Essays on Corporate Finance

Tiffany Yi Hong Thng

ICMA Centre, Henley Business School

University of Reading

This dissertation is submitted for the degree of

Doctor of Philosophy

April 2018

To my parents, Mr. Ah Chuan Thng and Mdm. Kim Houy Ang

Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Tiffany Yi Hong Thng
April 2018

Acknowledgements

I would like to dedicate this thesis to the following people who are and have always been there for me every step of the way. This thesis would not be possible without them.

My parents have been the most supportive, from the start to the end of this journey. Late night Skype calls, encouraging messages and relentless support over these few years. They were the ones who encouraged me to leave my previous job to pursue my dream of teaching and research.

To my supervisors, Dr. Carol Padgett and Prof. Michael P. Clements, to whom I would like to extend my heartfelt gratitude, thank you for your advice, knowledge and encouragement. Without you believing in me, I would not have this opportunity to embark on this journey. I would also like to extend my appreciation to my examiners, Prof. Charles Sutcliffe, Dr. Ufuk Güçbilmez and Dr. Yeqin Zeng for their time, advice and valuable comments for this thesis. To Prof. Andreas Hoepner, Dr. George Alexandridis, Dr. Nikolaos Antypas and Dr. Chao Yin, thank you for your helpful suggestions for the second essay of my thesis.

Embarking on this journey would be otherwise lonely, without impromptu drinking sessions, late nights in the office (thank God for Deliveroo) and research chats with colleagues, especially of Mirco Balatti, Ludovico Rossi, Dr. Nikolaos Antypas, Dr. Rupini Rajagopalan, Yiwei Li, Dr. Xiaoyan Zhang and Dr. Chardin Simen. Not forgetting friends who are always supportive in ways that I could not have imagined; Kaitlyn Quek, Edeline Cheong, Dawn Chai, Lian Ying Koh, Linda Teo, Michelle Yang, Renee Ong, Dr. Eunice Lo, Ya-Hui Liang, Claire Maheux, Gaini Nygymetova, Aleksandrs Šumilovs, Ahmed Tarek and Alex Beard. To my partner, Dr. Ivan Lim, thank you for being an amazing support. Having fully gone through this journey himself, he has been extremely patient and supportive.

Lastly, I would like to thank ICMA Centre not only for its financial support but also for its incredible faculty and administrative members who are always willing to extend their advice and help.

Abstract

This thesis revolves around the theme of corporate finance. The first and last chapters provide the overview and summary respectively.

The second chapter examines the impact of gender diversity of executive and non-executive (E&NE) directors on equity underpricing. Hand-collected data on U.S. firms that have issued Initial Public Offerings (IPO) and primary Seasoned Equity Offerings (SEO) show evidence of a positive relation between female E&NE members' representation and IPO underpricing, but no influence on SEO underpricing. Results are given by the periods before the Sarbanes-Oxley Act as IPO underpricing diminishes due to an increase in information disclosure of firms with more than two female directors.

The third chapter examines how and why venture capital-backed firms manage their tone during IPO and SEO. Analysis conducted using the Management Discussion and Analysis section of the prospectuses demonstrates that VC-funded firms are more negative in tone and in order to reduce litigation risks and protect their reputational capital; the effects of tone conservatism are more pronounced when they hire large auditors, receive more analyst coverage, operate in high tech sectors and in industries facing high litigation risk. Negative tone is not related to the conveying of private information as IPO firms that received VC funding experience larger surprise unexpected returns and perform better than non-VC backed offers in the long run.

Finally, the fourth chapter studies the impact of the presence of directors who are patent holders of the same firm on firms' innovation outcomes. Applying a name-matching algorithm to the U.S patent database to identify these directors, I document a positive relation between their presence and the intensity of patent applications and citations received by the firms. Despite experiencing stricter regulatory regime after the passage of the Sarbanes-Oxley Act and an increase in the demand for technological-related expertise, results remain consistent.

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Chapter 1

Introduction

This thesis consists of three essays on corporate finance. In the first essay (Chapter 2), I examine the relation between the presence of female executive and non-executive directors on equity underpricing. Using initial public offering (IPO) firms between 1997 and 2011 that have issued follow-on offerings (SEO) till 2013, primary results show a positive association between the proportion of female executive and non-executive members on IPO underpricing but no evidence on SEO underpricing.

Controlling for various directors' attributes as well as firm and offering characteristics, the findings remain unchanged. In addition, several robustness tests have been conducted to address endogeneity concerns arising from omitted variable bias and reverse causality. Following the notion of tokenism and critical mass (Torchia et al. 2011), I delved into the concept of comparing firms based on the number of female E&NE members present in the firm. The basic idea behind this is that, firms with one female E&NE director may not necessarily have similar proportions with respect to the team size. For instance, with one female director, the ratio of female E&NE members could be 10% when the total team size is 10, and 12.5% if team size decreases to 8.

Having few tokens may not be effective in bringing about a change in the firm and the increase in the number to the critical mass of three may be sufficient. Thus, it would be interesting to observe if there are any changes in the impact of having an incremental number of female director in the E&NE team on underpricing, instead of looking at the proportion. Further analyses show that the main result of a positive relation between female directors' representation and underpricing is driven by firms with few (one and two) female E&NE members. As the token groups move to a consistent minority group of three females and more, there is no evidence of their presence on underpricing.

Next, I proceed to provide plausible explanations. The impact of female presence in the E&NE team on underpricing could be link to improved corporate governance or rather, to lower levels of risk. Exploiting a natural experiment through the implementation of the Sarbanes-Oxley Act (SOX), firms with at least three female E&NE directors alleviate underpricing through the intensity of regulatory disclosures pre-SOX. Little evidence of the association between female directors and risk-aversion is documented. Findings point to the same conclusion that the representation of female directors are good corporate governance mechanisms.

Apart from examining the influence of diversity on offering discounts before and after SOX, I proceed to explore another aspect of IPOs. IPOs are often marketed in various ways by the issuing firm and/or underwriter and could be different when it comes to offerings that are backed by venture capitalists (VCs). In the second essay (Chapter 3), I look at the effects of VCs on the tone of firms' offering prospectuses, one of the channels through which IPOs are marketed.

Extracting the Management Discussion & Analysis (MD&A) section of the offering prospectuses of a similar set of sample used in the first essay, I calculate tone by taking the difference between the number of positive and negative words, scaled by the sum of the number of positive and negative words in the document. The larger is the tone, the more is the optimism of the MD&A. Regression results show a negative relation between VC-backed firms and tone, suggesting that these firms are more conservative as compared to firms that do not receive such funding.

To ensure that VCs do indeed influence tone, the impact is re-estimated for firms that have their original VCs who stay after the IPO as well as when new VCs enter the firm at the SEO in comparsion to non-VC-backed firms. Moreover, robustness tests to address potential endogeneity are employed. These tests not only strengthen the baseline results, but also take into account of unobservable factors that may influence the choice of VC funding as well as observable characteristics of VC-backed firms that may eventually affect tone. The negative association between VC-funded firms and tone remains consistent.

A natural progression is to examine the likely reason as to why firms with VC funding manage tone. Collecting successful litigation cases of the sample firms lead to a better understanding of the primary findings. Additional analyses suggest that VC-backed firms are more conservative in their regulatory disclosures to reduce the probability of being litigated successful. Interestingly, firms with VC financing can reduce tone (less optimistic) to mitigate IPO underpricing.

Evidence also show that these firms manage tone when they hire Big 4 auditors, are followed by more equity analysts, operate in litigious and tech industries. However,

tone does not contain information on the future performance of VC-backed firms. Despite being negative in tone, they perform well in the long-run.

Venture capitalists not only work with their portfolio firms in ensuring a successful exit through IPO or acquisitions, they are also known for their skills and expertise in evaluating projects of which lead to the maximisation of innovation efforts of VC-backed firms (Celikyurt et al. 2014). Apart from VCs, existing literature considers other elements which may also influence a firm's innovation vision and outcomes. One of factors is the characteristics of firms' CEOs or directors.

Hence, in the last essay of this thesis (Chapter 4), I examine the impact of the presence of innovative directors on innovation activities. Applying a name-algorithm to locate directors who are in-house patent holders, finding illustrates that the presence of these innovative directors has a positive influence on the number of successful patent applications on top of the number of future citations receive of granted patents. The intuition for adopting this measure is that, these directors possess the highest level of technology expertise required by the firms and their in-house knowledge allows them to allocate resource efficiently. In addition, they are not subject to any anti-trust issues which may hinder and prevent them from providing certain information while advising firms. Findings are robust to various measures of firms' innovativeness and specifications.

I also consider the possibility that the characteristics of firms with innovative directors may be driving the baseline results. Therefore, a propensity score matching method justifies that observable firm characteristics are not the basis for the finding of a positive impact of in-house patent directors and innovative outputs. Sub-sample

analyses give support to the notion that these directors are good advisers of firms in the sense that a stricter regulatory environment (through the enactment of SOX) or a larger demand in technology skills and expertise arising from high tech firms do not deter their function as firm advisers. Evidence demonstrates that the presence of innovative directors is positively associated with enhanced corporate innovation activities.

In sum, this chapter gives an overview of the three essays in this thesis. The subsequent three chapters have the following structure. Chapter 2 presents the first essay and is titled "Executive & Non-executive Female Directors and Governance at Equity Offerings", Chapter 3 shows the development of the second essay titled "Do VC-backed IPOs Manage Tone?", and finally, Chapter 4 documents the last essay which examines "Innovative Directors and Innovation". Conclusion is detailed in Chapter 5.

Chapter 2

Executive & Non-executive Female Directors and Governance at Equity Offerings

2.1 Introduction

A Wall Street Journal article by Demos and MacMillan (2014) states that " ... women CEOs are more prevalent before and after an IPO than around the time of an IPO ... Among companies in the S&P 500 index, 24, or almost 5.0%, are led by women, according to S&P Capital IQ". This article prompts two fundamental questions: 1) Does gender mix play a role in influencing the magnitude of underpricing, and why? 2) Are there differences between the factors which affect underpricing of IPO and SEO equity issues?

Previous research has examined the relationship between characteristics of the top management team or board members and the short- and long-term performance of IPOs, but there is little direct evidence of whether the attributes of both executive and

non-executive directors affect the underpricing anomaly[1]. This study uses a unique set of hand-collected data, comprising 649 firms that issued an IPO between 1997 and 2011, and re-entered the equity market for a seasoned issue between 1997 and 2013[2]. I investigate the relation between the proportion of female executive and non-executive directors (E&NE) listed in the firm's offering prospectuses and underpricing, measured by the difference between the offer price and the closing price of the first day of trading. Using over 16,000 director-firm-offering observations, I find that having a higher proportion of female E&NE members is associated with a higher degree of IPO underpricing.

I track the sample firms from IPO to SEO to see whether the influence of the characteristics of E&NE members on underpricing lessens as firms become more established in the market. I find that the attributes of E&NE directors do not have a statistically significant impact on underpricing at SEO, consistent with the view that the degree of information asymmetry lessens between the IPO and SEO issues, and that underpricing is at least in part due to such asymmetries.

I conduct a series of robustness tests: I control for investors' sentiments and replace the characteristics of the executive and non-executive directors at IPO and SEO with those as at the pre-offering stages. In addition, to address the issue of endogeneity that arises due to reverse causality, whereby female directors may self-select themselves into firms with higher levels of underpricing, for example, I use an instrumental variable approach. Finding plausible instruments is often challenging. I use as instrument

[1]One of the exceptions is Chemmanur et al. (2010), who studied top management characteristics of IPO and SEO issuance separately. In this paper, I look at top management (executive) and non-executives members

[2]The average time taken to issue a follow-on is approximately two years from the initial offering

an index which measures the level of friendliness across states (Di Noia 2002) to instrument for the percentange of women directors. They are correlated with the percentage of women directors, but do not directly affect the degree of underpricing. Therefore the "exclusion restriction" which omits these variables from the equation for underpricing would appear to be legitimate. The baseline results of a positive and significant between the proportion of female E&NE directors and underpricing obtained from OLS estimation of the model is unchanged but due to the weak significance from the second stage regression, an alternative approach is used to examine the relation between female E&NE presence and underpricing.

I proceed to examine two plausible reasons behind the positive relation between the ratio of female E&NE directors and underpricing; corporate governance mechanisms and offer price adjustment theory. First, I consider an event of which alters the corporate governance climate, the enactment of the Sarbanes-Oxley Act (SOX), and partition the sample into two periods; before and after year 2002, as the Act was signed into law on 30^{th} July 2002. One might expect the governance of firms to improve following the implementation of SOX. Since the percentage of female E&NE directors may not capture the real effect on underpricing, I classify firms based on the number of women present in the E&NE team. Following the notion presented by Torchia et al. (2011) that a critical mass is necessary to effect a change in a team, I group firms into all-male directors (zero female), few tokens firm (one or two female members), critical mass (at least three) and observe if underpricing lessens through an incremental increase in the presence of female E&NE representation.

The sub-sample analyses suggest that investors associate firms with at least three female directors with good corporate governance before the introduction of SOX. In particular, I find that these firms disclose more information in the offering prospectuses which mitigates the impact of female E&NE representation on underpricing. I also present evidence that the baseline result is primarily driven by periods before SOX, as the effect of female directors on IPO discounts virtually disappears after the SOX era. The results not only illustrate that the increase in the presence of women E&NE directors appears to be related to their function as monitors of the firms (Adams and Ferreira 2009) but also linked to their ability in approaching governance issues and in practicing accountability of the firm to stakeholders (Brown et al. 2002).

Next, the evidence suggests that underpricing is not due to women exhibiting a greater degree of risk-averse behaviour. It appears that the ex-ante price risk of the offer has no statistical relation with either the ratio of female E&NE directors or the number of female directors present in the firm.

This paper makes two main contributions. First, I add to the literature on underpricing and diversity by looking at the effect of female executive and non-executive directors on underpricing, and how they vary between equity issues. The prior literature mainly looks at membership of the corporate board, or the top executives listed in BoardEx/ExecuComp. I extend the literature by using a novel set of hand-collected data from offering prospectuses, and show that the composition of both the executive and non-executive members influence underpricing differently at IPO and SEO.

Second, I contribute to the strand of literature involving the impact of the enactment of the Sarbanes-Oxley Act. Previous studies have documented the effect of SOX on firms'

abnormal returns (Chhaochharaia and Grinstein 2007), IPO underpricing (Johnston and Madura 2009) and frequency of ethics-related words in offering prospectuses (Loughran et al. 2009). This essay not only looks at the effect of SOX on governance and underpricing, but also examines the influence of the role of women E&NE members before and after SOX. More closely related to my work are papers of Dalton and Dalton (2010) and Valenti (2008), who document an increase in the proportion of female directors as a consequence of the introduction of SOX. However, previous research has yet to look at the potential effect of the increase. From my understanding, this is the first study to explore the differences between the influence of female E&NE directors on underpricing before and after SOX. I add to the literature by citing evidence that corporate governance of firms with consistent minority (i.e. three and more female directors) improves after the implementation of SOX, leading to lower levels of IPO discounts.

The chapter is organised as follows. Section 2.2 provides an overview of the relevant literature and Section 2.3 describes the data and the data collection process, while Section 2.4 presents the main model and the empirical results and Section 2.5 discusses additional tests performed. Section 2.6 concludes.

2.2 Background

2.2.1 Equity Offers, Board Diversity and Underpricing

Underpricing is a market anomaly often measured by the difference between the first-trading day closing price of an equity offering and the offer price. Researchers attribute

the underpricing phenomenon to a wide range of factors such as economic conditions, investors' sentiments, reputation of underwriters, board structures and characteristics. Several work relates underpricing to information asymmetry (Howton et al. 2001; Rock 1986) while others argue that this puzzle is a form of indirect cost paid to the underwriter (Gao and Ritter 2010; Loughran and Ritter 2002). Underpricing can also be viewed as a form of compensation to the investors for generating information about the issuing firm (Chemmanur 1993).

Going public is a risky decision in which the success of the IPO is not guaranteed. Since female directors are often thought to be risk-averse in a corporate setting (Charness and Gneezy 2012; Fellner and Maciejovsky 2007; Huang and Kisgen 2013), underwriters may regard their presence on the board as a sign that the board has a relatively low level of risk. With the perception that firms with female directors' representation are risk-averse and exhibit lower levels of risk, firms and underwriters may low-ball the offer price to guard themselves against the possibility that the offer is being under-subscribed. If this assumption is correct, in this study, I will observe a positive relation between the proportion of female executive and non-executive (E&NE) directors and underpricing. Alternatively, the presence of female E&NE directors could have no impact on risk (Adams and Funk 2011; Sila et al. 2016), and therefore, no relation to underpricing.

Although having a female presence on the board may improve firm reputation and strategic direction (Bilimoria 2000), women are often at a disadvantage as CEO contenders (Dalton and Dalton 2010). Furthermore, it is unlikely for a firm to introduce another woman into the board when there is an existing female board member, although

the likelihood of replacing a departing female member with another is high (Farrell and Hersch 2005). Evidence suggests female directors are more prevalent on boards of companies that are big, well established, and have a higher degree of product diversification (Hillman et al. 2007).

Focusing on IPO firms, a study consisting of 534 U.S. firms that conducted IPOs in 1993 finds female presence in boardrooms impacts firm performance positively (Welbourne et al. 2007). Notably, firms with female board representation appear to produce better short- and long- run performance. The authors use Tobin's Q as a proxy for short-term performance and 1996's stock price growth as well as earnings per share as benchmarks for long-term performance. Results also indicate that women in the top management team are not concentrated in any specific industry while other studies find more females in women-centric industries such as consumer or financial firms (Adams and Ferreira 2009; Brammer et al. 2009; Grosvold et al. 2007; Joecks et al. 2012). In another study with 797 Fortune 1000 firms in 1997, it is shown that the fraction of women or minorities on board has a positive impact on firms' value, measured by Tobin's Q (Carter et al. 2003). Interestingly, an empirical analysis with fixed effects of S&P 500 firms from 1998 to 2002 reveals that gender or ethnic diversity of board members does not seem to impact firm performance (Carter et al. 2010).

A study by Bigelow et al. (2014) finds that female board representation is perceived as being unfavourable to the firm. Using an experimental study to evaluate investment choices in the U.S., 200 MBA students are given non-factual IPO prospectuses, on which they base their equity purchases. The study shows that investors perceive female CEOs to be less capable than their male counterparts, even though the proportion of

women on the board does not affect the attractiveness of an investment. Moreover, investors are willing to invest approximately four times more in a male-led IPO as compared to a female-led IPO. In addition, the anticipated share price of IPOs with male CEOs was about 11% higher than those of female-led IPOs.

Varied results are observed between gender diversity and firm performance. An empirical study reveals that CEOs' gender stereotypes are non-existent in IPOs between 1990 and 2001 (Mohan and Chen 2004). The authors contend that these IPOs are not underpriced based on the gender of the CEO and argue that underwriters do not use gender as a criterion for assessing the quality of the firm. However, this study uses a relatively short sample period. Similarly, it has been demonstrated that, for IPOs that went public in 1993, female-led offers do not suffer from short- or long- run underperformance relative to male-led offers (Welbourne et al. 2007).

Further, the ratios of male and female directors in Australian firms between 1994 and 1997 show no significant change from pre-IPO to IPO (Dimovski and Brooks 2006). For the following five to eight years after an IPO, the gender composition of the board remains stable. An interpretation is that the capital market is generally satisfied with the proportion of women present in firms during and after an IPO. A potential drawback of using the ratio is that the figure may not capture the real change in the number of female directors (i.e. there may be addition to the board but the ratio remains constant). My study differs from this strand of literature as I examine the effect of the proportion as well as the number of female executive and non-executive directors of IPO firms from 1997 to 2011.

Signalling models assume that firms can signal their quality to market participants in various ways. Ibbotson (1975) postulates that IPOs are underpriced to "leave a good taste in the investors' mouth" so that future underwritings from the same issuer could be sold at more lucrative prices. Information asymmetry arises when some market participants possess information that is superior to other market players. As access to information improves when a firm moves toward an SEO after entering the public market, investors are able to obtain more information required to reduce information asymmetry. Therefore, I argue that SEO discounts will be smaller than IPO discounts.

Managers in public firms have to answer to more stakeholders, become more capable in delivering performance and creating better bottom lines and these firms are exposed to tighter regulations. Since firms in the SEO market are more established, they are considered to have better corporate governance than they did in periods surrounding their IPO phase. Unlike an IPO, investors will have access to information such as stock prices, accounting ratios, analysts' reports and forecasts, on top of directors' biographies. With this financial knowledge, investors will shift their focus away from using directors' data in making investment decisions. Therefore, I posit that firms undergo less underpricing around the SEO than the IPO and that executive and non-executive members' characteristics do not influence underpricing at SEO.

2.2.2 Corporate Governance and Female Directors

The Sarbanes-Oxley Act (SOX) was signed into law on 30th July 2002. The enactment of SOX is an important event which shifted the dynamic of the regulatory climate in the U.S. and affects the corporate governance of firms operating in the country.

Firms are mandated to appoint independent members to their audit committees[3] and at least one member of this committee should be an expert in financial management or accounting.

Several papers have documented unintended outcomes following the passage of SOX. Other than the expected increase in the ratio of financial experts on the audit committee (Valenti 2008), there is evidence of an increase in the percentage of independent directors (Dalton and Dalton 2010), female directors (Dalton and Dalton 2010; Valenti 2008) and directors who are lawyers/consultants (Linck et al. 2009) during post-SOX years. However, the existing literature has not examined the impact of the increase in the number of female directors on ex ante risk and underpricing, as well as the effect (if any) before and after SOX.

Having female representation on board is often thought to result in firms being better governed. Firms with female directors have a higher level of accountability toward shareholders (Brown et al. 2002), as well as a higher probability in approaching governance-related issues of the firm (Brown et al. 2002). In addition, female board members are active monitors of the board (Adams and Ferreira 2009) and are associated with improved governance through contribution of independent views to the board (Fondas 2000). For an extensive review of the characteristics of women directors on boards, see Terjesen et al. (2009).

This suggests analysing the impact of SOX on underpricing: whether the magnitude of underpricing differs before and after the introduction of SOX. Specifically, does the role of female executive and non-executive directors (E&NE) changes after SOX?

[3]The audit committee must have at least three members.

Female directors are traditionally regarded as contributors to good governance of the firms. Does this remains true after SOX, or does the influence of female E&NE directors on the degree of underpricing changes?

2.3 Data and Descriptive Statistics

I use the Security Data Corporation (SDC) U.S. New Issues to identify IPO firms from 1997 to 2011, and track them till 2013[4] in order to compile a list of firms which have also issued a primary seasoned offering. Only common share offers listed on NYSE, AMEX or NASDAQ are considered. My dataset excludes IPOs with an offer price of less than $5, firms with SIC codes 4900-4949 (utilities and bills), 6000-6999 (financial firms and REITS), ADRs, warrants, rights, carve-outs, spinoffs, unit issues, private placements, and foreign issues. There is no price restriction for primary SEOs. The final sample includes 649 firms, having eliminated firms with unavailable share price data in Center for Research on Security Prices (CRSP) and financial data in Compustat.

In order to construct the sample of executive and non-executive (E&NE) members who are named in the prospectuses, the hand-collection of data is required. Although BoardEx/ExecuComp offers extensive data of the top members who receive the highest compensation in a firm, it is difficult to determine the other members who are present at the time of IPO and SEO. Because investors may evaluate an offer using prospectuses of which contain the biographies of E&NE members, I proceed to hand-collect this

[4]Firms usually issue SEOs within 1 year (Spiess and Pettway 1997) to 3 years after an IPO (Jegadeesh et al. 1993). I take an average of the two.

data. That is, details of the gender of the executive and non-executive directors, their educational background and age - from the Security Exchange Commission's online filing system, EDGAR - for the two events of interest; IPO and SEO.

The final prospectus or Form-424 provides information such as the location, nature, history, historical financial statements, future business strategies, potential risks, use of proceeds from the offering, and the management team of the firm. Under the management section of these filings, biographical details of firms' executive and non-executive directors, including, name, age, position, experience for the past five years and educational background are reported. I derive the percentages of female members, E&NE members who are highly educated (Ph.D. or equivalent), MBA holders, receive Certified Public Accountant (CPA) certification and/or Juris Doctor (JD) degree, non-executive directors, average age of the members, and size of the team by collapsing director-level data to firm-level data.

For the primary SEO issuance, the final prospectus allows me to construct similar variables. Large seasoned issuers with market capitalisation of more than US$700 million do not have to comply with the filing requirements unlike other issuers and therefore, details of E&NE members of these firms cannot be located in their final prospectuses. Instead, the latest annual report (10-K) or proxy statement (Def 14A) from the SEO issue date is retrieved from EDGAR. Form 8-Ks are filed when corporate events occur, for instance, alterations in financial statements, changes in executive officers and directors. Accordingly, I scrutinise Item 5.02 (corresponds to a change in executive officers and directors) in Form 8-Ks from the annual/proxy statement date to the SEO date. If a firm conducts an SEO soon after an IPO where no applicable filing

is available, the firm's IPO board composition will be used instead. With this two-step data collection approach, I am able to accurately determine the compositions of E&NE members at each offering. My dataset consists of 16,460 director-event observations, aggregated to 1,298 firm-event data points for 649 firms over two events.

Table 2.1 reports the differences between E&NE members and firm characteristics of IPOs and SEOs in the sample. The magnitude of underpricing for SEOs is substantially smaller than that of IPOs and the differences in means and medians are statistically significant at the 1% level. The mean level of IPO underpricing is 22.9% as compared to that of SEO at 2.9%. The results lend support to Koop and Li (2001), Corwin (2003) and Chemmanur et al. (2010). These findings are also in line with the notion documented in Chemmanur et al. (2010) that information asymmetry between firms' insiders and outsiders is lessened after the issuance of IPOs as more information is publicly available to market participants. Besides, firm size and offer size grew as firms become more established in the capital market.

At IPO, E&NE members who received high education and are MBA holders comprise 18.6% and 30.4% of the E&NE team respectively. The ratio of highly educated members remains relatively constant at approximately 19% at SEO. In addition, the average size of the team of executive and non-executive directors across the two offerings is around 12, similar to the board size of the firms in Fortune 1000 (Carter et al. 2003; Farrell and Hersch 2005). I observe a 1.8% rise in the percentage of CPA and/or JD holders. As firms become established, they are increasingly regulated which may require a more capable management to deal with multiple stakeholders as well as to better manage projects while maximising firm value.

The main variable of interest, the percentage of women directors (%*Women*), increases from 6.9% around the offer to 7.2% at primary SEO. However the difference is not statistically significant. I proceed with a multivariate setting to examine the relation between female E&NE representation and underpricing. The previous literature suggests that female directors tend to be found in firms in final consumer related industries. In this study, they are prevalent in the tech and healthcare industries[5]. On average, it appears that women who are in these two industries are more educated as compared to their peers in other industries, with 23% of women who received high education in the tech and healthcare sectors as compared to 15.9% for the other industries.

In Table 2.2, I present the summary of firms listed on the stock exchanges, segregated by industry. Close to 80% or 518 of the firms are listed on NASDAQ, which could be driven by firms in the technology sectors as they contribute to 35% of the population in the sample. The healthcare industry constitutes the second largest sector. Following Loughran and Ritter (2004), firms are categorised based on the Fama-French 10 Industry Classification, with SIC codes 3841 and 3845 (both correspond to the medical instruments sector) moved from the technology sector to the healthcare industry. During the sample period, four firms switch the exchange on which they are being traded and five firms changed their industry classification codes.

[5]At IPO, there are 582 women E&NE members. 189 belong to tech firms, 141 in the healthcare sector and 72 working for the service sector. At SEO, the figures are 619, 191, 149 and 80 respectively. Out of all the female E&NE members, about 12.5% are CEOs or CFOs. This percentage is 16% for men.

2.4 Methodology and Results

2.4.1 Equity Underpricing and Board Diversity

The main specification employed for this study is given by Equation 2.1, where $Underpricing_{i,t}$ is the dependent variable and is the market-adjusted (S&P 500) underpricing for each firm i at the respective equity offering date t. I use Ordinary Least Squares as the estimation method, and calculate White heteroskedastic-consistent standard errors (White 1980) to control for the possible presence of heteroskedasticity. In addition to the main variable of interest, $\%\,Women$, the proportion of female E&NE members, I also include the proportions of members who received high education, MBA and CPA and/or Juris Doctor degree holders to control for the attributes of E&NE directors on underpricing.

$$\begin{aligned} Underpricing_{i,t} = \alpha_0 &+ \beta_1 Women_{i,t} + \beta_2 HighEducation_{i,t} + \beta_3 MBA\ holders_{i,t} \\ &+ \beta_4 CPA\&/JD_{i,t} + \beta_5 Non-executive_{i,t} + \beta_6 Controls_{i,t} \\ &+ Industry\ \&\ Time\ Fixed\ Effects + \epsilon_{i,t} \end{aligned} \tag{2.1}$$

I also control for other E&NE directors and firm characteristics such as the percentage of non-executive directors, size of the team of E&NE directors, average age of E&NE members, firm size and age of the firm at the offering. I also include IPO- and SEO- specific variables to account for any confounding effects that could influence underpricing. For instance, venture-capital backed IPO dummy, offer size, greenshoe option dummy, offering technique dummy, underwriters' reputation, presence of Big 4 auditors and investors' sentiments are used in the IPO model. As investors' sentiments

could influence underpricing in the way that offers with higher sentiments are more underpriced, I add the *IV Sentiments* variable in the regressions. Appendix A shows the definition and construction of all variables used in this paper.

Table 2.3 reports the baseline results from estimating Equation 2.1. In Column 1, when no fixed effect specification is used, the coefficient of the variable of interest, %*Women*, is positive and statistically significant at the 10% level. Results are strengthened when industry fixed effects based on two-digit SIC codes are added in Column 2 to control for unobserved heterogeneity within industry that is time-invariant. The addition of yearly fixed effects in the model (Column 3) account for equity offering market fluctuations during "hot" and "cold" periods. A positive association between the proportion of female E&NE directors and underpricing remains when both fixed effects are considered in Table 2.3, Column 4. Using fixed effects model addresses the issue of omitted variable bias.

The higher is the sentiments, measured by the proportion of fulfilled over-allotment option, the larger is the demand for the offer. This effect is positive and statistically significant at the 1% level. I lend support to Beatty and Ritter (1986) and Chemmanur (1993) that IPOs with higher demands are linked with larger IPO discounts. Results are consistent when I adjust underpricing using other market indices, such as Russell 3000, NYSE and NASDAQ.

Next, I focus on the relation between E&NE members' gender and underpricing at the SEO level. Similar to the IPO, I re-estimate Equation 2.1 where the dependent variable, the main independent variable is the proportion of female E&NE directors, %*Women* and the various characteristics of the directors remain unchanged. In

addition to the IPO regression control variables - *E&NE Team Size*, *Directors Age*, *Firm Size*, *Firm Age*, *Offer Size*, *IB Reputation*, *IV Sentiments* - I include variables in the SEO literature that are SEO-specific, namely, *Years to SEO*, *IPO Underpriced Dummy*, cumulative abnormal return five days prior to the offer (*CAR(-5,-1)*), *Price Cluster Dummy*, *NASDAQ dummy*, return on assets (*ROA*), *Book-to-market Ratio* and earnings-to-price ratio (*E/P Ratio*) (see Corwin 2003; Jegadeesh et al. 1993).

I report the findings of the SEO regression[6] in Table 2.4. The results in Columns 1 to 4 show no evidence that the percentage of female E&NE members has a positive influence on SEO underpricing as the coefficient of the *% Women* variable is positive but not statistically significant. Other educational independent variables are also not indicative of any relation with underpricing.

