0.297***	[4.106]	0.211***	[2.818]
MANAGEMENT	-0.036	[-0.627]	0.047	[0.788]
RESTATEMENT	0.992***	[16.248]	0.944***	[14.964]
SALES GROWTH RATE	0.094	[1.562]	0.074	[1.151]
ALTMAN Z DECILE	-0.034***	[-3.138]	-0.029**	[-2.424]
LOSS	0.137**	[2.066]	0.184***	[2.639]
NET FINANCING	-0.611***	[-3.016]	-0.623***	[-2.961]
FIRM SIZE	-0.058***	[-3.546]	-0.052***	[-2.983]
R&D INTENSITY	-0.130***	[-3.584]	-0.095***	[-2.613]
# OF SEGMENTS	0.03	[1.214]	0.022	[0.818]
DIVIDEND PAYER	-0.201***	[-3.920]	-0.222***	[-3.954]
ΔSTYLE ADJUSTED	-0.134***	[-2.860]	-0.179***	[-3.540]
STYLE ADJUSTED	-0.129**	[-2.450]	-0.187***	[-3.296]
Constant	Yes		Yes	
Year dummies	No		Yes	
Industry dummies	No		Yes	
N	16879		16879	
pseudo R2	0.273		0.302	

Regression results for *ICW* are reported in Table 4.5. In column (1) we do not include the year dummies and industry dummies, while in column (2) we include them. Consistent with the literature about determinants of ICW disclosure, in two columns of Table 4.5 the coefficients of changes in *AUDIT FEES*, *MANAGEMENT TURNOVER*, AUDITOR TURNOVER, *RESTATEMENT*, and *LOSS* are positive and significant, suggesting that increases in audit fees, management turnover, restatements, and earnings loss are associated with higher probability of reported deterioration in IC. Also consistent with the literature, the coefficients of change in *ALTMAN-Z DECILE* are negative and significant in the three regressions, implying that increase in financial distress may also be among the causes of IC deterioration. These results are also consistent with the significant changes in *AUDIT FEES*, *MANAGEMENT TURNOVER*, AUDITOR TURNOVER, *RESTATEMENTS*, *ALTMAN Z DECILE* and *LOSS* reported in Table 4.3.

The coefficients of changes in *BIG 4*, *R&D INTENSITY*, and *DIVIDEND PAYER* are mostly insignificant, suggesting that they do not contribute to the reported IC deterioration. The coefficients of change in *SALES GROWTH RATE* are insignificant in both columns. The coefficients of changes in *NET FINANCING* are significant and negative, consistent with the argument that ICW disclosure will cause increase in cost of capital. The coefficients of change in *FIRM SIZE* are positive and significant in both regressions, implying that increase in firm size is associated with higher probability of reporting IC deterioration. The coefficients of change in *# OF SEGMENTS* are negative and significant in column (1), suggesting that the decrease in the number of segments is associated with higher likelihood of reporting IC deterioration.

Consistent with the agency hypothesis, Table 4.5 shows that the coefficients of change in *STYLE ADJUSTED RETURN* are negative and statistically significant in both regressions. These

results imply that decline in stock return is associated with higher likelihood of reporting IC deterioration. The agency hypothesis suggests that this is because when investors are not satisfied with firm performance, managers may weaken the IC system so that it becomes easier to manage earnings to meet investor expectations.

4.4.4 Regression Analysis: ENTITY vs. ACCOUNT

As discussed earlier, the agency hypothesis is more applicable to firm level ICW rather than account level ICW. Therefore we expect the negative relation between change in stock return and probability of reporting IC deterioration to hold for firm level ICW but not necessarily for account level ICW. So we re-estimate regression (1) using *ENTITY* and *ACCOUNT* as dependent variables. *ENTITY* a dummy indicator that is equal to one if the reported IC deterioration is at firm level. *ACCOUNT* is a dummy indicator that is equal to one if the reported IC deterioration is account specific.

Table 4.6 reports the results of regressions using *ENTITY* as the dependent variable. Following Doyle et al. (2007b), observations with ICW at account level are dropped. The results are generally similar to those in Table 4.5. The coefficients of changes in *AUDIT FEES, MANAGEMENT TURNOVER, RESTATEMENTS, AUDITOR TURNOVER, NET FINANCING, ALTMAN-Z DECILE, LOSS, and FIRM SIZE* are significant and the signs of the coefficients are the same as those in Table 4.5. The coefficients of changes in *NON-AUDIT FEES, BIG 4, SALES GROWTH RATE, R&D INTENSITY*, and *DIVIDEND PAYER* are mostly insignificant.

