Essays on Board Diversity: A Study of US IPO Firms

Ruth Oritsematosan Sagay

A Thesis Submitted in Fulfilment of the Requirements for the Degree of

Doctor of Philosophy

Cardiff University

Accounting & Finance Section, Cardiff Business School

January 2022

Acknowledgements

I would like to express my utmost gratitude to all my supervisors. I am grateful to Prof. Marc Goergen for his invaluable guidance at every stage of my doctoral studies. His expertise and knowledge about this thesis provided stimulating ideas and constructive detailed feedback during meetings. I cannot express enough thanks to Dr. Svetlana Mira for her tremendous insights, careful guidance, and prompt feedback throughout my doctoral journey, which have been instrumental to my self-development as a researcher. I thank Dr. Onur Tosun for his helpful comments on my research and willingness to share his experience in pursuing an academic career with me. I am grateful to my entire supervisory team for continuously encouraging me to be confident in expressing my ideas and fulfilling my potential. Without your support, I would not have completed this thesis.

I would like to thank the Faculty of the Accounting and Finance Section at Cardiff Business School, particularly Dr. Kevin Evans, for his support and encouragement during the annual reviews for this thesis. Additionally, I would like to thank Dr. Qingwei Wang and Prof. Kevin Holland for the constructive feedback I received from presenting part of this thesis at the PhD Symposium in 2019.

My appreciation goes out to the Research office staff, Sol Salah, and Administrator, Sally Osborne, for their general support and assistance during the PhD. I am grateful to Stephen Ratcliffe, the Aberconway librarian, for his support during the data search phase of this thesis.

To Arbab Cheema and Soma Housein, I appreciate your friendship, encouragement, and advice on my research. I am indebted to my parents and siblings for their financial support, for always believing in me, and for listening whenever I needed to talk. It is to my family and friends; I dedicate this thesis.

Abstract

This thesis comprises three empirical chapters on board diversity relating to gender, age, and professional expertise, using a proprietary dataset of 661 US initial public offering (IPO) firms. First, we examine the emergence of board diversity, and the impact of CEO, venture capitalist director, and non-executive director power on the evolution of board diversity. Second, we analyse the impact of board diversity and board connections on IPO survival. Third, we investigate whether board diversity influences innovative activity and innovative efficiency.

Due to minimal changes in age diversity, we focus in the first stage on gender and professional expertise diversity. Professional expertise diversity emerges first at the IPO and evolves by year 5 post-IPO, while the first female director is appointed in year 2 post-IPO. CEO duality and non-executive director voting share ownership inhibit gender diversity, while venture capitalist director voting share ownership facilitates the latter. For professional expertise diversity, non-executive director financial expertise is a facilitator, whereas venture capitalist director voting share ownership is an inhibitor. In the second stage, we provide evidence that professional expertise diversity improves IPO survival, but this effect is dampened in better-connected boards. Hence, there is a substitution effect between professional expertise diversity and board connections on IPO survival. Gender and age diversity have no robust relationship with the likelihood of survival post-IPO. In the third stage, we find that professional expertise diversity increases internal innovative input, measured by R&D investment. Thus, IPO firms will benefit from professional expertise diversity at the initial investment phase, but should consider age and gender diversity, which are detrimental to innovative efficiency and external innovation, respectively.

In summary, professional expertise diversity emerges around listing and improves IPO survival and investment in innovative activity. Therefore, IPO firms should focus on professional expertise diversity rather than gender or age diversity.

Table of Content

Chapter 1: Introduction 1
Chapter 2: The Determinants of Board Diversity in US IPO Firms 12
2.1 Introduction and Motivation 12
2.2 Theoretical Framework, Prior Evidence and Hypotheses Development 17
2.2.1 CEO Power and Board Diversity 20
2.2.2 Venture Capitalist Director Power and Board Diversity 23
2.2.3 Non-Executive Director Power and Board Diversity 25
2.3 Methodology 27
2.3.1 Sample Selection and Data Sources 27
2.3.2 Methodological Choices 29
2.3.3 Main Regression Model 31
2.3.4 Endogeneity Issues and Identification Strategy 34
2.4 Results 39
2.4.1 Preliminary Data Analysis 39
2.4.3 Main Results on the Impact of Power in the Boardroom on Board Diversity 48
2.4.4 Robustness Checks with Propensity Score Matching Analysis 57
2.5 Conclusion 66
Appendix 86
Chapter 3: Boards and IPO Survival: Does Diversity Alone Matter? 93
3.1 Introduction 93
3.2 Theoretical Framework, Prior Evidence and Hypotheses Development 97
3.2.1 Theoretical Framework 97
3.2.2 Empirical Evidence and Hypotheses Development 101
3.3 Methodology 108
3.3.1 Sample Selection and Data Sources 108
3.3.2 Methodological Choices 108
3.4 Results 114
3.4.1 Descriptive Statistics and Univariate Analysis 114
3.4.2 Multivariate Analysis on the Impact of Board Diversity and Board Connections on IPO Survival 119
3.4.3 Further Analysis and Robustness Test 127
3.5 Conclusion 133
Appendix 148
Chapter 4: Board Diversity and the Innovative Activity of IPO Firms 156
4.1 Introduction 156

4.2 Theoretical Framework 160
4.3 Prior Literature and Hypotheses Development 162
4.3.1 The Influence of Board Diversity on the Monitoring and Advising Roles of the Board 163
4.3.2 The Role of Board Diversity in Influencing Innovative Activity 164
4.4 Methodology 170
4.4.1 Sample Selection and Data Sources 170
4.4.2 Methodological Choices 170
4.5 Results 179
4.5.1 Descriptive Statistics and Univariate Analysis 179
4.5.2 Main Results for the Impact of Board Diversity on Innovative Activity 182
4.5.3 Robustness Tests 187
4.5.4 Further Analysis 192
4.6 Conclusion 198
Appendix 211
Chapter 5: Conclusion 215
5.1 Limitations of the Thesis and Directions for Future Research 219
References 222

List of Tables

Chapter 2

Table 2.1 The Representativeness of the Sample 73

Table 2.2 IPO Distribution by Year and Industry Classification 74

Table 2.3 Descriptive Statistics for the Determinants of Board Diversity 75

Table 2.4 Univariate Analysis for Gender Diversity 77

Table 2.5 Univariate Analysis for Professional Expertise Diversity 78

Table 2.6 Regressions for CEO Power and Board Diversity 79

Table 2.7 Regressions for Venture Capitalist Directors Power and Board Diversity 80

Table 2.9 Diagnostic Test Results - Propensity Score Matching Estimation for the Impact of Power in the Boardroom on Board Diversity 82

Table 2.10 PSM Analysis for CEO Power and Board Diversity 83

Table 2.11 PSM Analysis for Venture Capitalist Director Power and Board Diversity 84

Chapter 3

Table 3.1 IPO Survivorship Analysis 136

Table 3.2 Descriptive Statistics and Univariate Analysis Comparing Survivors and Non-Survivors 137

Table 3.3 Board Professional Expertise Analysis 138

Table 3.4 Pearson’s Correlation Matrix for Board Diversity, Board Connections, and Control Variables 139

Table 3.5 Regressions for the Impact of Board Diversity and Board Connections on the Likelihood of Survival Post-IPO 140

Table 3.6 Regressions for the Interaction of Gender Diversity and Board Connections on the Likelihood of Survival Post-IPO 141

Table 3.7 Regressions for the Interaction of Professional Expertise Diversity and Board Connections on the Likelihood of Survival Post-IPO 142

Table 3.8 The Impact of Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO 143

Table 3.9 The Impact of the Interaction Between Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO 144

Table 3.10 Sub-sample Survival Analysis for the Impact of Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO 145

Table 3.11 Sub-sample Survival Analysis for the Impact of the Interaction Between Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO 147

Chapter 4

Table 4.1 Descriptive Statistics and Univariate Analysis Comparing Innovative Activity in IPO Firms with High Board Diversity to Low Board Diversity....................................201

Table 4.2 Pearson's Correlation Matrix for Innovative Activity, Board Diversity, and Control Variables 202

Table 4.3 OLS Results for the Impact of Board Diversity on Innovative Activity 203

Table 4.4 Regressions for the Impact of Board Diversity on Innovative Efficiency.............204

Table 4.5 Diagnostic Test Results - Propensity Score Matching Estimation for the Impact of Board Diversity on Innovative Activity...205

Table 4.6 PSM Analysis for the Impact of Board Diversity on Innovative Activity.............206

Table 4.7 PSM Analysis for the Impact of Board Diversity on Innovative Efficiency 208

Table 4.8 OLS Results for Impact of Board Diversity on External Innovation 209

Table 4.9 Sub-sample Analysis for the Impact of Board Diversity on Innovative Input. 210

Table 4.10 Sub-sample Analysis for the Impact of Board Diversity on Innovative Efficiency. 210

List of Figures

Figure 2.1 Summary of Theoretical Framework for the Determinants of Board Diversity 69

Figure 2.2 The Proxies for Power in the Boardroom 70

Figure 2.3 Trend Analysis for the Measures of Board Diversity 71

Figure 2.4 Summary of Hypotheses on the Determinants of Board Diversity and Expected Signs 72

Figure 3.1 Summary of Theoretical Framework for the Impact of Board Diversity and Board Connections on IPO Survival 135

Figure 4.1 Trend Analysis for Innovative Activity 200

Chapter 1: Introduction

Prior empirical evidence conveys a mixed picture suggesting that increasing board diversity is beneficial in some mature firms, detrimental to others, and sometimes, has no effect on firm outcomes (see Adams and Ferreira 2009; Carter et al. 2010; Ali et al. 2014; Gray and Nowland 2017 for detailed results). Despite this mixed evidence in the literature, the consensus is that greater diversity in the boardroom improves the monitoring and advising functions of the board.[1] Still, these studies focus on mature listed firms, leading us to identify major gaps in the board diversity literature for initial public offering (IPO) firms. First, researchers are yet to explore why diversity emerges in the boardroom. Simply put, what are the factors facilitating or inhibiting the emergence and evolution of diversity in the boardroom (henceforth referred to as the determinants of board diversity)? Second, we are able to track IPO firms up to five years after listing and examine how vital board diversity is to the success of the firm in terms of survival and innovation, which hitherto, has been neglected in the IPO literature. Accordingly, this thesis provides first evidence on the determinants of board diversity and the impact of board diversity on survival and innovative activity in IPO firms. The thesis comprises three empirical chapters on board diversity in US IPO firms. Although each empirical chapter can be read as though it is independent, they all revolve around board diversity in US IPO firms. Board diversity in this thesis is defined in terms of gender, age and professional expertise.

IPO firms provide a unique setting to study board diversity, as this is the first time the board becomes visible to the public. Prior to listing, boards are smaller and predominantly composed of executive directors with fewer, if any, non-executive directors. Bakers and Gompers (2003) argue that establishing an effective corporate governance system at the time of the IPO is crucial, as board composition is a signal to investors of the quality of the firm. Hence, our focus on IPO firms allows us to examine how board diversity emerges around listing and track the evolution of board diversity post-IPO, at a time when board composition is invaluable. Furthermore, by examining the post-IPO period, we provide first evidence on the

[1] Particularly, female directors, who are usually independent directors on the board, allocate more resources towards monitoring (Adams and Ferreira 2009; Adams et al. 2015). In terms of age diversity, Ararat et al. (2015) argue that greater age diversity in the boardroom may enhance monitoring and advising in it since the larger risk appetite of younger directors may be balanced by the risk averse appetite and experience of older directors. Consistently, Gray and Nowland (2017) suggest that board monitoring and advising is influenced by greater professional expertise diversity since directors may use their expertise to improve board oversight, provide strategic advice, and access to invaluable external contacts.

aspects of board diversity that are vital to IPO firms' success after listing in terms of survival and innovative activity.

Since the US still represents one of the biggest IPO markets in the world compared to other countries (Doidge et al. 2017), this thesis examines board diversity in US IPO firms. To achieve the objectives of this thesis, we hand collect data for 661 IPO firms listed on the NASDAQ, NYSE, and AMEX between 1st January 1997 and 31st December 2015 and track these firms up to five years after the IPO. Hence, our sample de facto ends on 31st December 2019.[2] The 661 IPO firms are randomly selected from the initial sample of 2,641 US IPOs, which were completed during our research period. Due to the rigorous nature of manual data collection, we focus on this sample, which amounts to 25% of the initial sample, consistent with Boone et al. (2007) and Chahine and Goergen (2011). Data for the three measures of board diversity and all the determinants of board diversity considered in the thesis are hand collected from prospectuses for the pre-IPO year and the IPO year, while post-IPO data is obtained from the proxy statements. Therefore, this thesis uses a proprietary dataset comprising 661 IPO firms in all chapters. Next, we introduce the three empirical chapters in this thesis, their main findings and contributions to the literature.

Chapter 2 investigates the emergence and evolution of board diversity. Descriptive statistics show that there is minimal change in age diversity for IPO firms. Hence, the focus of this chapter is on the evolution of gender and professional expertise diversity in IPO firms. The determinants of board diversity relate to the power of the CEO, venture capitalist director, and non-executive director in the boardroom of IPO firms. Power is measured across five dimensions in line with Finkelstein et al. (1992) and Chahine and Goergen (2011). They are structural power based on hierarchical authority, ownership power based on shareholding, expert power based on experience, prestige power based on board connections and education, while control power is based on the voting share ownership.[3] For ease of identifying key trends in our results, we group the measures of power based on their sources i.e., internal (structural, ownership, and control) or external (prestige and expert). Put together, Chapter 2 examines the

[2] Our IPO sample is only tracked to 2019 as at the point of data collection, 2020 data were not available.
[3] Structural power is proxied by three variables, such as the number of positions held in the firm, CEO duality, and board tenure. Ownership power is measured by two variables, such as the founder status and share ownership whereas prestige power is captured by board connections and Ivy league education. Expert power relates to critical expertise and financial expertise, while control power is proxied by voting share ownership. These proxies for power in the boardroom are shown in Figure 2.2 and relate to all director groups, such as CEO, venture capitalist and non-executive directors.

impact of CEO power, venture capitalist director power, and non-executive director power on the measures of board diversity.

Hermalin and Weisbach's (1998) bargaining model underpins the predictions on the relationship between power in the boardroom, for each director group, and gender diversity. We argue that powerful CEOs, who have invested not just financial but also emotional capital in the firm, inhibit gender diversity as female board representation is related with better board monitoring (Adams and Ferreira 2009). Conversely, powerful venture capitalist directors and non-executive directors are focused on monitoring the CEO to protect shareholders' interests and facilitate gender diversity. Thus, according to the bargaining model, there is a negotiation between the CEO and other directors in the boardroom during director appointments. For professional expertise diversity, the resource dependency theory underpins the predictions for the relationship between power in the boardroom for each director group and the former. From the resource dependency perspective, what matters to directors is not maintaining their power in the boardroom but ensuring that the board is sufficiently equipped, including with professional expertise, to perform its advising and monitoring functions. Accordingly, we argue that all director groups are facilitators of professional expertise diversity in the boardroom.

In our analysis, we acknowledge that director appointments do not occur annually, leading to the largely persistent level of board diversity with some changes observed at the IPO, in year 2 and year 5 post-IPO.[4] Therefore, to ensure that the impact of power in the boardroom on board diversity is captured, we adopt cross-sectional ordinary least squares (OLS) regressions at the IPO, in year 2 and year 5 post-IPO. This allows us to examine the impact of power in the boardroom at the IPO, in the medium-term post-IPO (year 2), and in the long-term post-IPO (year 5) on board diversity. To address potential endogeneity concerns, we test the robustness of our results using propensity score matching (PSM).[5]

Chapter 2 provides novel results on the emergence and evolution of board diversity in the boardroom. In terms of the emergence of board diversity, IPO firms have higher levels of professional expertise diversity and on average no female directors on the board at the IPO.

[4] The trend analysis in Figure 2.3 provides more details on the changes in the level of board diversity, across the sample period.

[5] The PSM analyses the impact of power in the boardroom on board diversity in IPO firms with similar observable characteristics. We match at the IPO, firms with high CEO power/ venture capitalist director power/non-executive director power to firms with low CEO power/ venture capitalist director power/non-executive director power based on the median values of the boardroom power score (see section 2.3.4 for more details).

After listing, gender diversity emerges in year 2 post-IPO when the first female director is appointed to the board while professional expertise diversity evolves in year 5 post-IPO as this aspect of diversity is the focus of appointments in the long term. This indicates that IPO firms attempt to address the insufficient gender diversity in the two years after the IPO but focus more on professional expertise diversity in director appointments. The contribution of these results to the literature is that newly listed firms find a board with diverse professional expertise to be more valuable given the focus on the latter at the IPO and long-term post-IPO. Accordingly, the emergence of board diversity indicates that IPO firms require a more advising-oriented board (Field et al. 2013), specifically, with a diverse range of professional expertise for decision-making at the IPO and in year 5 post-IPO.

Regarding the evolution of board diversity, there are three main findings in Chapter 2. First, we find robust evidence in Chapter 2 suggesting that CEO internally generated power through duality inhibits gender diversity in year 2 post-IPO. However, there is no robust evidence suggesting a relationship between CEO power and professional expertise diversity. These results suggest that powerful CEOs are focused on maintaining their influence in the boardroom since gender diversity is related with better board monitoring (Adams and Ferreira 2009). Second, there is a positive relationship between venture capitalist director voting share ownership and gender diversity but a negative relationship between the former and professional expertise diversity at the IPO. These results allude to the venture capitalist director's preference in board appointments i.e., as a facilitator of gender diversity but an inhibitor of professional expertise diversity. Therefore, the evolution of gender diversity is based on the outcome of a negotiation between the powerful CEO and powerful venture capitalist director consistent with the bargaining model. Third, we find that IPO firms with powerful non-executive directors, as captured by their voting share ownership, have lower gender diversity at the IPO. In the long term post-IPO (year 5), non-executive director financial expertise improves professional expertise diversity. The results indicate that powerful non-executive directors are less focused on improving female board representation but ensure that a diverse pool of professional expertise is available to the board for decision-making. Overall, the results in Chapter 2 highlight the importance of professional expertise diversity in the boardroom of IPO firms.

Chapter 3 examines the impact of the board of directors on IPO survival using a broader lens. In addition to board diversity, we investigate whether board connections influence survival post-IPO. Hillman et al. (2000) suggests that a combination of human and social capital provides a valuable set of resources and improves economic outcomes for the firm. Although board diversity refers to aspects of both human and social capital, we incorporate board connections as external links may have reputational effects for IPO firms (Espenlaub et al. 2012) as such firms are new to stock markets. IPO survival is typically a consequence of good firm performance that has implications for shareholder value. To date, research on IPO survival suggests that aspects of board structure such as venture capitalist involvement (Jain and Kini 2000), board size (Chancharat et al. 2012) and board independence (Wilson et al. 2014) increase the likelihood of survival post-IPO. Still, there is no evidence on the impact of board diversity and board connections on IPO survival. Chapter 3 contributes first evidence in the field to answer whether board diversity and board connections influence the likelihood of firm survival until year 5 post-IPO. In addition to our broader focus on IPO survival, we also test whether board diversity and board connections influence the likelihood of exit due to a merger or delisting. In answering these questions, we provide new insights to IPO firms on board characteristics to consider in appointment decisions that improve the likelihood of survival or influence the likelihood of exit via a merger or delisting post-IPO.

Similar to Chapter 2, board diversity in this chapter is defined in terms of gender, age, and professional expertise diversity, while board connections are defined as the average number of prior and current board appointments of the board at the IPO.[6] IPO survival is categorised into two groups: survivors and non-survivors. Survivors are defined as firms that remain publicly traded and independent entities up to 5 years post-IPO or the last year of the sample period whereas non-survivors are all firms that exit the sample post-IPO due to mergers or delistings. Admittedly, mergers are not always an indication of firm failure, as there are merger motivated IPOs. However, we argue that IPO firms involved in a merger lose their identity as independent entities. Accordingly, mergers are defined as firms that have been involved in a merger or are acquired after listing and lose their identity as independent entities post-IPO.[7] Delistings are firms that do not survive as independent entities after the IPO and exit the stock market regardless of the reasons for delisting.[8] Therefore, Chapter 3 also

[6] We focus on the average board connections rather than the sum, as the latter is a noisy measure of board connections due to interlocking directorships. About 18% of directorships within the sample possess interlocking memberships. Thus, taking the sum of board connections inflates the value of board connections.

[7] Erel et al. (2015) show that target firms are financially constrained prior to mergers with bidders. With 97% of the mergers in our sample being target firms, we do not categorise mergers as survivors but rather as non-survivors.

[8] Delisting due to bankruptcy is typically more severe compared to mergers. However, there are only 20 such firms across our sample period which is too small to be explored as a separate event category. Thus, we focus on

examines the impact of board diversity and board connections on the likelihood of exit post-IPO.

The resource dependency theory underpins the predictions of the relationship between board diversity, board connections and IPO survival. In this context, diverse and better-connected boards provide resources from different perspectives by drawing on board members' experiences and external links, that improve decision-making and ultimately IPO survival. However, competing negative predictions rely on the diversity theory according to which greater diversity of views or connections to other boards may result in cognitive conflicts in the boardroom that inhibit board effectiveness in decision-making. Based on the diversity theory, we argue that IPO firms with more diverse and better-connected boards are less likely to survive to year 5 post-IPO.

Using the same sample of 661 IPO firms as in Chapter 2, we analyse the impact of board diversity and board connections on IPO survival in four specifications, such as the logit, multinomial logit, Cox proportional hazard model and accelerated failure time model. We examine the impact of board diversity and board connections on IPO survival, first independently, and then, through interaction terms to test whether the impact of board diversity changes in better-connected boards. The main findings in Chapter 3 are as follows. First, our results show that the role of professional expertise diversity is more pronounced compared to gender and age diversity in terms of IPO survival. We find that professional expertise diversity increases the likelihood of IPO survival, but this effect is dampened in IPO firms with better-connected boards at the point of listing. Hence, there is a substitution effect between professional expertise diversity and board connections on IPO survival, but the larger effect relates to professional expertise diversity. Second, our results also show that independently, board connections are beneficial for survival post-IPO and the results are driven by IPO firms with higher level of investment in innovation (R&D intensity). This suggests that IPO firms with better-connected boards benefit from the external contacts, information, and skills of directors consistent with the resource dependency theory. Furthermore, our results provide first evidence on the importance of better-connected boards for the survival of IPO firms, specifically for firms investing in innovation. Finally, there is some weak evidence that greater gender diversity increases the likelihood of an exit post-IPO. However, these results are not

all delistings as a category of exit and mergers as another category of exit in examining the impact of board diversity and board connections on the likelihood of exit.

robust across all specifications.[9] For age diversity, the results indicate that whether independently, or in an interaction with board connections, there is no relationship with the likelihood of survival post-IPO. Overall, the findings in Chapter 3 suggest that IPO firms will benefit in terms of IPO survival from director appointments that focus on board connections but more so from professional expertise diversity.

In Chapter 4, we examine the impact of board diversity on innovative activity and innovative efficiency of IPO firms. Innovation plays a key role in gaining competitive advantage and prior evidence suggests that innovation activity improves post-IPO performance (Guo and Zhou 2016). Hence, innovation is vital to the financial success of newly listed firms. To date, prior literature for mature US-listed firms has linked board diversity to better innovation activity and innovative efficiency (Miller and Triana 2009; Chen et al. 2018; Griffin et al. 2021). These studies suggest that greater board diversity provides tacit knowledge and relevant information for strategic decision-making, which is invaluable to the firm during the innovative process, typically involving significant risks. However, researchers are yet to examine the impact of board diversity on innovative activity and innovative efficiency in IPO firms. Therefore, Chapter 4 provides the first evidence in the field on the impact of board diversity on the innovative activity and innovative efficiency of IPO firms. We argue that the results in Chapter 4 provide guidance on the aspects of diversity to focus on during director appointments that facilitate the success of the IPO firms' innovative strategies. Similar to Chapter 3, board diversity is measured in terms of gender, age, and professional expertise.

The first research question in Chapter 4 is whether board diversity influences the innovative activity of IPO firms. Innovative activity is examined on a broader scale relating to internally and externally generated innovation. Internal innovative activity is defined as innovative input (research and development intensity, henceforth referred to as R&D intensity) and innovative output (patent count and patent citations), consistent with Chen et al. (2018). External innovative activity is defined as the IPO firms acquired intangible assets (henceforth known as intangible assets (IA) investment) consistent with Stone et al. (2008). The second research question is whether board diversity influences innovative efficiency in IPO firms. The firm's ability to convert R&D capital into patents has been referred to as innovative efficiency. Innovative efficiency is measured as the ratio of patents granted in the current period scaled by

[9] There is some evidence that merger-motivated IPOs will benefit from greater female board representation in the boardroom at the IPO, but these results are not robust in all specifications.

the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% as in Hirshleifer et al. (2013). For the third research question in Chapter 4, we test whether board diversity moderates the IPO firm's investment in external innovation. The rationale for this analysis is that IPO firms are typically smaller entrepreneurial firms that are more likely to rely on their internal components for innovative activity rather than invest largely in externally generated innovation. Greater board diversity provides a range of different perspectives, skills and knowledge to IPO firms. Thus, we investigate whether greater board diversity facilitates innovative strategies comprising investments in internal innovation (R&D intensity) and externally generated innovation (IA investment).