The nature of this dataset - that I have information on the same firms through both IPO and SEO - allows me to consider whether IPO underpricing has any predictive power for SEO underpricing. The dummy variable, *IPO Underpricing*, has positive but not statistically significant coefficients (Table 2.4, All Columns). Therefore, it seems that IPO underpricing does not predict SEO underpricing outcomes. The larger the cumulative abnormal returns (*CAR(-5,-1)*) of primary SEOs, the higher the underpricing and this effect is significant at the 10% level. High CARs are associated with firms that experienced price run-ups and are considered riskier than their peers. The findings lend support to Beatty and Ritter (1986), who find a positive link between

[6]I check the robustness of the results by using the characteristics of executive and non-executive directors extracted from the initial registration filings (pre-IPO) and annual/proxy statements a year prior to the primary seasoned offering (pre-SEO). If no annual/proxy statements are available in between the issuance of IPO and SEO, I use the characteristics of E&NE members at IPO instead. Results remain qualitatively similar. Appendix B and C record the results.

risky offers and underpricing, attributable to the higher level of uncertainty these offers face.

The results support the idea that information asymmetry declines as firms enter the public market. This is consistent with studies by Koop and Li (2001), Corwin (2003) and Chemmanur et al. (2010), which suggest a reduction of information asymmetry in the SEO market. The findings illustrate that market participants do not consider management characteristics while making investment decisions at SEO, notwithstanding the apparent importance of these factors to IPO investors.

In line with my expectation, the baseline result demonstrates that the proportion of female members has a positive association with underpricing. One possible explanation is that female presence is linked to lower levels of risks at the IPO, and in turn, result in a lower offer price set at IPO. In Section 2.5, I assess the evidence for whether women directors in this setting exhibit risk-averse behaviour or if an alternative explanation that associate the number of female E&NE members with better governance exists.

2.4.2 Reverse Causality

Many studies have allowed for an endogenous relationship between board characteristics and firm performance (Carter et al. 2003; Hermalin and Weisbach 1991; Huang and Kisgen 2013). I acknowledge reverse causality between E&NE membership and firm performance, in the sense that a member may self-select himself/herself into a specific firm and vice versa. To establish a causal relationship from members characteristics to offering discounts, I use an instrumental variable approach. I propose that female representation increases as a state becomes friendlier and more prosperous and may

move toward gender equality. I adopt the gender equality index developed by Di Noia (2002) which measures the economic growth associated with the gender equality index[7].

The approach requires that the instrument, say, the friendliness of the state, influences underpricing only through the effect it has on the percentage of women on the E&NE team, $\%\,Women$. That there is not a direct effect on "state friendliness" on underpricing does not seem an unreasonable exclusion restriction. I estimate the following Two-Stage Least Squares Instrumental Variable (2SLS-IV) model:

First Stage:

$$\%Women = \varphi + \gamma Friendliness\ of\ State_i + \theta \mathbf{X}_{i,t} + \eta_{i,t} \tag{2.2}$$

Second Stage:

$$Underpricing_{i,t} = \alpha + \beta Instrumented\ Female_i + \theta \mathbf{X}_{i,t} + \epsilon_{i,t} \tag{2.3}$$

Friendliness of the State$_{\text{i}}$ is the state-level gender equality index; *Instrumented Female*$_{\text{i}}$ is the fitted value from the first-stage regression; and $\mathbf{X}_{\text{i,t}}$ is the set of variables indicating the various education categories as well as control variables used in Equation 2.1.

The IV estimates are reported in Table 2.5. From the first-stage regression, the coefficient of the instrument is positive and significant at the 1% level, suggesting that a friendlier state is positively related to the proportion of women in the E&NE team. After introducing the fitted value from the first-stage regression into the second stage,

[7]The concept of the proposed instrument is adopted from Huang and Kisgen (2013).

the coefficient of the *Instrumented Female* variable in Table 2.5, Column 2, is positive but is only significant at the 10% level, suggest that female E&NE representation has a little impact on underpricing. The Stock-Yogo critical value for the instrument is more than the threshold of 10 but care is taken not to rule out the possibility of a weak instrument and thus, a causal effect of proportion of female directors on underpricing cannot be inferred. One plausible explanation is that using the ratio of female E&NE members may not be a good approach in examining the variation in underpricing. The coefficients of the baseline controls are excluded in Table 2.5 for brevity. Next, I move on to explore alternative methods and interpretations to the baseline results.

2.5 Alternative Explanations

2.5.1 Tokenism and Critical Mass

Although results suggest that the higher is the percentage of female directors (i.e. more women directors as a proportion of the team), the larger is the underpricing, it may be challenging to understand the impact of their presence. For instance, Firm i records a 10% in the proportion of female E&NE members whereas Firm j has 12.5%. At the first glance, it appears that Firm j has a higher ratio of female E&NE members. However, a larger percentage does not necessarily reflect a higher number of female directors. Given the following example, say, Firm i has 1 female member and the total number of members is 10 and Firm j has 1 female director but the team size is 8. Thus, when these ratios are put into another perspective, they may not be the best representation to study the impact of the presence of female E&NE directors

on underpricing. Instead, to obtain a more meaningful interpretation of the result, I look at the impact on underpricing of a sequential increase in the number of female directors.

Following the methodology presented by Brown et al. (2002) and Torchia et al. (2011), I delved into the concept of having a few tokens (one and two) of female E&NE members and the critical mass number (at least three). In particular, Torchia et al. (2011) argue that a critical mass is required to "enhances the overall level of firm innovation and board strategic tasks". Therefore, in order to examine the impact of a sequential increase in the number of female E&NE members on underpricing, I construct four dummy variables, *Zero female*, *One female*, *Two females* and *At least three females*. Each respective variable is a binary variable that takes up the value of 1 if zero, one, two or at least three executive and non-executive directors are female(s), and 0 otherwise. Firms with zero female members are similar to having a all-male team and the reference category is firms with at least one female director. Firms having one, two and at least three female directors are compared with firms with all-male members.

Out of my sample of 649 firms, 309 or 47.6% of these firms have all-male teams. 191 or 29.4% have one female director. The figures stand at 87 (62) for firms with two (at least three) females as their executive and non-executive directors. To address the issue of endogeneity due to reverse causality, I argue that, even though a firm may know the exact number of female directors to hire, it is unlikely that they are able to control the level of underpricing (outcome) with their hiring choices. Besides, I acknowledge that female members may self-select themselves to a certain type of firm.

However, it seems improbable to have an X number of women directors choosing to work for a firm that will eventually experience equity underpricing.

I examine if the magnitude of underpricing differs when there are fewer (more) women as E&NE directors. The baseline model is repeated with similar dependent, independent and control variables. The only exception is that, in addition to the main variable of interest, $\%\,Women$, each of the four female dummy variables, which corresponds to having zero, one, two and at least three female E&NE directors is used separately as the variable of interest. Results of the regressions are presented in Table 2.6. In Column 2, a negative and significant (1% level) coefficient of the *Zero female* variable suggests that firms with all-male directors underprice less than firms with at least one female member. One potential explanations is that investment bankers and investors may have the impression that such teams are more capable, and therefore, these offers are priced higher than its worth.

In Columns 2 and 3 of Table 2.6, a positive relation of having few tokens (one and two female members) and underpricing is observed. It could imply that having one female member disrupts the homogeneity of an all-male team and two female E&NE directors may not be adequate to introduce better corporate governance. When the number of female team members of a firm increases to three, of which reaches a consistent minority sufficient to bring about a change (in this case, improved governance) in influencing the majority group (all-male teams) as argued by Torchia et al. (2011), there is no evidence of the impact of their presence on underpricing. Findings suggest the importance of examining the number of female directors as having more female directors appear to alleviate the degree of underpricing. I provide further analyses in

the next section to test the relation between the number of female E&NE members, corporate governance and whether underpricing persists as governance improves.

2.5.2 Sarbanes-Oxley Act (SOX)

In the next two sections, I consider a number of possible explanations for the finding that female E&NE representation contributes to IPO underpricing; corporate governance mechanisms and the initial offer price adjustment theory.

One of the main objectives of the Sarbanes-Oxley Act was to enhance board governance (strengthen corporate governance) to prevent insolvency and the potential for firms to manipulate their accounts. The act brings forth a new regulatory climate in which firms are required to have a majority of independent directors on their boards. SOX can be viewed as an exogenous shock to board composition (Knyazeva et al. 2013): a natural experimental setting to observe the effects of board composition.

First, I present evidence that firms restructure their team of executive and non-executive directors in response to the change in the corporate governance climate. I partition the IPO sample into two periods; pre- and post-SOX[8]. From Table 2.7, the average ratio of women directors before and after SOX remain relatively constant at around 7% and the differences are not statistically significant. As expected, the average percentage of non-executive directors grew from 39.5% to 47.3% and the difference in means is significant at the 1% level. In line with Linck et al. (2009), I also observe meaningful differences, on average, that there are more directors who are MBA holders, professional accountants and lawyers after the enactment of SOX.

[8]In an unreported test, structural differences exist for IPO but not for SEO.

Post-SOX offers are approximately 18.8% less underpriced than those subscriptions before 2002 and the difference is significant at the 1% level. This is consistent with Johnston and Madura (2009), suggesting that IPOs issued post-SOX are better governed and experience lesser uncertainty and risks. With the enactment of SOX, firms are required to increase transparency and information disclosure, resulting in lower levels of information asymmetry, and consequently in lower IPO discounts. Yet, it remains unclear if post-SOX gender diversity of executive and non-executive directors of equity-issuing firms affect underpricing, therefore, my goal is to observe if there is any significant difference between the sub-samples.

I move on to the first possible explanation for observing a positive relation between female E&NE directors and underpricing. In a Canadian board study by Brown et al. (2002), authors exhibit evidence that firms with three or more women on board have a higher likelihood of dealing with firms' governance issues as compared to all-male boards (91% versus 76%). To check the robustness inference of the influence of having a steady increase in the number of women directors on underpricing, I make use of a governance specific event, the implementation of SOX, to see if the effect holds. I dissect the sample into two periods - before and after SOX - and replace the $\%\,Women$ variable with each of the four dummy variables created for having zero, one, two or at least three female E&NE directors and re-run the estimation model for these two periods separately. The dependent variable is underpricing and the set of independent and control variables are similar to the baseline model. Table 2.8, Columns 1 to 5 show the results for periods before the introduction of SOX and Columns 6 to 10 incorporate offers issued after the enactment.

During the pre-SOX era, the coefficient of the %*Women* variable is positive and statistically significant at the 1% level (Table 2.8, Column 1), suggesting that the higher is the proportion of female directors, the larger is the magnitude of underpricing. However, as argued in the previous section, it is crucial to look at the incremental increase in the number of female E&NE directors.

Next, I breakdown the composition of women E&NE members into four categories to test the differences between the influence of having no female director, few tokens and having three or more female directors. In Columns 1 and 6 of Table 2.8, the positive relation between the proportion of female E&NE members and underpricing disappears post-SOX. Not only does the impact diminishes for the %*Women* variable, similar cases are observed for the *Zero female* and *One female* variables. For instance, in Table 2.8, Column 2, the coefficient of the *Zero female* variable is negative and significant at the 1% level, implying that firms having all-male E&NE teams underprice less with respect to firms with at least one female E&NE director and this effect weakens post-SOX. Likewise, firms with one female director (Column 3) are more likely to suffer from underpricing as compared to firms with all-male directors in the sample. The impact is alleviated with the implementation of SOX. I offer the following two interpretations of these findings.

First, it appears that the results from the full sample are driven by periods before the enactment of SOX as none of the coefficients in Table 2.8, Columns 6 to 8 are significant. Therefore, enhancing female E&NE representation before the implementation of SOX is considered to be a good governance mechanism. Second, during pre-SOX years, when more female directors are present in the firms' E&NE team, their presence

seems to mitigate the degree of underpricing. Findings indicate that the teams of executive and non-executive directors with token females are more homogeneous and may steer towards a groupthink situation. Accordingly, this behaviour neither inculcate diversity nor improve governance, possibly leading to underpricing. To support the conjecture that a higher number of female E&NE members could be associated with better corporate governance, I proceed to examine whether their presence relate to improved governance through the intensity of regulatory disclosures.

Following the methodology proposed by Loughran and McDonald (2014), I extract the file size of the initial registration filings on EDGAR and derive the variable, *Log(File Size)* by taking the log of the file size. Firms with more readable filings (bigger file size) allow investors to process and use necessary information to value and generate information on the firms (Loughran and McDonald 2014). I acknowledge that firms may try to camouflage negative information by creating complex and long documents. Similar to Loughran and McDonald, I argue that defining complexity requires analysing the content of the text in greater detail. Often, information disclosure and board diversity are associated with better corporate governance. Therefore, I posit that firms with more female directors are better governed and they produce filings which are easier to read.

Table 2.9 shows the characteristics of *Log(File Size)* between the existence of firms with different numbers of female E&NE directors and the rest of the firms. Across the sample period, firms with at least three and four female directors disclose more as compared to firms with all-male E&NE members and these differences are statistically significant at the 5% and 1% levels respectively (Column 3). However, I do not find

supporting evidence of the differences for the post-SOX years, giving support that SOX is a good governance mechanism. If I conjecture that women are tougher monitors (Adams and Ferreira 2009) and they are more likely to disclose readable filings, then, this diminished effect from pre- to post-SOX is an indication of improved governance. After the post-SOX era, there is no imminent need for such roles as it proves to be an effective mandate to improve corporate governance mechanisms. This suggests that the presence of female E&NE members and SOX are substitute mechanisms for corporate governance.

When I turn the focus to the results during the pre-SOX period, findings in Columns 5 and 6 imply that female presence before the introduction of SOX is the driving force behind the differences between firms with at least three and four female members and firms having all-male directors in the full sample. This findings illustrate that increasing the number of female E&NE members enhances corporate governance as firms with at least three and four females disclose more information as compared to firms with all-male members. Alongside with more readable filings, these firms experience lesser information gap which may alleviate underpricing. This finding strengthens the previous conjecture that a critical mass of the minority (female) group is necessary before an improved in corporate governance is observed (Torchia et al. 2011).

Results also lend support to Brown et al. (2002) who find that firms with three or more women on board ensure the code of conduct for the organisation 86% of the time (versus 66% for all-male firms). In sum, I conclude that having more women as

executive and non-executive directors as well as the enactment of the Sarbanes-Oxley Act help mitigate the magnitude of underpricing.

2.5.3 Risk-Aversion and Price Adjustment Theory

Women are widely known to be less confident and risk-averse than men. I postulate that underwriters may perceive a higher proportion (or more number) of female E&NE directors as a decrease in the firm's willingness to take risk. Often, investors obtain information from the preliminary prospectus, together with other publicly available information to make their investment decisions. As a result, the initial offer price may be set lower for firms with female presence so as to attract investors as well as to safeguard themselves against an under-subscribed IPO.

In the event that the offering is high in demand (i.e. over-subscribed) after the initial pricing stage, it is likely that the underwriter revises the initial offer price upwards (Hanley 1993). Hence, I measure the demand for the offer by calculating the percentage change between the initial offer price and the final offer price (*Price Revision*). The larger is the *Price Revision* variable, the higher is the attractiveness of the IPO to the investors.

If women are indeed risk-averse, their presence as E&NE directors should be associated with firms with higher IPO demand. As such, I am expecting a positive and significant coefficient of the $\%\,Women$ variable when I re-run Equation 2.1, replacing the dependent variable with the *Price Revision* variable. The result from Table 2.10, Column 1 shows a positive and weak relation (10% significance level) between the percentage of women and the degree of price revision.

Since the percentage of female E&NE directors may not be an appropriate measure as it does not reflect the number of female directors in the team, I replace the dependent variable of the baseline model with each of the four dummy variables created that corresponds to having zero, one, two or at least three female E&NE directors. The notion for using the number of female directors is that these female members may not be risk-averse because they have broken the glass ceiling and conformed to the male-dominant corporate culture (Adams and Funk 2011).

The coefficients in Columns 2 to 4 of Table 2.10 are not statistically significant, suggesting that female members cannot explain the variation in the demand (price revision) of IPOs. This result is in line with Adams and Funk (2011) and Sila et al. (2016) that female directors' representation has no impact on firms' risk through the demand for the IPO. To examine whether the regulatory environment affects the impact of female E&NE representation on underpricing, I split the sample into pre- and post-SOX. Findings displayed in Table 2.10, Columns 6 to 15 show little or no evidence that the number of women - whether as tokens or when they constitute to a critical mass - has an effect on firms' risk.

2.6 Summary

I examine the impact of gender diversity of executive and non-executive (E&NE) directors on the underpricing of equity issues. Using hand-collected data on U.S. firms that have participated in both Initial Public Offerings (IPO) and primary Seasoned Equity Offerings (SEO) between 1997 and 2013, I find evidence of a positive relation between the presence of female E&NE members and IPO underpricing, but no influence

of women representation on SEO underpricing. I provide another perspective to look at the effect of female E&NE presence on underpricing by adopting an interesting approach of which compares firms with varying numbers (instead of proportions) of female directors and firms with only male E&NE members. I also show evidence that, before the Sarbanes-Oxley era, IPO underpricing diminishes as a result of an increase in information disclosure of firms with more than two female E&NE directors. Neither the attributes of executive and non-executive directors nor firm characteristics appear to influence SEO underpricing, suggesting that information asymmetry lessens as firms mature from IPO to SEO.

2.7 Tables and Appendices

Table 2.1 IPO and SEO Summary Statistics

This table summarises the characteristics of IPOs and primary SEOs in this paper. The sample consists of 649 IPO issuing firms from 1997 to 2011, which have subsequently re-entered the equity market via an SEO from 1997 to 2013. See Appendix A for the definition of the variables. Results of t-test for the difference in means and z-test (Wilcoxon signed-rank test) for the difference in medians are presented at the last two columns of the table. Values of these two statistics are reported in parentheses. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

		IPOs			SEOs			Test of difference	
	n	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	t-statistics	z-statistics
Underpricing	649	0.229	0.134	0.323	0.029	0.016	0.054	0.200***	0.117***
								(15.55)	(15.10)
%Women	649	0.069	0.056	0.083	0.072	0.067	0.082	-0.004	-0.011
								(-1.64)	(-0.84)
%High Education	649	0.186	0.125	0.188	0.191	0.143	0.178	-0.004	-0.018
								(-1.43)	(-0.86)
%MBA holders	649	0.304	0.300	0.156	0.310	0.304	0.152	-0.006*	-0.004
								(-1.68)	(-1.32)
%CPA &/ JD	649	0.145	0.125	0.117	0.163	0.150	0.121	-0.018***	-0.025***
								(-6.61)	(-5.53)
%Non-executive	649	0.427	0.429	0.129	0.456	0.462	0.121	-0.030***	-0.033***
								(-8.01)	(-6.52)
E&NE Team Size	649	12.54	12.00	3.44	12.82	12.00	3.45	-0.27***	0.00***
								(-2.77)	(-4.45)
Directors Age	649	48.19	48.20	4.44	49.98	50.00	4.75	-1.79***	-1.80***
								(-18.88)	(-17.74)
Firm Size($ mil)	649	329.90	68.20	1090.60	492.67	134.31	1433.30	-162.77***	-66.11***
								(-6.65)	(-18.56)
Offer Size($ mil)	649	107.46	65.10	166.85	143.87	90.11	196.73	-36.41***	-25.01***
								(-5.24)	(-9.07)

Table 2.2 Distribution of Firms by Stock Exchange

This table shows the distribution of sample firms by the stock exchange in which they are listed in. Firms are categorised based on Fama-French 10 Industry Classification, excluding utilities (4900-4949) and financials (6000-6999). Following Loughran and Ritter (2004), SIC codes 3841 and 3845 are moved from the technology industry to the healthcare industry. These two codes correspond to the medical instruments sector.

Industry	Exchange	IPO	SEO
Technology	NYSE/AMEX	16	14
	NASDAQ	227	226
Healthcare	NYSE/AMEX	7	8
	NASDAQ	120	118
Service	NYSE/AMEX	16	16
	NASDAQ	39	39
Oil & Gas	NYSE/AMEX	17	18
	NASDAQ	13	13
Manufacturing	NYSE/AMEX	15	14
	NASDAQ	16	17
Others	NYSE/AMEX	60	61
	NASDAQ	103	105
Total	NYSE/AMEX	131	131
	NASDAQ	518	518

Table 2.3 Characteristics of Executive and Non-executive Members and IPO Underpricing

This table reports the results from the OLS regressions using the IPO specifications, where IPO Underpricing is regressed on a set of independent and control variables defined in Appendix A. The value in parentheses is the associated t-statistic. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	(1)	(2)	(3)	(4)
%Women	0.215*	0.310**	0.255**	0.319**
	(1.88)	(2.29)	(2.23)	(2.36)
%High Education	-0.295***	-0.107	-0.242***	-0.078
	(-4.15)	(-1.15)	(-3.67)	(-0.89)
%MBA holders	-0.148**	-0.146*	-0.068	-0.057
	(-2.15)	(-1.89)	(-1.02)	(-0.75)
%CPA &/or JD	-0.057	-0.103	-0.006	-0.063
	(-0.65)	(-1.10)	(-0.07)	(-0.67)
%Non-executive	-0.091	-0.081	-0.051	-0.040
	(-1.01)	(-0.80)	(-0.56)	(-0.40)
E&NE Team Size	-0.000	0.001	0.001	0.002
	(-0.01)	(0.26)	(0.31)	(0.50)
Directors Age	-0.009***	-0.008**	-0.002	-0.003
	(-3.05)	(-2.54)	(-0.88)	(-0.90)
Firm Size	-0.061***	-0.061***	-0.049***	-0.051***
	(-5.04)	(-4.32)	(-3.90)	(-3.53)
Firm Age	-0.001**	-0.001**	-0.001	-0.001*
	(-2.36)	(-2.17)	(-1.63)	(-1.73)
VC Dummy	0.104***	0.096***	0.076***	0.075**
	(3.51)	(2.83)	(2.71)	(2.34)
Offer Size	0.094***	0.100***	0.079***	0.079***
	(4.61)	(4.38)	(3.88)	(3.50)
Greenshoe Dummy	-0.376	-0.348	-0.387*	-0.372
	(-1.42)	(-1.26)	(-1.72)	(-1.54)
Offer Tech Dummy	-0.081	-0.114	-0.135*	-0.150**
	(-0.99)	(-1.50)	(-1.67)	(-2.01)
IB Reputation	0.028***	0.030**	0.015	0.019
	(2.66)	(2.57)	(1.49)	(1.61)
Big 4 Auditors	0.077***	0.067***	0.064**	0.052*
	(3.32)	(2.65)	(2.56)	(1.95)
IV Sentiments	0.014***	0.014***	0.014***	0.014***
	(9.20)	(8.13)	(8.76)	(8.10)
Constant	0.171	-0.095	-0.049	-0.144
	(0.46)	(-0.23)	(-0.14)	(-0.37)
Year FE	No	No	Yes	Yes
Industry FE	No	Yes	No	Yes
Observations	649	649	649	649
Adjusted-R^2	31.30%	30.70%	40.20%	38.80%

Table 2.4 Characteristics of Executive and Non-executive Members and SEO Underpricing

This table displays the results from the OLS regressions using the SEO specifications, where SEO Underpricing is regressed on a set of independent and control variables defined in Appendix A. The value in parentheses is the associated *t*-statistic. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	(1)	(2)	(3)	(4)
%Women	0.037	0.045	0.033	0.041
	(1.58)	(1.62)	(1.40)	(1.44)
%High Education	-0.000	0.030*	-0.002	0.027
	(-0.01)	(1.74)	(-0.14)	(1.53)
%MBA holders	-0.010	-0.007	-0.018	-0.015
	(-0.69)	(-0.45)	(-1.19)	(-0.89)
%CPA &/or JD	-0.015	-0.031*	-0.013	-0.032*
	(-0.81)	(-1.66)	(-0.74)	(-1.68)
%Non-executive	-0.022	-0.017	-0.039*	-0.035
	(-1.17)	(-0.84)	(-1.85)	(-1.61)
E&NE Team Size	-0.001	-0.001	-0.001	-0.001
	(-1.43)	(-1.50)	(-1.51)	(-1.55)
Directors Age	0.000	0.000	0.000	0.000
	(0.57)	(0.68)	(0.23)	(0.25)
Firm Size	-0.002	-0.001	-0.004	-0.003
	(-0.85)	(-0.18)	(-1.44)	(-0.89)
Firm Age	0.000	0.000	0.000	0.000*
	(0.64)	(1.62)	(0.82)	(1.71)
Offer Size	0.003	0.003	0.004	0.005
	(1.10)	(1.10)	(1.53)	(1.63)
IB Reputation	0.003***	0.002**	0.002	0.001
	(2.93)	(2.09)	(1.50)	(0.83)
IV Sentiments	0.006	0.004	0.005	0.004
	(1.06)	(0.82)	(0.88)	(0.66)
Years to SEO	0.044**	0.043*	0.041*	0.038*
	(2.04)	(1.96)	(1.89)	(1.74)
IPO Underpriced Dummy	-0.010***	-0.010***	-0.010***	-0.009***
	(-4.81)	(-4.48)	(-4.86)	(-4.41)
CAR (-5, -1)	0.002	0.001	0.003	0.001
	(0.49)	(0.14)	(0.56)	(0.15)
Price Cluster Dummy	-0.000	0.004	-0.001	0.004
	(-0.05)	(0.63)	(-0.20)	(0.66)
NASDAQ Dummy	-0.008	-0.009	-0.008	-0.009
	(-1.54)	(-1.61)	(-1.32)	(-1.47)
ROA	-0.002***	-0.002***	-0.002*	-0.002
	(-3.31)	(-3.02)	(-1.78)	(-1.56)
Book-to-market Ratio	-0.004	-0.001	-0.004	-0.002
	(-0.34)	(-0.12)	(-0.32)	(-0.20)
IV Sentiments	0.001**	0.001**	0.001**	0.001**
	(2.15)	(2.03)	(2.17)	(2.08)
Constant	0.079	0.012	0.093	0.017
	(1.32)	(0.19)	(1.50)	(0.27)
Year FE	No	No	Yes	Yes
Industry FE	No	Yes	No	Yes
Observations	649	649	649	649
Adjusted-R^2	9.20%	8.80%	9.30%	8.90%

Table 2.5 Two-Stage Least Squares Instrumental Variable Approach

This table reports results from the two-staged least squares regressions in which the first stage estimates the relationship between the instrumental variable and the percentage of E&NE members who are female. The fitted value obtained from the residuals of the first stage is plugged into the second stage regression as a dependent variable in addition to the set of independent and control variables used in the baseline model. The instrument is a sub-scale of Di Noia's index that measure the economic condition of each state. The value in parentheses is the associated *t*-statistic. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	First stage (1)	Second stage (2)
Instrumented Female		1.940*
		(1.74)
Friendliness/Growth of State	0.161***	
	(3.26)	
Baseline Controls	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	649	649
Stock-Yogo Critical Value (10%)	16.38	
Adjusted-R^2	13.63%	23.81%

Table 2.6 Tokenism, Critical Mass and Underpricing

This table records the results of the relation between the frequency of female presence and underpricing. *Zero female*, *One female*, *Two females* and *At least three females* variables are dummy variables which have the value of 1 if there are zero, one, two or at least three women E&NE members present in the firms respectively, and 0 otherwise. Firms that have at least one female director are in the reference category for the zero female dummy variable and firms with all-male members are in the reference category for one, two and at least three females members. The set of independent and control variables used are similar to the baseline model and are excluded for brevity. The value in parentheses is the associated *t*-statistic. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Underpricing				
	(1)	(2)	(3)	(4)	(5)
%Women	0.319**				
	(2.36)				
Zero female		-0.075***			
		(-2.96)			
One female			0.078**		
			(2.56)		
Two females				0.081*	
				(1.95)	
At least three females					0.053
					(1.20)
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Observations	649	649	500	396	371
Adjusted-R^2	38.82%	39.37%	34.68%	36.58%	32.64%

Table 2.7 Sub-sample Summary Statistics

This table summarizes the characteristics of pre- and post-SOX IPOs. Offers that are issued prior to 2003 are in the first time period, denoted by Pre-SOX and offers made after 2002 are in the second time period, Post-SOX. The sample consists of 649 IPO issuing firms from 1997 to 2011, and have subsequently re-enter the equity market via an SEO from 1997 to 2013. See Appendix A for the definition of the variables. Results of t-test for the difference in means (unmatched) and z-test (Wilcoxon rank-sum test) for the difference in medians are presented at the last two columns of the table. Value of these two statistics are reported in parentheses. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Pre-SOX				Post-SOX				Test of Difference	
	n	Mean	Median	Std. Dev.	n	Mean	Median	Std. Dev.	t-statistics	z-statistics
Underpricing	388	0.305	0.189	0.382	261	0.117	0.089	0.149	0.188***	0.072***
									(7.58)	(5.87)
%Women	388	0.070	0.056	0.084	261	0.067	0.059	0.081	0.003	-0.011
									(0.42)	(0.34)
%High Education	388	0.175	0.125	0.185	261	0.204	0.143	0.191	-0.029*	-0.079**
									(-1.95)	(-2.12)
%MBA holders	388	0.286	0.279	0.156	261	0.331	0.333	0.153	-0.045***	-0.052***
									(-3.62)	(-3.82)
%CPA &/or JD	388	0.133	0.108	0.114	261	0.163	0.143	0.119	-0.030***	-0.055***
									(-3.22)	(-3.66)
%Non-executive	388	0.395	0.400	0.127	261	0.473	0.471	0.118	-0.078***	-0.073***
									(-7.93)	(-7.79)
E&NE Team Size	388	12.23	12.00	3.45	261	13.01	13.00	3.37	-0.78***	-1.01***
									(-2.86)	(-3.08)
Directors Age	388	46.78	46.59	4.50	261	50.29	50.13	3.41	-3.51***	-3.70***
									(-10.70)	(-10.26)
Firm Size($mil)	388	213.86	41.10	731.41	261	502.41	108.40	1455.39	-288.54***	-461.31***
									(-3.33)	(-8.05)
Offer Size($mil)	388	79.33	49.58	155.28	261	149.27	88.94	174.81	-69.94***	-99.70***
									(-5.35)	(-9.76)

Table 2.8 IPO Sub-Sample Analyses

This table presents the results of the IPO sub-sample analysis. Offers that are issued prior to 2003 are in the first time period, denoted by Pre-SOX and offers made after 2002 are in the second time period, Post-SOX. The variables of interest are the *%Women* and four dummy variables, *Zero female*, *One female*, *Two females* and *At least three females* have the value of 1 if there are zero, one, two or at least three women E&NE members present in the firms respectively, and 0 otherwise. Firms that have at least one female director are in the reference category for the zero female dummy variable and firms with all-male members are in the reference category for one, two and at least three females members. The set of independent and control variables used are similar to the baseline model and are excluded for brevity. T-statistics are in parentheses. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

Underpricing	Pre-SOX					Post-SOX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
%Women	0.430**					0.072				
	(2.03)					(0.61)				
Zero female		-0.124***					0.012			
		(-3.01)					(0.65)			
One female			0.141***					-0.022		
			(2.90)					(-1.07)		
Two females				0.115					-0.004	
				(1.64)					(-0.14)	
At least three females					0.007					0.007
					(0.17)					(0.17)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	388	388	302	236	153	261	261	198	160	153
Adjusted-R^2	37.53%	38.94%	33.81%	34.87%	26.74%	31.51%	31.51%	37.50%	33.14%	26.74%

Table 2.9 Number of Female E&NE Directors and Intensity of Disclosure

This table reports the differences in the magnitude of regulatory disclosure at varying numbers of female executive and non-executive members of the firm. Log(File Size) is the measurement of disclosure intensity, calculated by the log value of the file size of the firm's initial registration filing document on EDGAR (Loughran and McDonald 2014). There are 261 offers made after year 2002 (Sarbanes-Oxley Act enacted on 30th July 2002) and 388 offers that are issued prior to the enactment. Results of *t*-test for the difference in means for the difference in means are presented in Columns 2, 4 and 6 and the associated *t*-statistics are in brackets. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