Table 4.6 Probit Regressions Examining the Determinants of Entity-level ICW Deterioration

Table 4.6 reports the Probit regression results in which the dependent variable is equal to one if the firm reports entity-level ICW under SOX 404, zero otherwise. All variable are defined in Table 4.9. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-tailed t-tests.

	(1) ENTITY		(2) ENTITY	
ΔAUDIT FEES	0.011***	[12.919]	0.010***	[11.012]
ΔNON-AUDIT FEES	0	[0.136]	0	[-0.043]
ΔBIG 4	-0.035	[-0.195]	-0.016	[-0.086]
ΔAUDITOR TURNOVER	0.151*	[1.693]	0.149	[1.638]
ΔMANAGEMENT	0.228***	[4.047]	0.191***	[3.102]
ΔRESTATEMENT	1.197***	[18.029]	1.215***	[17.209]
ΔSALES GROWTH RATE	0.022	[0.320]	-0.005	[-0.069]
ΔALTMAN Z DECILE	-0.068***	[-3.059]	-0.064***	[-2.704]
ΔLOSS	0.260***	[3.586]	0.311***	[4.016]
ΔNET FINANCING	-0.579***	[-2.588]	-0.517**	[-2.183]
ΔFIRM SIZE	0.449***	[4.098]	0.420***	[3.588]
ΔR&D INTENSITY	0.04	[0.825]	0.04	[0.839]
Δ# OF SEGMENTS	-0.038	[-0.738]	-0.045	[-0.774]
ΔDIVIDEND PAYER	-0.12	[-0.909]	-0.124	[-0.875]
AUDIT FEES	0.010***	[11.961]	0.010***	[10.911]
NON-AUDIT FEES	0	[0.209]	-0.002	[-0.748]
BIG 4	-0.341***	[-4.094]	-0.429***	[-4.749]
AUDITOR TURNOVER	0.343***	[3.864]	0.248***	[2.642]
MANAGEMENT	-0.034	[-0.471]	0.065	[0.829]
RESTATEMENT	0.947***	[12.703]	0.936***	[11.738]
SALES GROWTH RATE	0.123*	[1.649]	0.104	[1.285]
ALTMAN Z DECILE	-0.026*	[-1.936]	-0.023	[-1.501]
LOSS	0.179**	[2.129]	0.226**	[2.490]
NET FINANCING	-0.565**	[-2.261]	-0.504*	[-1.906]
FIRM SIZE	-0.025	[-1.226]	-0.012	[-0.553]
R&D INTENSITY	-0.118**	[-2.420]	-0.078	[-1.590]
# OF SEGMENTS	0.049	[1.527]	0.03	[0.854]
DIVIDEND PAYER	-0.171***	[-2.583]	-0.177**	[-2.394]
ΔSTYLE ADJUSTED	-0.165***	[-2.726]	-0.210***	[-3.210]
STYLE ADJUSTED	-0.157**	[-2.271]	-0.228***	[-3.033]
Constant	Yes		Yes	
Year dummies	No		Yes	
Industry dummies	No		Yes	
N	16537		16537	
pseudo R^2	0.278		0.325	

Table 4.6 shows that the coefficients of *STYLE ADJUSTED RETURN* are negative and statistically significant in both regressions. This suggests that managers may weaken IC at entity level when their firms underperform. It is consistent with the agency hypothesis. Overall it seems there are no major differences in the determinants of reported IC deterioration at entity level relative to IC deterioration in general.