Using the same sample of 661 IPO firms as in the previous two chapters, the main findings in Chapter 4 are as follows. First, we find that greater professional expertise diversity in the boardroom improves R&D intensity, but there is no such robust effect for gender or age diversity. Therefore, IPO firms at the initial investment phase of the innovative process will benefit more from professional expertise diversity in the boardroom than other aspects of diversity, such as gender and age. These results are consistent with the resource dependency theory suggesting that directors link the firm to the external environment and provide strategic advice and expertise, as well as access to invaluable contacts and communication channels for the firm. In this vein, a diverse pool of professional experts in the boardroom brings unique experiences that improve the IPO firm's innovative input. Second, in terms of innovative output, Chapter 4 shows that board diversity has no effect on patenting activity, as measured by patent count and patent citations. These results conflict with prior US evidence in mature firms suggesting that greater gender diversity improves patenting activity (Chen et al. 2018; An et al. 2021). However, such an effect does not exist in IPO firms. Third, our results show that age diversity is detrimental to innovative efficiency, while gender and professional expertise diversity have no significant effect on innovative efficiency. This result is consistent with the diversity theory and suggests that greater age diversity results in cognitive conflicts that decrease the ability of the IPO firm to generate patents for each dollar of R&D capital. Importantly, our results show a significant positive relationship between board independence and innovative efficiency. Therefore, to improve the efficiency of the innovative process, IPO firms should focus on board characteristics such as board independence that improve innovative efficiency rather than board diversity. Finally, we find a negative relationship between gender diversity and IA investment but no significant evidence of a relationship between age or professional expertise diversity and the former. The negative effect persists when we account for the IPO firms' R&D intensity through an interaction term. This suggests that greater gender diversity is detrimental for IPO firms whose innovative strategy comprises investments in internally and externally generated innovation. Considering prior evidence suggesting that female directors are better monitors (Adams and Ferreira 2009), these results allude to the negative impact of better board monitoring on investment in external innovation.

Put together, the findings from this thesis make several contributions to the IPO and board diversity literature. Chapter 2 contributes to the dynamics surrounding the emergence and evolution of diversity in the boardroom. Furthermore, Chapters 3 and 4 contribute on the implications of greater board diversity for firm success post-IPO in terms of IPO survival, innovative activity, and innovative efficiency. We provide guidance on how IPO firms should design their boards to facilitate survival post-IPO and effective innovation. The contributions of this thesis are as follows.

First, IPO firms have a greater need for an advising-oriented board (Field et al. 2013) than a monitoring-oriented board, since diversity emerges more in relation to professional expertise compared to gender in IPO firms. Second, gender diversity evolves as the outcome of a negotiation between the powerful CEO who is an inhibitor using duality, and the venture capitalist director who is a facilitator using voting share ownership. An interesting contribution from Chapter 2 to the literature is that powerful venture capitalist directors focus on gender rather than professional expertise in director appointments. Given the lack of gender diversity in the venture capital industry, as shown in Calder-Wang and Gompers (2017), it is interesting to see that venture capitalist directors in their portfolio firms focus on improving female board representation. Third, a powerful non-executive director uses their financial expertise to improve access to resources by facilitating appointments that reflect greater professional expertise diversity. Accordingly, in the evolution of professional expertise diversity, the powerful venture capitalist director is the inhibitor, while the powerful non-executive director is the facilitator. Fourth, Chapter 3 suggests that newly listed firms should focus on improving professional expertise diversity or board connections in director appointments, as these independently influence the likelihood of survival post-IPO. However, none of the measures of board diversity or board connections influence the likelihood of exit through a merger or delisting post-IPO. The implication of our findings is that for IPO survival, it is about the IPO firm's access to resources relating to a range of different professional expertise in the boardroom and the external links to other boards. Finally, Chapter 4 contributes to the IPO and innovation literature by suggesting that different aspects of board diversity should be considered by IPO firms in appointment decisions, depending on the phase within the innovative process. At the initial investment phase, IPO firms will benefit more from professional expertise diversity, while age and gender diversity are detrimental to the efficiency of the innovative process and investment in external innovation, respectively. Furthermore, an advising-oriented board is more beneficial than a monitoring-oriented board for IPO firms engaging in innovative activity. Linking the main findings from Chapters 3 and 4 to the results in Chapter 2, the ripple effect of IPO firms focusing on professional expertise diversity in director appointments is a higher likelihood of survival post-IPO and a higher level of investment in innovative activity.

The findings of this thesis have implications for regulators, potential issuers, and academic researchers. For regulators, our findings in this thesis provide important implications for the recent SEC board diversity listing standards. On 6 August 2021, the SEC approved NASDAQ's board diversity listing standard requiring firms to comply and disclose or explain their board-level diversity statistics annually using a standardised matrix template. All listed firms on the NASDAQ stock market must have at least two diverse board members and these statistics are to be disclosed annually starting in 2022.[10] Although this board diversity listing standard focuses on improving representation, it only relates to demographic attributes. Our findings in this thesis suggest that incorporating representation in terms of professional expertise into this standard is beneficial to IPO firms not just at the IPO, but subsequently post-IPO. For potential issuers, this thesis provides a better understanding of the important board characteristics to consider in appointment decisions around the IPO that are beneficial for the survival post-IPO, innovative activity and innovative efficiency. Particularly, professional expertise and board connections, as these board characteristics may serve as signals of quality for the IPO firm. Consequently, these board characteristics improve the likelihood of survival post-IPO and innovation that influences the IPO firm's ability to compete effectively in the stock market. Finally, this thesis has important implications for academic researchers as the findings can be used a basis for further investigation. For example, prior research shows mixed evidence of the relationship between board diversity and firm performance. However, this thesis brings to light aspects of power in the boardroom as potential moderators of the board

[10] See NASDAQ's board diversity listing standard here

diversity-firm performance relationship. Specifically, power in the boardroom relating to CEO duality, venture capitalist director voting share ownership, non-executive director voting share ownership and non-executive director financial expertise.

The structure of this thesis is as follows: The first chapter (this chapter) provides the background, motivation for the thesis, summaries of the three empirical chapters and implications of our findings. Chapter 2 examines the determinants of board diversity, Chapter 3 investigates the impact of board diversity and board connections on IPO survival, while Chapter 4 examines the impact of board diversity on innovative activity and innovative efficiency. These three empirical chapters provide further discussion on the research questions, theoretical framework, literature review, methodology and empirical results. Finally, Chapter 5 provides the conclusion to the thesis, including the overall contribution, limitations and directions for future research.

Chapter 2: The Determinants of Board Diversity in US IPO Firms

2.1 Introduction and Motivation

The board of directors is an important internal governance mechanism to protect shareholder interests. In the last two decades, many firms have come under pressure to embrace more diversity in the boardroom. At a national level, some countries, Norway being the first, have moved into the age of gender quotas, mandating gender balance in the boardroom. Within the US more recently, the California State bill 979 signed into law on 20 September 2020 requires an increase in board diversity no later than 31 December 2021.[11] The investment bank, Goldman Sachs, released a statement in 2020 that they will only underwrite IPOs in the US for private firms that have at least two diverse board members from the start of 2021. Furthermore, on 6 August 2021, the SEC approved NASDAQ's board diversity listing standard requiring listed firms to comply and disclose or explain their board-level diversity statistics on an annual basis starting in 2022. Despite these global reforms for a greater commitment to board diversity and the myriad of research papers examining the impact of board diversity on firm outcomes, researchers are yet to examine why diversity emerges and evolves in the boardroom.[12] This chapter provides the first evidence in the field on the power of directors as determinants of board diversity in US IPO firms. In examining what drives board diversity, we provide a guide to IPO firms on the aspects of power in the boardroom to consider in board appointments.

Board diversity is defined in terms of gender and professional expertise in this chapter, as there is minimal change in age diversity and limited data availability on the other forms of diversity for IPO firms.[13] We examine the emergence of board diversity commencing with the firm's listing in the major US stock markets such as the NASDAQ, NYSE and AMEX. Furthermore, this chapter analyses the impact of the factors facilitating or inhibiting the

[11] Specifically, all companies listed on US exchanges and headquartered in California must have a minimum of two females for a board of five members or three females for a board with six members.

[12] Prior evidence in the board diversity literature suggests that diversity can be beneficial (Carter et al. 2010; Torchia et al. 2011) or detrimental (Sila et al. 2016 and Faccio et al. 2016) in terms of financial performance. Increased diversity is also related to more active monitoring (Adams and Ferreira 2009), though this promotes conflicts and divisiveness in the boardroom (Upadhyay and Zeng 2014) due to the range of different experiences and expertise present on the board.

[13] We observe that there is a gradual and consistent small decrease across the sample period in Figure 2.3 indicating that there is a minimal change in age diversity across the sample period. Therefore, compared to the other measures of board diversity, age diversity changes at the smallest rate. As such, we have excluded age diversity from any further analysis in this chapter.

evolution of board diversity over five years post-IPO.[14] This provides a rare opportunity to understand the role of power in the boardroom and examine the development of board diversity in US IPO firms.

Finkelstein (1992) and Chahine and Goergen (2011) highlight power in the boardroom as a factor influencing the board's monitoring and advising ability.[15] Following these studies, we capture power for each director group in the boardroom across five dimensions; structural power, ownership power, expert power, prestige power and control power.[16] A powerful board ensures that decision-making about long-term competitive strategy and resource allocation are in line with the firm's objectives (Gavin 2012). However, prior literature suggests that CEO power relative to board power affects the board's incentives and ability to monitor the CEO (Bailey and Peck 2013). The CEO/ founder has enjoyed entrepreneurial autonomy prior to floatation and has significant influence over decisions in the firm. With this in mind, we argue that CEO power is a determinant of board diversity in IPO firms. Furthermore, the ability of the board to monitor the CEO stems from their power; hence, we examine the power of venture capitalist directors and non-executive directors as determinants of board diversity.[17] Venture capitalist directors are not only financiers of IPO firms but provide value-added services to the IPO process through their screening activities, decision support, and connecting the firm with potential suppliers and customers (Iliev and Lowry 2020). The services provided to their portfolio firms coupled with the investment of venture capitalist directors improves the influence of the latter in the boardroom. Although non-executive directors' influence is typically less in IPO firms compared to the CEO or venture capitalist directors, but with external experience, they can ensure proper oversight of the CEO in the boardroom. To this end, we argue that a powerful board can control the actions of the CEO if the latter is diverting from the agreed strategy such as director appointments relating to board diversity.

[14] This chapter focuses on IPO firms listed in the NASDAQ, NYSE, and AMEX markets.
[15] The proxies of power in this chapter are consistent with Finkelstein et al. (1992) and Chahine and Goergen (2011) to ensure that the different aspects of power are captured- structural power, ownership power, expert power, prestige power and control power.
[16] Structural power measures the director's level of hierarchical authority, ownership power focuses on shareholding, expert power is based on experience, prestige power relates to board connections and education, while control power is operationalised through the voting share ownership.
[17] We do not analyse executive director power as their influence on board diversity is expected to mirror that of the CEO. In IPO firms, we argue that boards dominated by executive directors will not exert proper control over the CEO. On the one hand, executive directors may genuinely trust the CEO's motivations and decisions and will, therefore, support the CEO's decision. On the other hand, the CEO may be able to influence an executive director's career advancement within the firm; thus, executive directors will support the CEO's decision.

Accordingly, this chapter examines the impact of CEO power, venture capitalist director power and non-executive director power as determinants of board diversity. The chapter contributes to two strands of literature. First, the board diversity literature, by providing first-hand evidence on how gender and professional expertise emerges and evolves in the boardroom. Prior literature on corporate boards has focused on the determinants of board size and independence (see Boone et al. 2007; Linck et al. 2008). Second, this chapter contributes to the IPO literature on the structuring of corporate boards in firms around the IPO and in the post-IPO period (see Gounopoulos and Pham 2018; Rau et al. 2021).

The bargaining model is extended to develop the hypotheses predicting the relationship between power in the boardroom for each director group and gender diversity. The Hermalin and Weisbach (1998) bargaining model proposes that boards are structured based on the outcome of the negotiation between the CEO and other directors. This model suggests that there is a power balance between the board and the CEO, as the CEO prefers a less independent board while the board wants to maintain its independence and monitor the CEO. Since prior literature has linked gender diversity to better board monitoring (Adams and Ferreira 2009), we extend the bargaining model to hypothesise the relationship between the power of directors in the boardroom and gender diversity. On the one hand, CEOs intend to maintain their power on their boards and will inhibit gender diversity, as female directors have been identified as better monitors. On the other hand, venture capitalist directors and non-executive directors who may have substantial voting share ownership to influence decisions in the firm will facilitate female board representation as they are motivated to monitor the CEO. Accordingly, we expect powerful CEOs to inhibit gender diversity(H1a), while powerful venture capitalist directors (H2a) and non-executive directors (H3a) are facilitators.

Regarding professional expertise diversity, we rely on the resource dependency theory to explain the relationship between power in the boardroom for each director group and the former. The resource dependency theory views directors as links to the firm's external environment that provide strategic advice, expertise, access to invaluable contacts and communication channels for the firm. This implies that directors may improve board advising through their knowledge and external experience. Since Field et al. (2013) suggests that IPO firms require a more advising-oriented board, we argue all directors will use their power in the boardroom to facilitate professional expertise diversity as the goal is to improve the firm's access to resources, knowledge, and contacts with the external environment. Accordingly, we expect that powerful CEOs (H1b), powerful venture capitalist directors (H2b) and powerful non-executive directors (H3b) are facilitators of professional expertise diversity.

The hypotheses are tested on a sample of 661 IPO firms listed between 1st January 1997 and 31st December 2015 and tracked to 31st December 2019.[18] The start of the sample period is influenced by data availability, while the end date allows for changes in the level of board diversity to be tracked in the post-IPO period. The initial trend analysis across the sample period shows that board diversity is largely persistent but with changes observed at the IPO, in year 2 and year 5 post-IPO. Consistent with these results from the trend analysis, we adopt the cross-sectional ordinary least squares (OLS) regression to analyse the impact of power in the boardroom on board diversity. To ensure that the impact of power in the boardroom is captured, we regress board diversity at the IPO on the power in the boardroom in the pre-IPO year. In the medium-term post-IPO, board diversity at year 2 is regressed on power in the boardroom in the IPO year. Finally, in the long-term post-IPO, board diversity at year 5 post-IPO is regressed on power in the boardroom in year 2 post-IPO. Considering the pervasive issue of endogeneity in studies focusing on board diversity (Frye and Pham 2018), the robustness of the OLS results is also tested using propensity score matching (PSM), which adjusts for potential endogeneity.

The main results for the emergence of board diversity indicate that IPO firms focus on professional expertise diversity at the IPO, as there is on average no female director on the board. In year 2 post-IPO, we find that gender diversity emerges for the first time with the first female director on average being appointed to the board. By year 5 post-IPO, IPO firms have a higher level of professional expertise diversity compared to gender diversity. The implication of these findings is that a board with professional expertise diversity is more valuable in IPO firms. This is unsurprising, as prior literature has established that IPO firms require a more advising-oriented board than a monitoring-oriented board (Field et al. 2013) around listing. Consequently, the higher levels of professional expertise diversity at the IPO and in the long-term post-IPO indicate that the advising-oriented board relates to a diverse range of professional expertise for decision-making.

In terms of the evolution of board diversity, we find robust evidence consistent with the predictions of H1a, H2a, and H3b. In detail, consistent with hypothesis 1a, we find that CEO

[18] The sample of IPO firms is only tracked to 2019 as at the point of data collection, 2020 data were not available.

power through duality has a negative relationship with gender diversity in the boardroom.[19] This indicates that CEOs at the helm of affairs with discretion in decision-making are inhibitors of gender diversity in the boardroom. We find that powerful venture capitalist directors via voting share ownership facilitate greater gender diversity at the IPO consistent with the predictions of hypothesis 2a. In this vein, powerful venture capitalist directors ensure that the CEO is better monitored by facilitating appointments that incorporate different perspectives since female directors are related with better board monitoring (Adams and Ferreira 2009). Surprisingly, we find that powerful non-executive director voting share ownership inhibits gender diversity in the boardroom of IPO firms. However, compared to the venture capitalist director (12%), non-executive director voting share ownership is much less (2%) suggesting that the latter group have a lower influence in director appointments. Therefore, our results suggest that the negotiation in female director appointments is between the powerful CEO as the inhibitor and the powerful venture capitalist director as the facilitator in line with the bargaining model.

For professional expertise diversity, we find robust results suggesting that powerful venture capitalist director voting share ownership inhibits the former. The negative effect of venture capitalist director voting share ownership on professional expertise diversity and positive effect of the former on gender diversity, indicates the preference of these directors in board appointments. Powerful non-executive directors with financial expertise improve professional expertise diversity in IPO firms consistent with the predictions of hypothesis 3b. These results suggest that non-executive directors with financial expertise are knowledgeable on the expertise needs of the IPO firm and promote director appointments that reflect a diverse range of professional expertise. Finally, there is no robust evidence of a relationship between CEO power and professional expertise diversity.[20]

Overall, our findings in this chapter make four contributions to the literature. First, we show that IPO firms have a greater need for an advising-oriented board with a diverse range of professional expertise, since the latter is at higher levels compared to gender diversity. Second, for IPO firms committed to improving gender diversity, CEO duality is the main inhibitor, while venture capitalist director voting share ownership is the main facilitator. Hence, these aspects of power should be considered in female director appointments. Third, in the evolution

[19] There is some evidence suggesting that if CEO power is externally derived through board connections, powerful CEOs facilitate gender diversity. However, this result is not robust to all specifications.
[20] We find that CEO duality has a positive impact on professional expertise diversity. However, this result is not robust to all specifications.

of professional expertise diversity, which is seemingly more important than gender diversity in IPO firms, non-executive director financial expertise is the main facilitator. Finally, venture capitalist directors are focused on gender diversity while non-executive directors are more focused on improving professional expertise diversity. Thus, potential issuers and IPO firms will benefit from structuring the board in line with their commitment to board diversity and considering the preferences of different director groups in appointment decisions.

The remainder of this chapter is organised as follows: Section 2.2 discusses the main theories and prior evidence used to construct the theoretical framework and develop the hypotheses of the chapter. Section 2.3 discusses the data sources, sample selection, and methodology applied. Section 2.4 highlights the results from the regression analysis and section 2.5 concludes the chapter.

2.2 Theoretical Framework, Prior Evidence and Hypotheses Development

In an extension of the contractual view of the firm to the board, Hermalin and Weisbach (1998) propose a bargaining model explaining board composition as an outcome of the negotiation between the CEO and the other directors.[21] According to this model, board composition depends on the power balance between the board and CEO, as the CEO prefers a less independent board while the board wants to maintain its independence. Hence, if the CEO has high/low bargaining power, the monitoring intensity of the board decreases/increases, respectively. In IPO firms, introducing external financing results in the dispersion of ownership and a power shift in the boardroom from the founder/CEO to the other financiers of the firm, such as venture capitalist directors. According to Baker and Gompers (2003), venture capitalist directors play a significant role in enhancing the monitoring function of the board, which facilitates the achievement of their objectives (return on investment, exit, and their reputation). Since female board representation has been linked to better monitoring by the board (Adams and Ferreira 2009), we extend the bargaining model to theorise the impact of power for each director category (CEO, venture capitalist director and non-executive director) on gender diversity.

On the one hand, the CEO's bargaining power develops in line with their prior delivered performance and perceived ability (Baldenius et al. 2014). Powerful CEOs intend to maintain their power and control in the boardroom and view gender diversity as a tool to improve board

[21] The contractual view of the firm relates to the negotiation between shareholders and managers of the firm.

monitoring (Adams and Ferreira 2009), consequently diminishing their power. Accordingly, in the negotiation between CEOs and other directors during appointment decisions, we expect that powerful CEOs will inhibit gender diversity in IPO firms. On the other hand, we expect that venture capitalist directors and non-executive directors will have a substantial influence on decisions in the boardroom, comparable to the CEO. Venture capitalist directors are motivated by their objectives, while non-executive directors protect minority shareholders by monitoring the CEO. Despite Field et al.'s (2013) evidence suggesting that IPO firms require a more advising-oriented board compared to mature firms, we argue that it is also important to monitor the CEO who prior to floatation has enjoyed entrepreneurial autonomy. Therefore, we argue that powerful venture capitalist directors and non-executive directors ensure adequate monitoring of the CEO by influencing director appointments that will improve the monitoring function of the board. In this vein, powerful venture capitalist directors and non-executive directors will facilitate board gender diversity to improve the monitoring of the CEO and protect the interests of their venture capital firms and other minority shareholders.

The resource dependency theory forms the theoretical basis to explain the relationship between power in the boardroom and professional expertise diversity. According to this theory, firms do not exist in a vacuum and directors serve as inter-organisational links providing access to resources that cannot be generated internally. Pfeffer and Salancik (1978) suggest that the external links of directors provide strategic advice, expertise, access to invaluable contacts and communication channels for the firm. In this context, directors with different professional expertise in the boardroom provide a range of perspectives and experiences that improve decision-making. For example, CEOs, venture capitalist directors and non-executive directors increase the IPO firm's access to resources through their seats on other board, that minimise the potential liability of newness the firm faces.[22] Hence, we argue that powerful CEOs, venture capitalist directors, and non-executive directors facilitate professional expertise diversity as the firm will benefit from improved resource access and potentially better board advising. Thus, we expect a positive relationship between CEO power, venture capitalist director power, non-executive director power and professional expertise diversity.

[22] The term "liability of newness" was first coined by Stinchcombe (1965) and revisited by Yang and Aldrich (2017) to apply to current organisation constructs. The liability of newness refers to new firms, and in our context, IPOs who face a constellation of problems in their early years that may result in a higher likelihood of failure. These problems relate to the ability of the firm to access resources, establish strategies, and differentiate themselves from other firms in the industry in a bid to attract potential investors, without prior public operational track records (Yang and Aldrich 2017).

So far, this section has discussed how CEO power in the boardroom may be a potential inhibitor of gender diversity, while venture capitalist director power and non-executive director power are facilitators of gender diversity, in the director appointment negotiation (bargaining model). On this basis, we develop three hypotheses for the impact of power in the boardroom on gender diversity.[23] Hypothesis 1a predicts the relationship between CEO power and gender diversity. Hypothesis 2a relates to venture capitalist director power and gender diversity, while H3a predicts the relationship between non-executive director power and the latter. Furthermore, we have explained why power in the boardroom for all director groups may be a facilitator (resource dependency theory) of professional expertise diversity. Similarly, we develop three hypotheses predicting the relationship between power in the boardroom and professional expertise diversity. Hypothesis 1b relates to CEO power, while H2b and H3b relate to venture capitalist director power and non-executive director power, respectively. The theoretical framework for all the hypotheses is shown below in Figure 2.1.

[Insert Figure 2.1 about here]

Granted that this chapter examines the impact of power in the boardroom on board diversity, it is important to note that power in the boardroom context is broad and typically onerous to define, leading us to rely on prior literature as a guide. Finkelstein (1992) defines power as "the capacity of an individual actor to exert their will" (p. 506). Finkelstein classifies power in top management teams into four types: structural, ownership, prestige and expert power. Structural power derives from the hierarchical authority and formal structure of the firm. Ownership power relates to the strength of position in the agent-principal relationship. For example, in newly listed firms, founders are usually at the helm of affairs and are considered having a significant influence, since they have been part of the firm since incorporation. Prestige power is derived from the external status in the institutional environment while expert power relates to the ability to deal with various contingencies and contribute to the success of the firm. Chahine and Goergen (2011) propose an additional type of power, i.e., control power. This dimension relates to how pivotal board members are to voting decisions in the firm. Power in this chapter is defined based on these five types of power and relates to three director categories: the CEO, venture capitalist directors (VCs) and non-

[23] Hypotheses are developed similar to competing hypotheses using a and b. However, in this chapter, we categorise "a" hypothesis to relate to gender diversity while "b" hypotheses relate to professional expertise diversity.

executive directors (NEDs). Figure 2.2 shows the five types of power discussed above in more detail.

[Insert Figure 2.2 about here]

The sections below discuss prior literature and the development of the six hypotheses.

2.2.1 CEO Power and Board Diversity

The IPO signifies transition from a privately held business to a publicly held corporation. Hence, it is reasonable to infer that the role of the CEO is central in shaping the firm's public image (Huang et al. 2019) and that their role is preeminent in the boardroom (Graham et al. 2020).[24] Powerful CEOs view diversity as a potential source of divergent opinions in the boardroom and may not want to be challenged or constrained especially if they previously enjoyed entrepreneurial autonomy prior to listing. Moreover, the CEO will have invested not just financial but also emotional capital in growing the firm, and helped in developing strategies, which have successfully led the firm to the IPO. As a result, the CEO's influence on the board grows in line with their prior delivered performance and perceived ability (Baldenius et al. 2014). New female director appointments resulting in more divergent opinions and increased monitoring of the CEO's activities will curtail the CEO's power in the boardroom. Thus, we expect that powerful CEOs will use their bargaining power to inhibit gender diversity in the boardroom. Below, we discuss prior literature on CEO power and explain the potential negative impact of various factors augmenting CEO power on gender diversity. Subsequently, we discuss the literature linking CEO power to professional expertise diversity.