Log(File Size)	All Periods			Pre-SOX			Post-SOX		
	Obs	Mean	*t-test*	Obs	Mean	*t-test*	Obs	Mean	*t-test*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All-male	309	13.996	-0.040	184	13.814	-0.023	125	14.263	-0.072
Others	340	14.036	(-0.86)	204	13.837	(-0.38)	136	14.335	(1.21)
One female	191	14.005	0.009	118	13.806	-0.008	73	14.327	0.064
All-male	309	13.996	(0.17)	184	13.814	(-0.11)	125	14.263	(0.87)
Two females	87	13.993	-0.002	52	13.788	-0.026	35	14.299	0.036
All-male	309	13.996	(-0.03)	184	13.814	(-0.28)	125	14.263	(0.37)
At least three females	62	14.192	0.196**	34	14.020	0.206*	28	14.400	0.137
All-male	309	13.996	(2.35)	184	13.814	(1.85)	125	14.263	(1.31)
At least four females	21	14.451	0.455***	12	14.476	0.661***	9	14.417	0.154
All-male	309	13.996	(3.36)	184	13.814	(3.75)	125	14.263	(-0.87)

Table 2.10 Price Revision and Female E&NE Directors

This table presents the results of the IPO sub-sample analysis. Offers that are issued prior to 2003 are in the first time period, denoted by Pre-SOX and offers made after 2002 are in the second time period, Post-SOX. The variables of interest are the *%Women* and four dummy variables, *Zero female*, *One female*, *Two females* and *At least three females* have the value of 1 if there are zero, one, two or at least three women E&NE members present in the firms respectively, and 0 otherwise. Firms that have at least one female director are in the reference category for the zero female dummy variable and firms with all-male members are in the reference category for one, two and at least three females members. I replace the dependent variable of the baseline model with the Price Revision variable, measured by the percentage change of the difference between the latest amendment mid-price and final offer price. The set of independent and control variables used are similar to the baseline model and are excluded for brevity. *T*-statistics are in parentheses and significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	All					Pre-SOX					Post-SOX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
%Women	0.109*					0.078					0.104				
	(1.70)					(0.98)					(0.76)				
Zero female		-0.008					-0.023					0.019			
		(-0.79)					(-1.59)					(1.03)			
One female			0.005					0.027*					-0.033		
			(0.41)					(1.72)					(-1.58)		
Two females				-0.003					0.021					-0.046	
				(-0.19)					(0.94)					(-1.32)	
At least three females					0.024					0.016					0.007
					(1.12)					(0.53)					(0.18)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	649	500	396	371	388	388	302	236	218	261	261	198	160	153
Adjusted-R^2	26.41%	26.09%	26.77%	14.35%	15.89%	23.26%	23.65%	25.23%	13.47%	15.66%	26.88%	26.99%	31.62%	12.95%	14.59%

Table 2.11 Analysis of SEO Sub-Sample

This table reports the results from the OLS regressions using the SEO specifications, where SEO Underpricing is regressed on independent variables in Appendix A. Offers that are issued prior to 2003 are in the first time period, denoted by pre-SOX and offers after 2002 are in the second time period, post-SOX. The value in parentheses are the associated *t*-statistics. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Pre-SOX		Post-SOX	
	(1)	(2)	(3)	(4)
%Women	-0.002	-0.018	0.064	0.029
	(-0.06)	(-0.32)	(1.53)	(0.51)
%High Education	0.054	0.047	0.001	-0.011
	(1.51)	(1.16)	(0.03)	(-0.47)
*%Women * %High Education*		0.103		0.165
		(0.41)		(0.71)
%MBA holders	-0.001	-0.001	-0.021	-0.021
	(-0.03)	(-0.04)	(-1.08)	(-1.08)
%CPA &/or JD	-0.067**	-0.068**	0.003	0.004
	(-2.14)	(-2.13)	(0.14)	(0.16)
%Non-executive	-0.067**	-0.067**	0.007	0.007
	(-2.01)	(-1.99)	(0.23)	(0.24)
E&NE Team Size	-0.001	-0.001	-0.002	-0.002
	(-0.62)	(-0.63)	(-1.43)	(-1.47)
Directors Age	0.001	0.001	0.000	0.000
	(0.50)	(0.50)	(0.26)	(0.20)
Firm Size	-0.000	-0.000	-0.001	-0.001
	(-0.05)	(-0.04)	(-0.27)	(-0.26)
Firm Age	0.000	0.000	0.000	0.000
	(1.40)	(1.38)	(0.82)	(0.80)
Offer Size	0.009	0.009	0.002	0.002
	(1.25)	(1.25)	(0.52)	(0.58)
IB Reputation	-0.014***	-0.015***	-0.008***	-0.008***
	(-2.61)	(-2.61)	(-3.06)	(-3.06)
IV Sentiments	0.000	0.000	0.001***	0.001***
	(1.06)	(1.04)	(3.39)	(3.36)
Years to SEO	-0.005	-0.005	0.001	0.001
	(-0.99)	(-0.98)	(0.54)	(0.58)
IPO Underpriced Dummy	-0.001	-0.001	0.002	0.002
	(-0.13)	(-0.08)	(0.29)	(0.28)
CAR (-5, -1)	0.040	0.041	0.022	0.023
	(1.36)	(1.36)	(0.64)	(0.68)
Price Cluster Dummy	0.001	0.001	-0.005	-0.005
	(0.11)	(0.10)	(-0.71)	(-0.72)
NASDAQ Dummy	0.026**	0.026**	0.004	0.004
	(2.07)	(2.05)	(0.52)	(0.52)
ROA	-0.015**	-0.015**	-0.017	-0.016
	(-2.45)	(-2.43)	(-1.41)	(-1.36)
Book-to-market Ratio	-0.003	-0.003	-0.001	-0.001
	(-0.35)	(-0.36)	(-1.32)	(-1.33)
E/P Ratio	0.052**	0.051*	-0.008	-0.008
	(2.04)	(1.96)	(-0.56)	(-0.57)
Constant	-0.058	-0.056	0.029	0.031
	(-0.43)	(-0.42)	(0.34)	(0.37)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	279	279	370	370
Adjusted-R^2	0.54%	0.14%	13.39%	13.31%

Appendix A. Definition and Construction of Variables (Essay One)

Variables	Source	Construction Method	Used in
Dependent Variables			
Underpricing	Compustat	The natural log of the raw returns is adjusted by the natural log of S&P500 where the offer is listed	IPO,SEO
Price Revision	SDC	The percentage change of the latest amendment mid-price over offer price	IPO
Independent Variables			
E&NE members-specific			
%Women	Hand-collected from EDGAR	Percentage[1] of E&NE directors who are female	IPO;SEO
%High Education	Hand-collected from EDGAR	Percentage[1] of E&NE directors who hold Ph.D. and equivalent	IPO;SEO
%MBA	Hand-collected from EDGAR	Percentage[1] of E&NE directors who hold an MBA	IPO;SEO
%CPA &/ JD	Hand-collected from EDGAR	Percentage[1] of E&NE directors who are Certified Public Accountants &/or Juris Doctor holders	IPO;SEO
%Non-executive	Hand-collected from EDGAR	Percentage[1] of non-executive E&NE directors	IPO;SEO
E&NE Team Size	Hand-collected from EDGAR	Size of the board	IPO;SEO
Directors Age	Hand-collected from EDGAR	Average age of E&NE directors	IPO;SEO
Firm- and Offer-specific			
Firm Size	Compustat	Natural log of total Assets before the offer, adjusted to 2013 purchasing power	IPO;SEO
Firm Age	Hand-collected from EDGAR	Age of the firm	IPO;SEO
VC Dummy	SDC	1 = IPO is backed by venture capitalists, 0 = otherwise	IPO
Offer Size	SDC	Natural log of gross proceeds excluding fees and expenses, adjusted to 2013 purchasing power	IPO;SEO
Greenshoe Dummy	SDC	1 = offer has over-allotment option	IPO
Offer Tech Dummy	SDC	1 = Firm Commitment/Bookbuilt, 0 = otherwise	IPO
IB Reputation	Jay Ritter's website	Investment Banks/Underwriters Reputation where the lowest rank is 1.001 (i.e. Pacific Growth Equities Inc, 1992-2000) and the highest is 9.001 (i.e. Goldman Sachs since 1980)	IPO;SEO
Big 4 Auditors	SDC	1 = if firm hires an auditor from the Big 4	IPO
Investors' Sentiments	Compustat	Percentage of over-allotment amount sold over the expected total proceeds	IPO;SEO
Price Risk	SDC	Percentage[1] of latest amendment mid-price over offer price	IPO;SEO
Years to SEO	SDC	Years taken for a firm to issue primary SEO	SEO
IPO Underpriced Dummy	Compustat	1 = firm had an underpriced IPO, 0 = otherwise	SEO
CAR (-5, -1)	Eventus	Cumulative market-adjusted abnormal return over the 5 days prior to the SEO, SEO date excluded	SEO
Price Cluster Dummy	SDC	1 = the offer price is in mutiple of $0.25, 0 = otherwise	SEO
NASDAQ Dummy	SDC	1 = offer listed on NASDAQ, 0 = otherwise	SEO
ROA	Compustat	Return on Assets, latest fiscal year from the offer year	SEO
Book-to-market Ratio	Compustat	Book-to-market ratio, latest fiscal year from the offer year	SEO
E/P Ratio	Compustat	Earnings-to-price ratio, latest fiscal year from the offer year	SEO

[1]Percentages are expressed in decimals

Appendix B. Pre-IPO Characteristics and Underpricing

This table reports the results from the OLS regressions using the Pre-IPO specifications, where IPO Underpricing is regressed on a set of independent and control variables defined in 2.6. The value in parentheses is the associated t-statistics. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	(1)	(2)	(3)	(4)
%Women	0.238*	0.280**	0.524***	0.482***
	(1.71)	(2.15)	(2.76)	(2.62)
%High Education	-0.094	-0.055	0.001	0.012
	(-1.07)	(-0.67)	(0.01)	(0.13)
*%Women * %High Education*			-1.539**	-1.090**
			(-2.52)	(-1.98)
%MBA holders	-0.056	-0.085	-0.061	-0.088
	(-0.68)	(-1.08)	(-0.74)	(-1.13)
%CPA &/or JD	-0.071	-0.097	-0.056	-0.086
	(-0.70)	(-1.02)	(-0.55)	(-0.90)
%Non-executive	-0.019	0.028	-0.030	0.019
	(-0.19)	(0.31)	(-0.32)	(0.21)
E&NE Team Size	0.001	-0.000	0.001	-0.000
	(0.40)	(-0.07)	(0.44)	(-0.03)
Directors Age	-0.003	-0.003	-0.003	-0.003
	(-0.93)	(-0.87)	(-0.99)	(-0.92)
Firm Size	-0.056***	-0.049***	-0.056***	-0.049***
	(-4.04)	(-3.51)	(-4.04)	(-3.52)
Firm Age	-0.000	-0.001*	-0.000	-0.001*
	(-0.42)	(-1.91)	(-0.38)	(-1.84)
VC Dummy	0.102***	0.078**	0.103***	0.079**
	(3.09)	(2.44)	(3.11)	(2.46)
Offer Size	0.104***	0.080***	0.103***	0.080***
	(4.43)	(3.56)	(4.40)	(3.55)
Greenshoe Dummy	-0.232	-0.366	-0.236	-0.367
	(-1.04)	(-1.50)	(-1.05)	(-1.51)
Offer Tech Dummy	-0.176***	-0.152**	-0.184***	-0.158**
	(-2.90)	(-2.05)	(-3.09)	(-2.20)
IB Reputation	0.030**	0.021*	0.031***	0.022*
	(2.54)	(1.82)	(2.60)	(1.88)
Big 4 Auditors	0.067**	0.049*	0.067**	0.049*
	(2.36)	(1.80)	(2.36)	(1.80)
IV Sentiments		0.014***		0.014***
		(8.13)		(8.02)
Constant	-0.654*	-0.225	-0.679*	-0.250
	(-1.71)	(-0.59)	(-1.78)	(-0.66)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	649	649	649	649
Adjusted-R^2	31.06%	38.54%	31.56%	38.74%

Appendix C. Pre-SEO Characteristics and Underpricing

This table displays the results from the OLS regressions using the Pre-SEO specifications, where SEO Underpricing is regressed on a set of independent and control variables defined in 2.6. The value in parentheses is the associated *t*-statistics. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	(1)	(2)	(3)
%Women	0.025	0.023	0.017
	(0.97)	(0.90)	(0.49)
%High Education	0.030*	0.029*	0.026
	(1.70)	(1.68)	(1.37)
%*Women* * %*High Education*			0.039
			(0.26)
%MBA holders	-0.021	-0.021	-0.021
	(-1.18)	(-1.20)	(-1.20)
%CPA &/or JD	-0.030	-0.031*	-0.031*
	(-1.63)	(-1.66)	(-1.68)
%Non-executive	-0.028	-0.030	-0.030
	(-1.35)	(-1.44)	(-1.42)
E&NE Team Size	-0.001	-0.001	-0.001
	(-1.61)	(-1.63)	(-1.65)
Directors Age	0.000	0.000	0.000
	(0.14)	(0.03)	(0.03)
Firm Size	-0.003	-0.003	-0.003
	(-1.04)	(-0.97)	(-0.97)
Firm Age	0.000	0.000*	0.000*
	(1.61)	(1.71)	(1.71)
Offer Size	0.006*	0.005*	0.005*
	(1.85)	(1.66)	(1.67)
IB Reputation	-0.009***	-0.009***	-0.009***
	(-4.17)	(-4.40)	(-4.41)
IV Sentiments		0.001**	0.001**
		(2.10)	(2.10)
Years to SEO	0.001	0.001	0.001
	(0.99)	(0.86)	(0.87)
IPO Underpriced Dummy	0.005	0.004	0.004
	(0.95)	(0.79)	(0.80)
CAR (-5, -1)	0.044**	0.040*	0.040*
	(2.01)	(1.83)	(1.84)
Price Cluster Dummy	0.002	0.001	0.001
	(0.32)	(0.14)	(0.13)
NASDAQ Dummy	0.005	0.005	0.004
	(0.69)	(0.70)	(0.69)
ROA	-0.008	-0.009	-0.009
	(-1.36)	(-1.35)	(-1.35)
Book-to-market Ratio	-0.002	-0.001	-0.001
	(-1.60)	(-1.51)	(-1.53)
Earnings-to-price Ratio	-0.005	-0.005	-0.005
	(-0.41)	(-0.37)	(-0.36)
Constant	0.023	0.026	0.027
	(0.35)	(0.41)	(0.42)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	649	649	649
Adjusted-R^2	7.46%	8.97%	8.82%

Chapter 3

Do VC-backed IPOs Manage Tone?

3.1 Introduction

Extensive work has been done dissecting the role of venture capitalists. While some find that VCs are good monitors of firms, others document their excellent connections to a group of important players in the IPO market, to name a few, underwriters, auditors and lawyers. Indeed, VCs are pivotal in the process of taking their portfolio firms to the IPO and a successful exit symbolises a significant milestone for a VC.

In their efforts to ensure the completion of an IPO, VCs not only engage syndicate team members within their network to lower the costs associated with the offer (Megginson and Weiss 1991), but could also induce the market to perceive the firm in a way that is beneficial for the VCs. Cook et al. (2006) illustrate that VC-backed IPOs are advertised more aggressively by the underwriters to attract sentiment investors' participation, driving the initial filing price upward. More importantly, Loughran and McDonald (2013) cite evidence that the offer price adjustment is a result of the negative tone in the initial security registration filings (S-1s) of VC-backed firms, as these firms seek funding from their final source of capital, rather than using internal or

traditional bank financing. Although the authors postulate that their finding is due to uncertainties in VC-backed firms, this assertion has yet to be backed by statistical evidence. The main aim of this paper is to fill the gap in literature by investigating whether VC-backed firms manage tone and if they do, what are the mechanisms that may drive them to do so?

Reasons for the offer price adjustment theory may vary, but it is clear that firms with VC presence seem to engage in tone management. Therefore, the main focus of this study is to examine whether VC-backed firms adopt a different approach in tone management at IPO and SEO and the mechanisms attributing to their decision. The setting in this paper differs from prior work which predominantly looks at the registration of securities filings (S-1) or prospectuses during IPOs (Boone et al. 2016; Hanley and Hoberg 2010; Loughran and McDonald 2013, amongst others). Hanley and Hoberg (2010) and Boone et al. (2016) analyse firms' IPO prospectuses and final registration filings, respectively and find complementary results that disclosure of regulatory information is crucial to VC-backed firms in providing investors necessary information to price securities accurately.

In particular, I extract disclosure tone using the Management Discussion & Analysis section (MD&A) of the offering prospectuses at both equity offerings and is measured by the difference between the total number of positive words and the total number of negative words, normalised by the sum of the total number of positive and negative words (García 2013). Using Ordinary Least Squares on a set of firms that have issued both an IPO and SEO, findings unanimously point out that VC-backed firms display conservatism in regulatory disclosures. The economic impact of the full specification

translates to a decrease in 21.24% in tone or an increase in 8 negative words, on average, of a typical 6700-word MD&A section of the offering prospectus.

The intuition for analysing the same set of firms stems from the notion presented by Celikyurt et al. (2014) and Krishnan et al. (2011), who document that VCs' influence go beyond the IPO stage. In my sample, even though a small portion of VC directors maintain directorships in their portfolio firms years after an IPO, most VCs sell their equity stakes in these firms approximately two years post-IPO (around an SEO offer). Their departures could represent a decline in the influence of VCs on tone management when firms re-enter the equity market. However, if the influence of VCs that stay after the IPO on tone management remains at SEO, it is evident that VCs do indeed affect firms' tone management. Likewise, results are strengthened if I observe similar implication when new VCs join the firms at the SEO. Main findings show support that firms are more conservative in their disclosures as long as VCs' presence exists.

To address sample selection bias in which unobservable firm characteristics could affect the choice of VC funding, a Heckman-type model with the increase in National Science Foundation Basic Grant and GDP Growth are used as instruments in the first stage regression. An additional test to rule out the potential endogenous impact of VC backing on tone - a propensity score matching model based on the nearest neighbour - is employed to estimate the receipt of VC funding. These tests confirm the baseline result that VC-backed firms are more negative in disclosures.

Next, I partitioned the sample to investigate the relationship between participants of an equity offering as previous literature documents a syndication effect among prestigious members that leads to better performance (e.g. Hochberg et al. 2007). The

sub-sample analyses find that VC-backed firms have a higher tendency to engage in tone management when they hire Big 4 auditors, invest in tech firms, operate in highly-litigious sectors, have more analysts following, on average, post-IPO. Interestingly, this effect diminishes at the SEO with the exception of firms belonging to the high-technology industry. The implication not only gives support to the syndication effect but also strengthens the result that firms in volatile sectors make use of conservative disclosures. A possible explanation in adopting such tone management could emerge from the fact that these firms are safeguarding themselves against potential litigation risks, regardless of the stage they are at in their corporate lifecycle. With hand-collected lawsuits of the sample firms, I show that a decline in tone decreases the probability of VC-backed firms being sued after an offering issuance. The findings infer that these firms downplay their optimism in their offering prospectuses to protect against reputational losses as they are exposed to higher litigation risks, possibly arising from operating in nascent and high-technology industries. Results drawn from further analyses of the probability of VC-backed firms being sued lend support to the work of Hanley and Hoberg (2012), with the inference that VC-funded firms at both IPO and SEO could engage in tone management to mitigate successful class action lawsuits.

My earlier findings of conservatism in tone management at VC-financed firms is in line with their objective to minimise litigation risk. However, there could be an alternative interpretation to the findings; that VC-backed firms use negative tone to convey private information on future earnings of the firm. For instance, these firms are not conservative, but are simply sending "truthful" signals to the market. Therefore, I relate negative tone to a firm's future earnings and show that this is unlikely to be

the reason. VC-backed firms, in fact, outperform and have better future performance. This provides further evidence of the motive behind conservative tone management. Consistent with the above explanation that these firms are not underperforming, I also observe that these firms have large surprise unexpected earnings (SUEs) per share. If negative tone contains private negative information on a firm's future earnings, I would not expect to observe SUEs.

Finally, another aspect of this paper looks at the impact of pricing accuracy on VC-funded firms and whether tone management plays a part in influencing the pricing convention. Results show that IPO VC-backed firms are prone to erroneous valuation and thus, generate large surprise unexpected earnings per share as compared to firms without VC financing. Interestingly, these firms use tone management in the short-run to achieve large SUEs. This finding is also consistent with Lowry and Shu (2002) which suggests that VC-backed firms exposed to higher litigation risks are often linked with pricing inaccuracies.

One could argue that SUEs are susceptible to the challenge of disentangling the culprits behind such inaccuracies. I address this issue and find that the two countervailing forces - analysts' forecast errors and good future earnings performance - work in opposite directions and are significant factors contributing to large SUE values immediately following the IPO. This effect is persistent even at SEO and three years after the secondary issuance.

This article contributes to the current literature in four ways. First, this paper adds to the growing literature in textual analysis on firms and shows that VC-backed firms are more conservative in their disclosure. Although the result of tone management of

VC-funded firms is not new (Loughran and McDonald 2013), I offer plausible reasons behind their purported intention. This leads to the second and a novel contribution that sheds light on the underlying mechanisms to which VC-backed firms manage tone. Evidence shows that these firms mitigate concerns of being sued after an equity offering by portraying conservatism in disclosure tone. Tone conservatism is also pronounced in technology and highly-litigious industries, suggesting that firms facing higher uncertainty manage tone to protect their reputation and reduce the probability of being litigated in a lawsuit.

Third, findings lend support to a large body of literature on the outcome of syndication between participants in the IPO market. Besides providing evidence that firms with VC financing are associated with Big 4 auditors and have more analysts following them, more importantly, this paper highlights that negative tone management is persistent within the syndicate.

Finally, results drawn from this study deepen the understanding of whether a longstanding relationship exists between VCs and their portfolio firms and the impact of VC funding in the long-run. Despite the results revealing that VC-backed firms experiencing a higher propensity of imprecise offer price valuation, I document that firms maintaining the working alliance yield long-run positive performance.

The second essay takes the following structure: Section 3.2 provides the background of VC-backed firms and textual analysis. Section 3.3 describes the model and presents the baseline results. Robustness tests and further analyses are shown in Section 3.4 while Section 3.8 concludes.

3.2 Background

3.2.1 Venture Capitalists and Initial Public Offerings

Venture capitalists (VCs) are viewed traditionally as a source of funding for entrepreneurs at the initial stages of their business ventures. They fulfill their obligations to the investors of their fund by selling equity stakes in the invested firm during an IPO or upon the lock-up expiration date[1] of an IPO. Aside from using IPO as an exit strategy, VCs also realise their investments through acquisitions.

VCs are also known for their role of replacing or growing the management team of their portfolio firms as well as having an extensive network of bankers, lawyers and headhunters (Gorman and Sahlman 1989; Sahlman 1990). Besides, VCs often provide advice to the management team before leading a firm to its initial public offering (IPO) (Lerner 1994), which typically takes seven to ten years from the first round of VC funding. A more contemporary vein shows that VCs enhance firms' governance structures at IPO (Hochberg 2012).

Evidence suggests that VCs not only provide funding to entrepreneurial firms, but also shape the management team and enhance the product line of their portfolio firms, so as to maximise the success rate at the IPO. Indeed, Hellmann and Puri (2002) show that VCs dismiss inadequate directors and grow those whom they deem are suitable for the business. In addition, VCs instill a more independent board structure and are therefore, less aggressive in earnings management at IPO (Hochberg 2012). Since most VCs seek board membership in exchange for equity holdings of the firms, they may

[1] Usually 180 trading days from the IPO.

have an influence on the management team and marketing of the equity offerings could be done in a way favourable to the venture capitalists.

Firms with VC backing are evidently different in many ways as compared to non-VC-backed firms. Other than structuring the management team of their portfolio firms, VCs often draw upon a network of syndicate members (e.g. underwriters, auditors and lawyers). It has been contended that they are able to connect and access this network due to the social ties and working relationships they have built throughout their years in business. Research lends support to the syndication effect and documents that VC-backed firms tend to have more analysts' coverage following the IPO (Bradley et al. 2003; Liu et al. 2014) as well as frequently attracting prestigious underwriters to form a syndicate team at IPO (Benveniste et al. 2003; Cook et al. 2006; Lee and Wahal 2004; Megginson and Weiss 1991).

In a broader perspective, Lowry and Schwert (2004) reveal that IPO firms choosing better-quality underwriters are often subjected to higher offer price adjustments, with the explanation that such revisions are a consequence of underwriters' conservatism in the initial valuations to shield them against the negative outcome of pricing inaccuracy. Giving support for the price adjustment hypothesis, Loughran and McDonald (2013) illustrate that VC-backed IPOs are associated with larger absolute offer price revision. They relate this finding to the higher level of uncertainty faced by VC-backed firms, attributing to the notion that VCs are considered as the final source for firms seeking financing. Relating the implication drawn from above studies, the initial filing price of IPOs could suffer from mispricing. A more recent paper uses a sample of IPO firms from 1996 to 2011 shows that VC-backed firms hold more proprietary business

information and are more likely to redact information in their IPO prospectuses (Boone et al. 2016). As a result, these firms experience underpricing since investors do not have sufficient information to value them fairly.

IPO firms with VC-backing perform better in the long-run (Jain and Kini 1995; Krishnan et al. 2011). Moreover, following the IPO, well-reputed VCs are able to raise more capital for other funds they manage (Lee and Wahal 2004) and experience less litigation risk (Atanasov et al. 2012). VCs are also known to provide certification to their portfolio companies as the presence of VCs signals quality. Good VCs manifest their quality by selecting better-quality firms, which in turn, possess a higher likelihood of exiting via an IPO as compared to non-VC-backed firms (Krishnan et al. 2011; Nahata 2008; Sørensen 2007).

Since they are repeated players in the investment and IPO markets, they generally possess knowledge and skills in specified industries. Notably, they are more inclined to invest in young and high-technology firms. Despite the impact of VCs on initial offer price adjustment and IPO underpricing, current literature seems to acknowledge that VCs do bring certain expertise and experience to their portfolio firms.

3.2.2 Textual Research and Pricing Accuracy

Aside from quantitative data, prior studies indicate that qualitative information pertaining to firms contains additional information that is vital in pricing securities. Textual cues are either impounded in the initial IPO offer price (Hanley 1993; Lowry and Schwert 2004) or incorporated in stock prices much later after they are publicly

available (Cohen et al. 2016; Hendricks et al. 2017; Huang et al. 2014; Jegadeesh and Wu 2013).

Such narratives (e.g. prospectuses and annual reports) are required by regulatory bodies to ensure that potential investors have sufficient information pertaining to the current health and future outlook of the firms. Hendricks et al. (2017) disclose that investors are indifferent when assessing the tone of founder-led IPOs and other IPO firms that went public between 1997 and 2013. They conjecture that annual reports (10-Ks) contain information needed for investors to value the firm and if investors are unable to process these narratives, consequently, they are subjected to potential mispricing of these firms.

Taking a textual analysis approach, several works document that information disclosures are important for IPO firms. Hanley and Hoberg (2010) examine an extensive sample of IPO prospectuses and provide evidence that IPO firms engage in tone management through generating informative content to create higher investors' sentiments and demand and this leads to a greater level of pricing accuracy. The notion behind this conjecture is that firms that provide disclosures in excess of the "standard content" help investors in the information production process and improve the pricing accuracy of the offer. Moreover, Boone et al. (2016) find IPO firms redacting information in their initial registration statements suffer a higher level of mispricing during the first trading day closing.

Other than providing information to the public, disclosures may give signals to the capital market. Cohen et al. (2016) find that changes in the MD&A section of annual reports provide crucial information on future returns, even after employing various

similarity measurements and econometric models as well as controlling for firm-level characteristics. Huang et al. (2014) highlight that firms may use tone, derived from textual analysis to mask information and mislead investors. They model tone using earnings press releases and suggest that it contains information about future firm performance and predicts weak future earnings and cash flows. Besides, their results suggest that firms with compelling need to obfuscate information are more likely to manage earnings.

Further, Tetlock et al. (2008) show that the frequency of negative words in the firms' news story has a negative relation with future earnings. Li (2008) reports that managers have a strategic stance in manipulating tone so as to cloud investors' perception of the firms' true fundamentals and future performance. Overall, in spite of mixed evidence presented and discussed above, qualitative information has been undermined previously in terms of its ability in providing explanation for future firm performance.

3.2.3 Venture Capital and Tone Management

Previous research by Huang et al. (2014) illustrates that firms are more optimistic around seasoned equity offering (SEO) and merger and acquisitions (M&A) activities but has yet to look at VC-backed firms. Hanley and Hoberg (2010) analyse various sections of firms' initial IPO prospectuses from January 1996 to October 2005 and notice that VC-funded firms disclose less "informative" (unique) information in their Management Discussion and Analysis (MD&A) section as compared to those without VC funding. Similarly, the findings of Hanley and Hoberg support the conjecture

proposed by Boone et al. (2016) that VC-backed firms are more likely to redact and withhold information in their final registration statements (S-1s) due to the need to safeguard proprietary information. Although both studies offer explanations as to why VC-backed firms differ from non-VC-backed firms in disclosing regulatory disclosures, they did not examine the motivation and consequence of these firms managing information content, which this paper aims to investigate.

Currently, there are two sides to the coin. Given that firms know their potential best, there could be various reasons why they portray a more positive (or negative) tone in their regulatory disclosures. Positive tone may be a true reflection of firms' potential, in which case it is a predictor of future firm performance (Feldman et al. 2010; Li 2010). In addition, engaging in an optimistic tone could be a strategic decision made by the firm to induce enthusiasm about corporate events such as secondary stock issuance and acquisitions (Huang et al. 2014). Arguably, if the conjecture proposed by Huang et al. is followed and applied to both equity offering events in this study, the implication of VC-backed firms having a more positive disclosure tone is to hype the demand of the offer, resulting in an upward revision of the initial filing price. Consequently, ex-ante optimism of these firms should be associated with better performance after the issuance.

On the other side of the story, private firms prior to an IPO need guidance before they enter the capital market and receive public scrutiny. They have to deal with the possibility of negative outcomes, such as having insufficient interest at the roadshows or the failure of not being listed on the stock exchange. Firms may lower their expectations, adopt a more conservative approach and state risks to avoid potential

litigation. Along with this intention, they are more likely to use negative tone to "safeguard, underestimate, protect themselves against any future negative consequences" (Jegadeesh and Wu 2013). In a similar vein, Hanley and Hoberg (2012) find evidence that firms omitting information generated during the bookbuilding process - by not revising their prospectuses in response to a large offer price revision - are more likely to be litigated in the event of an unexpected drop in stock price immediately after the IPO. Particularly, Loughran and McDonald (2013) document that VC-backed IPOs are linked to conservatism in disclosures and experience larger absolute revisions in their initial offer price. However, negative tone can also convey unfavourable information on the offering, leading to a downward adjustment in the initial filing price. This conservatism in tone may also contribute to a longer run impact of persistent poor post-IPO performance. It should also be noted that if good future performance ensues from negative disclosure tone, then, firms are taking a more conservative approach to reduce reputational concerns.

At this point, it is apparent that VCs can have an influence on the tone of IPO disclosures of their portfolio firms. Although several studies delved into the effect of VC funding on offer price revision (Cook et al. 2006; Loughran and McDonald 2013; Lowry and Schwert 2004), to the best of my knowledge, no study attempts to address the reason behind VCs' intended purpose of tone management. The closest paper to this study is by Loughran and McDonald (2013), which examines the influence of VCs on the initial registration for new securities (S-1 filing) and attributes the use of negative/uncertain tone to ambiguity faced by a firm in running its operational

activities and VCs being the "capital providers of the last resort" to entrepreneurial firms. However, their assertion has not been complemented with statistical support.