Table 4.7 reports the results of regressions using *ACCOUNT* as the dependent variable. Like in Table 4.5, the coefficients of changes in *AUDIT FEES*, *RESTATEMENTS*, *NET FINANCING*, *ALTMAN-Z DECILE*, *LOSS* and *# OF SEGMENTS* are mostly significant and the coefficients of changes in *NON-AUDIT FEES*, *BIG 4*, *R&D INTENSITY*, and *DIVIDEND PAYER* are mostly insignificant. In the meantime, we see more differences in Table 4.7 comparing with Table 4.5. First, as for the change in *MANAGEMENT TURNOVER*, the coefficients are still positive but become insignificant in both regressions. In addition, the coefficients of change in *# OF SEGMENTS* become insignificant when year dummies and/or industry dummies are introduced. More importantly, the coefficients of change in *STYLE ADJUSTED RETURN* are insignificant in column (1) and only marginally significant in column (2). These results are consistent with our argument that the agency hypothesis is more applicable to IC deterioration at firm level.

Table 4.7 Probit Regressions Examining the Determinants of Account-level ICW Deterioration

Table 4.7 reports the Probit regression results in which the dependent variable is equal to one if the firm reports account-level ICW under SOX 404, zero otherwise. All variable are defined in Table 4.9. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-tailed t-tests.

	(1) ACCOUNT		(2) ACCOUNT	
ΔAUDIT FEES	0.012***	[11.327]	0.011***	[8.934]
ΔNON-AUDIT FEES	-0.003	[-1.466]	-0.004	[-1.596]
ΔBIG 4	0.08	[0.439]	0.088	[0.465]
ΔAUDITOR TURNOVER	0.215**	[2.403]	0.234**	[2.564]
ΔMANAGEMENT	0.082	[1.406]	0.02	[0.328]
ΔRESTATEMENT	1.311***	[19.754]	1.299***	[18.537]
ΔSALES GROWTH RATE	-0.031	[-0.448]	-0.051	[-0.692]
ΔALTMAN Z DECILE	-0.059***	[-2.708]	-0.059**	[-2.511]
ΔLOSS	0.184**	[2.503]	0.231***	[2.961]
ΔNET FINANCING	-0.421*	[-1.844]	-0.525**	[-2.171]
ΔFIRM SIZE	0.404***	[3.745]	0.377***	[3.242]
ΔR&D INTENSITY	-0.003	[-0.067]	-0.01	[-0.210]
Δ# OF SEGMENTS	-0.139**	[-2.557]	-0.041	[-0.636]
ΔDIVIDEND PAYER	-0.04	[-0.304]	-0.091	[-0.665]
AUDIT FEES	0.004***	[4.204]	0.006***	[5.309]
NON-AUDIT FEES	-0.004	[-1.559]	-0.005**	[-2.105]
BIG 4	-0.163*	[-1.941]	-0.251***	[-2.794]
AUDITOR TURNOVER	0.138	[1.447]	0.113	[1.145]
MANAGEMENT	-0.012	[-0.171]	0.044	[0.573]
RESTATEMENT	0.837***	[10.568]	0.798***	[9.702]
SALES GROWTH RATE	0.033	[0.421]	0.013	[0.153]
ALTMAN Z DECILE	-0.031**	[-2.223]	-0.027*	[-1.718]
LOSS	0.098	[1.162]	0.146	[1.640]
NET FINANCING	-0.618**	[-2.353]	-0.726***	[-2.622]
FIRM SIZE	-0.080***	[-3.706]	-0.084***	[-3.647]
R&D INTENSITY	-0.116***	[-2.576]	-0.091**	[-2.012]
# OF SEGMENTS	0.015	[0.455]	0.019	[0.531]
DIVIDEND PAYER	-0.189***	[-2.911]	-0.204***	[-2.837]
ΔSTYLE ADJUSTED	-0.094	[-1.574]	-0.137**	[-2.071]
STYLE ADJUSTED	-0.101	[-1.546]	-0.137*	[-1.916]
Constant	Yes		Yes	
Year dummies	No		Yes	
Industry dummies	No		Yes	
N	16513		16513	
pseudo R^2	0.239		0.277	

4.4.5 The Effect of Executive Compensation on IC Deterioration

The agency hypothesis predicts that the negative relation between stock return and reported deterioration in IC should be stronger when managerial compensation is more sensitive to stock price. As discussed earlier, we use *INCENTIVE* to measure the sensitivity of executive compensation to stock price. We test the agency hypothesis by adding an interaction variable, change in Δ*STYLE ADJUSTED RETURN*INCENTIVE*, to the independent variables and re-estimate regression (1). The agency hypothesis predicts that the coefficient of this interaction variable should be negative and significant. The results of the regressions are reported in columns (1) of Table 4.8.