Prior evidence on CEO tenure suggests that longer tenured CEOs represent an accumulation of specialised knowledge on the operations of the firm (Tanikawa and Jung 2019). Longer tenured CEOs have built a profile based on their performance visible to all shareholders and potential investors, which enhances their credibility and augments their structural power for decision-making in the firm. In IPO firms, CEOs with long tenures will most likely be founders or executives who have been involved in the firm from incorporation. With increasing CEO tenure, the board's allegiance and values will be close to that of the CEO, enhancing the CEO's structural power in the boardroom (Wowak et al. 2011). Therefore, CEOs use their structural power as a bargaining tool to inhibit new female director appointments.

[24] The literature on the influence of CEO power links the former to corporate performance (Adams et al. 2005), firm reputation (Love et al. 2017), corporate social responsibility disclosures (Muttakin et al. 2018), risk-taking (Lewellyn and Muller-Kahle 2012) and, in IPO firms, post-IPO survival (Bach and Smith 2007).

The practice of the CEO serving as the board chair is one of the most widely researched phenomena in the corporate governance literature. CEO duality has been identified as a double-edged sword as there is a trade-off between independent oversight and the unity of leadership in the boardroom (Krause et al. 2014). Yang and Zhao (2014) argue that CEO duality promotes organisational effectiveness and unity of leadership while DeBoskey et al. (2019) show that the board's monitoring of the CEO is weakened where duality exists. Furthermore, Lewellyn and Fainshmidt (2017) mention that CEOs occupying the board chair are conferred with board discretion in decision-making. In IPO firms, we argue that CEOs use their structural power and discretion from duality in decision-making to maintain their influence in the boardroom. Accordingly, such CEOs will not support appointment of female directors as gender diversity has been linked to better board monitoring (Adams and Ferreira 2009). Thus, we expect that powerful CEOs use the structural power derived from duality to inhibit gender diversity in IPO firms.

Moving ahead, we focus on CEO voting share ownership and founder status, which augments the CEO's control power and ownership power, respectively. With IPOs being entrepreneurial firms where many founders are CEOs, CEO voting share ownership may lie at the intermediate or high levels between 25% to 50% and above, reducing the influence of other directors and minority shareholders on voted decisions in the firm. Moreover, extant research suggests that there is a higher likelihood for founder CEOs compared to non-founder CEOs to make non-value maximising decisions because of their desire to maintain their influence in the boardroom (Jain and Tabak 2008). Prior to listing, CEOs' decisions are relatively unchallenged as entrepreneurs as such, they may be less inclined to support board selections that facilitate monitoring and constrain their power after listing.

In summary, powerful CEOs will have a crucial influence on board appointments regarding diversity and may avoid selecting board members that potentially improve monitoring. Rather, CEOs may focus on influencing appointments that match their preferences (Joseph et al. 2014). As such, powerful CEOs will influence board appointments in a way that maintains the homogenous board, inhibiting gender diversity to minimise the monitoring of their activities and preserve their power in the boardroom. This prediction is consistent with the bargaining model. Accordingly, the hypothesis on the relationship between CEO power and gender diversity is developed.

H1a: *Powerful CEOs decrease gender diversity in the boardroom of IPO firms.*

Next, we discuss the potential impact of powerful CEOs on professional expertise diversity, in line with the resource dependency theory. To begin, we argue that in IPO firms, CEOs have invested emotional, financial, and reputational capital in the business and any decisions influencing the business holds value to the CEO. In this context, what matters to the CEO is not maintaining their power in the boardroom but ensuring that the board is sufficiently equipped to perform its advising and monitoring functions. For instance, a CEO in the pharmaceutical industry who founded the IPO firm and has taken the firm up to the point of listing will have accumulated relevant expertise. Such a CEO is more likely to use their power to influence the appointment of directors with experience in deficient drug composition areas, providing resources to the IPO firm. Here, powerful CEOs will facilitate professional expertise diversity as it complements the skill set of current board members.

CEOs are more knowledgeable about the firm and have private information on the firm due to their position. Adams et al. (2007) mention that CEOs face a trade-off in disclosing information to the board. If the CEO discloses more information to the board, the former will receive better advice; however, a more informed board will be better monitors and increased monitoring of the CEO will minimise the influence of their power in the boardroom. Gounopoulos and Pham (2018) suggest that CEOs with financial expertise - a factor extending CEO expert power, improves the quality of financial reporting in IPO firms since these firms are more prone to engage in earnings management due to information asymmetry problems. We argue that such powerful CEOs will influence board appointments in a way that improves professional expertise diversity and complements their financial expertise for better decision-making processes.

Despite the resultant consolidation of power and discretion relating to CEO duality, Yang and Zhao (2014) show that duality promotes organisational effectiveness as CEOs have unparalleled firm-specific information. As such, the authors argue that firms with CEO duality are able to adapt in dynamic environments. Therefore, we argue that such well-informed CEOs who understand the expertise needs of their firms use their structural power to facilitate director appointments with different professional expertise. Moreover, the literature also suggests that CEO ownership power relating to founder CEOs reduces conflicts and political battles in the firm and ensures a continuation of the firm's strategy (Fischer and Pollock 2004; Ensley et al. 2006). In the CEO's view, an increase in professional expertise diversity is beneficial to the IPO firm as different professional expertise provides more resources to the firm and enhances the skill set of the board. Accordingly, the hypothesis on the relationship between CEO power and professional expertise diversity is developed.

H1b: *Powerful CEOs increase professional expertise diversity in the boardroom of IPO firms.*

2.2.2 Venture Capitalist Director Power and Board Diversity

The objectives of venture capitalist directors are to improve the return on their investment, improve the reputation of their venture capital firms and exit their portfolio firms (Amini et al. 2020). Venture capitalist directors differ from other non-executive directors on the board in several ways - the former negotiates with management for their venture capital firms' relative equity stakes, control and exit rights (Fairchild 2004). Beyond providing finance to the firm, venture capitalist directors provide value-added services to the IPO process through their screening activities, decision support, and connecting the firm with potential suppliers and customers (Iliev and Lowry 2020). In addition, Copley et al. (2021) show that venture capitalist directors influence the quality of auditing and assurance services obtained by the firm which improves the information reported to investors in the IPO. We argue that all these value-added services increase venture capitalist directors' knowledge of their portfolio firms and consequently, their influence in the boardroom.

In Section 2.2.1, we established that CEOs view gender diversity as a threat to their influence in the boardroom, as female board representation is related with better monitoring by the board (Adams and Ferreira 2009). According to the bargaining model, the CEO's motivation to influence board appointments might be self-serving and aimed at maintaining their power in the boardroom, hence, the CEO may no longer be trustworthy. To ensure that negotiations between the CEO and other board members regarding appointment decisions in the boardroom are in the best interest of the firm, this section focuses on venture capitalist directors who have a comparable influence on the board to the CEO. Below, we discuss prior literature on venture capitalist director power and explain the impact of various factors augmenting venture capitalist director power on gender diversity and professional expertise diversity.

Baker and Gompers (2003) show that the presence and reputation of venture capitalist directors on the board of IPO firms positively influences the appointment of other non-executive directors, consequently enhancing the monitoring function of the board. Furthermore, Roosenboom's (2005) findings allude to venture capitalist directors using their bargaining power derived from their voting share ownership to influence the appointment of independent directors in IPO firms.[25] Finally, Hsu et al. (2020) suggests that venture capitalist directors are highly motivated to facilitate better monitoring of CEO as their final return prior to exit is contingent on the firm's share price. To this end, we argue that venture capitalist directors use their control power to ensure proper monitoring of the CEO such that decision-making regarding female director appointments reflect the firm's best interests rather than the self-interest of influential board members like the CEO.

Ultimately, we expect that the need for increased monitoring of the CEO in IPO firms will be addressed through an increase in gender diversity especially in firms with powerful venture capitalist directors. Alternatively, venture capitalist directors may simply desire greater gender balance on the board given the lack of gender diversity in the entrepreneurship industry highlighted by Calder-Wang and Gompers (2017). Since the structuring of corporate boards is critical to IPO firm performance (Garg et al. 2019), venture capitalist directors have strong incentives to facilitate board appointments improving gender diversity to ensure the best outcomes for their investment (Chancharat et al. 2012). Therefore, we develop the hypothesis 2a.

H2a: *Powerful venture capitalist directors increase gender diversity in the boardroom of IPO firms.*

From a resource dependency perspective, venture capitalist directors are in a unique position to improve professional expertise diversity since they have access to the external environment through prior and current investments in other firms. Hasan et al. (2018) show that venture capitalist directors are not only present in IPO firms but also mature firms. The authors argue that these board seats in mature listed firms provide enhanced networks, greater visibility, and reputation, which inherently broadens the venture capital firms contacts for fundraising activities. Furthermore, Hasan et al. (2018) mention that the expertise and knowledge gained by venture capitalist directors from mature public firms is invaluable for their portfolio IPO firms that are new to stock markets. In this context, we argue that venture capitalist directors board connections and prior expertise augment their power in the boardroom. With greater access to potential directors and sufficient experience, we argue that venture capitalist directors are equipped to facilitate board appointments providing different professional expertise needed by IPO firms. Therefore, venture capitalist directors use their

[25] Independent directors are defined in Roosenboom (2005, p.180) as "outside directors that are not current managers, former managers, relatives of management or persons that have business relationships with the firm"

prestige power relating to board connections to facilitate professional expertise diversity in the boardroom.

Additionally, the value-added services venture capitalist directors provide to the firm which are not easily quantifiable but are inherently captured by longer board tenures mean that they are well informed on the business operations of the IPO firm and the firm's needs. Besides, prior literature shows that IPO firms in industries that are difficult to advise and monitor for non-experts will focus on director appointments that reflect professional expertise for such industries (Field et al. 2013; Faleye et al. 2018). Therefore, we argue that professional expertise diversity in the boardroom encompassing industry, business, operational knowledge, and skills is invaluable for decision-making. Consequently, IPO firms without sufficient professional expertise diversity may pose a threat to the achievement of venture capitalist director objectives. Hence, powerful venture capitalist directors facilitate director appointments that reflect different professional expertise to ensure that the board is well informed for decision-making. The next hypothesis is developed below.

H2b: *Powerful venture capitalist directors increase professional expertise diversity in the boardroom of IPO firms.*

2.2.3 Non-Executive Director Power and Board Diversity

Non-executive directors play a similar role in monitoring the CEO, as the venture capitalist directors, although the former may not have sufficient influence on voted decisions such as director appointments in the boardroom. The consensus in the literature is that a higher number of non-executive directors in the boardroom is largely related with greater board monitoring (Hutchinson et al. 2015) as is female board representation (Adams and Ferreira 2009).[26] Beyond the monitoring function, Fields and Keys (2003) mention that the greatest benefit non-executive directors receive from serving on corporate boards relates to their reputational effects. Consistently, evidence suggests that directors related with underperforming firms are less likely to receive additional directorships (Fich and Shivdasani 2007). Thus, non-executive directors have incentives to ensure proper oversight of top management teams to protect their reputation in the labour market and secure prospective directorships (Sila et al. 2017). Without sufficient access to firm-specific information, non-executive directors in IPO firms may be less effective monitors especially in the presence of

[26] Roberts et al. (2005) and Shen (2005) show that the presence of Non-Executive Directors on the board improves board effectiveness.

powerful CEOs. We argue that non-executive director power derives from their general knowledge and external links such as board connections, financial expertise, and critical expertise, and facilitates gender diversity to improve the board's monitoring function. Accordingly, we expect that powerful non-executive directors facilitate female director appointments. Therefore, we develop the following hypothesis.

H3a: *IPO firms with powerful non-executive directors have more gender diversity in the boardroom.*

Besides the monitoring role of the board, Field et al. (2013) show that IPO firms require an advising-oriented board to deal with the new challenges and competition in the stock market. Drawing on the resource dependency theory, we make two arguments to explain the relationship between non-executive director power and professional expertise diversity. In IPOs, non-executive directors may be founders affiliated with the firm or may be appointed externally to their board seats and independent of the firm. In both cases, we argue that powerful non-executive directors lean towards a board with greater professional expertise diversity improve board advising and information access for the firm. Founder non-executive directors may be ineffective monitors who are well informed on the business operations of the firm and have sufficient influence over director appointment decisions. These non-executive directors have firm-specific information, an in-depth understanding of the expertise needs of the firms, and sufficient control power to influence director appointment decisions. Furthermore, these directors are motivated to see the firm succeed as this maximises their returns (Borokhovich et al. 2014). Hence, founder non-executive directors may also view the appointment of directors with different professional expertise as a path to establish and expand business ties beneficial for the IPO firm.

Although non-executive directors appointed externally to the board in IPO firms do not possess sufficient access to firm-specific information, these non-executive directors draw on their expertise, connections, and general knowledge to augment their power in the boardroom. Wu and Hsu (2018) mention that non-executive directors' effectiveness in performing the monitoring role is impaired when they only rely on general knowledge rather than firm-specific information. For IPO firms, the board may comprise a mix of non-executive directors with both firm-specific and external knowledge, improving board effectiveness.

Accordingly, we argue that powerful non-executive directors will facilitate professional expertise diversity as this improves the IPO firms access to resources, the board's advising function and board effectiveness. This leads us to formulate the next hypothesis:

H3b: *IPO firms with powerful non-executive directors have more professional expertise diversity in the boardroom.*

2.3 Methodology

2.3.1 Sample Selection and Data Sources

The sample is drawn from the population of 5,222 completed IPOs listed on the NASDAQ, NYSE, and AMEX between 1st January 1997 and 31st December 2015 and tracked to 31st December 2019.[27] The start date of the sample period is influenced by data availability in the SEC's Edgar database, while the end date allows the researcher to track the evolution of board diversity to five years in the post-IPO period. In line with Boone et al. (2007) and Chahine et al. (2011), we exclude all American Depository Receipts, Real Estate Investment Trusts, unit offerings, spin-offs, carve-outs, closed-end funds, financial firms with Standard Industrial Classification codes (SIC) codes 6000-6799, and IPOs with an offer price below $5. Financial firms are also excluded as they have different corporate governance structures compared to the other firms in the sample (Anginer et al. 2018). For a firm to be included in the sample, they must be incorporated in the US at the offer date and be identified in both the Center for Research in Security Prices (CRSP) and Compustat databases. These criteria yield a population of 2,641 IPO firms.

Due to the time-intensive nature of hand collecting data and consistent with Chahine and Goergen (2011), the data-gathering exercise is only conducted for the random sample of 661 IPO firms which amounts to 25% of the 2,641 population of IPO firms. Board data for the IPO and pre-IPO years are manually obtained from the offering prospectuses, while subsequent

[27] An IPO is defined as the first equity offering of a firm in a public equity market. Data on the list of IPO firms has been obtained from the Thomson One Banker database which has been identified as a reliable source of data on IPOs (see Jain and Tabak 2008; Gounopoulos and Pham 2018). Other databases with IPO data explored in the sample selection process are the Ritter dataset and Capital IQ database. However, these databases were not used for three reasons. First, the Ritter dataset of US IPOs focuses on obtaining the founding dates for the IPO firms. As such, Ritter explicitly states that firms for which no founding date could be found have been excluded. Second, the Capital IQ database provides a list of US IPOs with a survivorship bias as only firms that are currently listed on US stock exchanges are drawn up as IPOs. In this case, IPO firms that are delisted or liquidated are not included. I went further to search Capital IQ based on prospectuses filed through Form 424, but the list of IPOs drawn up included firms that went through a direct listing rather than an IPO.

years are manually collected from the proxy statements.[28] IPO firm financial data is obtained from the CRSP and Compustat databases.

Table 2.1 shows the data representativeness of the final random sample of 661 firms compared to the final population of 2,641 IPOs. Panel A shows that the final sample represents the population. During the period of regulatory change due to the SOX Act between 2001 and 2003, there is a decrease in the number of listings in the population, which is reflected in the final random sample. Similarly, the period around the financial crisis in 2008, where there is a decrease in listing, is also reflected in the final random sample. Following the Jumpstart Our Business (JOBS) Act that was signed into law in 2012, which simplifies the IPO process for emerging growth companies, we observe an increase in listings.[29] Panel B shows the Fama-French industry classification for the final sample and population. We focus on the Fama and French 12-industry classification but exclude the financial industry as discussed above. The business equipment industry consists primarily of information technology (IT) firms and represents 29% of the population of IPOs, the largest industry with IPOs. Similarly, this industry is also the largest in the final sample, representing 34% of the 661 IPO firms. The healthcare industry has the second largest number of IPOs which amounts to 12% of the IPO firm population and it is represented in the final sample. The industry with the smallest number of IPOs- the utility industry, amounting to about 1% of the population is represented similarly in the final sample. Hence, our sample of IPO firms represents the wider population of IPO firms.

[Insert Table 2.1 about here]

[28] Sec.11 of the Securities Act of 1933 mentions that directors or proposed directors are personally liable for any untrue or misleading information contained in the listing particulars of the IPO firm. Therefore, any issues relating to the content validity of the information provided in an IPO prospectus, such as directors' biographical data used in this thesis, are minimal. Additionally, the use of IPO prospectuses is appropriate for this study because Sec.10 of the Securities Act of 1933 provides strict reporting and disclosure requirements as well as sanctions on any manipulation of information for any firm involved in listing securities. In the process of extracting data, another main concern is the reliability of the coding effort. To this end, variables created are clearly defined and supported by reasons for classification to ensure traceability.

[29] The Jobs Act allows firms within the IPO process to communicate relevant information with qualified institutional investors and accredited individual investors which minimizes information asymmetry problems, prior to the release of the registration statement. Furthermore, this Act allows firms within the IPO process to submit a confidential registration statement to the SEC. Thus, this Act protects potential issuers if the firm does not go through with the IPO. Although this Act encourages more firms to engage in IPOs due to better information protection, we argue that JOBS Act is not likely to influence how firms structure their board in terms of diversity but rather other firm specific information imperative for performance such as the firm's innovative strategies. Therefore, we account for the potential influence of the Jobs Act in Chapter 4 of this thesis that focuses on innovative activity of IPO firms.

2.3.2 Methodological Choices

This section discusses the methodologies used in this chapter to test the relationship between power in the boardroom and board diversity. The sample comprises a panel of 661 IPO firms tracked from the pre-IPO year up to year 5 post-IPO. Board diversity is measured in terms of gender and professional expertise. Gender diversity is defined as the percentage of female board representation. Professional expertise diversity is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board.[30] Since the dependent variable in this chapter is board diversity and director appointments do not occur annually but rather every three years on average, we begin our analysis by examining the trend in board diversity across the sample period.

The trend analysis for the measures of board diversity in Figure 2.3 shows that diversity is highly persistent in the boardroom over the sample period.[31] Gender diversity increases on average from 5% in the pre-IPO year to 8% by year 5 post-IPO, which translates from having on average no female directors at the IPO to one by year 5 post-IPO. Professional expertise diversity increases from 0.46 in the pre-IPO year to 0.51 by year 2 post-IPO but declines thereafter to 0.49 by year 5 post-IPO. In real terms, this increase in professional expertise diversity relate for IPO firms having an average of two professional expertise groups pre-IPO increasing to three groups in the post-IPO period. The trend analysis shows that the data on the measures of board diversity is highly persistent in time with some changes in the level of board diversity occurring at the IPO, in year 2 and 5 post-IPO. This indicates a lack of within firm variation in the measures of board diversity, as board appointments are not an annual occurrence and highlights the nature of the contractual environment for IPO firms in the sample. The consequence of this lack of within firm variation and breaks in the data is that panel data analysis loses its power due to the little changes over time in the firm's contractual environment (Zhou 2001).

---

[30] Board expert categories are based on Gray and Nowland's (2017) classification and it includes the following professional categories: academic, accountant, army, banker, consultant, dentist, doctor, engineer, executive, finance expert, IT expert, investment professional, lawyer, scientist, and politician. The Blau index for professional expertise diversity is appropriate as there are fifteen expert categories, and this index accounts for the differences in each category equally. The professional expertise index is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of board members in category i. High scores indicate higher professional expertise diversity.

[31] All the measures of board diversity lie between 0 and 1. Gender diversity and professional expertise diversity are measured using the Blau heterogeneity index. Values closer to 0 depict lower levels of diversity while values closer to 1 indicate that the firms have a higher level of board diversity.

Prior literature on the determinants of board structure has followed a somewhat arbitrary sampling technique using three-year intervals to mitigate persistent data concerns and estimate pooled regressions on these samples (Boone et al. 2007; Linck et al. 2008). Although this sampling choice reduces serial correlation and increases time-series variation, the sample size is smaller, which reduces the power of regressions. Furthermore, without prior confirmation, there is an implicit assumption in these studies that the sampling years chosen are the points where changes in board structure occurred, which may not necessarily be the case. In this chapter, the trend analysis provides insights into where the little changes in board diversity occur across the sample period (year 0, 2 and 5). However, following the three-year sampling intervals, the sampling years will be years 1 and 4, where there is relatively no change in board diversity. To mitigate this concern of persistence, we analyse the relationship between power in the boardroom and board diversity by focusing on the cross-sectional component of the data relating to the IPO year, year 2 post-IPO and year 5 post-IPO. In other words, we examine the impact of power in the boardroom at the IPO, in the medium-term post-IPO and in the long-term post-IPO.

[Insert Figure 2.3 about here]

To further support the choice to focus on the cross-sectional component of the sample, we introduce an autoregressive panel data model/ AR (1) model for board diversity to check how appropriate a dynamic panel model is for our analysis.[32] This analysis regresses current diversity on prior period diversity. Bond (2002) suggests that it is important to consider the time-series properties of data when the number of observations (N) is large, the sample period (T) is small, and the dependent variable is highly persistent. The ordinary least squares regression (OLS), fixed effects model (FE), difference generalised method of moments estimator (Diff GMM), and the system GMM (Sys GMM) estimator are applied in estimating the AR (1) model. According to Bond (2002), dynamic panel data models are only appropriate when the coefficients on the lagged dependent variable follow a specific pattern, such as FE<Diff GMM< Sys GMM<OLS. As a consequence of the latter, there is an upward bias in the OLS coefficients, a downward bias in the FE coefficients, and the Diff GMM and Sys GMM should lie between these coefficients.

Contrary to Bond (2002), the results of the AR (1) in Appendix 2.2 show that the Sys GMM coefficients are a unit root value of 1 for professional expertise diversity which is much

[32] Dynamic panel data models can be used in analysing data with many cross-sectional units and a small sample period as it is the case in our data with 661 IPO firms over 6 years.

greater than the OLS coefficient indicating that the panel data model is biased. Furthermore, the coefficients for professional expertise diversity in the Diff GMM estimator are biased downwards towards the FE estimator, signalling weak instruments in the Diff GMM according to Blundell and Bond (1998). Finally, the results suggest that the AR (1) model for professional expertise diversity does not pass the Sargan test of over-identifying restrictions. This indicates that the instruments (lags of board diversity) are weak and endogenous. Blundell and Bond (1998), and Bond (2002) mention that such inconsistencies in the coefficients might indicate a finite sample bias that arises in persistent data.

Overall, the results from trend analysis and the AR (1) analysis suggest that panel data analysis is not suited to the data due to high persistence relating to board diversity across time and a finite sample bias in the dynamic panel data models. This supports our rationale to focus on the cross-sectional component of the sample for analysis. Therefore, this chapter uses cross-sectional OLS regressions focusing on the IPO year, year 2 post-IPO and year 5 post-IPO to analyse the impact of power in the boardroom on the evolution of board diversity in IPO firms.

2.3.3 Main Regression Model

The cross-sectional OLS regression in this chapter estimates the relationship between the measures of power in the boardroom and board diversity. Based on our hypotheses, we test whether CEO power, venture capitalist director power and non-executive director power result in a higher or lower level of board diversity in IPO firms. We focus on three periods, such as the IPO year, year 2 post-IPO and year 5 post-IPO which reflect the state of board diversity at the point of listing, in the medium-term post-IPO and in the long-term post-IPO. In detail, we regress board diversity at the IPO (t=0) on the power in the boardroom in the pre-IPO year (t=-1). In the medium-term post-IPO board diversity in year 2 (t=2) is regressed on power in the boardroom in the IPO year (t=0), while the long-term post-IPO focuses on board diversity in year 5 (t=5) on the power in the boardroom in year 2 (t=2). The rationale for this approach is that the information set available during director appointments that influence board diversity are past realisations of power in the boardroom. We also adjust for past board diversity that may influence the level of board diversity reflected in new appointments, since board diversity is relatively persistent. Model 2.1 below shows the regression model for the impact of power in the boardroom on board diversity:

$$Board\ diversity_{i,t} = \beta_0 + \beta_1 Board\ diversity_{i,x} + \sum_{n=2}^{11} \beta_n Power\ in\ the\ boardroom_{i,x} + \beta_{12}\ Board\ characteristics_{i,x} + \sum_{n=13}^{20} \beta_n Firm\ characteristics_{i,x} + Industry\ dummies + Year\ dummies\ + \varepsilon_{i,x} \quad (2.1)$$

t relates to the current period (years 0, 2, 5), x relates to the prior period with a significant change in the level of diversity (years -1, 0, 2), while i is the firm. The dependent variable is board diversity, measured in relation to gender and professional expertise diversity.