Since VCs are known to provide certification to the firms they invest in, these firms are better-quality and should reflect their quality by attracting prestigious syndicate members. In addition, following the intuition of Henderson et al. (2017), alongside with the increase in monitoring by big auditors and analysts, VC-backed firms may be more careful in their regulatory disclosure. Therefore, I expect that firms with VC funding will have reputable syndicate members and taken together, magnifies the impact of tone management.

Despite having evidence depicting VCs' role of certification and IPO underpricing, little is known about whether the influence of VC-backing goes beyond the IPO. A study by Celikyurt et al. (2014) highlights that VC directors are found serving on the board of mature firms[2] which have been public for approximately seventeen years and the appointment of these directors has a positive impact on announcement returns and operating performance. Hence, VC directors not only play a role at the IPO, they are also valuable to the firms in the long-run due to their knowledge and expertise. Relevant to this study, I examine the long-run effect of VC-backing on IPO firms by tracking these firms from their IPO to their primary SEO. This setting also allows me to focus on the same set of firms to observe if VCs' influence on tone extends beyond IPO and the circumstances in which they employ tone management.

[2]35% of these firms are not VC-backed at IPO.

3.3 Data and Empirical Setting

I use the Thomson SDC One Banker to obtain IPOs from 1997[3] to 2011 and track them until 2013 to retain firms that have issued a seasoned equity during the sample period. This allows for a three-year firm performance following the last SEO in the sample. IPO offerings that are less than $5, unit-offer, carve-outs, private placements, in the utilities and financials (SIC 4900-4949; 6000s) are excluded. After filtering for missing offering proceeds and name of the underwriters, the final sample contains 649 firms. One advantage of this dataset consisting of the same set of firms across the equity offerings eliminates the need to control for firm fixed effects at SEO.

Following Loughran and McDonald (2013), I extract the Management Discussion & Analysis (MD&A) section[4] of the final IPO and SEO prospectuses of the sample firms, leaving out figures, headings and tables. However, if the number of words in the table consists of more than 15 words, I extract the text within that table. If the prospectuses are unavailable, I use the annual report closest to the issue date.

Once the document (or corpus) is retrieved, I split the individual corpus into separate tokens (words). Since the purpose of this study is to observe the effect of VC- and non-VC backed firms on tone, I adopt a three-step approach to quantify tone. First, I tag each token according to the various word lists created for the purpose of business and finance research (Loughran and McDonald 2011, LM lists[5], thereafter).

[3]SEC mandates firms to provide regulatory filings on EDGAR starting 1996. To ensure that firms are not excluded, I start the sample from 1997. Firms usually issue SEOs within 1 year (Spiess and Pettway 1997) to 3 years after an IPO (Jegadeesh et al. 1993). An average of the two is taken.

[4]Loughran and McDonald (2013) from SEC EDGAR suggest that to fully analyze narrative, it is advisable to parse a part of a text to serve its purpose. Since this section confirms information on the current health of the firm and prospects of the firm and is considered the least to be drafted by the syndicate, there is more freedom for management to provide their opinion on the firm.

[5]The comprehensive lists can be found at http://www3.nd.edu/~mcdonald/Word_Lists.html

Common English dictionaries have been found to be less useful in the financial context in evaluating tone. The Harvard Psychological Dictionary and DICTION are not appropriate in identifying words that are negative in the financial/business context. Besides, the Gunning Fog index classifies words with three or more than syllables as a complex word. As a result, the word "liability" is regarded as a negative (Harvard Psychological Dictionary) and a difficult (Gunning Fog index) word to comprehend.

The word lists can be considered as dictionaries constructed to assign a token to a specific category or list. Next, I count the number of words in the corpus using three sentiment LM word lists, namely the positive, negative and modal categories. Finally, after the allocation of each tagged token to its respective list, I proceed to compute four different measurements of tone. A summary of the calculation is shown in Table 3.1. The first measure is driven by García (2013), in which tone is the difference between the total number of positive words (denoted by g_{it}) in the MD&A section of a firm's prospectus and the total number of negative words (denoted by b_{it}), divided by the total number of positive and negative words. The second measure (Loughran and McDonald 2013) has the same numerator as the first measure, instead, it is scaled by the total number of words (denoted by w_{it}) in the corpus. The third measure is a modification of the second method, whereby the score is the proportion of the total number of negative words multiplied by minus 1, scaled by the sum of all words in the MD&A section of a firm's prospectus (Gurun and Butler 2012).

However, negation may exist prior to a positive or negative word that changes the polarity of that token. To address the issue of negation, a separate dictionary is created

to detect and alter the sentiment of a word. Examples of the words in this dictionary are “cannot”, “not”, “not be” and “lack of”.

The above three measurements of tone use only the positive and negative word lists whereas the fourth engages the modal word list. The last tonality proxy follows the intuition of Clements and Reade (2016), in which the authors enhance the sentiment index developed by Alba[6]. Similar to the first three techniques, a corpus is broken up into tokens and each token is tagged to a category that is derived from pre-defined dictionaries/word lists.

The Alba sentiment score is tabulated as follows. Alba sentiment gives a score of 1 with every positive word found in the MD&A of a firm and minus 1 for every negative word identified. Negation words that exist preceding a positive or negative token will flip the sign of the score of the word. For instance, if there are three positive words in a text, of which one negation word is found before one of these three positive words, the total score is 1 (=1+1-1), rather than the value of 3, since that positive word is now considered negative.

Another feature of the Alba index is that it incorporates the concept of “incrementers” and “decrementers”. This notion can be viewed as a measurement of the “strength” of a tagged token. Any incrementer word (i.e. “very” and “too”) preceding a tagged token increases its sentiment whereas a decrementer word (i.e. “barely” and “probably”) weakens the impact. Combining this element with the LM 3-category modal word list, I segregate modal words that are denoted by 1 as “incrementers” and modal words in the 2 and 3 categories as “decrementers”. A tagged token with a preceding incrementer

[6] http://fjavieralba.com/basic-sentiment-analysis-with-python.html

word will have its score multiplied by two. With a decrementer word, however, reduces the score by half[7].

Overall, the larger is the value of the tone measurements, the more optimistic is the disclosure of a firm's MD&A. The variable of interests are dummy variables that represent the presence of VC-backing at the IPO and SEO. For instance, at IPO, the dummy variable is equal to 1 if a firm is VC-backed at the time of the IPO, and 0 otherwise (*VC IPO*). During an SEO, a firm is considered VC-funded in the following two ways. First, the *VC Stay* variable takes the value of 1 if at least one of the original VC of a firm at the IPO remains, and 0 otherwise. Second, the *VC SEO* variable bears the value of 1 when a firm has at least one director who is from the VC that invests more than 1% of security ownership of the SEO firms *or* has more than 1% of security ownership held by a VC, and 0 otherwise.

Table 3.1 shows the results of a univariate regression of the various VC-backed dummy variables on the tonality measures. Consistent across all measures, VC-funded firms are negatively associated with tone, suggesting that the Management Discussion and Analysis section of the IPO prospectus of a VC-backed firm is more likely to be negative (i.e. less optimistic) as compared to a firm without such backing. SEO Tone do not appear to have a significant relation with VC-backing. Next, I look at the variables used in examining tone and VC-backed firms in a multivariate setting.

Appendix D presents the definition and construction of the variables used in this study. Out of the total sample of 649 firms, 333 IPO firms (or 51.3%) received

[7]For example, a negative token carries the score of -1. If an incremeter (decrementer) word precedes this token, the score becomes -2 (-0.5).

funding from venture capitalists[8]. At SEO, 14 IPO VCs left or sold their holdings and 48 new VCs are found to be funding firms that were not backed by VCs at IPO. The total number of VC-funded firms at the seasoned offering increases by 10.2% to 367. Although the main measurement of tone follows the methodology used by García (2013), the other three measurements are also adopted to ensure robustness. In summary, Table 3.2 shows that VC-backed firms at IPO have more negative scores[9]. The difference of 0.0065 in the score translates to an economic implication of an increase of approximately 8 negative words (or 10.3%) contained in a conventional MD&A of a VC-backed firm averaging 6700 words[10].

In addition, firms financed by VCs appear to have better-quality underwriters, higher level of investors' sentiments, form a management team with a larger proportion of highly educated members, on average, than non-VC-backed firms. However, VC-backed firms do not seem to affect tone at SEO. These firms are predominantly in the technology as well as the health care sectors. The above differences between VC- and non-VC- backed firms are statistically significant at the 1% level.

On the other hand, non-VC-backed firms are larger in size (supporting Celikyurt et al. (2014)) and gather more proceeds[11] during the IPO as opposed to VC-backed companies. The differences in mean and median are also statistically significant at the 1% level.

[8] A firm may be funded by more than than one venture capitalist.

[9] Results are similar when the other measurements are used.

[10] For a non-VC-backed firm, its MD&A contains an average of 8800 words, lending support to Boone et al. (2016) study which documents that VC-backed firms disclose lesser information due to proprietary business data.

[11] Hochberg (2012); Jain and Kini (1995); Krishnan et al. (2011) document the contrary in which VC-backed firms receive more proceeds. In my study, the proceeds are less fees and expenses and could possibly explain the contrast.

From Table 3.3, Tone at SEO remains negative for both VC- and non-VC- backed firms though the difference is not statistically significant. The differences in the means of the number of negative and positive words as well as the total number of sentences and words between VC- and non-VC- backed firms are statistically significant (between the 5% and 10% level). Besides having a larger percentage of highly educated board members in VC-backed firms as compared to those without VC funding, firms with VC financing also have a higher propensity operating in highly litigious sectors.

3.3.1 Main Model and Baseline Results

$$Tone_{i,t} = \alpha + \beta VC\ Dummy_i + \theta \mathbf{X}_{i,t} + Industry\ \&\ Time\ FE + \epsilon_{i,t} \tag{3.1}$$

I regress *Tone* on the main variable of interest, *VC Dummy*[12] and a set of independent variables that control for equity offering and management characteristics. Common variables used to control for IPO deals are the size of the firm before the IPO (*Firm Size*), the gross proceeds from the offering (*Offer Size*) and the demand for the offer. The demand for an IPO (*Investors' Sentiments, or IV Sentiments*) is measured by the percentage of the offer that is fulfilled in the over-allotment option. The consensus is that the higher is the proportion, the larger is the demand and investor's sentiment on the offer. Considering the results from Jegadeesh and Wu (2013) study, I control for offers that are discounted at IPO. The rationale for using an ex post variable is due to the finding of Jegadeesh and Wu that underpricing appears to have an association with tone. Therefore, to rule out the possible effect that the impact

[12]VC IPO, VC Stay or VC SEO.

of VC-backing on tone is driven by firms that experience underpricing, a continuous variable, *IPO Underpricing* is added as a control variable.

VC-funded firms are inherently different from non-VC-backed firms in the way that the former may have an extensive network and are often involved with prestigious underwriters. Also, to establish that the results are not due to the reputation of the investment banks, I control for this possible effect by including the average reputation of all the lead underwriters, calculated using data obtained from Ritter's website[13]. As the scores of some investment banks vary across time, the reputation variable (*IB Reputation*) is computed by using the score assigned to a particular underwriter at the firm's IPO year.

Certain management traits may influence the attributes of the disclosures made by firms, in particular, the linguistic features of the MD&A. To ensure that the results are not driven by the characteristics of the management team, I control for possible confounding effects in the regressions by including the percentage of board members who are Ph.D. holders and equivalent and the percentage of non-executive members. Results from Table 3.4, Columns 1 to 4 show that the coefficients of the *VC IPO* variable are negative and significant between the 1% and 5% level, providing evidence that VC-backed IPOs are less likely to be found with an optimistic tone in their MD&A disclosures. This finding seems to lend support to the notion that these firms may be underestimating their expectations to safeguard their reputational capital.

To ascertain whether the effect of VC-funded firms on tone is robust to variations in industry and an exogenous shock in the change of financial reporting requirement,

[13] https://site.warrington.ufl.edu/ritter/ipo-data/

industry and time fixed effects are added in Columns 3 and 4 of Table 3.4. Firms are classified into industries by the first two digits of the firm's SIC code. Due to a change in the regulatory environment by SEC with the enactment of the Sarbanes-Oxley Act (SOX) in July 2002, firms are required to be more transparent in disclosures, in order to provide a better representation of the firms to market participants. This may influence and change the way firms choose to disclose information in their regulatory filings. To alleviate concern that the implementation of SOX affects the impact of VC on tone, a PostSOX dummy (1 = IPO after 2002, 0 = otherwise) is added. Since the purpose of this study is to examine the effect of VC-funded firms on *Tone*, instead of adding a yearly time fixed effect to control for hot IPO markets, a PostSOX dummy seems more relevant.

From Table 3.4, Column 2, the presence of a VC-backed firm is associated with a decrease of 37.23% (=-0.095/0.255; 0.255 is the mean value of tone) in tone. Keeping the elements of tone at their means, this translates to an increase of approximately 13 negative words in an MD&A of a VC-financed firm (average of 6700 words). Furthermore, inferring the results displayed in the full specification (Table 3.4, Column 4), firms that received VC funding prior to an IPO are 5.4% (21.24% decrease in tone or 8 more negative words) less likely to use optimistic tone in their MD&As. With the introduction of industry fixed effects and *PostSOX* dummy (Table 3.4, Columns 3 and 4), the statistical power of the model increases by nearly twice. Although the coefficients of the *VC IPO* variable in Columns 3 and 4 are smaller in magnitude as compared to the results shown in Columns 1 and 2, they remain negative and statistically significant at the 5% level. This suggests that the baseline results are

unchanged when accounting for any time-variant differences across industries as well as time fixed effects to control for potential changes in tone before and after SOX.

The above results provide evidence that VC-backed firms are less likely to have an optimistic tone in their MD&A section of the IPO prospectuses. Moreover, findings from Table 3.4, Columns 1 to 4 also suggest that firm with smaller IPO proceeds, as measured by the gross proceeds less fees and expenses, have a more positive MD&A tone and IPO underpricing appears to have a negative relation with tone. The result of a negative relation between IPO underpricing and tone is largely consistent with Jegadeesh and Wu (2013). Findings also offer some evidence to Hanley and Hoberg (2010), indicating that investors' sentiments have a positive impact on tone. Next, I extend the analysis to SEO issuance and examine if tone management persists.

On top of the modification of the IPO control variables for the SEO regressions, several other control variables from the SEO literature (Corwin 2003; Jegadeesh et al. 1993) are also included in the main regression model, Equation 3.1. These variables are the number of years taken for the firm to issue an SEO (*Years to SEO*), a dummy variable that takes the value of 1 if the SEO offer price is clustered at quarters[14], and 0 otherwise (*Price Cluster Dummy*), cumulative abnormal returns (*CAR -5, -1*), *Litigation* and *Lock-up* Dummies. One argument for adding the *Lock-up Dummy* variable is that VCs no longer influence the management of the portfolio firm as they may have either liquidated their holdings after the lock-up expiration date (Brav and Gompers 2003) or the director who is placed by the VC in the management team

[14]SEOs tend to have offer prices clustered in multiples of \$0.25. Explanations offered for price clustering are the uncertainty in pricing these offers and the underwriters' reluctance in the price negotiation process. See Corwin (2003).

has left. Existing literature (Brav and Gompers 2003; Field and Hanka 2001) posits that firms may issue an SEO to shorten the lock-up expiration period as the issuance presents an opportunity for VCs to reduce their stakes in the portfolio firms. At this juncture, VCs may sell their holdings in order to realise investment returns for their funds. Therefore, to mitigate this concern, I add the *Lock-up Dummy*, which has a value of 1 if the lock-up expiration date is prior to an SEO issuance, and 0 otherwise.

In Table 3.4, Column 5, the coefficient of the *VC SEO* variable is negative and statistically significant at the 10% level. This suggests that VC-backed firms at SEO tend to have a more conservative tone (i.e. less likely to be positive) in their MD&A disclosures. To consider if this effect arises from the original VCs at IPO, I re-run the analysis by looking at IPO VCs who remain in the same firm at the seasoned equity issuance. The coefficient of the *VC Stay* variable from Table 3.4, Column 6 does not vary much from the previous analysis (-0.039 to -0.041). Although the economic significance of the results is marginal as compared to those at IPO, it is consistent with the findings that firms having their IPO VCs at the SEO are less likely to engage in an optimistic tone. Indeed, conclusions from both the IPO and SEO point out that VCs do engage in tone management. The next section ascertains whether the conclusions drawn from Table 3.4 are robust.

3.4 Robustness Tests

3.4.1 Sample Selection Bias

Being successful in receiving funding from a venture capitalist is not an exogenous event for a firm. Existing literature highlights that less than 0.5% of the business plans submitted to VCs by entrepreneurs ultimately receive funding (Sahlman 1990). It is also widely known that VCs are notoriously selective in the projects they eventually invest in. Therefore, in this non-random sample of firms that are successful in receiving such financing, selection bias exists. For instance, unobservable factors that might be correlated with conservatism in tone management are related to the VCs' choice to fund a firm. To address the problem of sample selection bias, I use a Heckman-type two-stage model that estimates the effect of unobservable factors affecting VCs' decision of investment on tone management (Chemmanur et al. 2011; Lee and Wahal 2004).

In the first stage, a probit model is used to estimate the probability of a firm being funded by VCs. The dependent variable equals to 1 if a firm is VC-backed and 0 otherwise, and the independent variables are similar to the main specification shown in Equation 3.1, except that the Tech and Health dummies are used to control for industry effects. The reason for doing so is that a large proportion of VCs typically invest in technology and/or health care firms, and therefore, these dummy variables are more appropriate than including industry fixed effects. Following Chemmanur et al. (2011), I include two instruments, the *Increase in National Science Foundation (NSF) Basic Grants* and *GDP Growth* in the first stage as they are related to the likelihood of receiving VC funding. Both instruments should have a positive relation with the

dependent variable as they reflect a growing economy which is a necessary environment for the formation of entrepreneurial firms that may eventually seek for VC funding. Not only do these instruments correlate with the probability of securing VC funding (*VC IPO* dummy variable), they should be exogenous to the dependent variable, *Tone*, in the second stage regression, in order to satisfy the standard exclusion restriction.

First Stage:

$$\begin{aligned} VC\ Dummy_i = \varphi + \gamma Increase\ in\ NSF\ Basic\ Grant_i + \psi GDP\ Growth_i \\ +\ \ \theta \mathbf{X}_{i,t} + Tech, Health\ \&\ PostSOX\ dummies + \eta_{i,t} \end{aligned} \tag{3.2}$$

Second Stage:

$$\begin{aligned} Tone_{i,t} = \alpha + \xi VC\ Dummy_i + \beta Inverse\ Mills\ Ratio_i + \theta \mathbf{X}_{i,t} \\ +\ \ Tech, Health\ \&\ PostSOX\ dummies + \epsilon_{i,t} \end{aligned} \tag{3.3}$$

Since $\eta_{i,t}$ cannot be observed directly, I estimate E($\eta|\mathbf{Z}$, *VC Dummy*=1) from Equation 3.2, in which $\mathbf{Z}$ consists of the two instruments, a set of control variables and Tech, Health and PostSOX dummy variables to obtain $\lambda_{i,t}(\mathbf{Z}\gamma)$, of which lambda is the inverse Mills ratio (Wooldridge 2012, Ch.17.5). As expected, analogous to Chemmanur et al. (2011) study, the increase in NSF grant has a positive relation with the *VC IPO* variable, suggesting that firms stand a higher chance of being funding by VCs when the amount of funds pumped into research increases. However, there is no relation between GDP Growth and the likelihood of receiving VC funding. The coefficients of the Tech and Health dummies bear positive signs and are significant at the 1% level, presenting strong evidence that firms operating in these industries are more likely to

be backed by VCs. Besides, smaller IPO firms in terms of total assets and offer size have higher probabilities in receiving such funding.

Next, the inverse Mills ratio, $\lambda_{i,t}$ is included as an additional regressor in the second stage. If unobservable characteristics do not affect firms in receiving funding, then the coefficient of the inverse Mills ratio, β, should be zero. Results of the Heckman estimation model is displayed in Table 3.5. The coefficient of the *Inverse Mills Ratio* in the second stage regression is positive and significant, indicating that unobservable factors arising from VCs' funding choice affect the tone of MD&A disclosures. Nonetheless, the coefficient of the main variable of interest, *VC IPO*, remains negative and significant at the 1% level even after addressing the issue of selection bias. This result strengthens the baseline result and implies that VC-backed firms do influence the tone of the MD&A disclosure in the IPO prospectuses.

3.4.2 Propensity Score Matching

To establish causality, it would be ideal to observe the tone of a VC-backed firm in the event if it does not receive funding and vice versa but such experiment is not possible. Specifically, given that Y_1 is the tone of VC-backed IPOs and Y_0 is the tone of the same firm had it not been backed by a VC. Similar to the notion in Lee and Wahal (2004), I am interested in the difference between the tone of VC-backed IPOs and non-VC backed IPOs, denoted by $Y_1 - Y_0$. Since Y_0 cannot be observed, the next step is to estimate the average treatment effect (ATE):

$$ATE = E(Y_1|W = 1, \boldsymbol{X}) - E(Y_0|W = 0, \boldsymbol{X}) \tag{3.4}$$

W is a dummy variable which equals to 1 if a firm is VC-backed, and 0 otherwise. Using $\boldsymbol{X}$ vector of control variables, $E(Y_1|W = 1, \boldsymbol{X})$ is the estimate of the average tone of VC-backed IPOs and $E(Y_0|W = 1, \boldsymbol{X})$ is the estimate of the average tone of non-VC-backed IPOs. The resulting ATE bears a statistically significant coefficient of -0.065 (t-stat: -3.44), showing that the treated firms are more conservative in regulatory disclosures as compared to firms in the control group. However, this estimate presents a bias as VC funding could be an endogenous choice (i.e. related to observable characteristics of the firm) and is not randomised. Even controlling for observable characteristics $\boldsymbol{X}$, it could be the case that VC-backed IPOs have a larger $Y_1 - Y_0$ than those which do not receive VC-funding.

Therefore, I use the propensity score method proposed by Rosenbaum and Rubin (1983) to construct a control group that is similar to firms that are VC funded on various characteristics to gauge the effect of VC on tone. First, following Lee and Wahal (2004), I run a probit regression of a dummy variable that equals to 1 if a firm is backed by VC and 0 otherwise to estimate the probability for the endogenous variable, *VC IPO*. The independent variables in the probit model are a vector of control variables, $\boldsymbol{X}$ and instrumental variables similar to the Heckman-type two-stage model in the previous section. Second, each treatment firm ($W = 1$) is matched[15] to a firm in the control group with the highest propensity score obtained from the first step. The outcome of the pre- and post-matching regressions are presented in Table 3.6, Columns 1 and 2 respectively. The Pseudo-R^2 in the post-treatment regression drops to 8.27% and majority of the independent variables are not statistically significant. This result

[15]All one-to-one matching is done with replacement.

indicates that observable factors of the matched sample have little or no predicting power in the probability of receiving treatment.

The matched sample yields 103 unique treatment and 333 treatment firms since one control firm may be matched to more than one treatment firm. Third, the baseline model is re-estimated using the matched sample and the results shown are in Table 3.6, Column 4. The coefficient of the variable of interest, *VC IPO*, is still negative and statistically significant after the matching process. The baseline findings remain robust.

Despite the negative relation between VC-backed firms and tone, it is not clear why these firms choose to be less optimistic in their disclosures. Accordingly, I offer some plausible explanations to this negative relationship in the following sections.

3.5 Tone and Litigation

Since VC-backed firms are more likely to experience litigation (Lowry and Shu 2002), they are less likely to engage in overly optimistic tone, possibly to mitigate the chance of being litigated (Atanasov et al. 2012; Hanley and Hoberg 2012). To test this conjecture, I follow the methodology in Hanley and Hoberg (2012) and hand-collect data from the Stanford Law School's Securities Class Action Clearinghouse database[16].

Out of the total sample of 649 firms, approximately 63 (or 9.7%) and 75 (or 11.6%) IPO firms are sued under Section 11 and Rule 10b-5 respectively. At SEO, these figures stand at 49 (or 7.6%) and 51 (or 7.9%) for Section 11 and Rule 10b-5 lawsuits correspondingly. Defendants of Section 11 of the Securities Act of 1933 are alleged to make material omission or disclose misleading information in firms' prospectuses.

[16] Available at http://securities.stanford.edu/

This type of class action lawsuit can only be filed by IPO investors whereas lawsuits pursuant to Rule 10b-5 (Securities Exchange Act 1934) assert that the intention for material omission is to deceit or defraud and can be filed by any investors.

A logit model where the dependent variable is a binary variable (1 = if litigated successfully; 0 = otherwise) and the independent variables are similar to those in the baseline model is estimated. Results presented in Table 3.8 offer some evidence that VC-backed firms are more likely to be litigated (all columns except for 1 and 3). In the event if a firm is not backed by any VC, the average impact of tone on litigation is positive (β_2). Similarly, for a VC-funded firm, the average effect is 0.2818 ($=\beta_1$VC + [β_2+β_3]Tone) when tone is held at the mean level. Overall, there seem to be a positive effect of tone on the probability of being litigated successfully. However, for a clearer interpretation of the influence of VC on litigation through tone management, it is necessary to examine the effect at different levels of tone. Results in Columns 2 and 6 of Table 3.8 are presented in terms of average marginal effects (see Figure 3.1). In Figure 3.1a, a drop in tone from -0.626 to -0.726, or an increase in 63 more negative words, ceteris paribus, leads to a 3.9% reduction[17] in the probability of a VC-backed firm being litigated under Section 11[18].

Findings are consistent with the notion that the probability of VC-backed firms being sued decreases with a decline in tone (i.e. become more conservative). Therefore, results not only emphasize that VC-backed IPO firms manage tone, but rather, give

[17]Results are similar for non-VC backed firms.

[18]In an unreported test, similar implications are documented when litigation under Rule 10b-5 is used as the dependent variable.

support to the conjecture that they use tone management strategically to reduce possible reputational losses.

3.6 Tone and Information Content

3.6.1 Tone and Syndicate Members

To the extent that VCs are often associated with better-quality syndicate members at IPO (Gorman and Sahlman 1989; Sahlman 1990), they may engage in tone management when they work with these members. Moreover, the rationale behind tone management could be attributed to the increase in monitoring by large auditors and analysts in the sense that VC-backed firms may exercise more care (i.e. more conservative) in their regulatory disclosures with the presence of these members. Therefore, I expect that the effect of VCs on tone remains pervasive when they are associated with Big 4 auditors and are followed by more equity analysts.

Table 3.7 displays results from repeating the estimation of the main model, Equation 3.1, on various sub-samples. Not surprisingly, findings in Columns 2 to 5 of Table 3.7 provide support to prior work (Bradley et al. 2003; Liu et al. 2014) and illustrate that VCs are less likely to be optimistic in their MD&A disclosures when the influence of syndication exists. The coefficients of the *VC IPO* variable in Columns 3[19] and 5 are negative and statistically significant at the 10% and 5% levels respectively. This results may suggest that VCs and their syndicate members signal quality

[19]The impact attenuates as the coefficient of the *VC IPO* variable increases from -0.054 (full sample) to -0.050. The evidence of tone conservatism of VC-backed firms using Big 4 auditors is weak. Thus, I cannot rule out that tone conservatism may not differ across auditors.

through tone management (Gorman and Sahlman 1989; Sahlman 1990) and may also be associated with the increase in oversight of the firms.

Besides contributing to the literature that VCs work closely within their networks of syndicate members, the findings also point out that the impact of VCs on tone is more pronounced for firms in the high-tech sectors and operating in highly-litigious industries. Columns 6 to 9 of Table 3.7 presents the estimation results of the sub-sample analyses of firms in the high-tech industries and firms that conduct their businesses in highly-litigious sectors. They are split into *Tech* and *Other Firms* using the method proposed by Loughran and Ritter (2004) and partitioned into *Low* and *High Litigation Risk* following the approach developed by Lim and Tan (2008).

This supports the notion proposed by Ferris et al. (2013) that high technology firms are more conservative (less optimistic) in their disclosures. Firms that belong to the high-tech industries are usually younger and face higher level of risks. Similar results are inferred from an unreported test in which VC-backed SEO firms operating in the high technology sectors are found to have a negative and significant (at 5% level) relation with SEO tone. However, the syndicate effect disappears at SEO as VC-funded firms are not linked to prestigious underwriters or the number of analysts following these firms.

3.6.2 Partial Adjustment Theory and VC-backed IPOs

Hanley (1993) documents that the "partial adjustment phenomenon" is an outcome of providing compensation for investors who render information prior to the IPO. Information gathered from the investors at the roadshow is partially reflected by the

offer price revision, and the rest, in the form of underpricing. The author also argued that an upward revision in the initial filing price of an IPO is linked to the high demand generated by the book-building process. Besides, a recent study by Hanley and Hoberg (2012) relate positive revisions to the production of new information after the initial filing stage.

In addition to the partial adjustment theory, Cook et al. (2006) and Loughran and McDonald (2013) also reveal that VC-backed IPOs are subject to larger price revisions. Cook et al. (2006) attribute the price revision to the marketing efforts by underwriters to solicit participation from sentiment investors, thereby, increasing the demand and accordingly, the revision of the initial offer price. On a separate note, Loughran and McDonald (2013) conjecture that a larger absolute price revision of VC-backed IPOs is due to the perception that firms are unable to obtain other traditional forms of financing and seek funding from VCs "as capital providers of the last resort". Therefore, I expect that VC-backed IPOs will be more prone to offer price revision and a greater tendency of receiving an upward adjustment.

Table 3.9, Column 1, shows the outcome of a multivariate regression in which the dependent variable is the positive values of the initial offer price adjustment and the independent variables are identical to those used in Equation 3.1. Results illustrate that VC-backed IPOs are 1.5% more likely to receive a positive price revision as compared to non-VC-backed IPOs. Coefficient of the *VC IPO* variable is positive and statistically significant at the 10% level.

However, in Column 2, when an interaction variable, *VC IPO*IPO Tone* is added as a regressor, results reveal that firms with VC funding do not engage in tone management

to obtain upward offer price revision by underwriters. To observe whether findings are applicable in the SEO market, I repeat the analysis with control variables used in the baseline model and results are displayed in Table 3.10, Columns 1 and 2. Similarly, there is no evidence exhibiting that VC-backed firms manage disclosure tone to obtain positive price revision. Both findings are inconsistent with Cook et al. (2006), Hanley and Hoberg (2012) and Loughran and McDonald (2013). One possible explanation is that VC-backed firms may have the intention to manipulate tone in other aspects of the offering for long-term benefits. The next section proceeds to explore the impact of tone on pricing accuracy.

3.6.3 Price Accuracy and Surprise Unexpected Earnings

Loughran and McDonald (2014) demonstrate that firms with well-written annual reports are more likely to experience smaller absolute surprise unexpected earnings (SUE) and standard deviation of the analysts' earnings per share (EPS) forecasts. The authors postulate that, while SUE can be viewed as the measurement of analysts' forecast accuracy, it can also be seen as an assessment of the efficacy of valuation information. In a similar vein, Lehavy et al. (2011) find that the more difficult it is to read firms disclosures (measured by the Gunning Fog index), the higher is the dispersion of analysts' forecasts. These firms also have analysts' forecasts that are lower in accuracy and sustain greater uncertainty.

Since VCs' influence improves information flow between firms and market participants, analysts' consensus should be more accurate and subject to smaller surprise EPS. I re-estimate Equation 3.1, replacing the dependent variable with the *Surprise*

EPS variable, calculated by taking the difference between the actual and mean EPS values of analysts' forecast, divided by the standard deviation of forecast values. Data is obtained from the Institutional Brokers' Estimate System (I/B/E/S) file, using the most recent annual EPS forecast prior to the date of the earnings announcement.

Results from the estimates are reflected in Columns 3 to 8 of Table 3.9. The coefficients of *VC IPO* are positive and statistically significant, contrary to my expectation regarding VCs' role of attenuating information asymmetry. Instead, VC-backed IPOs have larger surprise EPS as compared to IPO firms without such financing. Furthermore, VC-funded firms suffer from larger forecast discrepancies and this effect persists three years after the equity issuance. There are two potential explanations for these findings. First, in spite of the finding which shows that VC-backed firms have a positive relation with surprise EPS that is more pronounced in the longer run, this effect may be reduced if they use tone management. Second, it may be arduous to value these firms accurately as they are young and are operating in vulnerable industries.