In column (1) the coefficients of the interaction variable Δ*STYLE ADJUSTED RETURN*INCENTIVE* is negative, suggesting that the negative relation between change in stock return and the reported deterioration is stronger when managerial compensation is more sensitive to stock price although the relation is not statistically significant. This result is consistent with the prediction of the agency hypothesis. The coefficients of other explanatory variables are largely consistent with those reported in Table 4.5.

Because the agency hypothesis is more applicable to ICW at entity level, it implies that the effect of Δ*STYLE ADJUSTED RETURN*INCENTIVE* should be more pronounced for ICW at entity level. So we estimate another regression using *ENTITY* as the dependent variable and report the results in column (2) of Table 4.8. Column (2) shows that the coefficient of Δ*STYLE ADJUSTED RETURN*INCENTIVE* is negative and, statistically significant. In contrast, when we regress *ACCOUNT* on the same independent variables, as reported in column (3) of Table 4.8, the coefficient of the interaction variable is not significant at all. The stronger results for the *ENTITY* regression are consistent with the agency hypothesis.

Table 4.8 The Effect of Executive Compensation on Internal Control Deterioration

Table 4.8 reports the Probit regression results in which the dependent variable is equal to one if the firm reports ICW under SOX 404, zero otherwise. We primarily test the effect of executive compensation (proxied by INCENTIVE) on the internal control deterioration. All variable are defined in Table 4.9. *, **, and *** represent the significance at 10%, 5%, and 1% level respectively, and are based on the two-tailed t-tests

	(1) ICW		(2) ENTITY		(3) ACCOUNT	
ΔAUDIT FEES	0.010***	[7.258]	0.011***	[6.036]	0.015***	[5.806]
ΔNON-AUDIT FEES	-0.004	[-1.076]	-0.002	[-0.507]	-0.002	[-0.513]
ΔBIG 4	0.15	[0.341]	-0.988**	[-2.054]	1.174*	[1.864]
ΔAUDITOR	0.213	[1.544]	0.028	[0.143]	0.133	[0.726]
ΔMANAGEMENT	0.277***	[3.232]	0.354***	[3.036]	0.17	[1.510]
ΔRESTATEMENT	1.442***	[14.480]	1.356***	[10.019]	1.512***	[11.531]
ΔSALES GROWTH	0.198	[1.076]	0.287	[0.996]	0.075	[0.322]
ΔALTMAN Z DECILE	-0.093*	[-1.878]	-0.062	[-0.893]	-0.127*	[-1.955]
ΔLOSS	0.220*	[1.849]	0.202	[1.232]	0.127	[0.788]
ΔNET FINANCING	-0.263	[-0.567]	-0.622	[-0.975]	-0.142	[-0.228]
ΔFIRM SIZE	0.038	[0.141]	-0.115	[-0.304]	0.203	[0.571]
ΔR&D INTENSITY	0.007	[0.058]	-0.164	[-0.179]	0.041	[0.337]
Δ# OF SEGMENTS	-0.049	[-0.576]	-0.016	[-0.150]	-0.059	[-0.481]
ΔDIVIDEND PAYER	0.019	[0.094]	-0.179	[-0.621]	0.283	[1.131]
AUDIT FEES	0.012***	[8.440]	0.014***	[7.407]	0.009***	[3.616]
NON-AUDIT FEES	-0.002	[-0.648]	0.001	[0.138]	-0.005	[-1.108]
BIG 4	-0.236	[-1.185]	0.228	[0.590]	-0.155	[-0.626]
AUDITOR	0.289**	[2.020]	0.195	[0.999]	0.159	[0.815]
MANAGEMENT	0.019	[0.171]	0.041	[0.253]	-0.019	[-0.128]
RESTATEMENT	1.096***	[9.720]	1.091***	[7.138]	1.067***	[7.053]
SALES GROWTH	0.243	[1.079]	0.114	[0.313]	0.161	[0.568]
ALTMAN Z DECILE	-0.033	[-1.187]	-0.004	[-0.099]	-0.055	[-1.507]
LOSS	0.307**	[2.119]	0.345*	[1.690]	0.244	[1.261]
NET FINANCING	-1.020*	[-1.837]	-0.361	[-0.467]	-1.435*	[-1.947]
FIRM SIZE	-0.142***	[-3.823]	-0.019	[-0.386]	-0.235***	[-4.494]
R&D INTENSITY	-0.09	[-0.877]	-0.92	[-1.340]	-0.023	[-0.210]
# OF SEGMENTS	0.039	[0.803]	0.092	[1.388]	0	[0.005]
DIVIDEND PAYER	-0.304***	[-3.105]	-0.355***	[-2.633]	-0.209	[-1.623]
ΔSTYLE ADJUSTED	-0.104	[-0.871]	-0.342**	[-1.990]	0.013	[0.083]
STYLE ADJUSTED	-0.320**	[-2.212]	-0.694***	[-3.115]	-0.109	[-0.590]
INCENTIVE	0.202	[1.034]	0.056	[0.191]	0.365	[1.496]
ΔSTYLE ADJUSTED RETURN*INCENTIVE	-0.358	[-1.514]	-0.652**	[-2.104]	-0.008	[-0.024]
Constant	Yes		Yes		Yes	
Year dummies	Yes		Yes		Yes	
Industry dummies	Yes		Yes		Yes	
N	7637		7530		7523	
pseudo R^2	0.402		0.451		0.392	