- *Gender diversity* is defined as the percentage of females in the boardroom (Adams and Ferreira 2009; Sila et al. 2016).
- *Professional expertise diversity* is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. Board expert categories are based on Gray and Nowland (2017) and include the following fourteen categories, such as academic, accountant, banker, consultant, dentist, doctor, engineer, executive, finance expert, IT expert, investment professional, lawyer, scientist, and politician.[33] The Blau index for professional expertise diversity is appropriate, as the index accounts for the differences in each category equally. The professional expertise index is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$, where Pi is the proportion of group members in category i. High scores indicate higher professional expertise diversity on the board.

As discussed earlier in Figure 2.2, we use the following proxies to capture these five types of power:

Structural Power

- *No. of Positions* is measured as the average number of positions held by the members of the board within the IPO firm. Board seats count as one position, and any other positions such as a role as the board chair or chief risk officer, are counted accordingly.
- *CEO Duality* is a dummy variable that takes the value of one if the CEO is also the board chair, and otherwise zero.
- *Board Tenure* is measured as the average number of years directors served on the board.

Ownership Power[34]

[33] Each board member is classified into one expertise category based on the prior experience as shown in the prospectus. Expertise is classified, based on the work experience of the director. For example, if a director has more than one expertise such as, with a chartered accounting qualification, is a Juris Doctor in Law but has served on the board of several pharmaceutical companies, we classify such director to hold executive expertise as this is their primary expertise which is largely board based. This method of classification is follows Gray and Nowland (2017).

[34] Share ownership is considered as a measure of ownership power at the initial stage of the analysis but dropped due to high level of correlation with voting share ownership (0.89). Related to the founder is also measure of ownership power but has been excluded from analysis due to a small number of firms with directors related to the

- *Founder* is a dummy variable that takes the value of one if the founder of the firm is present on the board, and otherwise zero.

Prestige Power[35]

- *Board Connections* is the average number of prior and current board appointments of the board as stated in the prospectus and proxy statements.[36]

Expert Power

- *Critical Expertise* is a dummy variable that takes the value of one if the board has industry experience critical to the operations of the firm, and otherwise zero. (e.g., a board member that has worked previously as a software engineer serving on the board of an IT firm).
- *Financial Expertise* is a dummy variable that takes the value of one if the board has financial experience, and otherwise zero (e.g., a director with prior experience in finance institutions).

Control Power

- *Voting Share Ownership* is measured as the total percentage of voting shares owned by the board.

Considering the focus on gender diversity, we include a gender dummy relating to the CEO, venture capitalist directors, and non-executive directors in all the regressions to ensure that the results reflect the effect of power in the boardroom rather than a gender effect. Board and firm characteristics are included following Boone et al.'s (2007) IPO study on the determinants of board structure and Chen et al.'s (2018) study on board diversity. We control for the following board and firm-specific characteristics in our regression model, such as gender dummy, board size, board independence, leverage, firm size, firm age, return on assets, and risk. The regressions also control for IPO firms with dual-class shares, as these shares provide different ownership and control rights to directors on the board. Finally, we account for regulatory changes such as the SOX Act and the global financial crisis via the SOX dummy

---

founder. There are only 3 firms had a CEO related to founder, 1 firm had a VC related to founder and 8 firms had NED related to the founder.

[35] We also have a proxy for education which was excluded as only 70% of the sample was available. *Ivy League* is a dummy variable that takes the value of one if the board has Ivy League education, and otherwise zero. Since this variable is available for 70% of the sample, we report the results in the Appendix 2.4.

[36] We focus on the average board connections as this reflects the level of board busyness rather than the sum, which is a noisy measure of board connections due to the level of interlocking directorships. About 18% of directorships within the sample are interlocked memberships thus, taking the sum of board connections will result in an inflated value of board connections. An alternative route to computing this measure would be through board members unique connections. However, a limitation of our dataset is that the board connections variable only reflects the total. To mitigate this issue, we focus on the average, which alludes to the busyness of the board.

and the financial crisis dummy. All variables are defined in Appendix 2.1. A summary of the expected signs for each of the proposed hypotheses can be found in Figure 2.4.

[Insert Figure 2.4 about here]

2.3.4 Endogeneity Issues and Identification Strategy

As with any research involving the board of directors, potential endogeneity issues may cause biased inferences where a statistically significant result may not be interpreted as a causal relationship. In this chapter, potential endogeneity may arise due to omitted variables, selection bias, or reverse causality. Despite the broad range of variables included in estimating the impact of power in the boardroom on board diversity, there are still other omitted variables (both fixed and variable across time) that may influence board diversity that are unquantifiable. For example, the firm's corporate culture or the propensity of firms to be socially responsible. The corporate culture of the firm might influence the appointment of new female directors and directors with different professional expertise to the board. Evidence suggests that socially responsible firms are more likely to appoint female directors to seek legitimacy (Harjoto et al. 2015; Rao and Tilt 2016). However, female directors may also find socially responsible firms more attractive as they care about self-transcendence values like benevolence and universalism (Adams and Funk 2012). Although the literature on corporate social responsibility has identified various measures of social performance as proxies, such variables are based on disclosed outcomes rather than the tendency of the firm to be socially responsible. The tendency of the firm to be socially responsible is unobservable and therefore omitted in the model. The effect of such omitted unobservable variables is considered and adjusted for using industry and year fixed effects when estimating the impact of power in the boardroom on board diversity.[37]

Another potential source of endogeneity is a selection bias in appointing directors that improve board diversity. For example, IPO firms may appoint directors for their access to resources, information, and their contacts outside the firm and these directors may also be females or directors with different professional expertise. Conversely, directors who are females or with different professional expertise may self-select into specific firms that will improve their career prospects. In such a case, a positive relationship between power in the

[37] As the measures of board diversity are highly persistent across time, we do not include firm fixed effects as this will eliminate any within firm variation.

boardroom and board diversity will capture a selection effect rather than the treatment effect. To mitigate this issue, we employ the propensity score matching (PSM) technique.

Propensity Score Matching: Identification Strategy

The PSM uses predicted probabilities also known as propensity scores and a matching algorithm to estimate the effect of the treatment on the outcome allowing researchers to mimic the characteristics of randomised control trials (Austin, 2011).[38] In this chapter, the treatment refers to the measures of power in the boardroom, while the outcome refers to the measures of board diversity. Treated and untreated groups are constructed to analyse the impact of the treatment on the outcome. The treated/untreated groups relate to IPO firms with high/low CEO power, venture capitalist director power, and non-executive director power. Considering the large number of proxies for the measures of power, IPO firms are categorised into the treated and untreated groups using the following steps. To begin, we create a boardroom power score for CEO power, venture capitalist director power, non-executive director power, as there are eight proxies for power.[39] If an IPO firm has a value above the median for any of these proxies, we assign a value of one to the firm, and otherwise zero. Accordingly, the maximum boardroom power score will be eight and IPO firms above the median will be part of the treated group, while those below the median will be in the untreated group.

After categorising IPO firms into treated and untreated groups, the propensity score is estimated at the IPO (t=0) using logit regressions based on observable firm characteristics such as firm age, firm size, leverage, return on assets and risk. Model 2.2 below estimates the propensity score:

$$V_{i,t} = \beta_0 + \beta_1 Firm\ Age_{i,x} + \beta_2 Firm\ Size_{i,x} + \beta_3 Leverage_{i,x} + \beta_4\ Return\ on\ Assets_{i,x} + \beta_5 Risk_{i,x} + Year\ dummies\ + \varepsilon_{i,t} \quad (2.2)$$

V is an indicator variable for high/low CEO power, venture capitalist director power, and non-executive director power. The propensity score generated in model 2 is amended to adjust for industry as the board diversity in IPO firms will differ across industries (Cumming

[38] Randomised control trials are prevalently used in scientific experiments to explain causal relationships using a treatment and a control group and are a standard research method in scientific research.

[39] This is a boardroom power score which is a scoring variable based on the proxies for CEO power, VC power and NED power. There are eight proxies of CEO power and seven for VC power and NED power: *No of Position(s)*, *CEO Duality, Board tenure*, *Founder, Board Connections, Critical Expertise, Financial Expertise, and Voting Share Ownership.* Four of these proxies are continuous variables while the remaining are dummy variables. We assign a score of one to each continuous proxy of power that lies above the median value of said proxy for the sample. We also assign a score of one to each dummy proxy of power where the firm is classified with a value of one for each director category, and otherwise zero. In total, the maximum score for CEO power will be eight while VC power and NED power will be seven.

and Leung 2021).[40] The amended propensity scores are then matched using the nearest-neighbour matching without replacements.[41] To ensure that there are no differences between both groups, the maximum calliper difference between the propensity scores for the treated and untreated groups for CEO power is 0.05. For venture capitalist director power and non-executive director power, the maximum calliper difference is 0.1.[42] The resulting sub-sample of matched firms for CEO power (161 matched out of 322 total firms), venture capitalist director power (92 matched out of 184 total firms) and non-executive director power (198 matched out of 396 total firms) are then used to re-estimate the cross-sectional OLS regressions.

In summary, the main regression model and PSM analysis have been discussed to explore the relationship between board diversity and power in the boardroom. As the PSM analysis controls for potential endogeneity by focusing on the treatment effect, the results from this analysis are the main results for this chapter. In the next section, we discuss the instrumental variable estimation explored to address potential endogeneity arising from reverse causality.

Instrumental Variable (IV) Estimation Technique

The IV estimation in this chapter uses the two stage least squares (2SLS) regressions to address potential reverse causality issues by extracting the exogenous component of power in the boardroom to explain board diversity in IPO firms. There are eight proxies for power in the boardroom and we argue that three proxies for power in the boardroom might be potentially endogenous in our model due to reverse causality. These proxies include board connections, critical expertise, and financial expertise. Reverse causality arises when the outcome variable (Y), which in our context is board diversity, and one or more independent variables (Z), which in our case are proxies of power, are determined in equilibrium. Therefore, the argument can be made that Z causes Y or that Y causes Z (Roberts and Whited 2013, p.499). These potentially endogenous proxies are discussed further in the following highlighting how they might be endogenous.

[40] The amended propensity score is computed as follows: Fama-French 12 Industry Code * 100+Propensity Score.
[41] We do not match firms with replacement as the diagnostic tests from this method of matching reveal that the treated and untreated firms are still distinguishable in terms of leverage which may introduce bias in the PSM.
[42] The treated and untreated groups for CEO power were matched to a calliper distance of 0.1 However, the subsequent unreported diagnostic tests show that the two samples still exhibited differences in their firm characteristics leading us to focus on a more stringent calliper of 0.05. The option to apply a similar calliper distance for uniformity with the VC power and NED power is also explored but the resulting samples are too small for further analysis.

Board Connections: We expect that better-connected boards will have more links to prospective directors for appointment to the board. Directors may also self-select into boards with connected members to enhance their career advancement. For example, directors may accept appointments into IPO firms with venture capitalist directors representing prestigious venture capital firms or firms where non-executive directors have external contacts. This argument applies to all categories of directors on the board. Thus, board connections may give rise to reverse causality in the model, which is a source of endogeneity.

Critical Expertise and Financial Expertise: Critical expertise relates to the board's firm or industry experience crucial for the firm's operation. Financial expertise relates to the board's prior financial experience where directors were previously employed financial institutions. IPO firms may appoint directors for their relevant critical or financial expertise who are also female directors or directors with different professional expertise. Conversely, directors may also self-select into firms with such expertise to improve their career prospects. Accordingly, we argue that critical and financial expertise are a potential source of endogeneity in our model.

As discussed above, power in the boardroom is inherently endogenous and extracting the exogenous component of power in the boardroom with instrumental variables may be difficult. We attempt to mitigate the potential endogeneity concerns by proposing three instruments for the endogenous variables in the model, such as board connections, financial expertise and critical expertise. The instrumental variable for board connections is *CEOs in other firms,* defined as the percentage of firms in each industry whose CEOs are board members in other firms within the same industry. The rationale for this instrument is that having a board member who is a CEO in another firm within the same industry facilitates the firm's connection to its external environment. This satisfies the relevance criterion, as the correlation between board connections and the instrument is -0.058, respectively. The exclusion criterion for *CEOs in other firms* instrumenting board connections is also fulfilled as this variable is computed at an industry level and excludes the IPO sample firms.

Critical expertise is instrumented by the *Industry proportion by US state.* This is defined as the proportion of firms in the industry of the IPO firm to the total number of firms in the state where the IPO firm is headquartered. For example, IPO firms in the IT industry, headquartered in California are more likely to have more critical expertise on their board compared to mining firms. This is due to the large number of IT firms in Silicon Valley, satisfying the relevance criterion. The industry proportion has no direct influence on gender or professional expertise diversity in the boardroom, satisfying the exclusion criteria. The correlation between critical expertise and its instrument is 0.096.

Financial expertise is instrumented by the *No. of financial firms,* which is measured as the natural log of the number of financial firms in the state where the IPO firm is headquartered in each respective year. The justification for this instrument is that IPO firms headquartered in states with more financial firms are more likely to have directors with financial expertise on their board, which satisfies the relevance criterion. In terms of exclusion, we argue that the number of financial firms in a state has no influence on gender or professional expertise diversity in the boardroom. The correlation between financial expertise and the instrument is 0.044.

The first stage estimates the three endogenous variables, such as board connections, critical expertise and financial expertise assumed to be exogenous and the instrumental variables as explanatory variables. In the second stage, the estimated value of the endogenous variables in stage one are included as the explanatory variables in the second stage. This potentially eliminates any correlation between gender diversity, professional expertise diversity and the error term ($\varepsilon_{i,t}$). Models 2.3 and 2.4 below shows the first and second stage regressions for the 2SLS.

Stage one

$$P_{i,t} = \beta_0 + \sum_{n=1}^{3} \beta_n \theta_{i,x} + \sum_{n=4}^{10} \beta_n Power\ in\ the\ boardroom_{i,x} + \beta_{11}\ Board\ characteristics_{i,x} + \sum_{n=12}^{20} \beta_n Firm\ characteristics_{i,x} + Industry\ dummies + Year\ dummies + \varepsilon_{i,x} \quad (2.3)$$

Stage two

$$Board\ Diversity_{i,t} = \beta_0 + \beta_1 Board\ diversity_{i,x} + \sum_{n=2}^{4} \beta_n P^{\wedge}{}_{i,x} + \sum_{n=5}^{11} \beta_n Power\ in\ the\ boardroom_{i,x} + \beta_{12}\ Board\ characteristics_{i,x} + \sum_{n=13}^{21} \beta_n Firm\ characteristics_{i,x} + Industry\ dummies + Year\ dummies + \varepsilon_{i,x} \quad (2.4)$$

t relates to the current period (i.e., years 0, 2 and 5), x relates to the prior period with a significant change in the level of diversity (i.e., years -1, 0, 2), while i is the firm. In stage one, *P* the dependent variable, relates to the endogenous variable, such as board connections, critical expertise, and financial expertise. θ relates to the respective instrumental variables for each endogenous variable, such as *CEOs in other firms, Industry proportion by US state, and No. of financial firms*. In stage two, the dependent variable is board diversity and $P^{\wedge}$ is the estimated value for the endogenous variable from model 3.

This section has discussed the potentially endogenous proxies of power and the instrumental variables for these proxies. Despite the justification for these instruments, we perform the Cragg-Donald Wald weak instruments test to confirm the suitability of these instruments. Appendix 2.3 shows that none of the instruments pass the weak instrument identification test. Compared to the critical value of 16.380, the instruments for board connections, financial expertise and critical expertise all fail the weak instrument test with F statistics ranging between 0.005 to 3.413. Therefore, we do not rely on the results from the IV estimation as the main results in this chapter though they are reported in Appendix 2.3.

2.4 Results

2.4.1 Preliminary Data Analysis

Descriptive Analysis

The distribution of IPOs in the sample is shown in Table 2.2. Panel A shows the yearly distribution of IPOs while Panel B shows the industry distribution of IPOs. Compared to the rest of the sample, there are fewer IPOs around the enactment of the SOX Act in 2002 and the 2008 financial crisis. Engel et al. (2007) and Leuz (2007) find evidence that the SOX Act of 2002 imposed substantial costs on newly listed firms without commensurate benefits, resulting in fewer listings around the enactment of the SOX Act and subsequently. In the pre-IPO year, there are only 641 IPO firms, as 20 more firms are incorporated in the year of the IPO. About 85% of the IPO sample are still listed by year 2 post-IPO while in year 5 post-IPO, 54% of the sample remain as publicly listed firms. The distribution of the IPO firms in Panel A indicates that it is important to account for the timing of listings in our main analysis as IPOs occur in waves.

IPO firms are distributed across eleven industries, as shown in Panel B based on the Fama-French 12 industry classification. As discussed in Section 2.3.1 of this chapter, IPO firms in the financial industry (SIC codes 6000-6799) are excluded from the sample as these firms have different corporate governance structures compared to the other IPO firms (Anginer et al. 2018). 34% of the IPO firms in the sample are in the business equipment industry which relates to software and IT firms. This industry has the largest number of IPOs in our sample at year 0 (226 of 661) and the largest number of firms by year 5 post-IPO (118 of 357). The healthcare industry has the second largest number of IPO firms in year 0 (132 of 661) and still maintains this position at year 5 post-IPO (62 of 357). The utility industry has the lowest number of IPOs in year 0 (4 of 661) and similarly, the lowest in year 5 post-IPO (2 of 357) in the sample. Overall, the results in Panel B show that number of IPOs differ across industries and the post-IPO distribution for each industry follow a similar pattern. This suggests that the main analysis should account for the industry effect in the sample.

[Insert Table 2.2 about here]

The descriptive statistics for the 661 IPO firms in the sample at the IPO are reported in Table 2.3. Panel A shows the descriptive statistics of firm characteristics for all the IPO firms in the sample. The firms in the sample are much larger in firm size, with a mean of total assets at the IPO of $460 million, compared to Boone et al.'s (2007) mean of $150 million. The larger size of firms in our sample is unsurprising as they are, on average 10 years old, which is higher than the 7 years in (Boone et al. 2007) but much less than the 19 years for Gounopoulos and Pham (2018). This indicates that most IPO firms are not newly incorporated and have grown their assets since incorporation. Firms in the sample are undervalued at the IPO, evidenced by their IPO underpricing with a mean of 29% and IPO premium with a mean of 84%. On average, only 9% of IPO firms in the sample have dual-class shares, suggesting that most shares held in the firm have voting rights. A negative average return on assets (ROA) of minus 13% suggests that IPO firms still incur losses in the IPO accounting year and this value lies between the minus 2% reported by Chahine and Goergen (2013) and the 26% reported by Gounopoulos and Pham (2018). The average leverage is 15% while the risk of IPO firms measured as the standard deviation of the return on assets is at 37% for stocks listed by IPO firms consistent with the negative ROA. Overall, the results for firm characteristics show that the IPO firms in the sample are larger compared to prior studies, with a high level of risk, as expected for newly listed firms navigating the stock market for the first time.

Turning now to Panel B, we focus on board diversity, which represents the outcome variable in this chapter. For context, there are on average seven board members at the IPO and 6% female board representation, which in real terms suggests that there is on average no female director on the board. Boards are more diverse at the IPO in terms of professional expertise consistent with the trend analysis, as the mean professional expertise diversity is 0.50, which relates to an average of three expert categories in the boardroom. This preliminary analysis shows that, at the IPO, boards are structured to enhance professional expertise diversity. Furthermore, IPO firms are less concerned with the gender of the director providing this expertise, since there are on average no female directors on the board at the IPO.

Moving forward to the hypothesised determinants of board diversity, Panels C to E of Table 2.3 focus on the proxies of CEO power, venture capitalist director power, and non-executive director power at the IPO. Panel C shows that CEOs have on average two positions in the IPO firm and 47% of CEOs occupy the board chair position, consolidating power at the helm of management with one person.[43] CEOs have on average 6 years board experience with the IPO firm, which is close to the 5 years reported in prior IPO studies (Jain and Tabak 2008; Chahine and Goergen 2013). In terms of CEO structural power relating to the number of positions, CEO duality and board tenure, the results in Panel C indicates that at the point of listing, most CEOs in the sample have substantial influence in the boardroom. On average, about 37% of the CEOs in our sample are founders which in line with the prior evidence in the field. For example, Boone et al. (2007) report an average of 43% of founder CEOs, though this is below the average of 58% reported by Jain and Gao (2012). CEOs in the sample have less ownership power relating to their founder status compared to those reported in prior studies. CEOs have on average one board connection to other boards besides their seats on the board indicating the level of CEO prestige power. As expected, the better part of CEO expert power is derived from critical expertise as 78% of CEOs, on average, have critical expertise relevant to the business operations of the firm. The results also show that having CEOs with commensurate financial expertise is not imperative for IPO firms as only 7% of the CEOs have prior financial experience. Similarly, to Chahine and Goergen (2013), CEOs have an average voting share ownership of 12% indicating the control power in the firm though this is unsurprising as there are many founder CEOs in the sample.

In terms of venture capitalist director power, Panel D shows that venture capitalist directors have on average one position in the firm which is their board seat. Venture capitalist directors are tenured on average for a shorter period of 3 years compared to the 6-year tenure of the CEO, which is expected as the former usually represent their venture capital firms, who are investors in the IPO firm. The results for structural power (number of positions and board tenure) indicate that venture capitalist directors have less power compared to the CEO. Only 0.6% of venture capital directors are founders suggesting that venture capitalist director ownership power is much lower than those discussed above. Compared to CEOs, venture capitalist directors have more prestige power evidenced by the average of two board connection to other boards. Furthermore, only 17% have critical expertise relevant to the business

[43] Regarding CEO power in the boardroom at the IPO, there are 6 firms without CEO board members whose CEOs are only members of the management team.

operations of the firm, but about 69% of these venture capitalist directors on average have financial expertise. Thus, the majority of venture capitalist director expert power is derived from financial expertise. In terms of voting share ownership, venture capitalist directors have on average 11% which is close to the average of 12% control rights held by the CEOs. Notably, venture capitalist directors have comparable control power to that of the CEO and can influence decisions in the boardroom.

Next, we discuss the proxies of non-executive director power at the IPO. Panel E shows that non-executive directors have on average one position in the firm which is their board seat. Non-executive directors have served for 3 years on average at the IPO, which is much like the average tenure of venture capital directors on the board at the IPO. Regarding structural power (number of positions and board tenure) a conclusion to be drawn is that non-executive directors have a similar level of power to venture capitalist directors, which is much less than that of the CEO. 15% of the non-executive directors are founders which is much higher than for venture capitalist directors suggesting that non-executive directors have more ownership power in the boardroom of IPO firms. Non-executive directors also have an average of two board connections implying a similar level of prestige power to venture capitalist directors in the boardroom. Non-executive director expert power relates to a somewhat even mix of both critical and financial expertise as an average of 63% possess critical expertise while the average for financial expertise is 50%. Non-executive directors hold about an average of 2% voting share ownership by the IPO firm, which, as expected, is less than the voting shares held by venture capitalist directors and CEOs. Therefore, non-executive directors have much less control power in the boardroom compared to their counterparts.

Overall, the descriptive statistics for the proxies of power indicate that CEOs have more power in the boardroom on average compared to venture capitalist and non-executive directors. In more detail, CEO power is focused mainly on structural, ownership, and control power in the boardroom, which are mainly derived internally. Venture capitalist director power is focused on prestige and expert power mainly derived externally but also control power due to their investment in the IPO firm. For non-executive directors, the pattern emerging from the descriptive analysis suggests that power is derived externally and relates to prestige and expert power.

Finally, Panel F of Table 2.3 reports the gender characteristics of each director category at the IPO. This is not a proxy for power but considering our focus on board diversity, we examine the distribution of female CEOs, female venture capitalist directors and female non-executive directors as there may be a spillover effect on board diversity for firms with female directors (Boutchkova et al. 2020). Panel F shows that on average, 3% of CEOs are female directors while 6% of venture capitalist directors and non-executive directors are female directors at the IPO. The median values for all three director groups indicate that at least half of the sample at the IPO have no female directors. Despite these lower levels, firms with female board members may be more receptive to female director appointments and disentangling this from power in the boardroom allows us to capture the effect of the latter on board diversity.

[Insert Table 2.3 about here]

Untabulated results also show that IPO firms increase in size across the sample period with a corresponding increase in board size and board tenure. For example, total assets of IPO firms increase by 87% and board size increases by 6% between year 0 and year 5 post-IPO while the board tenure increases from 5 years to 7 years within the same period. In terms of board structure, non-executive directors hold the most seats, three on the board at the IPO, increasing to five seats in the post-IPO period. In the post-IPO period, at least one venture capitalist director on average is on the board up to year 2 post-IPO consistent with the trend showing that venture capitalist directors divest their interest in the firm and leave the board after year 2 post-IPO. The results from the descriptive analysis show that the characteristics of IPOs in the sample are comparable to prior IPO studies (Boone et al. 2007; Chahine and Goergen 2013; Gounopoulos and Pham 2018). The next section briefly discusses the results of hypotheses testing in a univariate setting for the impact of power in the boardroom on board diversity.