I evaluate the first inference by adding an interaction variable, *VC IPO*IPO Tone*. Results from Column 4 of Table 3.9 show that the effect of VC-funding on *Surprise EPS* increases with tone management. This impact is more distinct in the short-run (i.e. 1 year after IPO) and seems to have no explanatory power in the long-run. Collectively, it appears that VC-backed firms use tone management to generate larger dispersion between actual and mean EPS right after an IPO.

On the contrary, IPO VCs who remain in the firm at the seasoned equity issuance do not seem to engage in tone management to produce large Surprise EPS values (Table 3.10, Columns 4, 6 and 8). Findings at the SEO strengthen the conjecture that

tone management exists only in the short-run post-IPO. The coefficients of the *VC Stay* variable in Table 3.10, Columns 3 to 8, have a positive and significant relation with *Surprise EPS*, providing evidence that these firms suffer from a higher level of forecast inaccuracy which is persistent even after SEO.

Regardless of whether VC-backed firms are subject to larger valuation errors or that the analysts' are more conservative in their forecasts, results are consistent with the notion that VC-backed firms are harder to predict. More importantly, VC-backed firms engage in tone management in the short-run and potentially increase the forecasting difficulty faced by analysts.

3.6.4 Meeting or Beating Analysts' Forecast

One follow up question emerges from the analyses of the previous sections: Do VC-backed firms perform better than non-VC-backed firms after an equity issuance? If these firms are found to be less likely to use overall positive tone in response to larger surprise unexpected earnings in the short-run, does this translate to unfavourable future performance or do they exceed analysts' expectation pertaining to their performance? In addition, if *Tone* contains private information on a firm's future performance, then I would expect that VC-backed firms will underperform as a result of the negativity portray in their disclosures. To explore the post-IPO performance of VC-funded firms, I adopt the methodology used in the accounting literature (e.g. Huang et al. 2014; Lim

and Tan 2008; Reichelt and Wang 2010).

$$MBE_{i,t} = \alpha + \beta_1 VC\ Dummy_i + \beta_2 Tone_i + \beta_3 VC\ Dummy_i * Tone_i + \theta \mathbf{X}_{i,t} + Industry\ \&\ Time\ FE + \epsilon_{i,t} \tag{3.5}$$

The above logit model uses the meet and beat analysts' forecast variable (*MBE*) as the dependent variable to examine whether the firm has surpassed expectations post-IPO. The *MBE* variable is defined as 1 if a firm meets and beats its yearly analysts' forecast by 1 cent or more, and 0 if otherwise. The variable of interest is the interaction variable, *VC Dummy*Tone*. The *VC Dummy* variable and takes on the value of 1 if a firm has a director representing the VC or if a VC retains equity stakes in the firm at each fiscal year following the issuance, and 0 otherwise. The construction of the *VC Dummy* variable is similar to the *VC IPO*, *VC Stay* and *VC SEO* variables used in the previous section.

The control variables in the estimation model are the standard deviation of the analysts' forecast values (σ*(Forecast)*), the natural log of the number of analysts following the firm (*Log(Forecast)*), book-to-market ratio (*BTM Ratio*), natural log of the market capitalization (*Log(MktCap)*), earnings before extraordinary items (*Earnings*), a net loss dummy variable (*Net Loss Dummy*) that indicates 1 if a firm declares negative net income (0 otherwise) and *Cash Flows from Operations*. The *IPO/SEO Underpricing*, *IB Reputation* variable and *Litigation* dummy are obtained from the baseline specification and the *Big 4 Auditor* dummy from the sub-sample analysis (Table 3.7). Some observations are lost after matching firms' CUSIPs with the I/B/E/S archive for analysts' forecast data and Compustat for accounting data. Industry and

year fixed effects[20] are controlled with two-digit SIC codes and fiscal year dummy variables.

Across Columns 1 to 5 of Table 3.11, results illustrate that firms suffering from a loss in net income are less likely to meet and beat analysts' forecast, in line with the findings in Lim and Tan (2008) and Reichelt and Wang (2010). These results offer a possible explanation in which less well-governed firms tend to have worse future performance and are unable to meet market expectations.

From Table 3.11, across Columns 1 to 5, the coefficients of the *VC Dummy* reflect a positive relation with the likelihood of a VC-backed firm meeting and beating analysts' forecast post-IPO. The association is only significant in the last specification (Column 5), which suggests that the impact of VC on future performance is significant in the long-run. It could also imply that VCs have a long-standing working relationship with their portfolio firms and their influence on these firms extend beyond the initial public offering. The interaction variable, *VC Dummy* Tone* demonstrate that, even though VC-backed firms are more conservative in tone at IPO and SEO, tone does not seem to contain information on firms' future performance.

Coupled with the evidence from the previous section that VC-backed firms are subject to inaccurate valuation by underwriters and low-ball earnings forecast by analysts, they tend to beat the consensus target and perform well in the long-run. Findings strengthen the conjecture from commingled forces; their good future performance is associated with conservative disclosure in the short-run with the intention to cope

[20]Year fixed effects are more relevant in this estimation model as compared to *PostSOX* dummy used to the main regression. This is to reduce concern that the effect VC has on MBE is the result of timing and market conditions.

with potential litigation risks as well as their ability to perform and surpass market expectations.

3.7 Consequence of Tone Management

In the previous sections, attempts have been taken to offer plausible explanations to why VC-backed firms have a negative association with tone. However, a natural progression would be to question the consequence of tone management on equity offerings. Thus, I re-estimate the baseline equation, replacing the dependent variable with the *Adjusted Underpricing* variable, measured by the market-adjusted initial returns of IPOs and the independent variables are the interaction between the *VC IPO*, *IPO Tone* and *Litigation Dummy* variables, as well as a set of baseline controls. Regressions are controlled with industry and yearly fixed effects to address any heterogeneity factors within industries and potential IPO trends (hot and cold).

Results in Table 3.12 reflect that whether VC-backed firms operate in the litigious sector (Litg Dummy=1) or otherwise (Litg Dummy=0), tone has a positive link[21] with underpricing. To mitigate the possible effect that the tightening of the regulatory environment may influence underpricing, a *PostSOX* dummy variable, that takes the value of 1 if the equity offer is issued before 2002 and 0 otherwise, is added in the regression indicated in Table 3.12, Column 2. Finding of a positive relation between tone and underpricing VC-backed firms remain consistent and lend some evidence that firms funded by VCs can use conservatism to alleviate the degree of underpricing. For

[21]Drawing inference from Table 3.12, Column 2, the resulting coefficients are 0.1215 and 0.1133 for Litg Dummy=1 and Litg Dummy=0, respectively.

non-VC-backed IPOs, tone has almost no impact on underpricing as the corresponding coefficient[22] is close to zero.

3.8 Summary

This essay examines how and why VC-backed firms manage their tone during initial public offerings (IPO) and seasoned equity offerings (SEO). Analysis conducted using the Management Discussion and Analysis section of the prospectuses from 1997 to 2011 show that VC funded firms are more negative in tone. VC-financed firms do so to reduce litigation risks and protect their reputational capital; the effects of conservative tone management is more pronounced when they hire large auditors, receive more analyst coverage, operate in high tech sectors and in industries with high litigation risk. Further, negative tone is not related to the conveying of private information as IPO firms that received VC funding experience larger surprise unexpected returns and perform better than non-VC backed offers in the long run.

[22]For instance, in Table 3.12, column 2, when VC=0 and Litg Dummy=1, the coefficient is 0.0003 and for Litg Dummy=0, the coefficient is 0.008.

3.9 Tables, Figures and Appendices

Table 3.1 Tone and Venture Capital

The table shows the relationship between Tone and firms with Venture Capital funding at IPO and SEO. The number of total, positive, negative words in the Management Discussion & Analysis (MD&A) section of a firm's prospectus is denoted by w_{it}, g_{it} and b_{it} respectively. Standard errors are calculated using White-errors and t-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

Authors	Tone Measurements	Adjusted-R^2	IPO Tone	Adjusted-R^2	SEO Tone
García (2013)	$\frac{g_{it}-b_{it}}{g_{it}+b_{it}}$	1.64%	-0.065***	0.14%	-0.025
			(-3.44)		(-1.40)
Loughran and McDonald (2013)	$\frac{g_{it}-b_{it}}{w_{it}}$	0.58%	-0.001**	0.07%	0.000
			(-2.20)		(-1.21)
Gurun and Butler (2012)	$-\frac{b_{it}}{w_{it}}$	1.64%	-0.033***	-0.01%	-0.031
			(-3.44)		(-0.96)
Clements and Reade (2016)	Alba Sentiments	0.40%	-0.015*	0.11%	-0.012
			(-1.90)		(-1.31)

Table 3.2 IPO Summary Statistics

The table shows the mean, median, standard deviation of the variables of both VC- and Non-VC- backed firms. The last two columns are the results of the difference in means (t-statistics) and medians (Wilcoxon rank-sum/Mann-Whitney) respectively. T- and z-statistics are displayed in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	VC-backed firm; n=333			Non-VC-backed firm; n=316			Test of Difference	
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	t-statistic	z-statistic
IPO Tone	-0.287	-0.315	0.247	-0.221	-0.262	0.235	0.065***	0.053***
							(3.44)	(3.62)
Negative Words	60.4	53.0	34.8	81.2	66.0	66.5	20.8***	13.0***
							(5.02)	(3.39)
Positive Words	32.4	25.0	19.7	48.1	40.0	37.4	15.6***	15.0***
							(6.71)	(5.90)
No. of Sentences	255.2	223.0	125.3	334.7	290.0	177.8	79.5***	67.0***
							(6.61)	(5.91)
No. of Words	6706.4	5436.0	3690.3	8800.8	7285.0	5478.1	2094.4***	1849.0***
							(5.74)	(5.35)
Firm Size	17.802	17.632	1.049	19.144	19.279	1.719	1.342***	1.647***
							(12.08)	(11.41)
Offer Size	18.062	18.035	0.565	18.577	18.518	0.933	0.515***	0.483***
							(8.55)	(8.05)
IV Sentiments	10.973	15.000	6.580	9.501	15.000	6.834	-1.472***	0.000***
							(-2.80)	(-3.45)
IPO Underpricing	0.498	0.232	0.732	0.206	0.081	0.547	-0.292***	-0.151***
							(-5.73)	(-6.05)
IB Reputation	8.304	8.501	0.945	8.035	8.501	1.268	-0.270***	0.000***
							(-3.08)	(-2.74)
%High Education	0.239	0.167	0.220	0.131	0.108	0.126	-0.108***	-0.058***
							(-7.64)	(-5.87)
%Non-executive	0.426	0.421	0.114	0.427	0.429	0.144	0.001	0.008
							(0.13)	(0.25)
Tech Dummy	0.505	1.000	0.501	0.237	0.000	0.426	-0.267***	-1.000***
							(-7.30)	(-7.02)
Health Dummy	0.294	0.000	0.456	0.092	0.000	0.289	-0.203***	0.000***
							(-6.71)	(-6.50)

Table 3.3 SEO Summary Statistics

The table shows the mean, median, standard deviation of the variables of both VC- and Non-VC- backed firms. The last two columns are the results of the difference in means (t-statistics) and medians (Wilcoxon rank-sum/Mann-Whitney) respectively. T- and z-statistics are displayed in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	VC-backed firm; n=367			Non-VC-backed firm; n=282			Test of Difference	
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	t-statistic	z-statistic
SEO Tone	-0.258	-0.288	0.240	-0.233	-0.258	0.222	0.025	0.031
							(1.38)	(1.64)
Negative Words	80.7	63.0	85.2	95.2	75.5	77.0	14.5**	12.5***
							(2.24)	(3.11)
Positive Words	45.2	34.0	43.0	53.1	46.0	33.5	7.9**	12.0***
							(2.54)	(4.68)
No. of Sentences	291.9	254.0	150.1	358.0	321.0	181.4	66.1***	67.0***
							(5.08)	(4.83)
No. of Words	7904.3	6566.0	4882.8	9598.1	8205.5	5452.6	1693.8***	1639.5***
							(4.16)	(4.39)
Firm Size	18.751	18.640	1.002	19.717	19.700	1.379	0.966***	1.060***
							(10.34)	(9.60)
Offer Size	18.483	18.463	0.960	18.607	18.615	0.990	0.124	0.152*
							(1.61)	(1.74)
IV Sentiments	8.983	13.671	9.588	9.758	14.912	9.883	0.775	1.241
							(1.01)	(0.51)
SEO Underpricing	0.033	0.019	0.061	0.029	0.017	0.054	-0.004	-0.002
							(-0.88)	(-0.65)
IB Reputation	8.157	8.501	1.050	8.000	8.501	1.340	-0.157*	0.000
							(-1.68)	(-0.90)
%High Education	0.232	0.182	0.205	0.136	0.111	0.115	-0.096***	-0.071***
							(-7.08)	(-5.54)
%Non-executive	0.450	0.455	0.114	0.465	0.462	0.130	0.014	0.007
							(1.50)	(1.54)
Years to SEO	1.685	0.900	1.853	2.407	1.191	2.757	0.722***	0.291***
							(3.98)	(3.67)
Price Cluster Dummy	0.815	1.000	0.389	0.780	1.000	0.415	-0.035	0.000
							(-1.09)	(-1.09)
CAR (-5, -1)	-0.034	-0.036	0.144	-0.040	-0.032	0.094	-0.006	0.004
							(-0.59)	(0.06)
Litigation Dummy	0.580	1.000	0.494	0.277	0.000	0.448	-0.304***	-1.000***
							(-8.08)	(-7.71)
Lock-up Dummy	0.076	0.000	0.266	0.067	0.000	0.251	-0.009	0.000
							(-0.43)	(-0.43)

Table 3.4 Regression Results: Tone and Venture Capital

The table presents results from multivariate regressions with heteroskedasticity-covariance (White) standard errors. Tone is measured by the difference between positive and negative words in a firm's MD&A, scaled by the sum of positive and negative words. Results remain unchanged when three other measurements of tone (refer to Table 3.1) are used as the dependent variable. Definition and construction of the independent variables are shown in Appendix D. Columns 1 to 4 display findings at the IPO. Column 5 shows the results when the variable of interest is *VC SEO*, a dummy variable that has the value of 1 if a firm has VC-backing at SEO, and 0 otherwise. Column 6 presents results when a dummy variable, *VC Stay* (=1 if a firm has its IPO VC at the SEO, 0 otherwise) is replaced as the variable of interest. *T*-statistics, calculated with robust standard errors are in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	IPO Tone				*SEO Tone*	
	(1)	(2)	(3)	(4)	(5)	(6)
VC IPO	-0.096***	-0.095***	-0.055**	-0.054**		
	(-4.11)	(-4.06)	(-2.24)	(-2.20)		
VC SEO					-0.039*	
					(-1.75)	
VC Stay						-0.041*
						(-1.77)
Firm Size	0.020**	0.021**	0.014	0.014	0.007	0.006
	(2.35)	(2.41)	(1.55)	(1.57)	(0.68)	(0.59)
Offer Size	-0.067***	-0.065***	-0.046**	-0.046**	-0.003	-0.003
	(-3.70)	(-3.61)	(-2.52)	(-2.47)	(-0.25)	(-0.24)
IV Sentiments	0.004**	0.003**	0.003*	0.003*	-0.001	-0.001
	(2.33)	(2.26)	(1.77)	(1.73)	(-1.27)	(-1.27)
IPO Underpricing	-0.050**	-0.052**	-0.041*	-0.042*		
	(-2.18)	(-2.21)	(-1.65)	(-1.66)		
SEO Underpricing					-0.234	-0.229
					(-1.54)	(-1.50)
IB Reputation	0.011	0.010	0.006	0.006	-0.003	-0.003
	(1.23)	(1.12)	(0.69)	(0.65)	(-0.34)	(-0.32)
%High Education	0.286***	0.292***	0.098	0.099	0.126	0.131
	(4.89)	(5.03)	(1.29)	(1.31)	(1.60)	(1.65)
%Non-executive		-0.092		-0.061	-0.016	-0.024
		(-1.22)		(-0.81)	(-0.19)	(-0.30)
Years to SEO					-0.005	-0.005
					(-1.07)	(-1.06)
Price Cluster Dummy					0.002	0.002
					(0.11)	(0.07)
CAR (-5, -1)					0.059	0.060
					(0.65)	(0.67)
Litigation Dummy					0.051*	0.053*
					(1.86)	(1.94)
Lock-up Dummy					0.060	0.060
					(1.59)	(1.60)
Constant	0.473**	0.482**	0.010	0.025	-0.389*	-0.372*
	(1.99)	(2.02)	(0.04)	(0.10)	(-1.77)	(-1.69)
Industry FE	No	No	Yes	Yes	Yes	Yes
Post-SOX	No	No	Yes	Yes	Yes	Yes
Observations	649	649	649	649	649	649
Adjusted-R^2	10.50%	10.60%	17.20%	17.20%	13.70%	13.70%

Table 3.5 Heckman Two-stage Model

The table presents results from Heckman Two-stage Selection Model. In the first stage, a probit regression is used to estimate the probability of a firm being backed by a venture capitalist. The independent variables are the increase in the National Science Foundation (NSF) basic research grant in real million dollar term, real GDP growth the year during a firm's IPO and the control variables in this regression are similar to those employed in the baseline model. The Inverse Mills ratio is obtained from the residuals of the first stage probit regression and added as an additional regressor in the second stage. Standard errors are calculated using White-errors. T-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

First-stage Dependent Variable: VC Funding Dummy		Second-stage Dependent Variable: Tone	
Increase in NSF Basic Grant	0.000**	VC IPO	-0.078***
	(2.05)		(-3.19)
GDP Growth	-0.041	Inverse Mills Ratio	0.128**
	(-0.85)		(2.00)
Firm Size	-0.284***	Firm Size	-0.008
	(-3.99)		(-0.59)
Offer Size	-0.371***	Offer Size	-0.087***
	(-2.94)		(-3.52)
IV Sentiments	0.017*	IV Sentiments	0.005***
	(1.80)		(2.97)
IPO Underpricing	0.276**	IPO Underpricing	-0.026
	(2.03)		(-0.96)
IB Reputation	0.319***	IB Reputation	0.038**
	(4.75)		(2.42)
%High Education	1.581***	%High Education	0.297***
	(4.05)		(3.53)
%Non-executive	0.421	%Non-executive	-0.039
	(0.84)		(-0.51)
Tech Dummy	0.781***	Tech Dummy	-0.010
	(5.57)		(-0.24)
Health Dummy	0.725***	Health Dummy	0.095**
	(3.80)		(2.06)
Post-Sox	0.064	Post-Sox	-0.008
	(0.42)		(-0.40)
Constant	8.113***	Constant	1.013***
	(4.85)		(2.66)
Observations	649	Observations	649
Chi^2	199.8		
Pseudo-R^2	31.93%	Adjusted-R^2	12.94%

Table 3.6 Propensity Score Matching

The table presents results of the Propensity Score Matching model. The dependent variable in Columns 1 and 2 takes the value of 1 (=treatment firm) if an IPO firm is backed by VC and 0 otherwise. Column 1 is a Probit regression for the estimation of the probability of a firm being funded by a venture capitalist and the independent variables are the increase in the National Science Foundation (NSF) basic research grant in real million dollar term, real GDP growth the year during a firm's IPO and the control variables are similar to those employed in the baseline model. Firms in the control group are matched to treatment firms with the nearest propensity score. Column 2 shows the results of the Probit regression after the firms are treated. The average treatment effect between the treatment and the control group is significant (coefficient of -0.065, t-stats -3.44). Columns 3 and 4 report the selection bias adjusted average tone differences between VC backed and non-VC backed IPOs before and after treatment using the propensity score method. Standard errors are calculated using White-errors. *T*-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Pre-Match	Post-Match	Tone (All Firms)	Tone (Matched)
	(1)	(2)	(3)	(4)
VC IPO			-0.079***	-0.052**
			(-3.25)	(-2.57)
Increase in NSF Basic Grant	0.000**	0.000		
	(2.05)	(-0.28)		
GDP Growth	-0.041	-0.022		
	(-0.85)	(-0.35)		
Firm Size	-0.284***	-0.036	0.014	0.019**
	(-3.99)	(-0.43)	(1.60)	(2.42)
Offer Size	-0.371***	-0.252	-0.056***	-0.023
	(-2.94)	(-1.61)	(-3.14)	(-1.19)
IV Sentiments	0.017*	0.006	0.004**	0.000
	(1.80)	(0.50)	(2.35)	(0.23)
IPO Underpricing	0.276**	0.174	-0.044*	0.016
	(2.03)	(1.19)	(-1.80)	(1.24)
IB Reputation	0.319***	0.221***	0.012	0.003
	(4.75)	(3.04)	(1.39)	(0.42)
%High Education	1.581***	1.146**	0.192***	-0.083
	(4.05)	(2.48)	(2.88)	(-1.18)
%Non-executive	0.421	-0.232	-0.089	0.021
	(0.84)	(-0.36)	(-1.19)	(0.30)
PostSOX	0.064	0.134	-0.021	0.014
	(0.42)	(0.70)	(-1.04)	(0.62)
Tech Dummy	0.781***	0.331*	-0.078***	-0.042*
	(5.57)	(1.94)	(-3.25)	(-1.94)
Health Dummy	0.725***	0.373	0.034	0.118***
	(3.80)	(1.50)	(1.01)	(3.26)
Constant	8.113***	3.670	0.469*	-0.190
	(4.85)	(1.62)	(1.93)	(-0.69)
Observations	649	436	649	666
Pseudo/Adjusted-R^2	31.90%	8.27%	12.49%	4.70%

Table 3.7 VC, Tone and Syndicate Members

This table presents results from several sub-sample analysis that examine the relation between IPO Tone and VC-backed firms. Tone is measured by the difference between the number of positive and negative words in a firm's MD&A Section of its IPO prospectus, divided by the sum of positive and negative words. *Other Auditors* are non-Big 4 auditors. *Big 4 Auditors* are firms that engage Deloitte, Ernst and Young, KPMG or PricewaterhouseCoopers as their auditing firms at IPO. Columns 4 and 5 are regression based on the respective number of analysts' following the firm post-IPO. *Other Firms* are firms belonging to industries other than in tech or health care, whereas *Tech Firms* are firms that fall into Loughran and Ritter (2004) SIC classification of high-technology firms. *High Lit Risk* represents firms that are classified as having high exposure to litigation risk Lim and Tan, 2008). The rest of the firms are tagged as *Low Lit Risk*. Definition and construction of the independent variables are displayed in Appendix D. Standard errors are calculated using White-errors and t-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and *** correspondingly.

	IPO Tone								
	Full Sample (1)	Other Auditors (2)	Big4 Auditors (3)	<5 Analysts (4)	⩾5 Analysts (5)	Other Firms (6)	Tech Firms (7)	Low Lit Risk (8)	High Lit Risk (9)
VC IPO	-0.054**	-0.078	-0.050*	-0.024	-0.126**	-0.046	-0.069**	-0.024	-0.121***
	(-2.20)	(-1.31)	(-1.73)	(-0.76)	(-2.47)	(-1.17)	(-2.12)	(-0.82)	(-2.77)
Firm Size	0.014	0.031	0.008	0.023*	0.007	0.009	0.015	0.007	0.020
	(1.57)	(1.06)	(0.83)	(1.75)	(0.44)	(0.59)	(1.21)	(0.60)	(1.28)
Offer Size	-0.046**	-0.120**	-0.021	-0.050*	-0.059*	-0.038	-0.030	-0.018	-0.064*
	(-2.47)	(-2.46)	(-1.03)	(-1.92)	(-1.70)	(-1.52)	(-1.21)	(-0.85)	(-1.95)
IV Sentiments	0.003*	0.002	0.003	0.002	0.002	0.008***	0.000	0.003	0.003
	(1.73)	(0.59)	(1.53)	(0.82)	(0.89)	(3.42)	(0.22)	(1.45)	(1.19)
IPO Underpricing	-0.042*	0.005	-0.042	-0.034	-0.032	-0.093***	-0.029	-0.034*	-0.054
	(-1.66)	(0.10)	(-1.48)	(-0.87)	(-1.21)	(-2.84)	(-1.07)	(-1.69)	(-1.11)
IB Reputation	0.006	0.020	0.002	0.005	-0.005	-0.009	0.014	-0.011	0.040**
	(0.65)	(0.86)	(0.20)	(0.49)	(-0.18)	(-0.58)	(1.11)	(-1.08)	(2.15)
%High Education	0.099	-0.200	0.137*	-0.003	0.244	-0.047	0.091	-0.106	0.244**
	(1.31)	(-0.87)	(1.75)	(-0.02)	(1.64)	(-0.30)	(0.99)	(-0.89)	(2.34)
%Non-executive	-0.061	-0.304*	0.023	-0.053	0.085	-0.121	-0.042	-0.140	0.040
	(-0.81)	(-1.71)	(0.26)	(-0.56)	(0.59)	(-1.00)	(-0.41)	(-1.37)	(0.36)
Constant	0.025	1.078*	-0.019	0.287	0.469	0.164	0.088	-0.155	0.304
	(0.10)	(1.90)	(-0.06)	(0.74)	(0.88)	(0.43)	(0.25)	(-0.51)	(0.67)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post-SOX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	130	519	403	219	279	370	358	291
Adjusted-R^2	17.20%	28.40%	14.80%	21.90%	5.80%	18.80%	16.50%	16.20%	21.10%

Table 3.8 VC and Probability of a Class Action Lawsuit

This table presents the results from a logit model, showing the relation between VC-backed firms and the probability of being sued. The dependent variables are dummy variables and take the value of 1 if a firm is being sued under Section 11 or Rule 10b-5 following an IPO or SEO, and 0 otherwise. Class action lawsuits are obtained from *Stanford Law School's Securities Class Action Clearinghouse* Database. Definition and construction of the independent variables are displayed in Appendix D. Standard errors are calculated using White-errors and z-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and *** correspondingly.

	IPO Section 11		*IPO Rule 10b-5*		*SEO Section 11*		*SEO Rule 10b-5*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VC IPO	0.362	2.154*	0.720	2.725*				
	(0.72)	(1.82)	(1.46)	(1.84)				
IPO Tone		-8.017***		-9.387***				
		(-3.93)		(-3.54)				
VC IPO*IPO Tone		4.881**		5.339*				
		(1.98)		(1.76)				
VC Stay					1.154**	2.423**	1.219**	2.702**
					(2.09)	(2.02)	(2.21)	(2.25)
SEO Tone						-4.254*		-4.187*
						(-1.77)		(-1.71)
VC Stay*SEO Tone						3.983		4.579*
						(1.53)		(1.72)
Firm Size	-0.100	-0.119	-0.305*	-0.358**	-0.574**	-0.519**	-0.533**	-0.485*
	(-0.58)	(-0.67)	(-1.70)	(-1.97)	(-2.22)	(-1.98)	(-2.14)	(-1.89)
Offer Size	0.185	0.235	0.674**	0.785**	1.139***	1.143***	1.184***	1.204***
	(0.58)	(0.75)	(2.06)	(2.43)	(3.62)	(3.58)	(3.89)	(3.83)
IV Sentiments	0.064	0.066	0.063	0.078	0.009	0.010	0.015	0.015
	(1.09)	(1.43)	(0.95)	(1.42)	(0.66)	(0.73)	(0.89)	(1.00)
IPO Underpricing	1.416***	1.401***	1.656***	1.633***				
	(3.65)	(6.00)	(3.28)	(5.52)				
SEO Underpricing					-3.054	-3.737	0.586	-0.058
					(-0.92)	(-1.06)	(0.17)	(-0.02)
IB Reputation	0.240	0.206	0.226	0.183	1.227**	1.158**	1.120**	1.058**
	(0.92)	(0.74)	(0.88)	(0.68)	(2.37)	(2.28)	(2.32)	(2.24)
%High Education	0.667	0.447	-0.317	-0.680	-2.978	-3.184	-2.683	-2.987
	(0.55)	(0.30)	(-0.23)	(-0.37)	(-1.14)	(-1.18)	(-1.08)	(-1.20)
%Non-executive	-1.202	-1.142	-2.133	-2.277	-2.642	-2.911	-2.556	-2.944
	(-0.78)	(-0.66)	(-1.43)	(-1.34)	(-1.40)	(-1.60)	(-1.35)	(-1.62)
Litigation Dummy	-0.695**	-0.543	-0.791**	-0.641*	-0.497	-0.330	-0.402	-0.281
	(-1.96)	(-1.46)	(-2.21)	(-1.65)	(-1.03)	(-0.70)	(-0.85)	(-0.61)
Years to SEO					-1.461***	-1.445***	-1.437***	-1.449***
					(-3.26)	(-3.24)	(-3.36)	(-3.38)
Price Cluster Dummy					1.150*	1.152*	1.196*	1.190*
					(1.80)	(1.79)	(1.86)	(1.84)
CAR (-5, -1)					-4.467**	-4.305**	-4.182**	-3.992**
					(-2.56)	(-2.56)	(-2.41)	(-2.39)
Lock-up Dummy					0.310	0.366	0.180	0.188
					(0.49)	(0.56)	(0.28)	(0.30)
Constant	-8.403*	-11.482**	-13.380***	-17.596***	-23.803***	-25.474***	-24.811***	-26.629***
	(-1.66)	(-2.36)	(-2.63)	(-3.47)	(-3.34)	(-3.53)	(-3.66)	(-3.82)
Tech & Health Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	649	649	649	649	649	649	649
Pseudo-R^2	38.70%	44.60%	46.80%	53.40%	48.70%	49.60%	49.10%	50.00%

Table 3.9 VC, Tone and Price Accuracy

This table displays results in explaining the price accuracy of VC-funded firms. Columns 1 to 8 are OLS regressions, calculated with White errors and t-statistics are quoted in parenthesis. The dependent variables are Upward Price Revision, the positive values of the percentage change in the final offer price from the initial offer price and Surprise EPS (Surprise Unexpected Earnings, one to three years ahead), calculated by taking the difference between actual EPS and average analysts' forecasts, scaled by the standard deviation of the analysts' forecast. Definition and construction of the independent variables are displayed in Appendix D. Standard errors are calculated using White-errors and t-statistics are reported in parenthesis. *, ** and ***, are significant levels at 10, 5 and 1 percent respectively.