4.4.6 Robustness Check

Previous studies often view restatement as a strong indicator of ICW over financial reporting (e.g., see: Kinney and McDaniel 1989). Because the purpose of our study is to investigate the determinants of IC deteriorations rather than the determinants of restatement, we conduct a robustness test by excluding firms that announced a restatement within the two-year window prior to ICW disclosure. Specifically, we only include 345 firms with *RESTATE* equals 0 in the robustness analysis, which accounts for 48.7% of the 708 firms reporting IC deterioration. Then we re-estimate all regressions. The results for non-restatement firms are very similar to those restatement firms. The coefficients for key variables are generally in the same direction and have similar significance[13]. Therefore our study is different from the studies about determinants of restatement such as Dechow et al. (2011). In addition, to check the robustness of our results, we use value-weighted market adjusted return and size adjusted return as alternative measures. Our findings hold under alternative performance measures.

4.5 Conclusion

In this chapter we explore why some firms report deterioration in IC after previously reporting effective IC. Changes in some of the ICW disclosure determinants documented in the literature seem to be the major driver for the reported deterioration. Specifically, increases in earnings restatements, audit fee, management turnover, auditor turnover, and deterioration in financial conditions (decline in Altman Z score decile, and increase in earnings loss) are among the major contributors to the reported IC deterioration. Restatement seems to be the dominant factor. The

[13] The results are not tabulated for brevity but are available upon request.

probability of reporting IC deterioration is 32.72% among firms with restatement while only 2.78% of the firms without restatement report IC deterioration.

In addition, we propose an agency hypothesis about the incentive of mangers in this process. In this hypothesis, if the firm performance is below expectation, the managers will have incentives to weaken IC so that they can manipulate earnings to meet expectations. The auditors detect the deterioration in IC and disclose it. Consistent with the agency hypothesis, we find significant decline in stock performance before the reported deterioration and a negative relation between the change in stock performance and the probability of reporting IC deterioration. As predicted by the agency hypothesis, when managerial compensation is more sensitive to stock price, the negative relation between the change in stock return and the probability of reporting IC deterioration is stronger. All these relations are stronger for ICW disclosure at entity level.