Univariate Analysis for the Impact of Power in the Boardroom on Board Diversity

This section discusses univariate analysis results, testing the validity of the hypotheses in Figure 2.1 on the impact of power in the boardroom on board diversity in IPO firms. The univariate t-tests/z-tests comparing the mean/median differences for gender diversity and professional expertise diversity between firms with high/low CEO, venture capitalist director and non-executive director power are reported in Table 2.4. For each continuous proxy of CEO, venture capitalist director and non-executive director power, IPO firms with high power lie above the median value while those with low power lie below the median.[44] Regarding the dummy proxies of CEO, venture capitalist and non-executive director power, IPO firms with a

[44] The continuous proxies of CEO, venture capitalist director and non-executive director power include *No of Position(s)*, *Board tenure*, *Board Connections, and Voting Share Ownership.*

score of one lie above the median while those with a score of zero lie below the median.[45] We report the univariate analysis results for board diversity at the IPO (t=0) on the power in the boardroom in the pre-IPO year (t=-1). The univariate analysis for the medium-term post-IPO relates to board diversity in year 2 (t=2) on power in the boardroom in the IPO year (t=0) while the long-term post-IPO focuses on board diversity in year 5 (t=5) on the power in year 2 (t=2). This follows the pattern of the main results and allows us to test our hypotheses in a univariate setting. Panel A of Table 2.4 focuses on the relationship between gender diversity and CEO power, whereas Panel B reports the results on the relationship between the former and venture capitalist director power. Finally, Panel C shows the results on the impact of non-executive director power on gender diversity. Since the univariate analysis focuses on one proxy of power at a time for each director group, to capture the effect of power in the boardroom on board diversity. We exclude firms with female CEOs, female venture capitalist directors and female non-executive directors in untabulated results and re-run the analysis.

Panel A of Table 2.4 tests the validity of hypothesis 1a, which states that powerful CEOs decrease gender diversity in the boardroom of IPO firms. Our results show support for this hypothesis as gender diversity is lower in firms where the CEO holds more positions in the firm. Similarly, gender diversity is also lower in firms where there is CEO duality. The difference across the below and above (mean and median) groups are statistically significant at the 10% level or better at the IPO and in the medium-term at year 2 post-IPO. This suggests that the bargaining power of the CEO in the boardroom derives from consolidating the knowledge and managerial influence from other positions held by the CEO in the firm. IPO firms with powerful CEOs who have built their credibility in the firm may view new female director appointments as a pathway to increased board monitoring due to divergent opinions. This poses a threat to the influence of the CEO on the board. Thus, CEO structural power derived internally through duality in IPO firms will inhibit gender diversity. We find no evidence that the influence of CEO power on gender diversity persists to year 5 post-IPO. This may be attributed to the decrease in CEO duality from 47% of the sample at the IPO to 36% by year 5 post-IPO. This indicates that the power of the CEO decreases over time, as even the number of positions held by the CEO is now insignificant by year 5 post-IPO.

However, we also find some evidence suggesting that CEOs may be more receptive to female director appointments if they are connected to other boards at the IPO. The difference

[45] The dummy proxies of power include *CEO Duality, Founder, Critical Expertise, and Financial Expertise.*

across the mean and median groups are statistically significant at the 10% level or better. This indicates that CEO prestige power derived externally through board connections facilitates gender diversity at the IPO. These findings allude to such connected CEOs being more aware of external trends, demands and expectations in the stock market. In untabulated t-tests/z-tests results, we find that the results for the impact of CEO power are the same when firms with female CEOs are excluded. In summary, the results in results in Panel A show that depending on the source of CEO power (internal or external), the CEO (duality) may be an inhibitor of gender diversity consistent with H1a or a facilitator (CEO board connections) of gender diversity.

Moving on, Panel B focuses on venture capitalist directors and hypothesis 2a, which states that there is a positive relationship between venture capitalist director power and gender diversity.[46] The results show that firms with powerful venture capitalist directors as measured by their board connections, critical expertise, financial expertise, and voting share ownership have greater gender diversity at the 5% significance level or better at the IPO and in year 2 post-IPO. The results in Panel B show that venture capitalist directors use the control power derived internally from voting share ownership in the boardroom to facilitate gender diversity. Furthermore, the results indicate that venture capitalist director (expert and prestige) power from external experience and contacts improve gender diversity in IPO firms. These results allude to the important role of venture capitalist directors in driving for more gender diversity in IPO firms. In untabulated t-tests/z-tests, we exclude IPO firms with female venture capitalist directors, and we find that our results all become insignificant. This indicates that the major push for more gender diversity comes from not just venture capitalist directors, but female venture capitalist directors. Female venture capitalist directors constitute 11% of all venture capitalist directors at the IPO and 6% in year 2 post-IPO due to increased exits. These results suggest that there is a spillover effect of having women on the board consistent with the Boutchkova et al. (2020). In terms of the hypothesis, the results in Panel B are consistent with the predictions of H2a that powerful venture capitalist directors increase gender diversity in the boardroom of IPO firms, and this effect is due to the presence of female venture capitalist directors.

The univariate results for the impact of non-executive director power on gender diversity are reported in Panel C. This panel tests the validity of hypothesis 3a that IPO firms

[46] VC No of Positions is excluded in Panel B as most venture capitalist directors have one position in the firm which is their board seat.

with powerful non-executive directors have more gender diversity in the boardroom. At the IPO, firms with powerful non-executive directors, as measured by board connections and financial expertise have more gender diversity. In particular, the difference across the median groups is significant at the 10% level or better. Comparable with venture capitalist directors, non-executive directors use their power built on external experience to increase gender diversity in the boardroom. Notably, these significant results are only observed in the z-test as all the results for the t-tests are insignificant. Furthermore, unreported results show that these results become insignificant when firms with female non-executive directors are excluded.[47] This indicates a potential spillover effect from female non-executive directors in the boardroom of IPO firms. Nevertheless, Panel C shows weak support for hypothesis 3a that IPO firms with powerful non-executive directors have more gender diversity, which is mainly driven by female non-executive directors.

Overall, the results in Table 2.4 show that the impact of CEO power on gender diversity is mixed as the negative impact relates to CEO duality, which is internally generated while positive impact relates to external sources of CEO power such as board connections. This suggests that the relationship between CEO power in the boardroom and gender diversity is mixed and potentially an outcome of the source of power. Based on the results reported in Table 2.4, we accept hypothesis 2a and 3a and acknowledge that there is mixed evidence relating to hypothesis 1a. Firms with powerful CEOs have lower gender diversity at the IPO and post-IPOs whereas powerful venture capitalist directors and non-executive directors are related with more gender diversity consistent with the bargaining model. The results in Table 2.4 emphasize the importance of controlling for female CEOs, female venture capitalist directors and female non-executive directors in the multivariate analysis, as some significant results disappear when such firms are excluded.

[Insert Table 2.4 about here]

Table 2.5 reports the univariate analysis of the impact of power in the boardroom on professional expertise diversity. Panel A of Table 2.5 focuses on the relationship between CEO power and professional expertise diversity. Panel B relates to the relationship between venture capitalist director power and professional expertise diversity, while Panel C is related to the latter and non-executive director power.

[47] 19% of the non-executive directors in the sample at the IPO are females.

The results tabulated in Panel A show support for hypothesis 1b, which expects a positive relationship between CEO power and professional expertise diversity. We find that professional expertise diversity is higher in firms with powerful CEOs, as measured by their board connections and financial expertise at the IPO and the post-IPO period. These results are significant at the 10% level or better. This suggests that more exposed and specialised CEOs, well informed on the business operations of the firm, use their external links to influence appointments of directors with different professional expertise. The results in Panel A of Table 2.5 are consistent with the resource dependency theory that powerful CEOs use their board connections and financial expertise as inter-organisational links to provide access to resources (directors with different professional expertise) that cannot be generated internally. In this vein, the results in Panel A show that CEO board connections and financial expertise derived externally are facilitators of professional expertise diversity in IPO firms.

In Panel B, we test the validity of hypothesis 2b, which expects a positive relationship between venture capitalist director power and professional expertise diversity. The results show that firms with powerful venture capitalist directors in all dimensions except for founders have higher professional expertise diversity. The results are significant at the 5% level or better and are consistent at the IPO, in year 2 post-IPO, and in year 5 post-IPO. Longer tenured venture capitalist directors have sufficient firm-specific information, better-connected venture capitalist directors have more external contacts, while venture capitalist directors with critical expertise are well informed about the business operations of the firm. With this wealth of knowledge and experience, venture capitalist directors link their portfolio firms to potential professional expert directors. In addition, venture capitalist directors larger voting share ownership provides an opportunity to influence director appointment decisions. From a resource dependency perspective, powerful venture capitalist directors bridge the gap between IPO firms and the external environment, connecting the firm to potential directors with different professional expertise that can enrich the resource base of the firm.

Turning now to Panel C, we test the validity of hypothesis 3b, which predicts a positive relationship between non-executive director power and professional expertise diversity. We find that professional expertise diversity is higher in IPO firms with powerful non-executive directors as measured by the number of positions, board connections, critical expertise, and financial expertise and the results are significant at the 5% level or better. These results are consistent at the IPO, in year 2 post-IPO and in year 5 post-IPO. Following the same pattern as venture capitalist directors, non-executive directors also use their prestige and expert power derived from external experience and contacts to influence director appointments relating to professional expertise diversity. These results are consistent with hypothesis 3b. The only evidence contrary to hypothesis 3b is that, in the post-IPO period, professional expertise diversity is lower in firms with powerful non-executive directors as measured by the voting share ownership. This indicates that non-executive director control power inhibits professional expertise diversity in the post-IPO period.

[Insert Table 2.5 about here]

Overall, the results from the univariate analysis are consistent with the predictions of all the hypotheses except for hypotheses 1a and 3b where we find mixed evidence relating to the impact of CEO power on gender diversity and non-executive director power on professional expertise diversity. Thus, we accept all hypotheses apart from hypotheses 1a and 3b. The next section tests the hypotheses in a multivariate setting.[48]

2.4.3 Main Results on the Impact of Power in the Boardroom on Board Diversity

This section discusses and tests the validity of the six hypotheses outlined in Section 2.2, which predict the relationship between CEO power, venture capitalist director power, non-executive director power, and our two measures of board diversity. The findings from the OLS estimation for years 0, 2 and 5 are discussed in this section. We further test the robustness of the results using the PSM analysis and instrumental variable (IV) estimations in the next section of this chapter. All variables are winsorised at the 1% and 99% level to mitigate outliers influencing the results. We check for multicollinearity using the variance inflation factor and the maximum value across all regressions is 5.45, which is way below the threshold of 10.[49] The regressions include the control variables introduced in the methodology section and adjust for year and industry fixed effects.[50] Coefficients and robust t-statistics are reported in all results. The below sub-sections focus on each measure of power in the boardroom in turn, CEO power, venture capital power, and non-executive director power.

---

[48] In unreported results, we excluded firms with female CEOs, female VC directors, and female NED directors and the results are similar to those reported in Table 2.5. This indicates that powerful CEOs, powerful venture capitalist directors and powerful non-executive directors facilitate professional expertise diversity regardless of their gender.

[49] The variance inflation factor checks whether each variable in the regression can be considered as a linear combination of other independent variables.

[50] The SOX and financial crisis dummies are both excluded in the main regressions as they control for time in different chunks and are replaced by the year dummies.

The Impact of CEO Power on Board Diversity in IPO Firms

Table 2.6 presents the results for the OLS regressions, which estimate the relationship between the proxies of CEO power and board diversity. Based on hypothesis 1a, the expectation is that there is a negative relationship between CEO power and gender diversity, while hypothesis 1b predicts a positive relationship between CEO power and professional expertise diversity. Columns 1 to 3 show the results relating to hypothesis 1a on gender diversity while columns 4 to 6 show those relating to hypothesis 1b on professional expertise diversity. The regression coefficient for lagged gender diversity in years 0, 2, and 5 are 0.844, 0.680, and 0.320, respectively. These coefficient values suggest that, at the IPO, gender diversity is largely explained by their pre-IPO values. The high coefficient values in year 2 post-IPO indicate that gender diversity at the IPO still largely explain diversity, which allude to the persistent nature of our data since board appointments do not occur annually.

Regarding the proxies for CEO power, we find no evidence of a relationship with gender diversity in column 1, as all the proxies for CEO power are insignificant. This suggests that powerful CEOs in the pre-IPO year have no influence on gender diversity at the IPO. Column 2 relates to year 2 post-IPO and reports mixed evidence on the relationship between CEO power and gender diversity. The results indicate that firms with powerful CEOs at the IPO, as measured by CEO duality, negatively influence gender diversity in year 2 post-IPO. The negative coefficient on CEO duality indicates that an increase from 0 to 1 results in a corresponding decrease in the average percentage of females on the board by about 2%. These results are significant at the 1% level, and they are supported by Krause et al. (2014) who show that stronger power to the CEO stemming from CEO duality reflects lower board oversight as duality allows CEOs to consolidate their power. Consistent with the bargaining model, our result indicates that CEOs use the structural power and board discretion derived from duality to inhibit female board representation, which has been linked to better board monitoring (Adams and Ferreira 2009).

Nevertheless, there is evidence in column 2 indicating that powerful founder CEOs at the IPO will increase female board representation by about 1% in year 2 post-IPO. This result is significant at the 5% level. Untabulated results interacting founder CEOs with board independence show that this effect is due to founder CEOs on the board of IPO firms with low board independence.[51] In this vein, founder CEOs act in the best interest of their IPO firms by facilitating female director appointment, since greater gender diversity has been related with differing perspectives and better monitoring by the board (Adams and Ferreira 2009). Column 3 shows that in the year 5 post-IPO, the significant effect of CEO power on gender diversity disappears and there is no evidence of a relationship between all the proxies of CEO power and gender diversity. This is not surprising as CEO duality decreases from 47% to 36% while founder CEOs decrease from 37% to 24% between the IPO and year 2 post-IPO, respectively.

Overall, we find mixed results related to hypothesis 1a in Table 2.6. The results show that the impact of CEO power on gender diversity depends on the source of power whether internally or externally generated, consistent with the univariate analysis results. Internally generated CEO structural power through duality inhibits female director appointments while founder CEOs use their ownership power to facilitate gender diversity. This suggests that founders do not act in self-interest but support appointments that will improve board monitoring. These significant results only relate to year 2 post-IPO where IPO firms on average appoint their first female director to the board indicating that the influence of the CEO is pertinent in female director appointments.

Next, we focus on the results relating to professional expertise diversity in columns 4 to 6. The regression coefficients for lagged professional expertise diversity in years 0, 2 and 5 are 0.764, 0.726, and 0.272, respectively. In a similar way to those reported above for gender diversity, these values indicate that, at the IPO, professional expertise diversity is largely explained by their pre-IPO values. The high coefficient values in year 2 post-IPO indicate that professional expertise diversity at the IPO still largely explains diversity, which indicate the persistent nature of our data and the frequency of board appointments.

Moving ahead, we discuss the primary variables of interest, i.e., the proxies of CEO power and their relationship with professional expertise diversity, as predicted in hypothesis 1b. Column 4 shows that at the IPO, there is no significant relationship between powerful CEOs and professional expertise diversity. Similarly, in year 2 post-IPO, the results in column 5 show no relationship between CEO power and professional expertise diversity. In column 6, we find evidence of a positive relationship between CEO power, as measured by CEO duality and professional expertise diversity consistent with hypothesis 1b. This indicates that an increase

[51] We create a dummy variable for board independence based on the median value for board independence at the IPO. IPO firms that lie above the median are categorised as firms with high independence and take a value of one while those below the median are categorised as firms with low board independence.

in CEO duality from 0 to 1 results in a 0.053 units increase to professional expertise diversity in year 5 post-IPO respectively and the results are significant at the 5% level. Thus, powerful CEOs use the structural power consolidated in the board chair position to facilitate professional expertise diversity, as they are well informed on the expertise needs of the IPO firm. Moreover, the effects of CEO duality on gender diversity (negative) and professional expertise diversity (positive) in the post-IPO period indicates CEO's preference in board appointments.

[Insert Table 2.6 about here]

In terms of the control variables, columns 1 to 3 confirm that there is a gender effect on diversity in the boardroom, as IPO firms with female CEOs are more likely to have greater gender diversity across the sample period. Particularly, firms with female CEOs have on average 6% more female board representation at the IPO, 9% more in year 2 post-IPO, and 11% more female board representation by year 5 post-IPO. These results are significant at the 1% level. Board size is significant and positive at the 5% level or better in column 1. This indicates that an appointment of one new board member in IPO firms results in a 0.3% increase in female board representation. This is consistent with prior evidence that firms with a bigger board have more female directors (Rau et al. 2021). In columns 2 and 3 related to the post-IPO period, all other control variables have no significant effect on gender diversity.

The results for the control variables show a similar effect for board size in columns 4 and 5 leading us to conclude that firms with bigger boards have more professional expertise diversity (Gray and Nowland 2017). In both columns, an increase in board independence results in greater professional expertise diversity, indicating that independent directors appoint directors with different professional expertise to the board of the IPO firm. Particularly, a 1% increase in board independence is related with 0.006 units to 0.023 units increase in professional expertise diversity. These results are significant at the 5% level or better. This leads us to conclude that more independent boards focus on professional expertise diversity in the medium-term. The results for firm size in column 4 indicate that a negative relationship with professional expertise diversity significant at the 5% level, implying that larger IPO firms have lower professional expertise diversity. Finally, in columns 5 and 6, better performing IPO firms as measured by the return on assets have lower professional expertise diversity by 0.044 units to 0.095 units and the results are significant at the 10% level or better. In this context, better performing IPO firms may not see the utility in appointing directors with different professional expertise as Gray and Nowland (2017) show that not all professional expertise groups are beneficial to listed firms.[52] The authors document that only certain professional expertise in the boardroom such as lawyers, accountants, consultants, bankers, and directors with executive experience as CEOs are beneficial for firm performance as expansion beyond this subset has detrimental effects to firm performance.

Overall, the evidence for the impact of CEO power in Table 2.6 is mixed for hypotheses 1a but in line with the predictions of hypothesis 1b. Consistent with the bargaining model, we find that powerful CEOs, as measured by CEO duality decrease gender diversity in the boardroom of IPO firms but increase professional expertise diversity. This indicates the CEOs preference in board appointments as inhibitors of gender diversity but facilitators of professional expertise diversity. Conflicting results with hypothesis 1a relate to the positive impact of founder CEOs on gender diversity and unreported results show that this effect relates to firms with low board independence. Thus, founder CEOs act in the best interest of their IPO firms and facilitate board appointments that improve monitoring. Although only 3% of CEOs are females at the IPO, our results suggest that the presence of female CEOs improves gender diversity prospects in IPO firms. To conclude, at the IPO, there is no evidence of a relationship between CEO power and gender or professional expertise diversity. Subsequently, CEOs focus on gender diversity in the medium-term post-IPO, but professional expertise diversity in the long-term post-IPO as the firm matures.

Powerful Venture Capitalist Directors and Board Diversity

Table 2.7 reports the results testing the validity of hypotheses 2a and 2b on the relationship between venture capitalist director power and board diversity.[53] Hypothesis 2a predicts a positive relationship between venture capitalist director power and gender diversity and the results relating to this hypothesis are reported in columns 1 to 3 for years 0, 2 and 5 post-IPO.

All the proxies of venture capitalist director power in columns 1 to 3 are insignificant except for board connections and voting share ownership, which indicate a weak positive relationship with gender diversity at the IPO. These results are significant at the 10% level and are in line with the predictions of hypothesis 2a that powerful venture capitalist directors increase gender diversity in the boardroom of IPO firms. Specifically, an increase in venture capitalist directors board connections by one unit and venture capitalist directors voting share

[52] The results for the control variables included in our model are similar in the tabulated regressions for venture capitalist director power, non-executive director power but are not discussed subsequently for brevity.
[53] There are no firms with founder VCs on the board and this variable has been excluded from the regression.

ownership by 1% increases female board representation on average by 0.19% and 0.01%, respectively. This translates to venture capitalist directors using their prestige and control power to influence greater gender diversity at the IPO such that decision-making processes incorporate different perspectives. Thus, powerful venture capitalist directors are facilitators of gender diversity in the boardroom consistent with the bargaining model and the predictions of hypothesis 2a.

Columns 4 to 6 report the results relating to hypothesis 2b predicting a positive relationship between venture capitalist director power and professional expertise diversity. At the IPO (column 4), the results show a negative relationship between venture capitalist director power and professional expertise diversity significant at the 1% level. In detail, a 1% increase in the venture capitalist director voting share ownership decreases professional expertise diversity on average by 0.001 units. This result conflicts with hypotheses 2b. Moreover, the effects of venture capitalist director control power on gender diversity (positive) and professional expertise diversity (negative) at the IPO alludes to venture capitalist director's preferences. The negative effect of venture capitalist director voting share ownership disappears in year 2 post-IPO as column 5 shows no significant relationship between venture capitalist director power and professional expertise diversity. This is unsurprising as on average, venture capitalist directors in the sample exit their portfolio firms by year 2 post-IPO.

Regarding year 5 post-IPO, column 6 shows mixed results for the relationship between venture capitalist director power and professional expertise diversity. Powerful venture capitalist directors, as measured by board tenure and financial expertise improve professional expertise diversity at the 10% significance level or better. The results show that a one-year increase in board tenure and an increase in financial expertise from 0 to 1 result in a 0.008 and 0.177 units increase on average in professional expertise diversity, respectively. Consistent with hypothesis 2b, the results mentioned above suggest that longer-tenured venture capitalist directors use their experience in the firm to facilitate appointment of directors with different professional expertise. Sun and Bhuiyan (2020) mention that the wealth of firm-specific information gained by longer-tenured directors is used to implement changes to the firm's strategy such as in director-related appointments. Similarly, venture capitalist directors with financial expertise facilitate appointments of directors with different professional expertise to meet the expertise needs of the board. Finally, there is conflicting evidence that powerful venture capitalist directors, as measured by the number of positions in the firm decrease professional expertise diversity by 0.192 units. This result is significant at the 10% level and suggests that venture capitalist directors who have one more position in the firm beyond their board seat will inhibit appointments of directors with different professional expertise.

[Insert Table 2.7 about here]

Besides the proxies of venture capitalist director power in the boardroom, it is important to note that the spillover effect discussed for female CEOs is similar to what is observed for female venture capitalist directors. Specifically, columns 1 to 3 show that IPO firms with female venture capitalist directors have between 6% and 11% higher gender diversity on average, significant at the 1% level.

Overall, there is support for hypothesis 2a indicating that powerful venture capitalist directors use their board connections and voting share ownership to facilitate female board representation in IPO firms. Accordingly, powerful venture capitalist directors focus on gender diversity, which is related with better board monitoring (Adams and Ferreira 2009) in a bid to monitor the CEO and improve gender balance in the boardroom. This is interesting considering Calder-Wang and Gompers's (2017) finding that there is a lack of gender diversity in the venture capital industry. Regarding hypothesis 2b, the impact of venture capitalist director power on professional expertise diversity is mixed. The effects of the number of positions and voting share ownership are negative, whereas board tenure and financial expertise are positive. In terms of timing, the results show that venture capitalist directors focus on gender diversity at the IPO, in the medium-term post-IPO. There is no impact in year 5 post-IPO for venture capitalist director power on gender or professional expertise diversity as at least half of the sample of venture capitalist directors exit by year 2 post-IPO. However, venture capitalist directors who remain on the board past year 2 post-IPO focus on professional expertise diversity at in the long-term post-IPO.

Non-Executive Director Power and Board Diversity

In this section, we discuss the results reported in Table 2.8, which test hypotheses 3a and 3b. These hypotheses expect a positive relationship between non-executive director power and gender diversity as well as between the former and professional expertise diversity. Columns 1 to 3 tests the validity of hypothesis 3a regarding gender diversity. In column 1, powerful non-executive directors, as measured by voting share ownership decrease gender diversity at the IPO. A 1% increase in non-executive director voting share ownership results in an average 0.02% decrease in gender diversity, significant at the 10% level. In year 2 post-IPO (column 2), we find similar stronger results indicating that a 1% increase in non-executive director voting share ownership results in an average 0.03% decrease in gender diversity, significant at the 5% level. These negative results for voting share ownership indicate that non-executive directors use their control power to inhibit appointments of female directors to the board.[54] Considering powerful non-executive director have 2% voting share ownership on average, we argue that the influence of this director group is much less compared to the venture capitalist director and the CEO. Furthermore, IPO firms with a powerful non-executive director who is better-connected and has critical expertise have lower gender diversity of 0.42% and 1.41%, respectively. These results are significant at the 5% level. A plausible reason for these results is that better-connected non-executive directors perceive female board representation as a means for longer decision-making processes due to increased monitoring, infringing on their already limited availability to spend on their board role. Consequently, powerful non-executive directors decrease gender diversity in the boardroom of IPO firms. Column 3, relating to year 5 post-IPO shows that non-executive director board connections and critical expertise that were previously significant are now insignificant, as are all other proxies of power. This suggests that in the long-term post-IPO, non-executive director power has no influence on gender diversity. The results from the first three columns of Table 2.8 suggests that IPO firms focus on gender diversity at the IPO and in the medium-term post-IPO but not in the long-term post-IPO.