	Upward Price Revision		Surprise EPS *Year 1*		Surprise EPS *Year 2*		Surprise EPS *Year 3*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VC IPO	0.015*	0.011	17.525***	25.814***	19.569***	19.455**	25.387***	26.176***
	(1.95)	(1.19)	(4.71)	(3.96)	(3.88)	(2.33)	(5.76)	(3.79)
IPO Tone		-0.018		-24.601**		-11.548		-16.099
		(-1.07)		(-2.12)		(-0.96)		(-1.18)
VC IPO*IPO Tone		-0.010		31.448*		1.636		4.995
		(-0.40)		(1.77)		(0.08)		(0.26)
Firm Size	-0.015***	-0.015***	-0.972	-0.852	-5.401**	-5.217**	-3.625*	-3.444*
	(-4.77)	(-4.67)	(-0.52)	(-0.46)	(-2.30)	(-2.27)	(-1.73)	(-1.66)
Offer Size	0.033***	0.032***	-6.669*	-6.985*	-3.795	-4.324	-0.593	-1.186
	(5.55)	(5.33)	(-1.84)	(-1.94)	(-0.86)	(-1.00)	(-0.15)	(-0.30)
IV Sentiments	0.003***	0.003***	-0.197	-0.181	-0.026	-0.001	-0.353	-0.327
	(6.57)	(6.63)	(-0.69)	(-0.62)	(-0.07)	(-0.00)	(-1.14)	(-1.07)
IPO Underpricing	0.026***	0.025***	3.652*	3.782*	6.552*	6.123	6.117**	5.723*
	(3.38)	(3.33)	(1.78)	(1.91)	(1.68)	(1.59)	(2.00)	(1.76)
IB Reputation	0.002	0.002	1.081	1.163	4.591**	4.678**	0.363	0.444
	(0.87)	(0.93)	(0.71)	(0.77)	(2.08)	(2.12)	(0.18)	(0.22)
%High Education	-0.005	-0.001	23.328*	19.490	3.976	4.775	13.194	14.107
	(-0.22)	(-0.06)	(1.85)	(1.59)	(0.26)	(0.32)	(1.03)	(1.04)
%Non-executive	-0.007	-0.008	11.339	8.718	14.124	13.360	4.710	4.019
	(-0.34)	(-0.37)	(0.94)	(0.72)	(0.90)	(0.85)	(0.32)	(0.27)
Constant	-0.327***	-0.324***	131.768***	123.069**	134.564**	134.427**	6.819	5.608
	(-4.26)	(-4.23)	(2.69)	(2.51)	(2.12)	(2.15)	(0.11)	(0.09)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post-SOX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	649	623	623	630	630	560	560
Adjusted-R^2	24.20%	24.40%	15.10%	15.60%	14.00%	13.80%	28.60%	28.60%

Table 3.10 VC Influence from IPO to SEO

This table shows the relationship between SEO tone and IPO VCs who remain in the same firm until the secondary offering. Columns 1 to 8 are OLS regressions, calculated with White errors and t-statistics are quoted in parenthesis. The dependent variables are Upward Price Revision, the positive values of the percentage change in the final offer price from the initial offer price and the one to three year aftermarket Surprise EPS (Surprise Unexpected Earnings), calculated by taking the difference between actual EPS and average analysts' forecasts, scaled by the standard deviation of the analysts' forecast. Definition and construction of the independent variables are displayed in Appendix D. Standard errors are calculated using White-errors and t-statistics are reported in parenthesis. *, ** and ***, are significant levels at 10, 5 and 1 percent respectively.

	Upward Price Revision		Surprise EPS *Year 1*		Surprise EPS *Year 2*		Surprise EPS *Year 3*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VC Stay	0.006	0.001	20.651***	26.528***	27.109***	24.459***	20.663***	20.667**
	(0.74)	(0.09)	(4.21)	(3.76)	(5.74)	(3.02)	(3.37)	(2.41)
SEO Tone		-0.002		-34.672**		-28.362*		-19.069
		(-0.15)		(-2.19)		(-1.78)		(-0.97)
VC Stay*SEO Tone		-0.017		25.770		-5.601		2.429
		(-0.79)		(1.24)		(-0.21)		(0.10)
Firm Size	-0.010**	-0.010**	-6.206***	-5.890***	-4.108*	-3.655	-5.341*	-5.296*
	(-2.05)	(-2.04)	(-2.75)	(-2.65)	(-1.70)	(-1.51)	(-1.89)	(-1.88)
Offer Size	0.017***	0.017***	-2.073	-2.084	0.904	0.702	1.621	1.525
	(3.31)	(3.31)	(-0.87)	(-0.86)	(0.28)	(0.22)	(0.55)	(0.52)
IV Sentiments	-0.000	-0.000	-0.180	-0.200	0.570	0.521	0.100	0.072
	(-1.21)	(-1.26)	(-0.91)	(-1.00)	(1.27)	(1.17)	(0.32)	(0.23)
SEO Underpricing	0.003	0.001	3.095	-3.443	23.412	14.563	22.795	14.370
	(0.06)	(0.03)	(0.10)	(-0.11)	(0.70)	(0.43)	(0.61)	(0.38)
IB Reputation	-0.000	-0.000	1.228	0.835	-2.752	-2.944	-0.622	-0.660
	(-0.13)	(-0.09)	(0.64)	(0.43)	(-1.41)	(-1.48)	(-0.27)	(-0.28)
%High Education	0.019	0.022	19.659	19.752	-4.347	0.622	12.955	13.670
	(0.85)	(0.97)	(1.06)	(1.08)	(-0.24)	(0.04)	(0.69)	(0.72)
%Non-executive	-0.046**	-0.044**	25.506	22.641	-7.951	-7.514	21.007	21.186
	(-2.15)	(-2.10)	(1.40)	(1.25)	(-0.43)	(-0.42)	(1.11)	(1.12)
Years to SEO	0.001	0.001	0.666	0.547	2.769**	2.590**	3.164***	3.064***
	(1.30)	(1.29)	(0.65)	(0.54)	(2.25)	(2.12)	(3.12)	(3.03)
Price Cluster Dummy	-0.004	-0.004	-1.884	-1.821	6.762	6.926	5.351	5.321
	(-0.54)	(-0.55)	(-0.33)	(-0.32)	(1.13)	(1.17)	(0.87)	(0.86)
CAR (-5, -1)	0.080**	0.079**	-26.329**	-22.998*	-16.862	-15.044	-15.254	-12.100
	(2.44)	(2.39)	(-2.04)	(-1.79)	(-1.17)	(-1.00)	(-0.84)	(-0.66)
Litigation Dummy	-0.000	0.000	8.207	9.891*	9.376	11.341	11.576	12.871*
	(-0.01)	(0.01)	(1.40)	(1.69)	(1.35)	(1.61)	(1.55)	(1.70)
Lock-up Dummy	0.017	0.018	4.606	6.061	5.726	6.909	6.889	8.048
	(0.98)	(1.00)	(0.64)	(0.85)	(0.81)	(1.00)	(1.02)	(1.15)
Constant	-0.093	-0.093	159.869***	147.661***	22.292	9.441	-7.402	-12.001
	(-1.59)	(-1.57)	(2.96)	(2.76)	(0.35)	(0.15)	(-0.11)	(-0.18)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post-SOX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	649	615	615	552	552	461	461
Adjusted-R^2	3.50%	3.40%	20.90%	21.50%	17.10%	17.90%	25.20%	25.30%

Table 3.11 Long Run Performance of Firms

The table shows results of five logistic regressions, reflecting likelihood of VC-backed firms in meeting and beating analysts' forecast post-IPO. The dependent variable is a binary variable which equals to 1 if a firm exceeds the mean analysts' coverage by 1 cent or more, and 0 otherwise. *σ(Forecast)* is the standard deviation of the analysts' forecast values, *Log(Forecast)* is the natural log of the number of analysts following the firm, *BTM Ratio* is the book-to-market ratio, *Log(Mkt Cap)* is the natural log of the market value of firm, *Earnings* is the earnings before extraordinary items, scaled by the beginning value of total assets, *Net Loss Dummy* is a binary variable and has the value of 1 if a firm suffers a loss, and 0 otherwise, *Cash Flows from Operations* is the net operating cash flows scaled by lagged total assets, *Big 4 Dummy* has the value of 1 is a firm uses a Big 4 auditor, and 0 otherwise, *IPO/SEO Underpricing* is 1 when the IPO/SEO is underpriced, 0 otherwise, *IB Reputation* is the average reputation score of the underwriters at the IPO/SEO and *Litigation Dummy* is equal to 1 if a firm operates in a highly litigious industry, 0 otherwise. Standard errors are calculated using White-errors. Z-statistics are reported in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Meet & Beat Analysts' Forecast				
	IPO_{t+1}	IPO_{t+2}	SEO_{t+1}	SEO_{t+2}	SEO_{t+3}
	(1)	(2)	(3)	(4)	(5)
VC Dummy	0.616	0.075	0.060	0.352	0.935**
	(1.40)	(0.23)	(0.17)	(1.01)	(2.38)
Tone	-0.182	-0.295	0.526	0.888	-0.347
	(-0.23)	(-0.44)	(0.74)	(1.28)	(-0.41)
VC Dummy*Tone	-0.134	-0.008	-0.256	-0.768	1.137
	(-0.12)	(-0.01)	(-0.26)	(-0.84)	(1.03)
σ(Forecast)	0.003	0.004***	-0.148	-0.035*	0.039
	(0.37)	(2.76)	(-1.54)	(-1.76)	(0.78)
Log(Forecast)	-0.517	-0.448*	-0.081	-0.201	-0.416
	(-1.57)	(-1.93)	(-0.32)	(-0.81)	(-1.55)
BTM Ratio	0.176	-0.099	-0.110	-0.034	-1.347***
	(0.90)	(-1.16)	(-0.55)	(-0.54)	(-3.39)
Log(Mkt Cap)	0.608***	0.204**	0.391***	0.276**	0.086
	(4.68)	(2.07)	(3.18)	(2.34)	(0.48)
Earnings	0.068*	-0.208	0.098	-0.303	2.027*
	(1.68)	(-1.18)	(0.59)	(-0.49)	(1.82)
Net Loss Dummy	-1.265***	-1.198***	-0.554*	-0.881***	-1.441***
	(-3.30)	(-3.97)	(-1.90)	(-2.72)	(-4.28)
Cash Flows from Operations	0.545	-0.325	1.164**	0.093	-2.672*
	(1.39)	(-0.65)	(2.00)	(0.12)	(-1.91)
IPO Underpricing	-0.005	0.159			
	(-0.02)	(0.94)			
SEO Underpricing			1.221	0.668	-2.315
			(0.70)	(0.34)	(-0.85)
IB Reputation	-0.178	0.233**	-0.110	-0.282**	0.016
	(-1.25)	(2.22)	(-1.06)	(-2.32)	(0.11)
Litigation Dummy	-0.059	-0.098	-0.039	-0.103	-0.056
	(-0.16)	(-0.31)	(-0.12)	(-0.29)	(-0.13)
Big 4 Dummy	0.097	0.268	0.426	-0.418	-0.644
	(0.30)	(0.96)	(1.56)	(-1.30)	(-1.64)
Constant	0.460	-2.900***	-1.150	0.987	1.179
	(0.35)	(-2.74)	(-0.96)	(0.77)	(0.66)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	453	512	519	438	344
Pseudo-R^2	19.30%	13.50%	18.80%	12.00%	22.50%

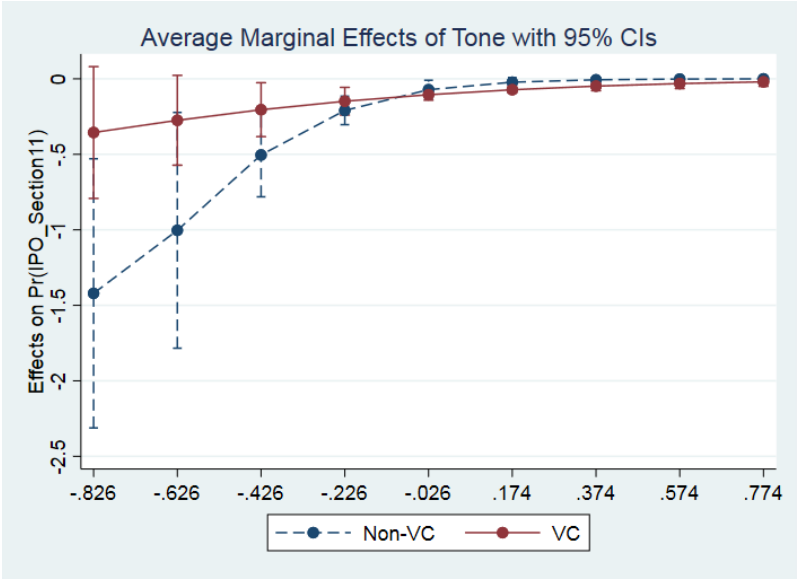
Table 3.12 Tone and Litigation

This table displays the results from the OLS regressions, where Adjusted Underpricing, measured by the market-adjusted initial returns of IPOs, is regressed on a set of independent and control variables defined in Appendix D. *VC IPO* and *Litg Dummy* are dummy variables and take the value of one (zero otherwise) if a firm is funded by VC at its IPO and operates in litigious sectors (see Lim and Tan (2008)) respectively. Results of the baseline controls are excluded for brevity. The value in parentheses is the associated *t*-statistics. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

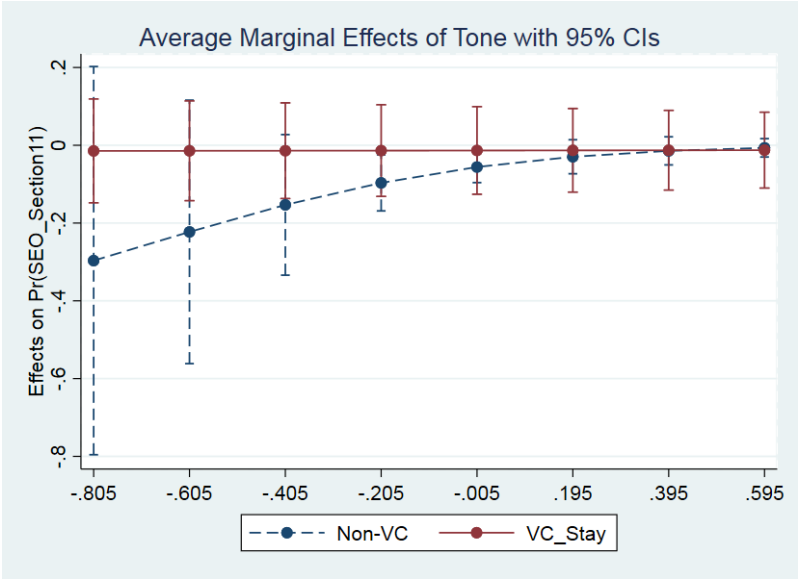
	Adjusted Underpricing	
	(1)	(2)
VC IPO	0.033	0.040
	(0.63)	(0.71)
IPO Tone	0.073	-0.035
	(1.11)	(-0.53)
VC IPO*IPO Tone	-0.198	-0.258
	(-1.22)	(-1.48)
Litigation Dummy	-0.103**	-0.092**
	(-2.37)	(-2.24)
VC IPO*Litg Dummy	0.109*	0.122*
	(1.65)	(1.80)
Litg Dummy*IPO Tone	-0.331**	-0.325**
	(-2.42)	(-2.46)
VC IPO*IPO Tone*Litg Dummy	0.363*	0.412*
	(1.68)	(1.85)
PostSOX Dummy		-0.120***
		(-5.46)
Constant	-0.784**	-1.161***
	(-2.34)	(-3.27)
Baseline Controls	Yes	Yes
Industry & Year FE	Yes	Yes
Observations	649	649
Adjusted-R^2	37.64%	32.43%

Fig. 3.1 Effects of Tone on Litigation

Both figures plot the differences in margins between VC and non-VC backed IPOs using the minimum and maximum range of IPO and SEO tone respectively. The marginal effects is the results from the logit regression shown in Table 3.8, Columns 2 and 6, where the dependent variable is a binary variable, and bears the value of 1 if a firm has been successfully sued under Section 11 following an IPO or SEO issuance, and 0 otherwise. The effects of the tone of VC and non-VC backed firms on litigation are represented by the solid and dotted line respectively.



(a) Effects of IPO Tone on Litigation



(b) Effects of SEO Tone on Litigation

Appendix D. Definition and Construction of Variables (Essay Two)

Variables	Source	Construction Method
Dependent Variables		
Tone	SEC EDGAR	Tone measurement used by García (2013), see Table 3.1 for all tone measurements
MBE	I/B/E/S	1 = if firm meets and beats analysts' forecast by 1 cent, 0 = otherwise
Independent Variables		
VC Dummy	SDC	1 = if firm is funded by venture capitalists, 0 = otherwise
Firm Size	Compustat	Natural log of total assets before the offer, adjusted to 2013 purchasing power
Offer Size	SDC	Natural log of gross proceeds excluding fees and expenses, adjusted to 2013 purchasing power
IV Sentiments	Compustat	Percentage[1] of over-allotment amount sold over the expected total proceeds
IPO/SEO Underpricing	CRSP	Underpricing at IPO/SEO, adjusted for CRSP returns
IB Reputation	Jay Ritter's website	Average score of Investment Banks/Underwriters Reputation
%High Education	Hand-collected from EDGAR	Percentage[1] of directors who hold Ph.D. and equivalent
%Non-executive	Hand-collected from EDGAR	Percentage[1] of non-executive directors
Years to SEO	SDC	Number of years taken to issue an SEO
Price Cluster Dummy	SDC	1 = if the SEO offer price is clustered at integers/quarters (i.e. \$0.00 \$0.25, \$0.50 & \$0.75), 0 otherwise
CAR (-5, -1)	Eventus	Cumulative abnormal returns from a period of -5 day to the day prior to an SEO
Litigation Dummy	Lim and Tan (2008)	1 = if firm falls under the High Litigation SIC codes used by Lim and Tan (2008), 0 = otherwise
Lock-up Dummy	SDC	1 = if firm issues an SEO prior to the lock-up expiration date
Increase in NSF Basic Grant	National Science Foundation	Increase in the amount of basic grant provided in research by NSF, in millions
GDP Growth	FRED	Real GDP growth during firm's IPO year
Tech & Health Dummies	Loughran and Ritter (2004)	1 = firms belong to technology or health care industry, 0 = otherwise
Other Definitions		
Analysts	I/B/E/S	The natural log of the number of analysts following the firm
Big 4	SDC	1 = if firm hires Deloitte, PricewaterhouseCoopers, Ernst & Young or KPMG, 0 = otherwise
IPO/SEO Section 11 or Rule 10-b5	Stanford Law School Securities Class Action Clearinghouse	1 = if firm is sued under Section 11 or Rule 10b-5, 0 = otherwise
Upward Price Revision	SDC	Positive values of the percentage[1] of initial filing mid-price over final offer price
Surprise EPS	I/B/E/S	Actual earnings per share minus mean EPS value, divided by standard deviation of EPS value

[1]Percentages are expressed in decimals

Chapter 4

Innovative Directors and Innovation

4.1 Introduction

Innovation is often regarded as the driving force behind a firm's propensity to create new products and technologies. Several studies have documented the importance of the attributes of CEOs and directors of firms on corporate innovation. CEOs who fly during their leisure time (Sunder et al. 2017), are overconfident (Hirshleifer et al. 2012), have more social connections (Kang et al. 2014), possess general management skills (Custódio et al. 2015), are specialists in the science fields (Koo 2013), obtain educational qualification in engineering, natural science or medical areas (Baranchuk et al. 2014) are positively associated with firms' innovation outcomes. On the contrary, CEOs who acquire financial expertise during their professional and educational background (Custódio and Metzger 2014) and hired externally (Cummings and Knott 2017) are unfavourable to innovation.

Shifting the focus to the board, an area of research examines the effect of board attributes on the innovativeness of the firm. VC directors (Celikyurt et al. 2014),

entrepreneurs (Faleye et al. 2014), first time independent directors (Kang et al. 2016), directors with relevant industry knowledge (Faleye et al. 2017; Wang et al. 2015) and have extensive external social connections (Chang and Wu 2017) are shown to benefit firms' innovative outputs.

Interestingly, a strand in the literature agrees on one factor that influences innovation positively: the importance of having subject-matter experts. Bereskin and Hsu (2014) demonstrate that new internal CEOs are well acquainted with resources within the firms and thus, are more competent in allocating resources, spurring innovation. Dass et al. (2014), Wang et al. (2015) and Faleye et al. (2017) reach a consensus that industry-expertise of the directors matters for innovation productivity of the firms. Dass et al. (2014) classify directors with industry-expertise by identifying directors who are connected to the firms' up- and down- stream industries whereas Wang et al. (2015) and Faleye et al. (2017) use the 2-digit Standard Industrial Classification (SIC) codes to construct a sample of directors who have had experience in affiliated industries.

One crucial question emerges: Do directors who possess the exact knowledge required by the firms foster innovation? Gao et al. (2016) find that CEOs who are patent holders contribute to a greater level of patent applications and citations and these CEOs tend to serve as an independent director of another firm that innovate in similar technology space. Likewise, Islam and Zein (2017) reveal that inventor-CEOs have skills and knowledge necessary to advise high-tech firms in their innovation activities.

Using a direct measure of identifying firm experts following Gao et al. (2016) and Islam and Zein (2017), I run a name matching algorithm on the U.S. patent database

and ExecuComp to locate directors who hold patents of the same firm. Authors of these two studies have used CEO as the main proponent in their studies. A key distinction of this paper is that it accentuates the importance of having *directors* (not CEOs) with direct knowledge and expertise of the firm through the creation of inventions within the same firm on innovation outcomes. Baseline results show a positive relation between the existence of innovative directors and innovation outputs, derived by the log of one plus the number of patent applications, log of one plus the number of citations received and two other measurements of which adjust the number of citations due to truncation issues.

It is plausible that a firm's ability to generate more innovation is due to the extent of the firm's willingness and capacity to inject resources. Controlling for R&D spending, capital expenditures and firm size, I find that the influence of innovative directors on innovation remains consistent and firms that devote more resources tend to generate higher quantity and quality of innovation. In addition, the specifications also take into account firm, CEO and board characteristics that have been documented in prior literature to affect innovation. Findings are robust to a set of control variables that considers firm leverage, tangible assets, growth, industry concentration, dividend policy, CEO confidence and compensation, board size, ownership, diversity and age.

To ensure robustness of the main findings, two other identification strategies - poisson and negative binomial regressions - are adopted to consider the ordinal nature of the dependent variables. The baseline result of a positive impact of innovative directors on innovation productivity of the firms remains consistent. Next, I address an endogeneity issue in which firms with certain observable characteristics hire these

innovative directors. The propensity score matching (PSM) method is used to construct a matched sample of firms that have similar characteristics of the treated firms based on the highest propensity scores. Across the six measures of innovative outcomes, a positive and statistically significant effect between innovative directors and firms' innovativeness persists.

I proceed to test the fundamental contribution of these directors to the firms. R&D intensive firms tend to have a greater demand for advising needs (Coles et al. 2008), which may imply that these firms benefit more from having innovative directors. Therefore, I re-run the baseline model separately for non-tech and tech firms. Findings show that the impact of the presence of innovative directors on innovation is not affected by the type of industry a firm operates in. This suggests the importance of the existence of these directors as they have a favourable effect on firms' innovation outcomes and that they are good advisers of the firms.

In order to observe whether innovative directors take on a monitoring role, the sample is split into periods before and after the enactment of the Sarbanes-Oxley Act in July 2002 and re-estimated using the main model. A stricter regulatory regime with the introduction of SOX brings forth an increase in board independence, resulting in tighter board monitoring and leads to a decline in a firm's risk appetite and innovation activities (Bargeron et al. 2010; Shadab 2008). However, results reject the monitoring hypothesis as the impact of innovative directors on innovation remains positively significant throughout the entire sample. This lends support to the competing advisory hypothesis whereby directors use their firm/technology-expertise in advising firms regardless of the regulatory climate.

This paper contributes to the current literature in two ways. First, it adds to the board characteristics and innovation literature and documents that directors who possess firm-specific knowledge are important for firms' innovation trajectories (Dass et al. 2014; Faleye et al. 2017; Wang et al. 2015). I find a positive relation between directors who hold patents in the same firm and firms' innovation outcomes. This aspect of the directors have been undermined previously with the exception of Gao et al. (2016) and Islam and Zein (2017) who examine inventor-*CEOs*. In my paper, I document the importance of having board *directors* who are patent holders of the same firm (i.e. sharing the same research interests as the firm) as it is a direct benchmark of having the exact knowledge in the field. Hence, it fills a gap in the literature exhibiting the importance of an attribute of directors: directors with invention-specific knowledge.

Last, contributing to the governance and innovation literature (Bargeron et al. 2010), I present some evidence that innovative directors are better in their role as advisers than monitors of the firm. I extend this literature by showing that the positive influence of these directors on innovation persists with the implementation of SOX, implying that their invention-specific knowledge surpasses their assumed roles as firm monitors.

The last essay is organised as follows. Section 4.2 reviews literature related to the impact of the characteristics of CEOs and directors on innovation. Section 4.3 provides detailed information on the name-matching algorithm applied to obtain a inventor-director match, discusses the limitations and challenges of the name matching process and describes all the variables used in this study, while Section 4.4 states the

identification strategies and empirical results. Section 4.5 shows the robustness of the main results. Section 4.6 presents the concluding remark.

4.2 Background

Innovation is an important aspect of a firm that could potentially materialise into profits. Firms with successful patents have exclusive rights to the invention for a limited period[1] and possibly have an edge over the industry, especially for tech and healthcare sectors. Patent holders can only claim benefits in the jurisdiction in which patents are granted. Hence, they are usually file in the region where they distribute the technology/product.

Resources and efforts used to conceptualise a novel technology which can subsequently be filed as a patent require a firm's willingness to invest in R&D, as well as having good foresight and long-term commitment from the management of the firm. A firm that invests in R&D may not necessarily convert or realise the investment into an invention and if a technology is successfully created, firms may or may not choose to file for a patent. Gathering statistics from the United States Patent and Trademark Office's (USPTO) website[2], close to 50% of the patents applied for are eventually granted. In this study, R&D spending is considered as an input essential to generate patents and is used as an independent variable, rather than a measure of innovation outcome of the firm, as R&D investment may not capture a firm's endeavour in innovating (Becker-Blease 2011).

[1]Utility (standard) patents filed with The United States Patent and Trademark Office (USPTO) expire 20 years from the date of filing before May 13, 2015 and 15 years on and after May 13, 2015.

[2]https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm

Other than tangible support, an environment that promotes innovation and rewards long-term success spurs innovation activities (Shadab 2008). For instance, firms which provide job security to the managers and are committed to long-term managerial compensation plan give incentives to the manager to innovate (Manso 2011). In a similar vein, CEOs who have longer contracts, have more time to innovate and patent (Gonzalez-Uribe and Groen-Xu 2017). In addition, firms that are better governed through having a higher percentage of institutional holders drive managers to increase innovation outputs (Aghion et al. 2013).

4.2.1 CEO, Directors and Innovation

Since CEOs are vital players in promoting innovation within the firm, existing literature explores the impact of CEOs on corporate innovation. One strand of literature looks at various elements of CEOs' skills set and asks whether their attained experiences and educational background have an effect on innovation. Custódio and Metzger (2014) reveal that CEOs with stints in the finance sector or in a financial role devote less funds to R&D and yield lower levels of patent applications and citations as compared to CEOs without such experience.

A principal component analysis (PCA) of five aspects of a CEO's prior work experience finds CEOs who are equipped with general skills acquired from previous work experience spur innovation (Custódio et al. 2015). They take the first factor of the PCA of a CEO's past experience based on the position held, the type of firm managed, the industry of the firm he/she worked in, whether he/she managed another firm as a CEO and if he/she worked for a conglomerate firm. The authors postulate that these

skills are transferable and therefore beneficial for the firm's innovation ventures. In contrast, when Koo (2013) adopts the same methodology to define generalist CEOs, he discloses that these CEOs innovate less than those with educational qualifications and a career background in science. Supporting the notion that specific skills and knowledge are necessary in innovative firms, Baranchuk et al. (2014) illustrate that only CEOs who received engineering, natural science or medicine education[3] matter for innovative firms in the sense that these firms are more likely to file for a patent within two years following an initial public offering.

Aside from prior work experience and the type of educational qualification a CEO possesses, a personal trait of the firm's leader appears to be crucial in fostering innovation: risk orientation. Overconfident CEOs in innovative industries exemplify risk-taking behaviour which leads to greater innovation outputs, measured by the number of patent applications and the intensity of citations received by granted patents (Hirshleifer et al. 2012). In addition, they are more efficient in using R&D investment to generate innovation. Authors attribute their findings to the risk appetite of overconfident CEOs that is essential in taking these risky projects. Moreover, Sunder et al. (2017) use CEO's flying hobby as a proxy for his/her risk behaviour due to the exposure to danger while carrying out this leisure activity. Pilot-CEOs are able bring this tolerance for risk to their professional work environment and hence, increase firms' innovation outcomes.

Another area in the literature examines the difference in the characteristics of internally and externally appointed CEOs. A common consensus from researchers is

[3]As compared to CEOs with business and legal background.

that CEOs who are promoted internally are better at cultivating innovation as compared to external CEOs. Using R&D productivity as a result of innovation, Cummings and Knott (2017) document that external CEOs are less effective than internal CEOs. They present evidence that external CEOs do not have relevant domain expertise (i.e. are not subject-matter experts) whereas internal CEOs have the ability to acclimatise and increase R&D efficiency. This effect is larger in firms which focus on R&D. Bereskin and Hsu (2014) not only find support for Cummings and Knott's work, but also reveal that newly appointed CEOs who are hired externally contribute to uncertainties in firms' future innovation strategies. They postulate that internally promoted CEOs are more acquainted with firms' technological capacity to innovate.

At this point, it appears that firm-specific skills and knowledge of the CEO are associated with positive innovation outcomes. More related to my study is the work of Islam and Zein (2017) in which the authors identify CEOs in high-tech industries who are patent holders and discuss the impact of their presence on innovation. These inventor-CEOs are more proficient in assessing the calibre of investments while acquiring target firms which result in better acquirer announcement returns, and also in higher market returns alongside with new product announcements. In my study, I generalise their concept and include directors in all industries to observe whether any differences arise from tech and non-tech firms. Next, I review related literature and explain the importance of analysing the influence of board directors on innovation.

Boards that are gender and ethnically diverse lead to more innovation success, with the rationale that diverse boards promote an inclusive environment which is an important catalyst for teamwork and in turn, make room for innovation activities

(Cao et al. 2016a). To the extent that cohesion improves innovation, another area in the literature advocates the positive effects of having friendly boards. Chang and Wu (2017) rely on the intensity of boards' external connections - employment history, educational background, social activities and social network - to measure the degree of friendliness and find that such connections of the board are associated with greater patent applications and citations received. Similarly, Kang et al. (2014) illustrate that friendly boards reflected through personal connections between outside directors and the CEO lead to more patent filings and granted patents receive more citations.

Apart from exploring the dynamics within the board, several studies demonstrate that the attributes of the directors affect the innovation productivity of firms. Outside directors who are entrepreneurs possess a set of general business skills that contribute to greater levels of corporate risk-taking and larger R&D expenditures (Faleye et al. 2014). Furthermore, firms with directors who are venture capitalists (VC) invest more in R&D, generate more patents and receive more citations after the appointment of these directors (Celikyurt et al. 2014). The authors posit that VC-directors have extensive network connections, function as good monitors of the board and have the ability in assessing R&D intensive projects.

On the other hand, Kang et al. (2016) consider inexperienced directors with less than three years of boardroom involvement to be better at carrying out the role of board monitors than advisers as compared to their peers with more than three years of experience. Consequently, following the appointment of these directors, firms suffer a decline in innovative activities which is an advisory-related output. Supporting Kang et al.'s findings, Faleye et al. (2017) show that directors who are more focused in fields

related to firms' industry appear to benefit firms' innovation outcomes. An increase in firms' R&D investment is associated with firms whose directors that have prior dealings in the other firms with the same 2-digit SIC (standard industrial classification) codes. The authors argue that these directors are professionals in the field and render expertise specific to the respective industries.

Adopting Faleye et al.'s method of measuring corporate directors' industry expertise, Wang et al. (2015) reveal that the knowledge gain from within similar industries allows independent directors to play their role as monitors of the firms more effectively. Besides, Dass et al. (2014) conjecture that innovative firms are subjected to greater information asymmetry between the board and the management and find that this information gap is alleviated through the presence of directors from industries of the firms' clients and suppliers. The reduction in information asymmetry leads to an improvement in patent applications, citations and R&D intensity. From an alternate perspective, Gao et al. (2016) provide evidence that CEOs of firms with high levels of innovation bring relevant expertise to other firms in which he/she serves as a director and therefore, boost innovation outputs.

Gathering various strands of literature in innovation, it is evident that the characteristics of directors on corporate boards is related to the extent of the innovativeness of firms. In particular, directors who are well-connected and possess expertise in the field benefit the innovation efforts of the firms. However, a potential downside in measuring expertise of the directors arises from the concern that the working relationship between these directors and the related firm is not direct.