Table 4.9 Variable Definition

Variable Names	Variable Definitions
ICW	An indicator variable that is equal to one if the firm's auditor report at least one material internal control weakness under SOX 404 in year t, zero otherwise.
ENTITY	An indicator variable that is equal to one if there is at least one entity-level internal control material weakness reported, zero otherwise. Entity level material weaknesses are those in which Audit Analytics identifies as (1) non-routine transaction control issues (code 77); (2) journal entry control issues (code 76); (3) foreign, related party, affiliated or subsidiary issues (code 38); (4) an ineffective, non-existent, or understaffed audit committee (code 11); (5) senior management competency, tone, or reliability issues (code 13); (6) an insufficient or non-existent internal audit function (code 18); (7) ethical or compliance issues with personnel (code 21); or (8) accounting personnel resources, competency, or training issues (code 44). Audit Analytics' codes are in parentheses.
ACCOUNT	An indicator variable that is equal to one if there is at least one account-level material weakness and no entity-level material weakness reported, zero otherwise.
AUDIT FEES	Audit fees in the most recent year scaled by the square root of total assets in the most recent year
NON-AUDIT FEES	Total non-audit fees paid to the auditor scaled by the square root of total assets in the most recent year
BIG 4	An indicator variable that is equal to one for firms hiring a prestigious audit firm in the recent two years, zero otherwise.
AUDITOR TURNOVER	An indicator variable that is equal to one if the firm experienced an auditor change in the recent two years, zero otherwise.
MANAGEMENT TURNOVER	An indicator variable that is equal to one if the firm experienced CEO or CFO change in the recent two years, zero otherwise.
RESTATEMENT	An indicator variable that is equal to one if the firm restated its earnings in the recent two years, zero otherwise.
SALES GROWTH RATE	Sales growth rate in the recent year
ALTMAN Z DECILE	The decile of Altman Z-score value in Compustat in the recent year
NET FINANCING	The sum of net new equity issues plus net new debt issues (Compustat item: SSTK+DLTIS-PRSTKC-DLTR), scaled by total assets in the recent year.
FIRM SIZE	The log of total assets in the recent year
R&D INTENSITY	Research and development expenses to sales in the recent year
# OF SEGMENTS	Log of one plus total number of geographic segments and business segments in the recent year

DIVIDEND PAYER	An indicator which is equal to one if the firm pays dividends in the recent year
STYLE ADJUSTED RETURN	The difference between the buy and hold return of a stock in the year before and the return of the corresponding size and B/M benchmark portfolio
LOSS	An indicator variable that is equal to one for firms with negative net income in the recent year
INCENTIVE	Calculated as ONEPCT/(ONEPCT+SALARY+BONUS), in which ONEPCT is the dollar change in the value of CEO's stock and option holdings coming from a one percent change in the firm's stock price.

Chapter 5 General Conclusion

In the dissertation, we examine three issues on corporate finance: market mispricing, insider trading, and corporate disclosure with an emphasis on behavioral corporate finance theories. In Chapter 2, we test the hypothesis that issuers can value initial public offerings (IPOs) more accurately than the market. We use price premium relative to the issuers' reservation price (the lower bound price of initial filing range), to measure the degree of mispricing. We consider the reservation price to be close to the insiders' perceived intrinsic value of the firm plus a minimum profit to compensate for the risk and costs related to the issue. Consistent with our hypothesis, we find that closing price premium can predict the subsequent stock performance. For example, the mean 3-year market-adjusted abnormal return is -43.8% for IPOs in the highest quartile of first day closing price premium and -27% for IPOs in the lowest quartile of first day closing price premium. Our results are robust after controlling for various determinants documented in prior studies and robust to various econometric specifications. Our results also provide insights into various theoretical explanations about IPO long run performance by lending support to the IPO over-optimism hypothesis.

In Chapter 3, we investigate the insider selling activities in IPO firms. Recent studies reveal that many lock-up agreements are not binding in practice and insiders could be allowed to trade before the lockup agreements expire. To the best of our knowledge, our study is the first one dedicated to examine the incentives of IPO early sales activities prior to lockup expiration date. We find that the degree of price premium is positively correlated with the occurrence and the

magnitude of insider sales in IPOs.

In Chapter 4, we explore why some firms disclose internal control weaknesses under section 404 of Sarbanes-Oxley Act after previously reporting effective internal control. We find that increase in restatement is the most significant predictor for reported IC deterioration, which suggests that a large portion of the reported deteriorations in IC result from detection of previously unreported weaknesses. Our analysis also reveals that these ICW firms pay higher audit fees, have higher frequency of management turnover and auditor turnover, less financing need, lower Altman Z-score deciles, and suffer more losses when compared to the previous year. More importantly, we propose and test the agency hypothesis about the reported deteriorations in IC from a new angle: we examine the interactions between managers' incentives and the maintenance of proper IC, while prior studies appear to focus on the effects of managerial incentives on the detection and disclosure of IC problems. Consistent with an agency hypothesis that managers try to manipulate the IC process when firm performance declines, the reported deterioration in IC is also associated with poor stock returns in the year before disclosure. ICW disclosure is more likely when poor stock return is combined with higher sensitivity of executive compensation to stock price change.

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