The results for professional expertise diversity reported in the last three columns of Table 2.8 show that at the IPO (column 4) and in year 2 post-IPO (column 5) there is no relationship between the proxies of non-executive power and professional expertise diversity. However, in the long-term post-IPO, column 6 reports mixed results on the impact of powerful non-executive directors on professional expertise diversity. In the same way as venture capitalist directors, powerful non-executive directors as measured by financial expertise increase professional expertise diversity by 0.053 units. This result is significant at the 1% level. Our findings suggest that non-executive directors with financial expertise have an in-depth understanding of the expertise needs of the firms and influence director appointments that provide different professional expertise.

The negative pattern emerging in the results in column 6 relate to the impact of non-executive director critical expertise on professional expertise diversity. The results suggest that IPO firms with the former in year 2 post-IPO have on average a lower professional expertise

[54] In unreported results, we explore whether powerful non-executive director with voting share ownership are founders using an interaction term. However, these results show no relationship with gender diversity.

by 0.038 units, significant at the 10% level. Although Faleye et al. (2018) mention that an increase in directors with critical expertise implies better board advising from informed directors, we argue that a large similarity in the background of directors in terms of professional expertise is detrimental to professional expertise diversity.

To sum up, the results in Table 2.8 show that non-executive director voting share ownership, board connections and critical expertise inhibit gender diversity. For professional expertise diversity, the results are mixed with financial expertise being a facilitator, while critical expertise is an inhibitor. Non-executive directors focus on gender diversity at the IPO and in the medium-term, but professional expertise diversity in the long-term post-IPO. Similar to CEOs and venture capitalist directors, the results in Table 2.8 show that IPO firms with female non-executive directors have on average 6% to 8% greater gender diversity, significant at the 1% level.

[Insert Table 2.8 about here]

Overall, the main results for the impact of CEO power, venture capitalist director power, and non-executive director power on board diversity is mixed.[55] In terms of emergence of gender diversity, IPO firms focus on gender diversity in the medium-term post-IPO when the firm appoints on average the first female director to the board. For the evolution of gender diversity, we find mixed evidence in relation to hypothesis 1a, support for hypothesis 2a but conflicting results with the predictions of hypothesis 3a. For H1a, the results suggest that the source of CEO power (internal or external) is an important factor to consider understanding the influence of CEO power on female director appointments. Internally generated power placing the CEO at the helm of affairs such as duality is an inhibitor of gender diversity. However, if such internally generated power relates to ownership as the founder, we observe better gender diversity in the boardroom. Therefore, the presence of a founder CEO at the IPO is beneficial for firms seeking to improve gender diversity in the boardroom.[56] Hypothesis 2a is supported as we find evidence of a positive relationship between venture capitalist director board

[55] Appendix 2.4 shows the main results for the impact of power in the boardroom for each director group on the measures of board diversity including Ivy League education which is only available for 80% of the sample as a proxy for prestige power in the boardroom. Our main results are upheld in the regressions, but we find new evidence that CEOs with Ivy League education facilitate professional expertise diversity while venture capitalist directors with Ivy League education have an opposite effect. In unreported results, we control for the enactment of the Employment Non-Discrimination Act of 2013 and the results are upheld. Sec 4 of this act prohibits firms from engaging in employment discrimination on the basis of an individual's actual or perceived sexual orientation or gender identity.

[56] In untabulated results, we introduce an interaction of CEO duality and founder CEO, but the results show no relationship with gender diversity in the boardroom.

connections, voting share ownership and gender diversity. Another interesting result is the evidence contradicting H3a showing that IPO firms with powerful non-executive directors have lower gender diversity in the boardroom. A possible reason for this result is that non-executive directors perceive female board representation as a means for longer decision-making processes due to increased monitoring. Consequently, infringing on non-executive directors already limited availability to spend on their board role. Finally, IPO firms with female directors, regardless of the type of director - CEO, venture capitalist director, non-executive director in a prior period (pre-IPO or at the IPO) have more gender diversity in subsequent periods post-IPO.

In terms of the emergence of professional expertise diversity, the main results show that IPO firms focus on professional expertise diversity at the point of listing and in the long-term post-IPO, but not in the medium-term. Moving forward to the evolution of professional expertise diversity, the predictions of hypothesis 1b are supported while the results relating to hypothesis 2b and 3b are mixed. Powerful CEOs use their structural power derived from duality to improve professional expertise diversity consistent with hypothesis 1b. Therefore, the effect of CEO duality in the boardroom is two-fold in director appointments. A recurring theme relating to venture capitalist director power (H2b) and non-executive director power (H3b) is that financial expertise is beneficial for firms seeking to improve professional expertise diversity in the boardroom. This evidence provides further support for the importance of directors with financial expertise in the boardroom. Güner et al. (2008) shows that directors with financial expertise influence better corporate investment decisions in their firms, but our results find that such directors also facilitate professional expertise diversity. Ultimately, in evolution of professional expertise diversity, the expert power relating to financial expertise of the venture capitalist director and non-executive director are important facilitators.

2.4.4 Robustness Checks with PSM Analysis

Our baseline results discussed in the previous section focus on the OLS regressions. As a robustness check, we adopt the PSM analysis to control for the potential endogeneity in estimating the impact of power in the boardroom on board diversity. PSM controls for potential endogeneity by matching based on firm characteristics, IPO firms with high CEO, venture capitalist director and non-executive director power to those with low power, respectively. To perform matching, we measure the propensity score as the conditional probability that an IPO firm received the treatment using logit regressions. The logit regressions estimate the likelihood that an IPO firm has high CEO power, venture capitalist director power and non-executive director power. In these regressions, we control for firm characteristics such as firm age, firm size, leverage, return on assets, risk, and year fixed effects. The propensity scores generated from the regressions are then amended to adjust for industry, as board diversity in IPO firms will differ across industries (Cumming and Leung 2021). The amended propensity scores are then matched using the nearest-neighbour matching without replacements and a calliper distance of 0.05 for CEO power and 0.01 for venture capitalist director and non-executive director power, between the treated and untreated groups.

After matching, an analysis of the impact of power in the boardroom on board diversity captures the treatment effect rather than a selection effect. A selection effect may arise where IPO firms appoint directors for their access to resources, information, and their contacts outside the firm. These appointed directors may also be females or directors with different professional expertise. Table 2.9 reports the results for the two diagnostic tests performed to ensure that the treated and untreated firms are indistinguishable in terms of firm characteristics, such as firm age, firm size, leverage, return on assets, and risk. These tests verify the quality of the match for the treated and untreated firms.

Panel A in Table 2.9 shows the results for the pre-match and post-match logit regressions for CEOs, venture capitalist directors, and non-executive directors. Comparing the pre-match and post-match logit regression is the first diagnostic test to check the quality of matching. Coefficients and robust t-statistics are reported for the logit regressions in Panel A. The dependent variable in the logit regressions reported in columns 1 and 2 is the CEO power dummy, in columns 3 and 4, the venture capitalist director power dummy, and in columns 5 and 6, the non-executive director power dummy. CEO power dummy takes a value of one if the firm's CEO power score is above the median and zero otherwise. Venture capitalist director power dummy takes a value of one if a firm's venture capitalist director power score is above the median and zero otherwise. Non-executive director power dummy takes a value of one if the firm's non-executive director power score is lower than the median value for the sample and zero otherwise. This indicates that firms with high levels of CEO, venture capitalist director and non-executive director power in the boardroom take a value of one, while those with a low level of power take a value of zero.[57]

[57] Boardroom power score is a scoring variable based on the proxies of power for CEO power, VC power and NED power. There are eight proxies of *CEO power and seven for VC power and NED power*: *No of Position(s)*, *Board tenure*, B*oard Connections, Voting Share Ownership, Founder, CEO Duality, Critical Expertise, and Financial Expertise.* The first four are continuous proxies while the last four are dummy variables. I assign a score

In the first test, we estimate a logit regression predicting the probability that IPO firms have CEOs, venture capitalist director and non-executive director with a high level of power in the boardroom. In the pre-match logit regression in Panel A, the results (column 1) indicate a negative relationship between firm size, leverage, and CEO power dummy, significant at the 1% level. This suggests that larger IPO firms or highly levered IPO firms are less likely to have a powerful CEO. In column 2 post-match, the results show that previously significant results for firm size and leverage disappear, and all firm characteristics are now insignificant. The implication of these findings is that between the treated (firms with high CEO power) and the untreated (firms with low CEO power) groups, there is no significant difference in observable firm characteristics which confirms the quality of the match for CEO power. Furthermore, we use the chi-square test to determine whether the proportion differences of firms with high CEO power to those with low CEO power is statistically significant. Accordingly, the chi-square value, which was previously significant in the pre-match logit for CEO power is now insignificant post-match confirming the quality of the match.

Columns 3 and 4 of Panel A show the pre-match and post-match logit regressions for venture capitalist director power. Despite all firm characteristics being insignificant in the pre-match (column 3) and post-match (column 4) logits, the chi-square value in column 4 is now insignificant post-match, similar to what is observed for the CEO. This confirms the quality of the match for venture capitalist director power. Columns 5 and 6 show similar insignificant results in predicting non-executive director power. However, the chi-square value, which was previously significant in the pre-match logit (column 5) is now insignificant post-match (column 6), confirming the quality of the match. Hence, firms with high non-executive director power are indistinguishable from their counterparts with low power. Overall, the matched samples for CEO, venture capitalist director and non-executive director power show that there is no significant difference between the observable firm characteristics of the treated and untreated firms' post-match.

Next, we employ t-tests on the matched samples to test the mean difference in firm characteristics between the treated and untreated firms consistent with Chen et al. (2018). The results from the diagnostic tests in Panel B show that there is no significant difference between the mean values for firms with high CEO, venture capitalist director and non -executive director

---

of one to each continuous proxy of power that lies above the median value of said proxy for the sample. I also assign a score of one to each dummy proxy of power where the firm is classified with a value of one for each director category, and otherwise zero. In total, the maximum score for CEO power will be eight while VC power and NED power will be seven.

power to those with low power. The untabulated results for the Wilcoxon rank-sum tests, which tests the median difference between groups show similar results to the t-tests. To sum up, these results indicate that the matching system employed is appropriate, and the OLS re-estimated on the matched sample will reflect the treatment effect (i.e., the effect of CEO, venture capitalist director, and non-executive director power on board diversity) which mitigates endogeneity concerns.

[Insert Table 2.9 about here]

Accordingly, we re-estimate the OLS on the matched samples for the impact of CEO power, venture capitalist director power and non-executive director power on board diversity in Tables 2.10-2.12. The results are discussed in detail below. All regressions include the control variables introduced in the methodology section and adjust for year and industry fixed effects. The coefficients and robust t-statistics are reported in the result tables.

PSM Analysis for the Impact of CEO Power on Board Diversity

Table 2.10 shows the PSM results on the relationship between CEO power and gender diversity in the first three columns, while the last three columns report the results on the relationship between the former and professional expertise diversity. Our main results reported in Table 2.6 are upheld in Table 2.10 except for the weak positive impact of CEO power as measured by founder CEO on gender diversity in year 2 post-IPO, which is now insignificant. There is still no evidence of a relationship between the proxies of CEO power and gender diversity in column 1, which is unsurprising as there are on average no female directors on the board at the IPO. In year 2 post-IPO (column 2), where the firm on average appoints the first female director, there are mixed results on the impact of CEO power on gender diversity. Similar to the main results, we find that CEO power, as measured by CEO duality decreases gender diversity by 2.5%, significant at the 5% level. This alludes to the detrimental effect of CEO structural power, which is derived internally on female director appointments. Conversely, new results in column 2 suggests that IPO firms with better-connected CEOs improve female board representation by 0.6% which is a small effect as it is only significant at the 10% level. This implies that better-connected CEOs are able to identify suitable female candidates for directorships due to their external links to other boards. Thus, CEO prestige power, which is derived externally from connections to other boards is beneficial for female director appointments. Similar to the main results, column 3 show that there is no significant relationship between the proxies of CEO power and gender diversity. Finally, we find that the spillover effect for improved female board representation from female CEOs is robust in Table 2.10.

To sum up, the results for gender diversity in Table 2.10 consistently highlight a mixed relationship between CEO power and gender diversity, which only exists in the post-IPO period when IPO firms, on average appoint their first female director to the board. We find robust results that powerful CEOs use their duality status to decrease gender diversity in the boardroom of IPO firms, consistent with the bargaining model and the predictions of hypothesis 1a. Although there is contrary evidence suggesting that CEO power(board connections or founder CEO) improves gender diversity, this evidence is weak (only significant at the 10% level), smaller in magnitude and not robust to all specifications.[58] Our robust results provide empirical support for Krause et al. (2014) who mention that CEOs consolidate their power derived from duality, which reduces board oversight and as such, will inhibit female board representation linked to better monitoring (Adams and Ferreira 2009).

Regarding professional expertise diversity, the results are reported in the last three columns of Table 2.10 and contradict the main results in Table 2.6. In the main results, we only find significant results for year 5 post-IPO, suggesting that powerful CEOs as measured by CEO duality increase professional expertise diversity. However, this result is now insignificant in Table 2.10. Thus, there is no robust evidence from the main results indicating a relationship between CEO power and professional expertise diversity. Below, we discuss the new results emerging only in the PSM.

Column 4 relating to the IPO year suggests a mixed relationship between CEO power and professional expertise diversity. In particular, there is a positive impact of powerful CEOs derived from their board tenure and financial expertise on professional expertise diversity, a significant 10% level. This supports the predictions of hypothesis 1b. The respective regression coefficient shows that a one-year increase in CEO tenure and firms with financial expert CEOs increases professional expertise diversity by 0.004 units and 0.051 units, respectively. This indicates that CEO power has little impact on professional expertise diversity at the IPO. The results show that longer tenured CEOs use the accumulated specialised knowledge on the operations of the firm, which enhances their credibility and augments their structural power (Tanikawa and Jung 2019) to facilitate appointments of directors with different professional

[58] This result alludes to the impact of CEO power on gender diversity not as clear cut as predicted in hypothesis 1a as the source of CEO power (internal or external) have different effects (negative or positive) on gender diversity, respectively.

expertise. Furthermore, Sun and Bhuiyan (2020) mention that the wealth of firm-specific information gained by longer tenured directors is used to implement changes to the firm's strategy such as in director-related appointments. Finally, CEOs with financial expertise facilitate the appointment of directors with different professional expertise to the board.

The negative patterns emerging in the results for professional expertise diversity relate to the impact of CEO power as measured by voting share ownership and board connections. Column 4 shows that powerful CEOs as measured by their voting share ownership decrease professional expertise diversity by 0.001 units at the IPO, significant at the 10% level. The results indicate that powerful CEOs are more concerned with the resulting constraints to their influence in the boardroom as they use their control power derived internally to decrease professional expertise diversity. Unreported results reveal that the negative effect of CEO voting share ownership on professional expertise diversity is due to the influence of the CEO in firms with low board independence.[59] Column 5 shows that CEO board connections at the IPO decreases professional expertise diversity in year 2 post-IPO, significant at the 10% level. A one unit increase in board connections results in a 0.009 units decrease in professional expertise diversity. The opposite effects of CEO externally derived prestige power-board connections for gender diversity (positive) and professional expertise diversity (negative) alludes to the preference of CEOs with prestige power in director appointments.

Overall, Table 2.10 shows that professional expertise diversity emerges at the IPO where the firm requires a more advising-oriented board (Field et al. 2013) while gender diversity emerges in the medium-term post-IPO, two years after listing. The results for the evolution of board diversity in Table 2.10 are mixed in relation to both hypotheses 1a and 1b. The main takeaway is that the results in Table 2.6, consistent with hypothesis 1a are robust indicating that CEO duality is the main inhibitor of gender diversity. However, the results for the impact of CEO power on professional expertise diversity from Table 2.6 are not robust to Table 2.10. Therefore, the conclusion is that powerful CEOs are inhibitors of female board representation but have no robust effect on professional expertise diversity. Additionally, the spillover effect for IPO firms with female CEOs having greater gender diversity in subsequent periods is robust to the PSM.

[Insert Table 2.10 about here]

[59] This analysis compares the impact of CEO power in sub-samples of IPO firms with high board independence to those with low board independence based on the median value of board independence.

PSM Analysis for the Impact of Venture Capitalist Director Power on Board Diversity

The PSM results for the impact of powerful venture capitalist directors is reported in Table 2.11. The results indicate a positive relationship between venture capitalist director power and gender diversity in line with the predictions of hypothesis 2a that powerful venture capitalist directors increase gender diversity in the boardroom of IPO firms. At the IPO (column 1), the results from Table 2.7 indicating a positive relationship between venture capitalist director power as measured by voting share ownership is robust to the PSM. However, the positive result for venture capitalist director board connections in the same preiod from the main results is now insignificant.

In year 2 post-IPO, there is new evidence in column 2 that venture capitalist directors with critical expertise increase gender diversity by 3%. This result is significant at the 10% level. Faleye et al. (2018) mention that directors who have industry experience critical to the business operations facilitate better board advising as they are well informed on the risk and reward profiles of the firm's industry. Therefore, venture capitalist directors with critical expertise have sufficient information to steer board appointments towards enhancing female board representation to ensure that a range of diverse views are represented in decision-making. Column 3 relating to year 5 post-IPO also shows new evidence that powerful venture capitalist directors, as measured by board connections improve gender diversity by 1.5% and this is significant at the 5% level. In IPO firms where venture capitalist directors are focused on achieving their objectives (profits, exit, and improved reputation), our findings indicate that powerful venture capitalist directors improve female board representation in their portfolio firms. To sum up, the results suggest that powerful venture capitalist directors are clearly facilitators of gender diversity in the boardroom. Regardless of the source of power, whether internally generated (voting share ownership) or externally generated (critical expertise and board connections, respectively), we find a positive impact on gender diversity.

Although the main results in Table 2.7 show that the relationship between for venture capitalist director power and professional expertise diversity is mixed, Table 2.11 shows robust results that the relationship is actually negative. Column 4 in Table 2.11 reports similar results to Table 2.7, indicating that professional expertise diversity decreases by 0.001 units when powerful venture capitalist directors voting share ownership increases by 1%. This result is significant at the 10% level. Column 5 now reports new results that in year 2 post-IPO, powerful venture capitalist directors with critical expertise decrease professional expertise diversity by 0.055 units. This result is significant at the 5% level. Although an increase in directors with critical expertise implies better board advising from informed directors (Faleye et al. 2018), we argue that a large similarity in terms of professional expertise is detrimental to diversity. Column 6 now shows no evidence of a relationship between all the proxies of venture capitalist director power and professional expertise diversity.

To conclude, Table 2.11 provides robust evidence to support hypothesis 2a, as evidenced by the positive relationship between venture capitalist director voting share ownership and gender diversity. The results indicating a positive relationship between venture capitalist director critical expertise, board connections and gender diversity are not robust to all specifications. There is no support for hypothesis 2b but contrary evidence indicating that a detrimental impact of powerful venture capitalist directors on professional expertise diversity. The opposite effect of venture capitalist director control power on gender diversity (positive) and professional expertise diversity (negative) alludes to the venture capitalist director's preference in board appointments. Finally, we find that the spillover effect of female venture capitalist directors on greater gender diversity in subsequent periods, observed in the OLS, is also robust to the PSM.

[Insert Table 2.11 about here]

PSM Analysis for the Impact of Non-Executive Director Power on Board Diversity

In this section, we discuss the PSM results relating to the impact of non-executive director power on board diversity in Table 2.12. There is some evidence in Table 2.8 indicating a negative relationship between non-executive director power and gender diversity and a positive relationship between the former and professional expertise diversity that is robust to the PSM in Table 2.12. Column 1 shows robust results indicating that a 1% increase in non-executive director voting share ownership results in a 0.02% decrease in gender diversity. This negative effect is significant at the 10% level. All the significant results previously reported in the post-IPO period (columns 2 and 3) of the main results are now insignificant in Table 2.12, suggesting that post-IPO, there is no relationship between non-executive director power and gender diversity. In summary, the results from the first three columns of Table 2.12 suggest that there is a negative relationship between non-executive director power and gender diversity, which contradicts the predictions of hypothesis 3a.

Regarding the impact of non-executive director power on professional expertise diversity, the results in Table 2.12 show mixed evidence. In columns 4 and 5 relating to the IPO year and year 2 post-IPO, there are new results indicating a negative relationship between non-executive power and professional expertise diversity. At the IPO, non-executive director critical expertise decreases professional expertise diversity by 0.024 units while year 2 post-IPO shows that better-connected boards decrease the former by 0.010 units(significant at the 10% level). However, the regression results in column 6 show that firms with powerful non-executive directors as measured by the number of positions and financial expertise have on average a higher level of professional expertise diversity by 0.218 units and 0.057 units respectively. These results are significant at the 10% level or better. The positive results relating to non-executive director financial expertise are robust to the PSM in Table 2.12

Overall, the evidence on the impact of powerful non-executive directors on board diversity is mixed in Table 2.12. The robust results are conflicting with the predictions of hypothesis 3a that IPO firms with powerful non-executive directors have greater gender diversity in the boardroom. Particularly, we find consistent evidence that powerful non-executive director voting share ownership is an inhibitor of gender diversity. In terms of professional expertise diversity, we find robust evidence in Table 2.12 suggesting that powerful non-executive director financial expertise is the main facilitator of the former. All other significant results in relation to non-executive director power and professional expertise diversity are not robust in all specifications.

[Insert Table 2.12 about here]

Put together, the PSM results largely support the main results discussed in Section 2.4.3. We find robust results in the PSM to support the predictions of hypotheses 1a, 2a, and 3b. For hypotheses 1b and 2b, the results are mixed, while hypothesis 3a is contradictory. Powerful CEOs use their structural power derived from duality to maintain their influence in the boardroom and inhibit female board representation, which is related with greater board monitoring (Adams and Ferreira 2009). Powerful non-executive director with voting share ownership also inhibit gender diversity in the boardroom. However, powerful venture capitalist directors, who have a similar level internal influence as the CEO, use their control power derived from voting share ownership to improve gender diversity in the boardroom. As venture capitalist directors have on average, at least 10% higher voting share ownership compared to the non-executive directors in the boardroom. We argue that the directors with influence in negotiations regarding female director appointments are CEOs and venture capitalist directors.

Regarding professional expertise diversity, robust results to the PSM suggest that venture capitalist director voting share ownership is the inhibitor, while non-executive director financial expertise is the facilitator. Furthermore, there is a positive relationship between venture capitalist director voting share ownership and gender diversity but a negative relationship between the former and professional expertise diversity at the IPO. These results allude to the venture capitalist director's preference in board appointments i.e., as a facilitator of gender diversity but an inhibitor of professional expertise diversity. There is no robust evidence to the PSM of a relationship between CEO power and professional expertise diversity. Finally, our results consistently show that IPO firms with female CEO, venture capitalist director, and non-executive director in the prior period (pre-IPO and at the IPO) have a higher level of gender diversity subsequently post-IPO.

2.5 Conclusion

This chapter investigates the emergence of board diversity and the factors facilitating or inhibiting the evolution of the former, referred to as the determinants of board diversity. We examine the power of directors as determinants of board diversity in IPO firms. Power in the boardroom relates to the CEO , venture capitalist director , and non-executive director , while board diversity is measured in relation to gender and professional expertise. Drawing on the bargaining model predicting a negotiation between the CEO and other directors in director appointments, we hypothesise that there is a negative relationship between CEO power and gender diversity (H1a) as CEOs intend to maintain their influence in the boardroom. Conversely, we hypothesise that there is a positive relationship between venture capitalist director power (H2a)/non-executive director power (H3a) and gender diversity stemming from a need to monitor the CEO. The resource dependency theory underpins that hypotheses predicting a positive relationship between CEO power(H1b), venture capitalist director power (H2b), and non-executive director power(H3b), and professional expertise diversity.

The results show that IPO firms focus on different aspects of board diversity across the sample period. Professional expertise diversity emerges at the IPO when IPO firms are still new to stock markets but is also the focus of appointments in the long term post-IPO (year 5). Gender diversity emerges in the medium-term (year 2) when the first female on average is appointed to the board. Thus, IPO firms focus more on professional expertise diversity in the boardroom. We find robust results for the impact of CEO power, venture capitalist director power, and non-executive director power on board diversity consistent with hypotheses 1a, 2a, and 3b. However, there is no consistent result relating to hypotheses 1b and 2b, while we find conflicting results relating to hypothesis 3a.

Firstly, the results suggest that internally generated CEO structural power through duality placing the CEO at the helm of affairs with discretion inhibits gender diversity in the boardroom. Secondly, venture capitalist directors use their control power relating to voting share ownership to facilitate greater gender diversity at the IPO such that the CEO is better monitored, and decision-making processes incorporate different perspectives. For powerful non-executive directors, this group inhibits gender diversity in the boardroom using their voting share ownership. However, in terms of voting share ownership, the non-executive directors are less influential compared to venture capitalist directors in appointment decisions reflecting board diversity. Therefore, our results suggest that the negotiation in female director appointments is between the CEO and venture capitalist directors. This result is consistent with the predictions of the bargaining model. Accordingly, in the evolution of gender diversity, CEO duality and voting share ownership of other directors are the most important factors to consider in the boardroom.