For instance, the passage of the Clayton Act, Section 8, stipulates that interlocking directorates are not permissible if the firms in question are exposed to antitrust issues. Subsequent to the introduction of the Act in 1914, "enforcement has been lax and sporadic" (Fischer 2015) and such interlocking directorships are common (Schoorman et al. 1981). This suggests that directors with interlocking board responsibilities or in competing industries may not fully disclose information in line with their expertise and may retain certain firm-specific information as they are aware of the boundaries imposed by the antitrust law. In addition, directors who have professional or social connections with members of the board may be lenient while advising people they are familiar with (Wang et al. 2015).

Hence, I propose a direct method to identify directors that does not suffer from potential conflicts of interest arising from the decrees of non-compete clause or non-disclosure agreement. Using U.S. patent data, I search for inventors who are also directors of the same firm. Adopting this approach not only ensures that the director possesses the exact skills needed to develop a novel technology that results in a patent application, but also mitigates the problem of directors being unable to fully provide firm-specific knowledge when advising information-sensitive industries (i.e. innovative and tech industries).

The main question in this chapter investigates whether the presence of directors who hold patent(s)[4] of the same firm has an impact on firms' innovation activities. I argue that these directors share same the research interests as the firm and should

[4]They will be referred to as innovative directors or internal patent holders interchangeably.

have the most firm-specific knowledge if they were to participate in developing a novel technology, therefore, are deemed as one of the best candidates in advising firms.

Another salient attribute of these directors is that they are good advisers of the firms due to their abilities in understanding the availability of in-house resources and in providing advice on its reallocation to increase efficiency, thereby generating more innovative outputs. Therefore, I predict a positive relation between innovative directors' representation in the boardrooms and firms' innovation outcomes with the notion that these directors have the required technical skills, vision and willingness to drive innovation.

In addition, Coles et al. (2008) highlight that it is important for firms with a greater focus on R&D to obtain advice from insiders as these firms often have a higher demand for firm-specific knowledge. They argue that firms' executives who are also board directors are the most suited candidates in bringing necessary advisory needs to the firms. They document a positive relation between the proportion of insider directors and Tobin's Q for research-intensive firms.

I conjecture that directors who innovate successfully within the same firm have a higher capacity to provide firm-specific knowledge since they are less likely to enter into a non-compete clause or a non-disclosure agreement with other firms. Hence, I expect that high-tech firms (i.e. require more advice) will benefit more from having these directors on board.

4.2.2 Governance and Innovation

Besides exploring observable firm, CEO and board characteristics, it is important to examine the impact of the change in regulatory environment on innovation. Several studies have documented the effects of the implementation of Sarbanes-Oxley Act (SOX) on innovation.

A law article by Shadab (2008) contends that the implement of SOX in July 2002 leads to an improvement in corporate governance which discourages firms from innovation. He conjectures that the tightening of the regulatory environment creates a stricter and less risk-tolerant climate, and as a result, hinders innovation. However, when Balsmeier et al. (2017) take on a quantitative approach, they find that firms which are more compliant after SOX - having boards that are increasingly independent - patent more and produce patents of higher quality. Interestingly, these patents are inventions in safer innovations and in areas that the firm has previous patent history.

Bargeron et al. (2010) disclose that an increase in board monitoring through the rise in the ratio of independent directors post-SOX, decreases firms' willingness to take risks and leads to a fall in R&D spending. Indeed, if these directors perform a monitoring role, then, I should observe a reduction in the effect of the presence of innovative directors on innovation during periods in the post-SOX era.

However, if the presence of innovative directors represents their competencies in advisory expertise, the relation between firms with innovative directors and corporate innovation should remain persistent.

4.3 Data

4.3.1 Innovative Directors

A three step approach is used to identify innovative directors in a set of S&P1500 firms from 1997 to 2010. First, I merge the Harvard Business School patent database with the database from Kogan et al. (2017) (thereafter, HBS and KPSS respectively) to obtain firm-patent-inventor observations. Similar to the patent literature, only standard (utility) patents are included. The raw patent database from the United States Patent and Trademark Office (USPTO) has neither firm nor inventor identifiers. The HBS database contains a comprehensive list of patents from 1975 to 2010 which might be tagged to a firm (also known as assignee) or inventor(s) and/or both. The last scenario typically occurs when the inventors are employees of the firm. The KPSS database has firm-level observations from 1926 to 2010, uniquely identified by PERMNOs. Both the HBS and KPSS databases only contain patents that are applied for and eventually granted. There could be many applications but only those granted are considered novel and innovative. A patent can be assigned to more than one firm.

Second, using Compustat in which GVKEYs and CUSIPs are found, I extract firms that belong to the S&P1500 index from 1997 to 2010. I convert CUSIPs into PERMNOs and match this set of firms to those obtained from the first step. This merged dataset consists of a list of S&P1500 firms, together with the names of the employees which have patent(s) assigned to them. This is the firm-patent-inventor dataset with firm identifiers and has 835,662 observations. Finally, in order to find out if these inventors are also members of the board, I compile a list of directors in the

S&P1500 constituent firms from ExecuComp, the firm-year-director dataset, containing 61,926 observations, and match them individually with the firm-patent-inventor dataset using a name matching algorithm.

The name matching algorithm has the following properties. Names are converted to lowercase, salutations, punctuation marks and accent of the names are removed. Next, names are then broken down into three tokens, specifically, first, middle and last names. The name tokens of a director of a firm are then matched to the name tokens of all the inventors within the same firm. Also, I run the matching procedure with two (first and last names) tokens.

One caveat for matching a director to *all* the inventors in the patent database instead of matching a director to inventors of the same firm is that the director may have the same name as an inventor, but may not necessarily be the same person. For example, Don E. Ackerman is a director of Schlumberger Limited and when a two-token matching process is applied to *all* the inventors in the patent database, he will be matched to patent numbers 3983277 and 4458435 that are assigned to Percare Inc and Economy Color Card Co. Inc in 1976 and 1984 respectively. However, Ackerman was working for J.H. Whitney & Co, a venture capital firm, from 1967 to 1991. Therefore, I restrict the matching process to inventors of the same firm. A firm is considered to have an internal patent holder if a director is also an inventor of the same firm[5].

[5]I acknowledge that there may be an instance whereby a director of a non-patent firm is an inventor of another firm that is not in S&P1500. However, this is not within the scope of this study. For instance, Henri Seydoux is a director of several companies in S&P1500 which do not have any patents. Yet, Seydoux do have patents tagged to him and his own firm, Parrot, a company that produces drones but is not in the S&P1500.

Next, I remove directors from the merged dataset which result in perfect matches (i.e. all characters in the tokens match) and proceed to use the Jaro-Winkler similarity measure and Levenshtein edit distance on the rest of the unmatched directors.

$$sim_{jaro}(s_i, s_d) = \frac{1}{3}\left(\frac{c}{|s_i|} + \frac{c}{|s_d|} + \frac{c-t}{c}\right) \tag{4.1}$$

$$sim_{jaro-wink}(s_i, s_d) = sim_{jaro}(s_i, s_d) + \frac{m}{10}(1.0 - sim_{jaro}(s_i, s_d)) \tag{4.2}$$

The Jaro-Winkler distance finds the number of characters insertions, deletions, and transpositions (t) and calculates the number of common characters, c, the number of characters that appear within half the length of the longer string and give more weight to the count of the first four matching characters, denoted by m (Christen 2006). The total count of characters in the inventor and director names, including space, is $|s_i|$ and $|s_d|$, respectively. For example, this inventor-director pair, *james m walker* and *j mike walker*, generates a Jaro-Winkler score of 0.8622, with c=10, $|s_i|$=14, $|s_d|$=13, t=0 and m=2. The transposition value, t, equals to 0 as the matched characters of the two strings do not require any switch in positions. This measure is suitable for matching personal names as it gives more attention to similarities at the beginning of a director's name than toward the end of the string.

The Levenshtein edit distance adds up the number of adjustments - insertions, deletions and substitutions of characters - needed to transform one string to another. For the same example, whereby the underscore symbol represents a space between the characters, the Levenshtein edit distance for *james_m_walker* and *j_mike_walker* is 5

as there are five actions involve in changing from $|s_i|$ to $|s_d|$. The adjustments include substituting " a " for "_ ", inserting " i " and " k " and deleting " s " and " m ". This approach is appropriate for longer strings (i.e. name of firms) and is considered as one of the weakest methods in the matching process for personal names (Raffo and Lhuillery 2009). However, this method is complementary to the Jaro-Winkler calculation for sorting unmatched directors. To identify directors who are also inventors of the same firm, I filter for inventor-director pairs that generate a Jaro-Winker score of at least 0.8 from the three and two tokens matching process[6] and rank them by ascending Levenshtein edit distance. Then, I manually check for potential inventor-director matches.

A simple search of the potential director from the results of the manual checking procedure on the internet and the image of the patent filed in the USPTO system verifies that it is the same person. For instance, the search determines that James M Walker and J Mike Walker is the same person from Dril-Quip Inc whereas James E Perrella (inventor; a graphic art designer) and James Elbert Perrella (director of Ingersoll-Rand Company) are different persons even though their names are similar. The final process produces 447 inventor-director pairs, which is matched to 2950 firm-year observations.

A probable drawback to this inventor-director matching strategy is the timing of the appointment of these directors. For instance, a director may join the firm before or after a patent is applied. If a director is appointed to the board prior to the application of a patent, it could be argued that time is required to conceive an invention.

[6]There are 317,361 and 119,444 pairs generated from the three and two tokens name matching algorithm respectively.

Therefore, at the time of the appointment, this director still possesses firm-specific knowledge necessary to develop the new product. On the other hand, if a director comes on board after the patent is filed, he/she would have worked alongside with other inventors of the firm. In this case, the director could advise the firm more effectively through extenuating the information gap between the board and the management. I acknowledge that this approach is not perfect in identifying innovative directors but argue that the basis of which measures the depth of directors' firm-specific knowledge remains plausible.

4.3.2 Innovation Outputs

Innovation outcomes are commonly measured by the quantity and quality of a firm's granted patents. Following Hirshleifer et al. (2012), Cho et al. (2016) and Ma (2018), the quantity of a firm's innovation is the natural log of one plus the number of patents applied for (and eventually granted) by a firm in a given year, *Log(1+n.patents)*. The quality of a firm's innovation is calculated by the natural log of one plus the number of citations received by all patents during a year, *Log(1+n.cites)*. The log transformation method takes into account firms that do not have any patents, and therefore, in some cases, zero citations. For robustness, raw counts of the number of patents and citations, *Raw Patents* and *Raw Cites* are also used as dependent variables.

Citations receive by a patent are subject to truncation bias as a patent granted in 1998 may receive more citations as compared to a patent granted in 2006. Therefore, the number of citations needs to be adjusted in order to make meaningful inferences. To account for this bias, two adjustments for the number of citations receive are adopted.

The first adjustment follows a fixed-effects approach (Hall et al. 2005) and measures the average number of citations, *Avg Citation*. It is derived by taking the sum of the number of citations received by all patents of a firm in a given year scaled by the total number of patent applications received by the firm in the same year. The second adjustment uses the methodology in Hirshleifer et al. (2012) and takes the sum of the number of citations received by each patent of a firm in a given year divided by the number of citations received by all patents in the same technology class in the same year (*Adj Citation*). The average time for a patent to be reviewed and subsequently approved requires approximately two years from its initial application date (Hall et al. 2001, 2005). Therefore, observations after 2008 are excluded.

4.3.3 Control Variables

A set of control variables is constructed using Compustat and ExecuComp. Firms that are large and have more resources may have a higher propensity to innovate. To mitigate concerns that firms' characteristics have an influence on innovation, the natural log of the R&D Expenditures[7] (*R&D Spending*), market-to-book ratio (*Market-to-book*), net property, plant and equipment scaled by total assets (*Asset Tangible*), the portion of long and short-term debt in total assets (*Leverage*), net income divided by assets (*Return on Assets*), total assets of the firm (*Firm Size*), natural log of capital expenditure (*Capex*) and Industry Concentration (*Industry HHI*) are added. Industry concentration is measured by the Herfindahl-Hirschman index, calculated using the annual industry (Fama-French 48 classification) sales figure (Kang et al. 2014). The

[7]Similar to Gao et al. (2016) and Islam and Zein (2017), missing R&D values are replaced with zero.

portion of dividends paid to common shareholders from a firm's net income (*Dividend Payout*) controls for the potential agency effect.

Previous literature illustrates that the attributes of the firm's CEO can have an impact on innovation. CEOs who are powerful (Faleye et al. 2017; Kang et al. 2014) may drive innovation activities. Often, CEOs who function as the board chairman are not only powerful, but also viewed to be overconfident. Hence, the *CEO duality* variable is a dummy variable that captures CEO overconfidence and is equal to one if the CEO is concurrently the chairman of the board during a firm-year observation, and zero otherwise. Moreover, CEOs' incentives may affect firms' innovation trajectories. Following Islam and Zein (2017), a CEO's incentive is measured by the value of annual option pay scaled by the amount of salary, bonus and the value of annual option pay a CEO receives in a firm-year observation (*CEO Compensation*).

Other than firm and CEO characteristics, the attributes of the board may also influence a firm's innovation activities. Board characteristics are controlled for using the total number of members on the board (*Board Size*), the total percentage of shares owned by board members (*Board Ownership*), the percentage of female directors on board (*Board Diversity*) and the average age of all board members (*Board Avg Age*). Following the observation of Hirshleifer et al. (2012) and Islam and Zein (2017) that innovation outputs require time to materialise, all control variables are lagged by one period and the definition and construction of the variables are presented in Appendix E.

4.3.4 Descriptive Statistics

The summary statistics of all the variables used in this paper are reported in Table 4.1. Across the six measures of innovation outcomes, firms with innovative directors tend to file for more patents which are eventually granted and these patents are of better quality. On average, both the log transformation of the number of patents and citations as well as the raw number of patents and citations are larger for firms with innovative directors. The differences in means and medians are statistically significant at the 1% level. In terms of the number of citations receive per patent, these firms receive approximately three more citations (*Avg Citation*) relative to firms with no innovative directors and the difference is statistically significant at the 1% level.

Besides engaging in a greater level of innovation activities, firms with innovative directors spend $252 million more, on average, on research and development (*R&D Exp ($)*) as compared to firms with no internal patent holders. It appears that they are not only investing heavily in research and development which may manifest in more patent applications, but also in physical assets, illustrated by the capital expenditure figure. *Capex* for firms with innovative directors is $484.6 million, almost twice as much as their peers with no innovative director present at $264.4 million.

Despite being found in firms that are bigger in size as measured by total assets, innovative directors are present in firms with lower leverage ratios, which may suggest that these firms do not use debt to finance their investments. They also have lower market-to-book ratios, implying that the market is undervaluing these firms and possibly, the impact of the presence of innovative directors in the boardroom. The full sample yields 15,088 firm-year observations (2,347 unique firms) from 1997 to 2008, in

which 2,822 observations (346 unique firms) are firms with innovative directors and 12,226 observations (2,001 unique firms) without internal patent holders, after merging with the set of control variables.

To address the issue that the regression results could be driven by the correlations between the variables, I show that the correlations between the dependent and independent variables are small. In Table 4.3, the variable of interest, *Innovative Director*, has positive relation with the various measures of innovation outcomes, suggesting that firms with innovative directors representation have positive influence on innovative activities. However, economic inference cannot be made at this stage. In the next section, univariate and multivariate regressions are conducted to examine the impact of innovative directors on firms' innovation outcomes.

4.4 Methodology and Results

4.4.1 Main Model

I estimate the following OLS regression to examine the effect of the presence of innovative directors on firms' innovation outputs:

$$\begin{aligned} Innovation\ Outcome_{i,t} = \alpha + \beta Innovative\ Director_i + \theta \mathbf{X}_{i,t} \\ + Industry\ \&\ Year\ FE + \epsilon_{i,t} \end{aligned} \tag{4.3}$$

The dependent variable is *Innovation Outcome*, measured by four different methods and are denoted by *Log(1+n.patents)*, *Log(1+n.cites)*, *Avg Citation* or *Adj Citation*, the variable of interest is *Innovative Director*, a dummy variable that takes the value

of one if there is a director of a firm who holds a patent that belongs to the same firm, and zero otherwise, and a set of control variables, represented by a vector of **X**. The results for the univariate regression of the various dependent variables on the variable of interest are presented in Table 4.5, Columns 1 to 4.

Across all columns, the coefficients of the *Innovative Director* variable are positive and significant at the 1% level, suggesting that these directors generate higher levels of innovation activities as compared to firms without innovative directors. The economic magnitude of the coefficients in Columns 1 and 2 imply that firms with innovative directors generate approximately 28 times (=exp(3.338)) more successful patent applications and 45 times (=exp(3.826)) more citations of the firms' granted patents. Innovative directors are associated with an increase of 68.25% (=1.914/2.804; 2.804 is the mean value of *Avg Citation*) in the average number of citations per patent than firms with no innovative directors (Column 3). In Column 4, the coefficient of the *Innovative Director* variable suggests that firms with innovative directors have a positive relation with patent citations that are adjusted for citations from the same technological class and year of the patent (*Adj Citation*).

Next, a set of control variables is added to the regressions to ensure that the relation remains robust. Year and industry fixed effects control for unobservable time-invariant and industry-specific effects and standard errors are clustered at the firm level to allow for variation of director across firms (Petersen 2009). Table 4.6 reports the baseline results.

In Columns 1 to 4 of Table 4.6, I find strong evidence that the presence of innovative directors has a significant impact on firm's innovation. Firms with innovative directors

are 7.6 times (=*exp*(2.028)) more likely to apply for patents and granted patents receive 10.2 times (=*exp*(2.319)) more citations than firms with no innovative directors (Columns 1 and 2, Table 4.6). In addition, the average number of citations per patent (*Avg Citation*) for these firms is 39.16% more (=1.098/2.804) relative to firms without innovative directors. Similarly, the presence of innovative directors in firms leads to 65.75% more citations when truncation bias is taken into account (Column 4). All the effects are statistically significant at the 1% level. In line with the innovation literature, I observe that investments associated with R&D (*R&D Spending*) and capital expenditures (*Capex*) are positively related to the innovativeness of the firm (Gao et al. 2016; Kang et al. 2014).

The baseline result that innovative directors have a positive impact on firms' innovation activities is robust to the various measures of innovation outputs. This is largely consistent with the proposition in Dass et al. (2014) and Wang et al. (2015) whose studies find that the effect of industry-expertise directors on innovation is positive.

4.4.2 Negative Binomial Regressions

The nature of the dependent variables - the number of patents and citations - are ordinal variables. Therefore, other than OLS regressions in which these two dependent variables are log transformed, I proceed to re-estimate the baseline model using Negative Binomial regressions shown in Equation 4.4.

This method provides robustness to the baseline result and is appropriate for count data as well as in situation where the variance of the count data is larger than its mean

(*Var(y|x)>E(y|x)*)(Wooldridge 2012, Ch.17.3). The summary statistics in Table 4.1 reflect that the variances of both the *Raw Patent* and the *Raw Cites* variables are larger than their means, exhibiting a scenario of over-dispersion. Hence, the Negative Binomial regression is more relevant as it models over-dispersed count variable and explains the choice over Poisson regressions[8] which have been used in prior literature (e.g. Islam and Zein (2017)).

$$E(y|\mathbf{X}_{i,t}) = exp(\alpha_0 + \beta Innovative\ Director_i + \theta \mathbf{X}_{i,t} + Year\ \&Industry\ FE + \epsilon_{i,t}) \tag{4.4}$$

The raw number of patent applications during a firm-year observation, *Raw Patents*, as well as the raw count of the number of citations for a firm, *Raw Cites*, are used as dependent variables, *Innovative Director* remains the variable of interest, and a vector of control variables, **X**, from the baseline regression. Results of the Negative Binomial regressions are shown in Table 4.7.

The coefficients of the *Innovative Director* variable are positive and highly significant at the 1% level. For instance, in Column 1, when the raw count of the number of patent filings is regressed on the variable of interest, the coefficient suggests that firms with innovative directors produce 137.57% (=*exp*(0.865)) more patents than firms without innovative directors. In Column 2, when a set of control variables is added in the regression, the magnitude of the differences between firms with and without innovative

[8]In an unreported test, I estimated Equation 4.4 using Poisson regression. Poisson regression follows a poisson distribution of the non-negative integer value of the dependent variable and is appropriate in the situation where the mean of the count data is assumed to be equivalent to its variance (*Var(y|x)=E(y|x)*). Results estimated using Poisson regressions are similar. The coefficients are significant at the 1% level and takes the value of 0.503, 0.285, 0.484 and 0.252, replicating Table 4.7, Columns 1 to 4 respectively.

directors drops to 89.83% or (=$exp(0.641)$). The economic impact of the coefficients of the *Innovative Director* variable continues to be large and significant at the 1% level. Similar inferences are made when the dependent variable is replaced by the raw count of citations received by a firm during a year as presented in Table 4.7, Columns 3 and 4.

Results in Table 4.7 give support to the baseline result that firms with internal patent holders generate more patents as well as citations than those without internal patent holders after controlling for firm, CEO and board characteristics. Findings are robust to alternate models and specifications. In sum, both the quantity and quality of the patents generated by firms with innovative directors appear to be better than those produced by firms without innovative directors.

4.5 Robustness Tests

In this section, I conduct several robustness tests and show that the baseline result of a positive relation between the presence of innovative directors and firms' innovative outcomes remains consistent.

4.5.1 Propensity Score Matching

The impact of innovative directors on firms could be due to reverse causality in the sense that certain firms appoint these directors to the board. To establish causality, I adopt the propensity score matching methodology. First, a probit regression in which the dependent variable is the endogenous variable, *Innovative Director*, and

the independent variables are variables in the set of baseline controls is estimated. Propensity scores calculated from the probit regressions are used to match a treatment firm (i.e. with innovative directors) to a firm in the control group. The highest propensity score is used to match to the nearest neighbour with replacement.

Next, I run two sets of regressions for both the before and after matching procedure and results are shown in Table 4.8, Columns 1 and 2. The Pseudo-R^2 decreases from 19.36% at the pre-match stage to 1.51% at post-match stage and the majority of the control variables are not significant. This indicates that the treatment is successful in removing differences in firm, CEO and board characteristics between the samples and has little explanatory power in the probability of receiving treatment. There are 1,894 unique treatment and 2,822 treatment firms in the matched sample.

Last, a comparison of the log transformed number of patent applications is done between the baseline sample and the matched sample. Results are presented in Table 4.8, Columns 3 and 4. Although the *Innovative Director* coefficient of the matched sample regression suffers a drop in the magnitude from the baseline regression (2.028 to 1.888), the economic impact continues to be large. For instance, drawing inference from the matched sample regression in Table 4.8, Column 4, firms with innovative directors apply 6.6 times (=exp(1.888)) more patents as compared to firms with no innovative directors. The coefficient of the variable of interest, *Innovative Director*, remains positive and significant at the 1% level. Besides using *Log(1+n.patents)* as a dependent variable in the propensity score matching method, I re-estimate the PSM model with the other five innovative outputs measures, *Log(1+n.cites)*, *Avg Citation*, *Adj Citation*, *Raw Patents* and *Raw Cites* and results are consistent with the baseline result that

the presence of innovative directors has a positive impact on innovation activities and outputs.

4.5.2 Tech Firms and Innovation

Gao et al. (2016) consider the effect of having a CEO who makes use of his/her patenting expertise on innovation output when he/she serves on a board of another firm in a similar technology, as measured by the technological proximity between the CEO's firm and the firm in which the CEO serves as an outside director. Instead of applying the concept of technological proximity, my goal is to establish a wider implication of the presence of these innovative directors. For instance, Chang and Wu (2017) illustrate that boards with more connections help improve R&D and patenting activities. In addition, Lu and Wang (2018) find that independent directors have a positive relation with innovation outcomes, and the effect is more pronounced in firms operating in the non-tech industries. They postulate that a higher proportion of outside directors translate to a surge in firms' risk appetite, thereby increasing the level of innovation activities in non-tech firms.

Since prior literature has highlighted the importance of the potential consequences of independent directors, in particular, on innovation, I test whether the presence of innovative directors of the firms affect the innovation activities of non-tech and tech firms. The notion is that, if an inventor is also serving as a director of the same firm, his/her presence could be a signal that the firm has a higher propensity to invest in innovation. This method appears to be more relevant in comparison to the technological proximity methodology as it directly identify directors who possess the same expertise

based on the invention (patent) they created for the same firm. Hence, I predict that these internal patent holders, albeit subjected to higher levels of risk (i.e. in high-tech firms), will have more motivation and incentive to innovate which manifest through the quantity and quality of patents.

Next, I split the sample into non-tech and tech firms using the same method adopted in essay one and two, following Loughran and Ritter (2004). In regressions where the dependent variables are the six measures of innovation activities, the variable of interest is a dummy variable that takes the value of one for firms with internal patent holders and zero otherwise, *Innovative Director*, and the set of control variables is similar to those in the baseline model are re-estimated. Panel A and Panel B of Table 4.9 show the findings of the sub-sample analysis for non-tech and tech firms respectively. Across both panels, the coefficients of the *Innovative Director* variable are positive and highly significant at the 1% level. Results imply that innovative directors are competent regardless of the nature of industry in which they serve as a director and suggest that the presence of directors who innovate within the same firm matters for firms' innovation outputs.

4.5.3 Impact of SOX on Innovation

With the enactment of the Sarbanes-Oxley Act (SOX) in July 2002, researchers have documented a negative impact of change of the regulatory climate on corporate innovation. Bargeron et al. (2010) illustrate that the increase in the monitoring of the board (i.e. more independent directors) leads to a decline in R&D spending and an increase in cash holdings of US firms relative to UK and Canadian firms. The authors

attribute their findings to the conjecture that these firms take fewer risks due to the increase in the intensity of monitoring by independent directors post-SOX. In a similar vein, studies by Shadab (2008) and Cao et al. (2016b) give support to the notion proposed by Bargeron et al. (2010) and argue that corporate innovation decreases after the introduction of SOX.

In contrast, if these innovative directors possess superior advisory skills which are beneficial for firms' innovation efforts, the positive relation between their existence and firms' innovation outcomes should remain unchanged.

To observe whether the influence of innovative directors on firms' innovative outputs differs pre- and post- SOX, I divide the sample into two; before and after year 2002, and re-estimate the baseline model. Panel A and Panel B of Table 4.10 report the regression results of the various measures of innovation outcomes on the variable of interest, *Innovative Director*, and the set of baseline controls, for periods before and after SOX, respectively.

Across all specifications, the coefficients of the *Innovative Director* variable are positive and statistically significant at the 1% level. Interestingly, the economic impact of firms with innovative directors does not vary much for most of the innovation outputs. For instance, when a comparison is done for the raw count of the number of patents applied between the pre- and post- SOX periods, firms with innovative directors apply 1.29 times more patents before SOX and 1.44 times more patents after SOX relative to firms without innovative directors. The figures are 1.26 and 1.44 for the raw count of the number of citations received by granted patents of the firms, on average. The only substantial difference arises from the average number of citations receive per

patent, *Avg Citation*, whereby firms with internal patent holders receive 5.08 times more citations pre-SOX, and 1.86 times more citations post-SOX, as compared to the other firms. Results not only suggest that the impact of innovative directors on corporate innovation is robust to the change in regulatory environment, but also imply that the presence of these directors portray their ability in advising firms as they encompass firm/technology-specific knowledge.

4.6 Limitations and Summary

This essay investigates the effect of innovative directors on firms' innovation outcomes. I propose a direct measure to identify innovative directors by applying a name matching algorithm to the U.S. patent database of inventors and the ExecuComp dataset consisting of directors. I argue that these directors possess the highest degree of firm-specific knowledge and are less likely to be constrained by potential antitrust issues arising from advising firms in a similar industry, such as the decrees of non-compete clause and non-disclosure agreement. Hence, they have less restrictions in advising firms and are considered to be one of the best candidates for providing firm-specific knowledge.

I document a positive relation between the representation of innovative directors in boardrooms and the intensity of patent applications and citations received by the firms. Findings imply that the technology-specific knowledge through their internal patenting activities allow these directors to better advise firms, resulting in a greater level of granted patents and future citations. In addition, with the expectation that tech-firms require more intense advisory, the sub-sample analysis rejects the hypothesis

that the influence of innovative directors is more pronounced in firms operating in industries with higher demand of technology-specific knowledge. Results strengthen the implication that these directors are crucial in providing advisory regardless of the extent of technological-related expertise a firm requires. Even though firms experience a stricter regulatory regime which may alter their risk-taking preferences, the enactment of the Sarbanes-Oxley Act does not appear to affect their propensities to advise firms. Overall, findings are in line with the notion that innovative directors possess expertise that is beneficial to firms' innovation activities.

Like any academic study, there are limitations to this paper. I acknowledge that it would be intuitive to adopt a more general method to locate innovative directors as it measures the in-house patent development expertise. In particular, the name matching algorithm could be less restrictive. Instead of identifying inventor-director within the same firm, the algorithm could create a loop and iterate each director to the entire sample of inventors so as to detect directors who have been assigned patent(s). However, this iteration process will produce more than 51 billion pairs, with 835,662 inventors from the patent database and over 60,000 directors from ExecuComp. Although the implication of having directors who patent successfully on firms' innovation output as well as the comparison between directors with internal and external patents of the firms would be interesting, it is not within the scope of this study. In addition, by filtering pairs generating more than 0.8 using the Jaro-Winkler calculation may leave out some possible matches. I randomly extract observations in different deciles and find that pairs with lower scores are unlikely to be matches.

Future work can be extended to include the timing of the appointment of these directors. For instance, subsequent analysis can examine the impact of directors who have successfully patented with other firms before being appointed to the firm in question on corporate innovation. Since they have acquired more experience patenting outside the firm, they could possibly possess skills which are vital in developing in-house patents. If these directors do have other patents filed before his/her appointment to the firms, does this leads to a pronounced impact on innovation as compared to firms with directors that hold internal patents?