In terms of professional expertise diversity, our findings suggest that venture capitalist director voting share ownership inhibits professional expertise diversity. The opposite effect of venture capitalist director control power, positive (gender diversity) and negative (professional expertise diversity) indicates that venture capitalist director's preference in board appointments. In line with the resource dependency theory, we find that powerful non-executive directors improve professional expertise diversity in IPO firms, which is attributed to an increase in directors with financial expertise. This result suggests that financial expertise is beneficial for firms seeking to improve professional expertise diversity in the boardroom. There is no robust evidence of a relationship between CEO power and professional expertise diversity. Therefore, in the evolution of professional expertise diversity, the venture capitalist director voting share ownership and non-executive director financial expertise are the most important factors to consider in the boardroom.

The main conclusion of this chapter is that, at the IPO , professional expertise diversity is more important to IPO firms than gender diversity, as IPO firms have on average no female directors. We provide the first evidence that professional expertise diversity emerges first in the boardroom and is also the focus for IPO firms in the long term post-IPO. This is consistent with prior literature suggesting that IPO firms require an advising-oriented board at the point of listing (Field et al. 2013). Our findings extend this literature to suggest that such an advising-oriented board in IPO firms should focus on a diverse range of professional expertise. To answer the research question on the evolution of board diversity, gender diversity evolves as an outcome of CEO duality and venture capitalist director voting share ownership. Non-executive director financial expertise facilitates the evolution of professional expertise diversity while venture capitalist director voting share ownership inhibits the latter. To sum up, the venture capitalist director's preference for gender diversity over professional expertise diversity in board appointments is reflected in the findings of this chapter. This is an interesting contribution to the literature considering Calder-Wang and Gompers (2017) findings that there is a lack of gender diversity in the venture capital industry and 94% of the venture capital directors in our sample being male directors. The implication is that venture capitalist directors in their portfolio firms push for greater gender diversity in the boardroom.

A notable limitation of this chapter is that power in the boardroom is a broad concept and although we have used many proxies to capture power, there may still be other unquantifiable aspects that play into whether diversity emerges or evolves in the boardroom. In terms of future research, it may be interesting to incorporate power in the boardroom relating to CEO duality, voting share ownership and financial expertise as mediators in explaining the relationship between board diversity and firm outcomes. Since this chapter has explained how board diversity emerge and evolves in IPO firms, the next chapter examines the impact of board diversity on IPO survival post-IPO.

Figure 2.1 Summary of Theoretical Framework for the Determinants of Board Diversity

This figure summarises the theoretical framework discussed in section 2.2. The measures of power in the boardroom are linked to board diversity outcomes through the bargaining power model and resource dependency theory. There are six hypotheses, three relating to gender diversity (H1a, H2a, and H3a) and three relating to professional expertise diversity (H1b, H2b, and H3b). Although using a and b in hypothesis typically relate to competing, in this chapter each letter relates to a type of diversity: a for gender diversity and b for professional expertise diversity.

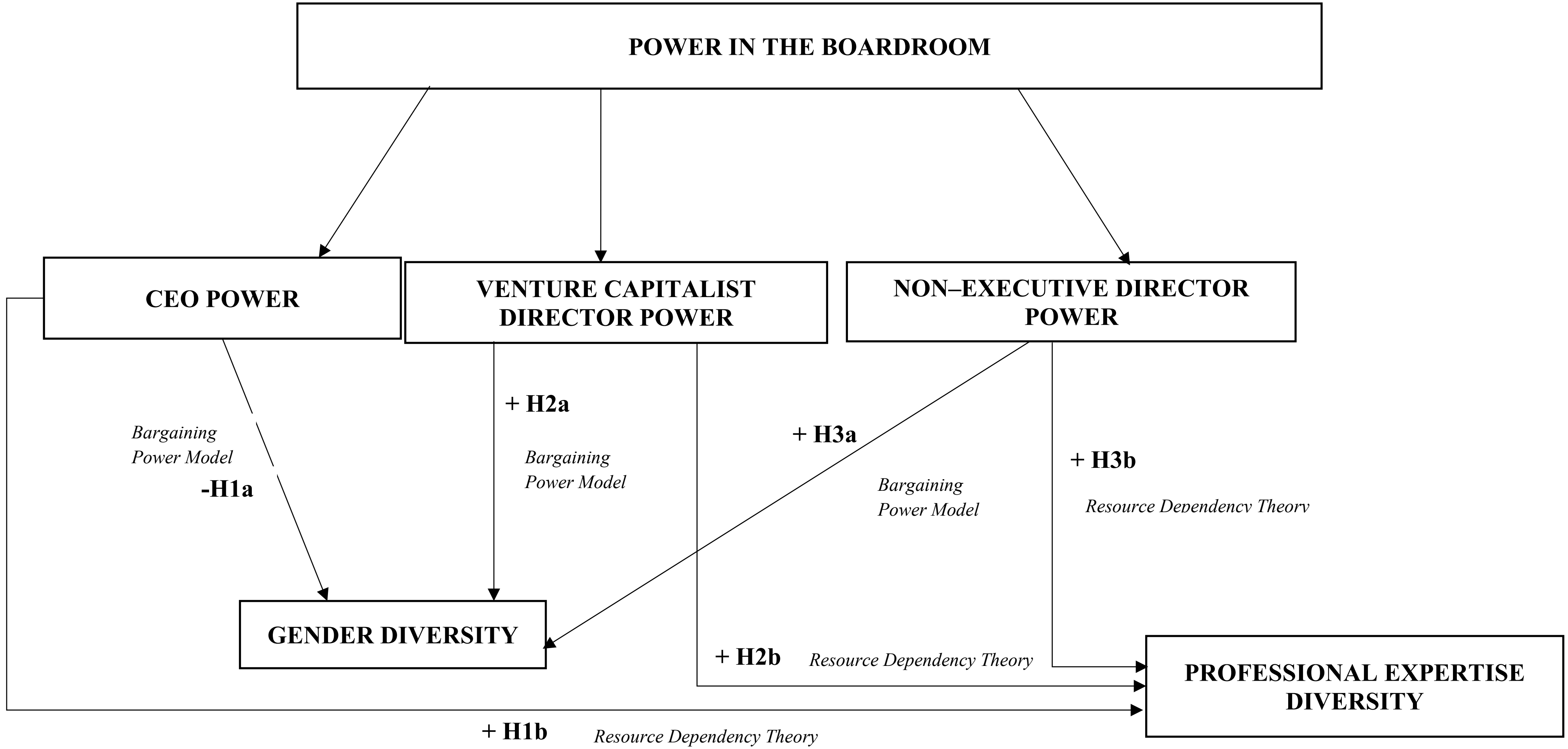


Figure 2.2 The Proxies for Power in the Boardroom

This figure shows all the proxies for power in the boardroom. From the proxies of power, it is evident that some types of power are derived internally such as structural power, ownership power, and control power, while others such as prestige power and expert power are derived externally. Although Ivy League education is excluded from the main analysis due to missing data, we report the results including Ivy league education in Appendix 2.4 as 70% of the IPO firms in the sample have data for this proxy.

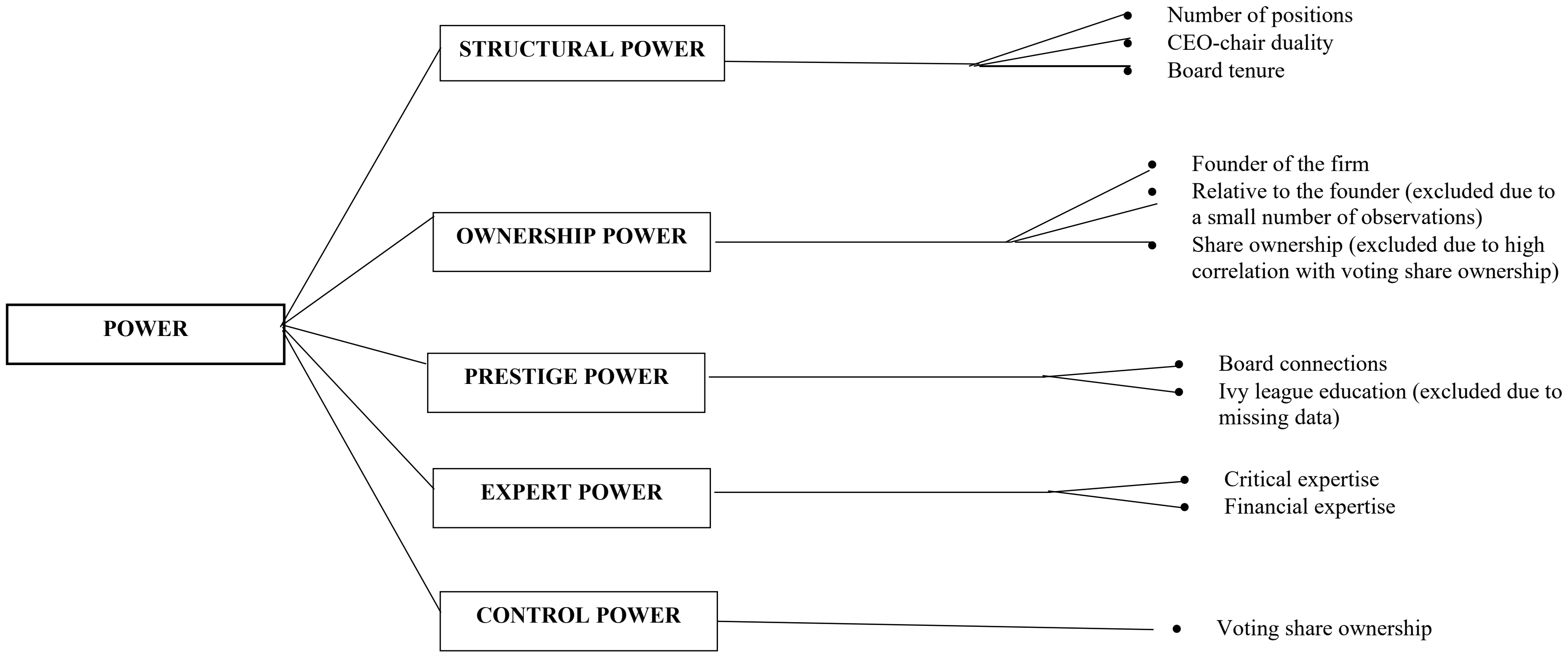


Figure 2.3 Trend Analysis for the Measures of Board Diversity

This graph shows the time trend in the measures of board diversity across the sample period. For comparability, all the measures of board diversity lie between 0 and 1. Gender diversity and professional expertise diversity are measured using the Blau heterogeneity index, while age diversity is measured using the coefficient of variation formula. Values closer to 0 depict lower levels of diversity, while values closer to 1 indicate that the firms has a higher level of board diversity.

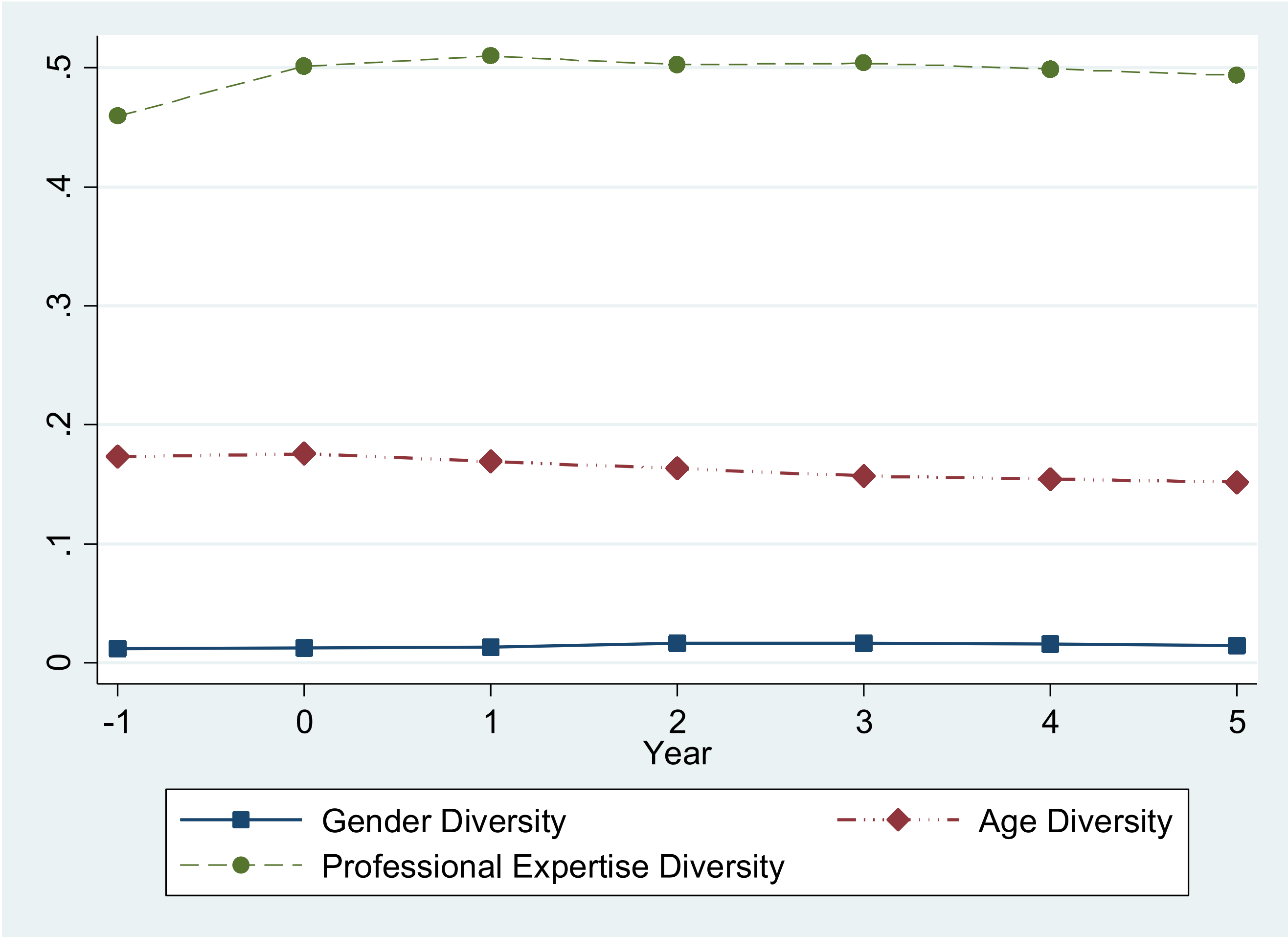


Figure 2.4 Summary of Hypotheses on the Determinants of Board Diversity and Expected Signs

This diagram shows the expected signs for all variables included in testing the relationship between power in the boardroom and board diversity.

Expected signs	CEO Power Proxies
-	CEO No of Positions
-	CEO Duality
-	CEO Board Tenure
-	Founder CEO
-	CEO Board Connections
-	CEO Critical Expertise
-	CEO Financial Expertise
-	CEO Voting Share Ownership

H1a on CEO Power

Expected signs	VC/NED Power Proxies
+	VC No of Positions/NED No of Positions
+	VC Board Tenure/NED Board Tenure
+	Founder VC/Founder NED
+	VC Board Connections/NED Board Connections
+	VC Critical Expertise/NED Critical Expertise
+	VC Financial Expertise/NED Financial Expertise
+	VC Voting Share Ownership/NED Voting Share Ownership

H2a on VC Power / H3a on NED Power

+/-	CEO/VC/NED Gender Dummy
+	Board Size
+	Board Independence
+/-	Leverage
+	Firm Size
+	Firm Age
+/-	Return on Assets (ROA)
+/-	Risk
+/-	Dual Class Share Dummy

Control Variables for all Hypotheses

Gender Diversity

Professional Expertise Diversity

Expected signs	CEO Power Proxies
+	CEO No of Positions
+	CEO Duality
+	CEO Board Tenure
+	Founder CEO
+	CEO Board Connections
+	CEO Critical Expertise
+	CEO Financial Expertise
+	CEO Voting Share Ownership

H1b on CEO Power

Expected signs	VC/ NED Power Proxies
+	VC No of Positions/NED No of Positions
+	VC Board Tenure/NED Board Tenure
+	Founder VC/Founder NED
+	VC Board Connections/NED Board Connections
+	VC Critical Expertise/NED Critical Expertise
+	VC Financial Expertise/NED Financial Expertise
+	VC Voting Share Ownership/NED Voting Share Ownership

H2b on VC Power / H3b on NED Power

Table 2.1 The Representativeness of the Sample

This table shows the data representativeness of the final sample of 661 IPOs as compared to the population of 2,641 IPO firms. Panel A shows a comparison of the distribution of IPOs by year for the final sample and the final population. Panel B shows a comparison of the Fama and French industry classification for the final sample and final population across 11 industries as the financial industry has been excluded from the sample.

Panel A: IPO Distribution by year for the sample and population

Year	Sample (N=661)	Percentage	Population (N=2,461)	Percentage
1997	95	14.37	400	15.15
1998	62	9.38	232	8.78
1999	87	13.16	408	15.45
2000	80	12.10	312	11.81
2001	14	2.12	60	2.27
2002	10	1.51	50	1.89
2003	7	1.06	50	1.89
2004	28	4.24	134	5.07
2005	21	3.18	124	4.7
2006	27	4.08	119	4.51
2007	36	5.45	119	4.51
2008	5	0.76	17	0.64
2009	13	1.97	35	1.33
2010	18	2.72	64	2.42
2011	25	3.78	63	2.39
2012	20	3.03	81	3.07
2013	33	4.99	119	4.51
2014	52	7.87	155	5.87
2015	28	4.24	99	3.75
Total	661	100	2,641	100

Panel B: Fama-French Industry Classification for final sample and population at the IPO

Industry	Sample (N=661)	Percentage	Population (N=2,461)	Percentage
Consumer non-durables	21	3.18	81	3.07
Consumer durables	10	1.51	28	1.06
Manufacturing	35	5.30	122	4.62
Oil, gas and coal extraction and products	16	2.42	79	2.99
Chemical and allied products	6	0.91	30	1.14
Business equipment	226	34.19	777	29.42
Telephone and television transmission	33	4.99	133	5.04
Utilities	4	0.61	20	0.76
Wholesale, retail, and some services	79	11.95	235	8.9
Healthcare, medical equipment and drugs	132	19.97	306	11.59
Other	99	14.98	830	31.43
Total	661	100	2,641	100

Table 2.2 IPO Distribution by Year and Industry Classification

This table shows the distributions of the IPO firms and industry classification for the years -1, 0, 2, 5 consistent with the trend analysis results indicating significant changes in diversity for these years. In the IPO year +5, for 2015 IPO year, the 0 signifies data collection period ends in 2019 as data for year 2020 were not available at the time of data collection. Panel B shows the industry classification for the 661 firms in our sample across 11 industries as the financial industry has been dropped from the sample.

Panel A: Sample Distribution of IPO by Year

Year	Pre-IPO year	IPO	IPO +2	IPO +5
1997	88	95	76	44
1998	58	62	49	32
1999	84	87	64	41
2000	79	80	66	50
2001	14	14	13	9
2002	10	10	10	9
2003	7	7	6	4
2004	27	28	24	17
2005	19	21	20	15
2006	27	27	24	14
2007	36	36	32	22
2008	5	5	4	4
2009	13	13	11	8
2010	18	18	18	13
2011	25	25	21	17
2012	18	20	18	12
2013	33	33	30	16
2014	52	52	49	30
2015	28	28	26	0
Total	641	661	561	357

Panel B: Fama-French Industry Classification for 661 IPOs

Industry	Pre-IPO year	IPO	IPO +2	IPO +5
Consumer non-durables	21	21	19	12
Consumer durables	10	10	8	6
Manufacturing	35	35	35	24
Oil, gas, coal extraction and products	13	16	15	13
Chemical and allied products	6	6	6	4
Business equipment	223	226	184	118
Telephone and television transmission	32	33	23	18
Utilities	4	4	3	2
Wholesale, retail, and some services	71	79	66	45
Healthcare, medical equipment and drugs	132	132	119	62
Other	94	99	83	53
Total	641	661	561	357

Table 2.3 Descriptive Statistics for the Determinants of Board Diversity

This table provides descriptive statistics for the sample of 661 IPOs in the year of the IPO. Firm Size is the log of total assets. Firm Age is the difference between the year of incorporation and the year of the IPO. IPO Underpricing is the difference between the price at the end of the first day of trading and the offer price expressed as a fraction of the offer price. IPO Premium is the difference between the offer price and the book value per share expressed as a fraction of the offer price. Dual Class Dummy is a dummy variable that takes the value of 1 if an IPO firm issues dual-class shares (Class A and B), and 0 otherwise. Return on Assets (ROA) is the ratio of net income to total assets. Leverage is the ratio of long-term debt to the total asset. Risk is the standard deviation of return on assets. Board Size is the average number of directors on the board in the year of the IPO. Gender Diversity is the percentage of females on the board. Professional Expertise Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. No. of positions is the average number of positions in the firm held by the board beyond the board seat. CEO Duality is a dummy variable that takes a value of 1 if the CEO is also the board chair, and zero otherwise..Board Tenure is the average number of years directors have served on the board. Founder is a dummy variable that takes the value of 1 if the founder is present on the board, and 0 otherwise. Board Connections is the average number of connections the board has to other boards. Critical Expertise is a dummy variable that takes the value of 1 if previous specialist experience in the firm's industry is present on the board, and 0 otherwise. Financial Expertise is a dummy variable that takes the value of 1 if the previous financial experience is present on the board, and 0 otherwise.Voting Share Ownership is the average percentage of voting shares held by the board.