4.7 Tables and Appendices

Table 4.1 Summary Statistics
The table shows the mean, median, standard deviation of the variables of firms with internal patent holder(s) and those without. The last two columns are the results of the difference in means (t-statistics) and medians (Wilcoxon rank-sum/Mann-Whitney) respectively. T- and z-statistics are displayed in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Full Sample				Innovative Director = 1				Innovative Director = 0				Test of Difference	
	N	Mean	Median	S.D.	N	Mean	Median	S.D.	N	Mean	Median	S.D.	t-statistics	z-statistics
Log(1+n.patents)	17742	4.048	0.000	5.565	2950	8.801	11.527	4.996	14792	3.100	0.000	5.174	-5.701***	-11.527***
													(-54.96)	(-47.59)
Log(1+n.cites)	17742	4.706	0.000	6.494	2950	10.155	12.870	5.825	14792	3.619	0.000	6.059	-6.536***	-12.870***
													(-53.83)	(-46.72)
Raw Patents	17742	44967.8	0.000	67004.5	2950	93557.1	101457.0	66710.0	14792	35277.5	0.000	62713.5	-58279.6***	-101457.0***
													(-45.59)	(-47.59)
Raw Cites	17742	417309.4	0.000	751310.4	2950	803468.8	388285.0	835780.1	14792	340296.8	0.000	708593.1	-463172.0***	-388285.0***
													(-31.41)	(-46.72)
Avg Citation	17742	2.804	0.000	4.704	2950	5.526	3.827	4.954	14792	2.262	0.000	4.459	-3.264***	-3.827***
													(-35.61)	(-46.72)
Adj Citation	17742	0.473	0.000	1.376	2950	1.123	0.527	2.111	14792	0.343	0.000	1.132	-0.780***	-0.527***
													(-28.75)	(-51.50)
R&D Exp ($)	17742	91.332	0.000	474.400	2950	301.683	35.500	840.606	14792	49.381	0.000	344.198	-252.302***	-35.500***
													(-26.91)	(-52.23)
Market-to-book	16779	0.543	0.536	0.246	2916	0.456	0.461	0.236	13863	0.561	0.551	0.244	0.105***	0.090***
													(21.14)	(20.98)
Asset Tangible	16400	0.277	0.212	0.234	2916	0.220	0.180	0.164	13484	0.289	0.222	0.244	0.069***	0.042***
													(14.64)	(9.02)
Leverage	16717	0.233	0.220	0.191	2908	0.186	0.171	0.172	13809	0.243	0.233	0.193	0.057***	0.061***
													(14.80)	(16.12)

Table 4.2 Summary Statistics - continued
The table shows the mean, median, standard deviation of the variables of firms with internal patent holder(s) and those without. The last two columns are the results of the difference in means (t-statistics) and medians (Wilcoxon rank-sum/Mann-Whitney) respectively. T- and z-statistics are displayed in parenthesis. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Full Sample				Innovative Director = 1				Innovative Director = 0				Test of Difference	
	N	Mean	Median	S.D.	N	Mean	Median	S.D.	N	Mean	Median	S.D.	t-statistics	z-statistics
Return on Assets	16780	0.034	0.043	0.145	2916	0.028	0.055	0.206	13864	0.035	0.040	0.129	0.007**	-0.015***
													(2.31)	(-8.38)
Firm Size ($)	16782	14271.1	1759.8	71801.0	2916	17861.7	1814.7	84906.5	13866	13516.0	1750.8	68707.3	-4345.7***	-63.9
													(-2.97)	(-0.43)
Capex ($)	17742	301.1	44.248	1169.0	2950	484.6	64.4	1565.9	14792	264.4	41.367	1068.7	-220.186***	-23.033***
													(-9.36)	(-12.48)
Industry HHI	17742	0.112	0.083	0.100	2950	0.124	0.085	0.118	14792	0.109	0.082	0.096	-0.015***	-0.002***
													(-7.34)	(-6.76)
Dividend Payout	16697	0.254	0.050	4.428	2908	0.277	0.000	4.979	13789	0.249	0.061	4.303	-0.028	0.061***
													(-0.31)	(5.47)
CEO Duality	17742	0.569	1.000	0.495	2950	0.600	1.000	0.490	14792	0.563	1.000	0.496	-0.037***	0.000***
													(-3.69)	(-3.68)
CEO Compensation	17742	0.061	0.000	0.187	2950	0.078	0.000	0.217	14792	0.057	0.000	0.181	-0.021***	0.000***
													(-5.57)	(-4.02)
Board Size	16486	6.109	6.000	1.355	2902	6.167	6.000	1.360	13584	6.096	6.000	1.354	-0.071**	0.000***
													(-2.58)	(-3.06)
Board Ownership	16486	0.740	0.000	4.322	2902	0.631	0.000	2.972	13584	0.764	0.000	4.558	0.133	0.000
													(1.51)	(-0.21)
Board Diversity	17742	0.057	0.000	0.105	2950	0.050	0.000	0.098	14792	0.058	0.000	0.106	0.007***	0.000***
													(3.52)	(3.30)
Board Avg Age	16484	51.449	51.500	4.548	2902	51.300	51.400	4.514	13582	51.481	51.500	4.555	0.181*	0.100*
													(1.95)	(1.81)

Table 4.3 Correlation Table
The table presents the correlation between the variables used in this study. The definition and construction method of the variables are in Appendix E. Variables *R&D Exp*, *Firm Size* and *Capx* are displayed in $millions. Significance at the 10, 5 and 1 percent levels are denoted by *, ** and ***, respectively.

	Innovative Director	Log(1+ n. patents)	Log(1+ +n.cites)	Raw Patents	Raw Cites	Avg Citation	Adj Citation	R&D Exp ($)	Market-to-book	Asset Tangible	Leverage
Innovative Director	1										
Log(1+n. patents)	0.318***	1									
Log(1+n.cites)	0.310***	0.998***	1								
Raw Patents	0.250***	0.909***	0.931***	1							
Raw Cites	0.151***	0.714***	0.758***	0.883***	1						
Avg Citation	0.179***	0.777***	0.816***	0.899***	0.992***	1					
Adj Citation	0.155***	0.398***	0.395***	0.356***	0.260***	0.286***	1				
R&D Exp ($)	0.171***	0.206***	0.199***	0.145***	0.084***	0.105***	0.077***	1			
Market-to-book	-0.128***	0.020	0.024*	0.040***	0.063***	0.060***	-0.051***	0.101***	1		
Asset Tangible	-0.161***	-0.138***	-0.127***	-0.068***	0.017	-0.003	-0.098***	-0.071***	0.157***	1	
Leverage	-0.091***	0.024*	0.028**	0.048***	0.059***	0.054***	-0.032**	0.033**	0.775***	0.209***	1
Return on Assets	-0.023*	-0.032**	-0.034**	-0.059***	-0.030**	-0.024*	0.012	0.020	-0.154***	0.049***	-0.133***
Firm Size ($)	0.073***	0.116***	0.110***	0.073***	0.032**	0.046***	0.037***	0.541***	0.146***	0.012	0.123***
Capex ($)	0.036***	0.107***	0.104***	0.079***	0.058***	0.068***	0.035**	0.522***	0.128***	0.114***	0.101***
Industry HHI	0.014	0.083***	0.081***	0.061***	0.036***	0.045***	0.039***	0.068***	0.135***	0.001	0.092***
Dividend Payout	0.008	0.012	0.012	0.006	0.006	0.008	-0.007	0.004	0.016	0.014	0.007
CEO Duality	-0.008	0.081***	0.087***	0.108***	0.115***	0.112***	0.014	0.055***	0.153***	0.079***	0.093***
CEO Compensation	0.034**	-0.086***	-0.107***	-0.261***	-0.256***	-0.226***	-0.034**	0.075***	-0.011	-0.087***	-0.026*
Board Size	-0.003	0.106***	0.117***	0.172***	0.192***	0.181***	0.036***	0.071***	0.124***	0.031**	0.081***
Board Ownership	0.002	-0.100***	-0.104***	-0.128***	-0.109***	-0.109***	-0.041***	-0.014	-0.037***	-0.010	-0.043***
Board Diversity	-0.069***	-0.128***	-0.133***	-0.137***	-0.143***	-0.147***	-0.045***	-0.024*	-0.014	0.015	-0.047***
Board Avg Age	0.007	0.063***	0.063***	0.044***	0.057***	0.065***	-0.012	0.090***	0.148***	0.103***	0.115***

Table 4.4 Correlation Table - continued

- continued. The table presents the correlation between the variables used in this study. The definition and construction method of the variables are in Appendix E. Variables *R&D Exp*, *Firm Size* and *Capx* are displayed in $millions. Significance at the 10, 5 and 1 percent levels are denoted by *, ** and ***, respectively.

	Return on Assets	Firm Size ($)	Capex ($)	Industry HHI	Dividend Payout	CEO Duality	CEO Compsn	Board Size	Board Ownshp	Board Diversity	Board Avg Age
Return on Assets	1										
Firm Size ($)	0.019	1									
Capex ($)	0.030**	0.809***	1								
Industry HHI	-0.004	0.173***	0.107***	1							
Dividend Payout	0.004	0.005	0.008	-0.003	1						
CEO Duality	0.017	0.073***	0.069***	0.057***	0.017	1					
CEO Compensation	0.055***	0.041***	0.045***	-0.013	0.016	-0.068***	1				
Board Size	-0.075***	0.035**	0.042***	0.011	-0.014	0.082***	-0.076***				
Board Ownership	0.024*	-0.020	-0.018	-0.021*	0.004	-0.020	0.156***	-0.034**	1		
Board Diversity	0.022*	-0.036***	-0.046***	-0.029**	-0.015	-0.031**	0.070***	0.009	0.014	1	
Board Avg Age	0.056***	0.118***	0.123***	0.048***	0.023*	0.103***	0.025*	-0.049***	-0.007	-0.134***	1

Table 4.5 Univariate Results

The table presents results from univariate regressions of innovation outcomes on firms with internal patent holder(s). The dependent variable is the natural log of one plus the number of patents applied (and eventually granted), the natural log of one plus the number of citations received by all patents of a firm, the average citations received by all patents for a firm in a given year and the adjusted citation received by all patents for a firm in a given year for Columns 1 to 4 correspondingly. The main independent variable, *Innovative Director*, is a dummy variable that takes on the value of one if a firm has at least one director who holds the patent of the same firm, and zero otherwise. Industry (Fama-French 48 classifications) and year fixed effects are included in all regressions. T-statistics are in parenthesis and standard errors are clustered at the firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Log(1+n.patents)	Log(1+n.cites)	Avg Citation	Adj Citation
	(1)	(2)	(3)	(4)
Innovative Director	3.338***	3.826***	1.914***	0.519***
	(13.71)	(13.64)	(12.02)	(7.42)
Constant	6.040***	7.403***	7.713***	0.307**
	(3.69)	(3.93)	(5.97)	(2.30)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	17,742	17,742	17,742	17,742
Adjusted-R^2	40.21%	40.32%	39.75%	9.72%

Table 4.6 Regression Results: Internal Patent Holders and Innovation

The table presents results from multivariate regressions of innovation outcomes on firms with internal patent holder(s). The dependent variable is the natural log of one plus the number of patents applied (and eventually granted), the natural log of one plus the number of citations received by all patents of a firm, the average citations received by all patents for a firm in a given year and the adjusted citation received by all patents for a firm in a given year for Columns 1 to 4 correspondingly. The main independent variable, *Innovative Director*, is a dummy variable that takes on the value of one if a firm has at least one director who holds the patent of the same firm, and zero otherwise. The control variables are lagged by t-1 and the definition and construction are in Appendix E. Industry (Fama-French 48 classifications) and year fixed effects are included in all regressions. T-statistics are in parenthesis and standard errors are clustered at the firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Log(1+n.patents) (1)	Log(1+n.cites) (2)	Avg Citation (3)	Adj Citation (4)
Innovative Director	2.028***	2.319***	1.098***	0.311***
	(9.03)	(8.97)	(7.41)	(4.62)
R&D Spending	0.967***	1.110***	0.582***	0.139***
	(16.40)	(16.28)	(14.24)	(9.53)
Market-to-book	0.254	0.334	0.449	-0.244**
	(0.55)	(0.62)	(1.37)	(-2.30)
Asset Tangible	-0.340	-0.365	-0.032	-0.462***
	(-0.64)	(-0.59)	(-0.08)	(-2.97)
Leverage	-1.107**	-1.404**	-1.662***	0.011
	(-2.18)	(-2.38)	(-4.25)	(0.10)
Return on Assets	-0.265	-0.327	-0.189	0.125
	(-0.66)	(-0.69)	(-0.58)	(1.45)
Firm Size	0.207**	0.230**	0.063	-0.010
	(2.16)	(2.08)	(0.89)	(-0.44)
Capex	0.155*	0.192**	0.203***	0.051***
	(1.93)	(2.07)	(3.34)	(2.76)
Industry HHI	-1.581	-2.074	-2.588*	-0.254
	(-1.01)	(-1.16)	(-1.94)	(-0.51)
Dividend Payout	-0.002	-0.003	-0.005	-0.002
	(-0.24)	(-0.32)	(-1.08)	(-1.58)
CEO Duality	0.099	0.111	0.037	0.007
	(0.86)	(0.84)	(0.42)	(0.22)
CEO Compensation	0.056	-0.124	-1.020***	-0.057
	(0.25)	(-0.49)	(-6.55)	(-0.90)
Board Size	0.018	0.032	0.089***	0.001
	(0.50)	(0.74)	(2.73)	(0.14)
Board Ownership	-0.024***	-0.026***	-0.006	-0.004***
	(-3.71)	(-3.50)	(-0.98)	(-2.80)
Board Diversity	0.473	0.523	0.123	0.068
	(0.90)	(0.86)	(0.33)	(0.51)
Board Avg Age	-0.012	-0.012	0.008	-0.005
	(-0.86)	(-0.72)	(0.71)	(-1.51)
Constant	2.622*	3.415**	5.181***	0.479
	(1.84)	(2.05)	(3.55)	(1.50)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	15,088	15,088	15,088	15,088
Adjusted-R^2	49.40%	49.41%	47.01%	12.50%

Table 4.7 Negative Binomial Model

The table reflects the results from negative binomial regressions. In Columns 1 and 2, the dependent variable is the raw count of the total number of patents applied (and eventually granted) by the firm in a given year and in Columns 3 and 4, the dependent variable is the raw count of the total number of citations received by all patents for a firm in a given year. The variable of interest, an independent variable, *Innovative Director*, is a dummy variable that takes on the value of one if a firm has at least one director who holds the patent of the same firm, and zero otherwise. The control variables are lagged by t-1 and the definition and construction are in Appendix E. Industry (Fama-French 48 classifications) and year fixed effects are included in Columns 2 and 4. *Z*-statistics are in parenthesis and standard errors are clustered at the firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Raw Patents		Raw Cites	
	(1)	(2)	(3)	(4)
Innovative Director	0.865***	0.641***	0.865***	0.641***
	(10.95)	(8.02)	(10.95)	(8.02)
R&D Spending		0.209***		0.209***
		(9.75)		(9.75)
Market-to-book		0.196		0.196
		(0.81)		(0.81)
Asset Tangible		-0.539*		-0.539*
		(-1.65)		(-1.65)
Leverage		-0.534		-0.534
		(-1.58)		(-1.58)
Return on Assets		-0.137		-0.137
		(-0.76)		(-0.76)
Firm Size		0.114*		0.114*
		(1.68)		(1.68)
Capex		0.096		0.096
		(1.50)		(1.50)
Industry HHI		-0.348		-0.348
		(-0.50)		(-0.50)
Dividend Payout		-0.001		-0.001
		(-0.46)		(-0.46)
CEO Duality		0.057		0.057
		(0.83)		(0.83)
CEO Compensation		0.446**		0.446**
		(2.37)		(2.37)
Board Size		-0.008		-0.008
		(-0.38)		(-0.38)
Board Ownership		-0.035***		-0.035***
		(-3.44)		(-3.44)
Board Diversity		-0.346		-0.346
		(-0.99)		(-0.99)
Board Avg Age		-0.010		-0.010
		(-1.31)		(-1.31)
Constant	11.399***	10.088***	14.151***	12.841***
	(29.86)	(15.75)	(37.07)	(20.04)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	17,742	15,088	17,742	15,088
Pseudo-R^2	0.50%	0.59%	0.60%	0.68%

Table 4.8 Propensity Score Matching

The table presents results of the Propensity Score Matching model. The dependent variable in Columns 1 and 2 takes the value of 1 (=treatment firm) if firm has at least an internal patent holder (innovative director) and 0 otherwise. Column 1 is a Probit regression for the estimation of the probability of a firm having an internal patent holder and the control variables are similar to those used in the baseline model. Firms in the control group are matched to treatment firms with the nearest propensity score. Column 2 shows the results of the Probit regression after the firms are treated. Columns 3 and 4 report the selection bias adjusted average log number of patents differences between firms with internal patent holder and those without, before and after treatment using the propensity score method. Industry (Fama-French 48 classifications) and year fixed effects are included. *Z*- and T- statistics are reported in parenthesis and standard errors are clustered by firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

	Pre-Match	Post-Match	Log(1+n.patents) All Firms	Log(1+n.patents) Matched Firms
	(1)	(2)	(3)	(4)
Innovative Director			2.028***	1.888***
			(9.03)	(8.23)
R&D Spending	0.284***	0.085*	0.967***	0.885***
	(5.31)	(1.68)	(16.40)	(10.31)
Market-to-book	-1.702***	-0.388	0.254	-0.642
	(-3.32)	(-0.73)	(0.55)	(-0.74)
Asset Tangible	-1.342**	-0.357	-0.340	-0.867
	(-2.27)	(-0.56)	(-0.64)	(-0.81)
Leverage	-0.247	-0.023	-1.107**	0.803
	(-0.40)	(-0.04)	(-2.18)	(0.82)
Return on Assets	-0.587	-0.282	-0.265	0.573
	(-1.59)	(-0.88)	(-0.66)	(1.23)
Firm Size	-0.067	-0.046	0.207**	-0.081
	(-0.63)	(-0.43)	(2.16)	(-0.45)
Capex	0.205**	0.078	0.155*	0.251
	(2.22)	(0.87)	(1.93)	(1.57)
Industry HHI	2.302***	0.925	-1.581	4.815*
	(2.80)	(0.83)	(-1.01)	(1.77)
Dividend Payout	0.001	-0.002	-0.002	0.002
	(0.29)	(-0.32)	(-0.24)	(0.13)
CEO Duality	-0.009	-0.038	0.099	0.303
	(-0.08)	(-0.33)	(0.86)	(1.39)
CEO Compensation	-0.252	-0.170	0.056	0.568
	(-1.33)	(-0.77)	(0.25)	(1.13)
Board Size	-0.012	0.001	0.018	0.022
	(-0.37)	(0.03)	(0.50)	(0.34)
Board Ownership	0.001	-0.005	-0.024***	-0.026**
	(0.09)	(-0.71)	(-3.71)	(-2.04)
Board Diversity	-0.565	-0.498	0.473	1.836*
	(-0.98)	(-0.83)	(0.90)	(1.80)
Board Avg Age	-0.011	-0.000	-0.012	-0.026
	(-0.77)	(-0.03)	(-0.86)	(-1.03)
Constant	-0.983	-0.025	2.622*	5.380***
	(-0.93)	(-0.02)	(1.84)	(2.97)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	13,500	4,716	15,088	5,644
Pseudo/Adjusted-R^2	19.36%	1.51%	49.40%	39.85%

Table 4.9 Tech Firms and Innovation

This table presents results from the sub-sample analysis when the sample is split into Non-Tech and Tech firms. Firms that fall into Loughran and Ritter (2004) SIC classification of high-technology firms are classified under Tech Firms and the rest are considered Non-Tech Firms. Panel A shows the regression results for Non-Tech Firms and Panel B, for Tech Firms. In both panels, Columns 1 to 4 are OLS regressions and Columns 5 and 6 are poisson regressions. The dependent variable measures firm's innovation outcome and is calculated by the natural log of one plus the number of patents applied (and eventually granted), the natural log of one plus the number of citations received by all patents of a firm, the average citations received by all patents for a firm in a given year and the adjusted citation received by all patents for a firm in a given year, for Columns 1 to 6 respectively. The variable of interest, *Innovative Director*, is a dummy variable that is equal to one if a firm has at least one director that holds a patent that belongs to the same firm, and zero otherwise. The set of control variables is similar to those in the baseline model. Industry (Fama-French 48 classifications) and year fixed effects are included. *Z*- and T- statistics are reported in parenthesis and standard errors are clustered by firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

Panel A

Non-Tech Firms	Log(1+n.patents)	Log(1+n.cites)	Avg Citation	Adj Citation	Raw Patents	Raw Cites
	(1)	(2)	(3)	(4)	(5)	(6)
Innovative Director	2.092***	2.392***	1.138***	0.325***	0.331***	0.291***
	(7.67)	(7.61)	(6.19)	(4.19)	(6.73)	(5.97)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,386	12,386	12,386	12,386	12,386	12,386
Pseudo/Adjusted-R^2	48.30%	48.29%	45.05%	11.94%	47.71%	57.24%

Panel B

Tech Firms	Log(1+n.patents)	Log(1+n.cites)	Avg Citation	Adj Citation	Raw Patents	Raw Cites
	(1)	(2)	(3)	(4)	(5)	(6)
Innovative Director	1.890***	2.175***	1.114***	0.264**	0.228***	0.202***
	(5.04)	(5.05)	(4.80)	(2.00)	(4.58)	(3.97)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,702	2,702	2,702	2,702	2,702	2,702
Pseudo/Adjusted-R^2	37.28%	38.27%	54.94%	6.92%	39.66%	59.87%

Table 4.10 Impact of SOX

This table presents results from the sub-sample analysis when the sample is split into the pre- and post- SOX era (i.e. before and after 2002). Panel A shows the regression results for observations before the enactment of SOX and Panel B, after SOX. In both panels, Columns 1 to 4 are OLS regressions and Columns 5 and 6 are poisson regressions. The dependent variable measures firm's innovation outcome and is calculated by the natural log of one plus the number of patents applied (and eventually granted), the natural log of one plus the number of citations received by all patents of a firm, the average citations received by all patents for a firm in a given year and the adjusted citation received by all patents for a firm in a given year, for Columns 1 to 6 respectively. The variable of interest, *Innovative Director*, is a dummy variable that is equal to one if a firm has at least one director that holds a patent that belongs to the same firm, and zero otherwise. The set of control variables is similar to those in the baseline model. Industry (Fama-French 48 classifications) and year fixed effects are included. *Z*- and T- statistics are reported in parenthesis and standard errors are clustered by firm level. Significance at the 10, 5 and 1 percent levels are indicated by *, ** and ***, respectively.

Panel A

Pre-SOX	Log(1+n.patents)	Log(1+n.cites)	Avg Citation	Adj Citation	Raw Patents	Raw Cites
	(1)	(2)	(3)	(4)	(5)	(6)
Innovative Director	2.018***	2.391***	1.626***	0.348***	0.252***	0.235***
	(7.67)	(7.62)	(6.82)	(3.92)	(6.70)	(6.22)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,100	8,100	8,100	8,100	8,100	8,100
Pseudo/Adjusted-R^2	49.22%	49.20%	48.33%	11.39%	39.48%	42.88%

Panel B

Post-SOX	Log(1+n.patents)	Log(1+n.cites)	Avg Citation	Adj Citation	Raw Patents	Raw Cites
	(1)	(2)	(3)	(4)	(5)	(6)
Innovative Director	2.040***	2.256***	0.621***	0.277***	0.362***	0.365***
	(8.20)	(8.22)	(8.40)	(3.59)	(7.49)	(7.56)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,988	6,988	6,988	6,988	6,988	6,988
Pseudo/Adjusted-R^2	50.12%	50.12%	49.03%	14.19%	51.09%	56.47%

Appendix E. Definition and Construction of Variables (Essay Three)

Variables	Source	Definition
Dependent Variables		
Log(1+n.patents)	HBS Database and Kogan et al. (2017)	Natural log of one plus the no. of patents applied by the firm during a year
Log(1+n.cites)	HBS Database and Kogan et al. (2017)	Natural log of one plus the no. of citations received by all patents of the firm during a year
Raw Patents	HBS Database and Kogan et al. (2017)	No. of patents applied by the firm during a year
Raw Cites	HBS Database and Kogan et al. (2017)	No. of citations received by all patents of the firm during a year
Avg Citation	HBS Database and Kogan et al. (2017)	Sum of the no. of citations received by all patents of the firm during a year divided by the no. of patent applications made by the firm in the same year
Adj Citation	HBS Database and Kogan et al. (2017)	Sum of the no. of citations received by all patents of the firm during a year divided by the no. of citations received by all patents in the same technology class in the same year
Independent Variables		
Innovative Director	ExecuComp, HBS Database and Kogan et al. (2017)	1=if the director(s) of a firm is a holder of the same firm's patent, and 0 otherwise
R&D Exp	Compustat	Natural log of research and development expenditures
Market-to-book	Compustat	(total assets - book equity + market equity - deferred taxes) / total assets
Asset Tangible	Compustat	net property, plant and equipment / total assets
Leverage	Compustat	(long-term debt plus short-term debt) / total assets
Return on Assets	Compustat	net income / total assets
Firm Size	Compustat	Natural log of total assets
Capex	Compustat	Natural log of capital expenditures
Industry HHI	Compustat	Herfindahl-Hirschman index, calculated using annual sales figure
Dividend Payout	Compustat	net income / dividends paid to common shareholders
CEO Duality	ExecuComp	1=if the CEO also serve as a chairman of the board, and 0 otherwise
CEO Compensation	ExecuComp	value of annual option pay/ salary plus bonus plus value of annual option pay
Board Size	ExecuComp	total number of board members
Board Ownership	ExecuComp	total percentage of shares owned by board members
Board Diversity	ExecuComp	percentage of female directors on board
Board Avg Age	ExecuComp	average age of all members on board

[1]Percentages are expressed in decimals

Chapter 5

Conclusion

This thesis consists of three essays on various aspects of corporate finance. In particular, the Initial Public Offering (IPO) and primary Seasoned Equity Offering (SEO) markets, board characteristics such as gender diversity and educational background of executive and non-executive directors, tone management of venture capitalists-backed equity offerings, litigation risks faced by issuing firms, impact of the Sarbanes-Oxley Act, the role of directors who possess firm-specific knowledge as well as the application of contemporary techniques in analysing financial data.

The first essay uses a hand-collected dataset consisting of 649 firms that have issued both an IPO and SEO between 1997 to 2013 to investigate the impact of female executive and non-executive directors (E&NE) on equity offering discounts. My main result reveals that a larger representation of female E&NE directors leads to a higher level of IPO underpricing. To establish causality, an instrumental approach is used to estimate the probability of having women directors and the baseline result of a positive impact of female E&NE directors on IPO underpricing remain robust. Besides, I show that characteristics of executive and non-executive members of these firms do not appear to influence SEO underpricing.

Next, I contend that the ratio of women directors may not fully capture the impact of female E&NE representation on underpricing, in the sense that the number of female directors in the E&NE team is the same but the percentage differs due to the team size, or the ratio may remain constant due to a proportionate increase in the number of female directors and the total number of directors. Further analyses reveal that firms with two or more female directors do not appear to explain IPO underpricing. Indeed, when I delve into a possible explanation to the diminished effect, I find that firms with more than three women directors disclose more regulatory information and this effect is driven by the increase in disclosures of firms with at least three female directors.

Finally, I shed light on the impact of SOX on IPO firms and find that women directors are good monitors and disclose more readable corporate documents, and their presence is a substitute for governance in the pre-SOX environment. Neither the percentage nor the number of female directors after the passage of SOX influence IPO underpricing.

Several important findings emerge from this paper. Overall, the gender mix of the team of executive and non-executive directors affects the magnitude of underpricing, and this is clearly relevant to underwriters who are pricing and marketing IPOs, as well as for market participants who are interested in investing. Above all, firms can reduce the IPO discount (i.e. cost of equity) by appointing highly educated directors into their top management teams and/or boardrooms. However, findings do not transfer directly to the SEO context, as information asymmetry lessens when firms progress beyond their first equity issues, and develop into established, public-listed entities.

I provide two propositions which could support the baseline result of a positive relation between the ratio of female E&NE directors and IPO underpricing. Firstly, I propose the notion that female directors exhibit greater levels of corporate governance through regulatory disclosures. I examine the impact of having zero, one, two, at least three and four female E&NE directors on underpricing through the intensity of information disclosures in offering prospectuses. Findings lend support to the latter conjecture and reveal that firms with at least three female directors disclose more information relative to the other firms. As a consequence, the magnitude of underpricing declines with the sequential increase in the number of women E&NE members. Secondly, investors may associate female presence with having a more risk-averse behaviour. I show evidence that this is not the case as there is no significant relationship recorded between the two.

This study has limitations. Although I include all IPO firms that have re-entered the capital market via a primary seasoned equity offering, I do not include those that have done so two years after their IPOs. To the extent that there are systematic differences between 'late' SEO firms and the 'within-two-year' firms in the study, the findings may no longer hold for SEO underpricing.

Shifting the focus to an important player in the IPO market, venture capitalists (VCs), the second essay proceeds to examine whether VC-funded firms formulate offering prospectuses differently from those which are not funded. VCs have been important players in financing promising entrepreneurial firms and are known to excel in bringing these firms to their IPO. This paper explores the way in which VC-backed firms differ from firms without VC funding in their regulatory disclosure tone at IPO,

and whether VC-backed firms play a role in tone management when firms re-enter the market for a seasoned issuance.

Extracting the Management Discussion & Analysis (MD&A) section of firms' offering prospectuses from 1997 to 2011, baseline results show that VC-backed firms tend to adopt a more conservative tone in their regulatory disclosures. This finding is unaffected when both the Heckman two-stage model and propensity score matching model are used to account for sample selection bias and reverse causality issues. Delving into the underlying reasons for these firms to employ such approach, I find that firms with VC presence have a higher probability of using conservatism when they are associated with prestigious syndicate team members and operate in the tech and litigious spheres. This conjecture is in line with Lowry and Shu (2002), offering support that they face higher litigation risks due to the nature of the industry they operate in, and therefore, are more reserved in their disclosures. Additional analyses confirm the notion proposed by Hanley and Hoberg (2012), whereby VC-financed firms use conservative disclosure tone to reduce the chance of being litigated successfully.

More importantly, despite the inference that VC-backed firms are linked to inaccurate valuation at IPO and persistent large surprise unexpected earnings (SUEs) in the long-run, findings suggest that large SUEs in the short-run is a result of tone manipulation of VC-financed firms. A reasonable explanation is that VCs not only have longstanding relationships with their portfolio firms, but they also have remarkable foresight in these firms and this effect is reflected in the good long-run performance they achieve in comparison to non-VC-backed firms.

Overall, results are consistent with the idea that VCs use tone management strategically (Huang et al. 2014; Loughran and McDonald 2013) - when they are operating in high-tech and litigious sectors, and when associated with syndicate members - with the intention to reduce litigation risk and reputational losses. Even though VC-backed firms are more difficult to value and are subject to erroneous forecasts, they tend to outperform non-VC-backed firms in the long-run, suggesting that tone does not contain future expectations of firms' performance. For future research, it would be ideal to obtain documents or narratives (i.e. business proposals, minutes from meetings, conference calls) produced independently by the venture capitalists and explore the distinctions between those generated by the VCs and those provided by other firms.

Moving the attention away from the expertise offered by VCs, a group of professionals who are equipped with firm-specific knowledge could have favourable outcome on the firms' performance from the innovation perspective. Specifically, the influence of the presence of directors who are patent holders (inventors) of the same firm on firms' patenting activities, which is the focus of the last essay in this thesis. The representation of inventor-directors provide a direct bridge between the board and the management and tightens the information gap that stems from the asymmetry in firm-specific knowledge. Applying a name matching algorithm to spot directors in the ExecuComp database who are inventors recorded in the U.S. patent database, I find that the presence of these directors have a positive impact on firms' innovation outcomes, measure by the intensity of patent applications and citations received by the firms' granted patents.

Results are robust to other identification strategies namely the poisson and negative binomial models which account for the ordinal nature of the dependent variables. A propensity score matching methodology is employed to address the concern that firms with certain characteristics may have a higher tendency to hire these directors. Baseline results remain unchanged.

Directors are often said to be good monitors of the firms as well as providers of firms' advisory needs. To examine whether innovative directors are functioning as monitors or advisers of the firms, first, I test for the persistency of the impact of innovative directors on innovation when the sample is split into non-tech and tech firms. If these directors lean toward an advisory role, then, the positive influence of their presence on innovation should prevail regardless of the degree of firm/technology specific knowledge required by the firms. Findings show that innovative directors possess expertise essential to spur firms' innovative outputs notwithstanding the intensity of advisory needs or the industry a firm operates in.

Apart from segregating firms into non-tech and tech firms to test whether innovative directors posses the firm/technology knowledge relevant to advise firms, the second test uses an external shock to examine whether the positive effect of innovative directors documented in the baseline result remains consistent. I give evidence that the impact of the presence of innovative directors is not affected by the decline in firms' risk appetite through the passage of SOX, which has been documented by prior literature to curb innovation activities. Overall, results point to the direction which suggest that innovative directors embrace the innovation endeavours of the firms and are envisioned to be experts in understanding firms' technology capacities.

Although careful considerations have been taken to ensure the robustness of this study, one constraint of the implication is that it does not take into account of other directors who hold patents of other firms. This would be of interest for future studies as there may be meaningful differences between directors with internal and external patents on firms' innovation efforts. A foreseeable obstacle is the magnitude of the outcome generated by the name-matching process of which could hinder a researcher from undertaking the study.

In conclusion, this thesis has covered several elements of corporate finance. The main contributions are in the area of gender diversity of executive and non-executive directors on the underpricing of equity offerings, the mechanisms through which may have motivated venture capitalists-backed firms to manipulate tone of the offering prospectuses and the implication of having directors who are patent holders of the same firm on firms' innovation outcomes.

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