Panel A: Firm and Board Characteristics at the IPO					
	Mean	Median	St Dev	Min	Max
Total Assets ($‘b)	0.461	0.128	1.102	0.000	8.586
Firm Size	4.989	4.861	1.462	-0.761	10.332
Firm Age (years)	10.491	7.000	12.578	0.000	78.000
IPO Underpricing (%)	-0.288	-0.125	0.545	-4.750	0.996
IPO Premium (%)	0.838	0.795	0.541	-0.707	7.428
Dual Class Dummy	0.091	0.000	0.288	0.000	1.000
Return on Assets (%)	-0.130	-0.034	0.291	-2.408	0.276
Leverage	0.150	0.016	0.231	0.000	1.158
Risk	0.368	0.102	0.761	0.002	4.163
Board Size	6.956	7.000	1.786	2.000	12.000
Panel B: Board Diversity at the IPO					
	Mean	Median	St Dev	Min	Max
Gender Diversity (%)	5.648	0.000	9.300	0.000	40.000
Number of Females on the Board	0.402	0.000	0.662	0.000	3.000
Professional Expertise Diversity	0.501	0.531	0.176	0.000	0.778
Number of Board Expert Categories	2.814	3.000	0.960	1.000	6.000
Panel C: CEO Power Proxies at the IPO					
	Mean	Median	St Dev	Min	Max
CEO No of Positions	2.201	2.000	0.657	0.000	5.000
CEO Duality	0.469	0.000	0.499	0.000	1.000
CEO Tenure (years)	5.621	4.000	4.946	1.000	34.000
Founder CEO	0.368	0.000	0.483	0.000	1.000
CEO Board Connections	0.998	0.500	1.348	0.000	6.000
CEO Critical Expertise	0.782	1.000	0.413	0.000	1.000
CEO Financial Expertise	0.073	0.000	0.260	0.000	1.000
CEO Voting Share Ownership (%)	11.627	4.402	16.527	0.000	77.550

Panel D: Venture Capitalist Director (VC) Power Proxies at the IPO					
	Mean	Median	St Dev	Min	Max
VC No of Positions	0.734	1.000	0.447	0.000	2.000
VC Tenure (years)	2.880	2.500	2.564	0.000	13.500
Founder VC	0.006	0.000	0.078	0.000	1.000
VC Board Connections	1.738	1.500	1.363	0.000	6.000
VC Critical Expertise	0.169	0.000	0.375	0.000	1.000
VC Financial Expertise	0.693	1.000	0.462	0.000	1.000
VC Voting Share Ownership (%)	11.114	9.619	10.003	0.000	49.833
Panel E: Non-Executive Director (NED) Power Proxies at the IPO					
	Mean	Median	St Dev	Min	Max
NED No of Positions	0.964	1.000	0.199	0.000	1.600
NED Tenure (years)	3.143	2.500	2.694	0.000	20.667
Founder NED	0.142	0.000	0.350	0.000	1.000
NED Board Connections	1.672	1.000	2.031	0.000	9.667
NED Critical Expertise	0.634	1.000	0.482	0.000	1.000
NED Financial Expertise	0.498	0.000	0.500	0.000	1.000
NED Voting Share Ownership (%)	2.338	0.115	5.770	0.000	31.615
Panel F: Director Gender Characteristics at the IPO					
	Mean	Median	St Dev	Min	Max
CEO Gender Dummy	0.030	0.000	0.171	0.000	1.000
VC Gender Dummy	0.061	0.000	0.239	0.000	1.000
NED Gender Dummy	0.061	0.000	0.240	0.000	1.000

Table 2.4 Univariate Analysis for Gender Diversity

This table provides results for univariate analysis testing the hypotheses for gender diversity. There are 641 firm observations relating to year 0, 561 firm observations in year 2 post-IPO and 357 firm observations in year 5 post-IPO. *Gender Diversity* is measured as the percentage of female board representation. The sample is divided into two groups based on the medians of the proxies of CEO power, venture capitalist director power, and non-executive director power in Panels A,B, and C, respectively. Two-tailed t-tests for the differences in the means for gender diversity and z-tests (Wilcoxon rank-sum test) to test the difference in medians are conducted. The Wilcoxon rank-sum tests is used to test the equality of medians for the unmatched data when firms with a powerful CEO/ venture capitalist directors/ non-executive directors are compared to firms with less powerful CEOs /venture capitalist directors/ non-executive directors. In Panel B, directors are classified as venture capitalist directors regardless of their gender. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively

Panel A: CEO Power and Gender Diversity

	t=0			t=2			t=5		
Proxies for CEO power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
CEO No of Positions$_x$	7.023	4.543	2.264**/1.787*	9.690	5.496	3.111***/2.443**	5.581	5.094	0.282/-0.020
CEO Duality$_x$	5.515	4.169	1.761*/2.028**	6.499	5.220	1.553/1.497	5.074	5.198	-0.136/-0.212
CEO Tenure $_x$	4.477	5.494	-1.309/-1.202	5.577	6.302	-0.883/-0.890	5.202	5.059	0.156/0.163
Founder CEO$_x$	4.601	5.372	-0.978/-0.601	5.586	6.519	-1.091/-1.068	4.779	5.782	-1.049/-1.110
CEO Board Connections$_x$	4.508	6.042	-1.741*/-2.079**	5.795	6.282	-0.521/-0.920	4.812	6.034	-1.177/-1.124
CEO Critical Expertise$_x$	5.196	4.789	0.461/-0.067	7.012	5.616	1.409/1.016	6.049	4.911	0.986/1.005
CEO Financial Expertise$_x$	4.872	5.143	-0.179/0.195	5.958	5.459	0.317/0.750	5.158	4.700	0.236/0.624
CEO Voting Share Ownership$_x$	4.113	5.197	-1.279/-1.381	6.899	5.472	1.618/1.502	5.987	4.707	1.322/1.395

Panel B: Venture Capitalist Director Power and Gender Diversity

	t=0			t=2			t=5		
Proxies of Venture Capitalist Director Power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
VC Tenure$_x$	4.763	5.460	-0.708/-0.983	5.795	6.299	-0.532/-0.498	5.399	4.316	1.023/0.974
Founder VC$_x$	4.854	10.714	-1.209/-1.264	5.909	8.333	-0.431/-0.273	5.104	8.333	-0.646/-0.388
VC Board Connections$_x$	3.798	6.157	-3.102***/-4.261***	5.135	6.746	-1.967**/-2.530**	4.705	5.624	-1.004/-1.228
VC Critical Expertise$_x$	4.395	7.394	-2.936***/-2.041**	5.552	7.607	-1.929*/-2.392**	4.829	6.434	-1.376/-1.360
VC Financial Expertise$_x$	3.531	5.582	-2.551**/-4.115***	4.582	6.490	-2.133**/-2.557**	4.299	5.489	-1.196/-1.411
VC Voting Share Ownership$_x$	3.724	5.647	-2.470**/-3.319***	4.919	6.526	-1.90*/-2.015**	4.353	5.654	-1.399/-1.227

Panel C: Non-Executive Director Power and Gender Diversity

	t=0			t=2			t=5		
Proxies of Non-Executive Director Power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
NED No of Positions$_x$	4.908	3.571	0.388/0.117	5.950	2.857	0.708/0.643	5.164	2.857	0.594/0.525
NED Tenure$_x$	4.927	4.748	0.187/-0.375	5.850	6.193	-0.340/-0.752	4.980	5.637	-0.606/-0.781
Founder NED$_x$	4.804	5.439	-0.573/-1.337	5.937	5.834	0.088/-0.542	5.132	5.079	0.014/-0.116
NED Board Connections$_x$	4.458	5.359	-1.180/-1.921*	6.018	5.863	0.183/-0.005	5.135	5.109	0.020/0.562
NED Critical Expertise$_x$	4.858	4.922	-0.084/-1.271	6.450	5.627	0.961/0.672	5.477	4.942	0.561/0.491
NED Financial Expertise$_x$	4.537	5.588	-1.303/-2.097**	5.828	6.011	-0.222/-0.746	4.641	5.611	-1.063/-1.0371
NED Voting Share Ownership$_x$	5.145	4.404	0.922/0.215	5.936	5.886	0.054/-0.622	5.268	4.930	0.556/0.009

Table 2.5 Univariate Analysis for Professional Expertise Diversity

This table provides results for univariate analysis testing the hypotheses for professional expertise diversity. There are 641 firm observations relating to year 0, 561 firm observations in year 2 post-IPO and 357 firm observations in year 5 post-IPO. *Professional Expertise Diversity* is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. The sample is divided into two groups based on the medians of the proxies of CEO power, venture capitalist director power, and non-executive director power in Panels A,B, and C, respectively. Two-tailed t-tests for the differences in the means for professional expertise diversity and z-tests (Wilcoxon rank-sum tests) to test the difference in medians are conducted. The Wilcoxon rank-sum tests is used to test the equality of medians for the unmatched data when firms with a powerful CEO/ venture capitalist director/ non-executive director are compared to firms with less powerful CEOs /venture capitalist director/ non-executive director. In Panel B, directors are classified as venture capitalist directors regardless of their gender. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: CEO Power and Professional Expertise Diversity

	t=0			t=2			t=5		
Proxies for CEO power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
CEO No of Positions$_x$	0.426	0.465	-1.610/-0.519	0.496	0.506	-0.419/-0.192	0.467	0.484	-0.466/-0.630
CEO Duality$_x$	0.461	0.457	0.219/-0.001	0.504	0.507	-0.175/-0.476	0.480	0.487	-0.381/-0.711
CEO Tenure$_x$	0.455	0.466	-0.693/-0.888	0.495	0.516	-1.381/-1.419	0.481	0.485	-0.211/-0.052
Founder CEO$_x$	0.465	0.449	0.934/1.325	0.508	0.500	0.542/0.424	0.486	0.477	0.435/0.329
CEO Board Connections$_x$	0.449	0.489	-2.051**/-2.449**	0.497	0.529	-1.869*/-2.353**	0.476	0.504	-1.277/-1.946*
CEO Critical Expertise$_x$	0.457	0.460	-0.139/0.010	0.498	0.507	-0.478/-0.157	0.450	0.491	-1.617/-1.315
CEO Financial Expertise$_x$	0.454	0.527	-2.222**/-1.804*	0.502	0.539	-1.239/-1.042	0.480	0.533	-1.251/-0.8620.9
CEO Voting Share Ownership$_x$	0.438	0.468	-1.624/-1.109	0.502	0.507	-0.295/-0.783	0.479	0.485	-0.313/-0.747

Panel B: Venture Capitalist Director Power and Professional Expertise Diversity

	t=0			t=2			t=5		
Proxies of Venture Capitalist Director Power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
VC Tenure$_x$	0.436	0.561	-5.912***/-5.557***	0.482	0.574	-5.366***/-4.774***	0.460	0.553	-4.118***/-3.667***
Founder VC$_x$	0.459	0.458	0.012/0.834	0.505	0.461	0.422/1.034	0.483	0.461	0.203/0.784
VC Board Connections$_x$	0.389	0.541	-9.672***/-7.485***	0.457	0.555	-6.680***/-5.898***	0.439	0.534	-4.920***/-4.413***
VC Critical Expertise$_x$	0.442	0.547	-4.750***/-3.875***	0.494	0.556	-3.174***/-2.918***	0.469	0.542	-2.884***/-2.909***
VC Financial Expertise$_x$	0.311	0.535	-14.668***/-10.035***	0.395	0.552	-10.300***/-7.255***	0.364	0.534	-8.625***/-5.845***
VC Voting Share Ownership$_x$	0.345	0.534	-12.247***/-8.988***	0.423	0.554	-8.906***/-7.078***	0.406	0.535	-6.752***/-5.351***

Panel C: Non-Executive Director Power and Professional Expertise Diversity

	t=0			t=2			t=5		
Proxies of Non-Executive Director power	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values	Below the median	Above the median	t-values/z-values
NED No of Positions$_x$	0.457	0.609	-2.019**/-2.030**	0.505	0.534	-0.362/-1.069	0.482	0.534	-0.611/-1.261
NED Tenure$_x$	0.455	0.475	-0.928/-0.885	0.502	0.517	-0.830/-0.709	0.477	0.505	-1.193/-1.406
Founder NED$_x$	0.455	0.486	-1.293/-1.095	0.507	0.491	0.765/1.014	0.485	0.470	0.535/0.641
NED Board Connections$_x$	0.414	0.509	-5.824***/-5.188***	0.484	0.518	-2.163**/-2.308**	0.462	0.496	-1.687*/-2.076**
NED Critical Expertise$_x$	0.429	0.488	-3.599***/-3.688***	0.513	0.500	0.830/0.772	0.495	0.477	0.868/0.943
NED Financial Expertise$_x$	0.415	0.546	-7.724***/-7.450***	0.465	0.543	-5.229***/-5.252***	0.438	0.528	-4.671***/-4.971***
NED Voting Share Ownership$_x$	0.457	0.464	-0.405/0.598	0.520	0.466	3.253***/4.420***	0.497	0.452	2.075**/2.854***

Table 2.6 Regressions for CEO Power and Board Diversity

This table reports the OLS regressions testing hypothesis 1a and 1b on the relationship between CEO power in the boardroom and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 relate to professional expertise diversity. *Gender Diversity* is defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All the proxies of CEO power, board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	x=-1	x=0	x=2	x=-1	x=0	x=2
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity$_x$	0.844***	0.680***	0.320***			
	(22.48)	(18.15)	(5.12)			
Prof. Exp. Diversity$_x$				0.778***	0.726***	0.272***
				(22.47)	(18.59)	(4.41)
CEO No of Positions$_x$	-0.422	0.735	0.901	0.001	0.001	-0.027
	(-1.01)	(1.53)	(1.07)	(0.14)	(0.11)	(-1.38)
CEO Duality$_x$	-0.535	-1.661**	-1.046	0.018	0.021	0.053**
	(-0.97)	(-2.29)	(-0.85)	(1.47)	(1.57)	(2.01)
CEO Board Tenure$_x$	0.007	-0.073	-0.002	0.001	-0.001	-0.000
	(0.14)	(-1.16)	(-0.02)	(1.04)	(-0.63)	(-0.02)
Founder CEO$_x$	-0.024	1.259**	1.479	-0.001	-0.004	0.010
	(-0.05)	(2.03)	(1.34)	(-0.14)	(-0.30)	(0.42)
CEO Board Connections$_x$	0.224	0.091	-0.098	0.001	-0.004	-0.010
	(1.58)	(0.47)	(-0.36)	(0.14)	(-0.87)	(-0.82)
CEO Critical Expertise$_x$	-0.283	0.388	0.274	-0.006	0.017	0.037
	(-0.55)	(0.54)	(0.20)	(-0.47)	(1.25)	(1.39)
CEO Financial Expertise$_x$	0.172	-0.803	-0.084	0.031	0.007	0.030
	(0.24)	(-0.79)	(-0.03)	(1.64)	(0.33)	(0.87)
CEO Voting Shares Ownership$_x$	0.014	0.024	0.019	-0.000	0.000	-0.001
	(1.20)	(1.14)	(0.49)	(-0.86)	(0.41)	(-1.65)
CEO Gender Dummy$_x$	5.731***	8.562***	11.470***	0.002	0.060***	-0.008
	(4.26)	(3.42)	(4.17)	(0.10)	(2.79)	(-0.18)
Board Size$_x$	0.309**	-0.033	-0.090	0.023***	0.006**	0.007
	(2.52)	(-0.19)	(-0.31)	(6.35)	(2.05)	(1.10)
Board Independence$_x$	0.981	-0.010	-0.025	0.114***	0.001	0.000
	(0.93)	(-0.50)	(-0.71)	(3.41)	(1.59)	(0.59)
Leverage$_x$	0.196	1.282	-0.391	0.018	-0.030	-0.035
	(0.36)	(0.92)	(-0.31)	(1.48)	(-1.10)	(-0.92)
Firm Size$_x$	-0.144	0.041	0.718	-0.009**	-0.006	0.001
	(-0.94)	(0.14)	(1.45)	(-2.14)	(-1.01)	(0.11)
Firm Age$_x$	-0.000	-0.001	-0.039	0.000	-0.000	0.000
	(-0.00)	(-0.03)	(-1.22)	(0.21)	(-0.36)	(0.26)
Return on Assets$_x$	-0.001	1.227	-1.057	-0.001	-0.044*	-0.095**
	(-0.01)	(0.99)	(-0.48)	(-0.23)	(-1.76)	(-2.32)
Risk$_x$	-0.281	-0.594	0.262	0.000	-0.010	0.006
	(-1.50)	(-1.49)	(0.29)	(0.04)	(-1.18)	(0.36)
Dual Class Dummy$_x$	-1.061	0.909	0.516	-0.032	-0.006	-0.036
	(-1.30)	(0.94)	(0.29)	(-1.57)	(-0.24)	(-0.83)
Constant	-1.082	5.718*	1.108	-0.089*	0.096**	0.346***
	(-0.72)	(1.85)	(0.24)	(-1.94)	(2.43)	(3.26)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	641	561	357	641	561	357
Adjusted R^2	0.747	0.592	0.212	0.662	0.607	0.250
F-value	45.664***	14.916***	4.124***	38.356***	18.323***	3.475***

Table 2.7 Regressions for Venture Capitalist Directors Power and Board Diversity

This table reports the OLS regressions testing hypothesis 2a and 2b on the relationship between venture capitalist director power in the boardroom and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 relate to professional expertise diversity. *Gender Diversity is* defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ *where* Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All the proxies of venture capitalist director power, board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	x=-1	x=0	x=2	x=-1	x=0	x=2
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity$_x$	0.779***	0.615***	0.336***			
	(15.98)	(17.00)	(5.39)			
Prof. Exp. Diversity$_x$				0.762***	0.702***	0.316***
				(20.27)	(18.94)	(5.55)
VC No of Positions$_x$	-1.917	1.962	4.658	0.055	0.038	-0.192*
	(-0.97)	(0.43)	(0.80)	(0.34)	(0.79)	(-1.69)
VC Board Tenure$_x$	0.012	-0.139	-0.277	0.003	0.002	0.008*
	(0.13)	(-0.89)	(-1.25)	(1.56)	(0.85)	(1.79)
Founder VC$_x$	0.194	-0.183	-1.450	0.023	-0.067	-0.037
	(0.21)	(-0.12)	(-0.25)	(1.23)	(-1.27)	(-0.64)
VC Board Connections$_x$	0.194*	-0.040	-0.000	0.001	-0.000	-0.002
	(1.73)	(-0.26)	(-0.00)	(0.47)	(-0.00)	(-0.37)
VC Critical Expertise$_x$	-0.049	0.541	0.269	0.004	-0.015	-0.001
	(-0.11)	(0.86)	(0.22)	(0.53)	(-1.35)	(-0.04)
VC Financial Expertise$_x$	-0.818	0.460	-1.334	0.030	0.035	0.177***
	(-0.83)	(0.37)	(-0.52)	(0.99)	(1.44)	(3.00)
VC Voting Share Ownership$_x$	0.013*	-0.021	-0.001	-0.001***	-0.000	-0.000
	(1.69)	(-1.60)	(-0.02)	(-3.47)	(-1.47)	(-0.39)
VC Gender Dummy$_x$	5.824***	10.147***	11.398***	0.005	0.012	0.010
	(6.16)	(10.78)	(5.58)	(0.60)	(0.98)	(0.49)
Board Size$_x$	0.242*	-0.115	-0.312	0.005	0.003	0.004
	(1.85)	(-0.68)	(-0.88)	(1.44)	(1.11)	(0.82)
Board Independence$_x$	0.725	-0.036**	-0.030	0.134***	0.000	0.000
	(0.60)	(-1.99)	(-0.88)	(3.63)	(0.93)	(0.03)
Leverage$_x$	0.391	1.047	-0.134	-0.000	-0.084***	-0.130**
	(0.56)	(0.64)	(-0.04)	(-0.01)	(-2.81)	(-2.13)
Firm Size $_x$	-0.178	0.020	0.071	-0.005	0.002	0.012
	(-0.98)	(0.06)	(0.12)	(-1.00)	(0.28)	(1.11)
Firm Age$_x$	-0.005	-0.039*	-0.068*	-0.000	0.000	0.001
	(-0.27)	(-1.86)	(-1.66)	(-0.08)	(0.25)	(1.19)
Return on Assets$_x$	0.060	0.387	-2.353	0.005	-0.005	-0.024
	(0.17)	(0.27)	(-0.97)	(0.61)	(-0.21)	(-0.48)
Risk$_x$	-0.072	-0.628**	-0.021	0.000	0.001	0.011
	(-0.42)	(-1.97)	(-0.03)	(0.07)	(0.19)	(0.62)
Dual Class Dummy$_x$	-0.127	-0.901	-0.381	-0.003	0.003	-0.026
	(-0.17)	(-0.77)	(-0.19)	(-0.20)	(0.19)	(-0.70)
Constant	-0.702	3.399***	4.338*	-0.080***	0.069*	0.221***
	(-1.16)	(2.64)	(1.66)	(-3.39)	(1.77)	(3.02)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	641	561	357	641	561	357
Adjusted R^2	0.755	0.691	0.281	0.642	0.606	0.259
F-value	38.972***	27.618***	4.148***	24.969***	19.152***	3.799***

Table 2.8 Regressions for Non-Executive Directors Power and Board Diversity

This table reports the OLS regressions testing hypothesis 3a and 3b on the relationship between the non-executive director power and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 professional expertise diversity *Gender Diversity* is defined as the percentage of female board representation on the board.*Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All proxies of non-executive directors power, board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and$^{*, **, ***}$ represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	(1)	(2)	(3)	(1)	(2)	(3)
Independent Variables	x=-1	x=0	x=2	x=-1	x=0	x=2
Gender Diversity$_x$	0.797***	0.543***	0.242***			
	(17.09)	(11.76)	(3.71)			
Prof. Exp. Diversity$_x$				0.784***	0.712***	0.270***
				(22.23)	(16.71)	(4.46)
NED No of Positions$_x$	-0.441	-0.602	-8.295	0.053	-0.038	0.084
	(-0.18)	(-0.08)	(-0.68)	(0.72)	(-0.50)	(0.55)
NED Board Tenure $_x$	0.005	0.081	0.028	-0.000	0.000	0.004
	(0.08)	(0.89)	(0.18)	(-0.34)	(0.27)	(1.15)
Founder NED$_x$	0.321	-0.673	-1.503	0.020	0.005	0.010
	(0.61)	(-0.86)	(-1.19)	(1.58)	(0.39)	(0.39)
NED Board Connections$_x$	0.047	-0.420**	-0.205	0.000	-0.006	-0.008
	(0.27)	(-2.20)	(-0.61)	(0.16)	(-1.60)	(-0.86)
NED Critical Expertise$_x$	-0.068	-1.414**	-0.928	-0.012	-0.003	-0.038*
	(-0.15)	(-2.28)	(-0.93)	(-1.20)	(-0.24)	(-1.71)
NED Financial Expertise$_x$	0.008	0.088	0.170	0.015	0.012	0.053***
	(0.02)	(0.15)	(0.18)	(1.59)	(1.15)	(2.74)
NED Voting Share	-0.018*	-0.033**	0.006	-0.000	-0.000	-0.001
Ownership$_x$	(-1.85)	(-2.01)	(0.22)	(-0.05)	(-1.45)	(-1.07)
NED Gender Dummy$_x$	5.538***	7.922***	7.362***	0.002	0.008	-0.004
	(5.66)	(7.54)	(5.29)	(0.20)	(0.66)	(-0.20)
Board Size$_x$	0.077	-0.242	-0.495*	0.018***	0.003	0.005
	(0.63)	(-1.41)	(-1.67)	(4.46)	(1.12)	(0.78)
Board Independence$_x$	1.350	-0.018	-0.052	0.128***	0.001	0.000
	(1.19)	(-1.02)	(-1.52)	(3.62)	(1.51)	(0.50)
Leverage$_x$	-0.267	-0.507	-0.990	0.019*	-0.027	-0.041
	(-0.55)	(-0.65)	(-0.99)	(1.76)	(-0.95)	(-0.87)
Firm Size$_x$	-0.016	0.112	0.354	-0.013***	-0.004	0.002
	(-0.12)	(0.49)	(0.82)	(-3.41)	(-0.78)	(0.16)
Firm Age$_x$	0.019	0.000	-0.020	0.001	-0.000	-0.000
	(1.05)	(0.02)	(-0.79)	(1.19)	(-1.12)	(-0.59)
Return on Assets$_x$	-0.033	0.732	-1.423	0.007	-0.043*	-0.096**
	(-0.19)	(0.76)	(-0.65)	(1.44)	(-1.85)	(-2.27)
Risk$_x$	-0.072	-0.549	-0.660	0.001	-0.010	0.005
	(-0.36)	(-1.55)	(-0.69)	(0.19)	(-1.09)	(0.27)
Dual Class Dummy$_x$	-0.722	0.459	0.199	-0.008	0.001	-0.022
	(-1.05)	(0.54)	(0.12)	(-0.41)	(0.06)	(-0.52)
Constant	-0.534	2.420	5.354*	-0.100***	0.024	0.244***
	(-0.70)	(1.58)	(1.73)	(-3.93)	(0.48)	(2.88)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	641	561	357	641	561	357
Adjusted R^2	0.754	0.652	0.266	0.658	0.606	0.246
F-value	60.451***	25.542***	4.506***	39.747***	18.367***	20.453***

Robustness Analysis

Table 2.9 Diagnostic Test Results - Propensity Score Matching Estimation for the Impact of Power in the Boardroom on Board Diversity

The results reported in this table refer to the logit regression underlying the propensity score matching for the pre-matching and post-matching sample using each of the measures of power as a dependent variable. Panel A reports the pre and post-match logit regressions to estimate the propensity score for CEO power, VC power and NED power. The dependent variables in the logit regressions reported in columns (1) and (2) is CEO Power Dummy, in columns (3) and (4) is VC Power Dummy, and in columns (5) and (6) is NED Power Dummy. CEO Power Dummy takes a value of one if the firm's CEO power score is above the median and zero otherwise. VC Power Dummy takes a value of one if the firm's VC power score is above the median and zero otherwise. NED Power Dummy takes a value of one if the firm's NED power score is lower than the median value for the sample and zero otherwise. This is a boardroom power score is a scoring variable based on the proxies of power for CEO power, VC power and NED power. There are eight proxies of *CEO power and eight for VC power and NED power*: No of Position(s), Board tenure, Board Connections, Voting Share Ownership, Founder, CEO Duality, Critical Expertise, and Financial Expertise. The first four are continuous proxies, while the last four are dummy variables. I assign a score of one to each continuous proxy of power that lies above the median value of said proxy for the sample. I also assign a score of one to each dummy proxy of power where the firm is classified with a value of one for each director category, and otherwise zero. The maximum score for CEO power will be eight, while VC power and NED power will be seven.All the dependent variables are measured at the IPO while independent variables are calculated in the pre-IPO year. As independent variables are lagged to the pre-IPO year, we lose 20 observations for firm incorporated in the IPO year. The independent variables in this table are the controls used in main regressions. Robust t-values are presented in parentheses. Panel B reports the result for the two-tailed t-tests on the differences in the means of firm characteristics for the treated and untreated sub-samples. All variables are defined in Appendix 1.*, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: Pre- and Post-matching logit regressions for measures of board diversity						
Dependent Variables	CEO Power Dummy $_t$		VC Power Dummy $_t$		NED Power Dummy $_t$	
	Pre-match logit	Post-match logit	Pre-match logit	Post-match logit	Pre-match logit	Post-match logit
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Firm Age$_x$	-0.004	0.017	-0.014	-0.013	-0.001	0.000
	(-0.49)	(1.37)	(-1.27)	(-0.68)	(-0.16)	(0.01)
Firm Size$_x$	-0.170***	0.085	0.083	0.079	-0.007	0.035
	(-2.78)	(0.96)	(0.85)	(0.50)	(-0.11)	(0.43)
Leverage$_x$	-0.680***	0.263	0.481	-0.808	0.324	-0.134
	(-2.94)	(0.84)	(1.14)	(-1.10)	(1.23)	(-0.37)
Return on Assets$_x$	0.017	0.163	-0.009	-0.436	0.002	0.024
	(0.22)	(0.91)	(-0.06)	(-1.48)	(0.03)	(0.20)
Risk$_x$	-0.035	0.174	-0.187	0.212	0.103	-0.031
	(-0.35)	(1.29)	(-1.50)	(1.21)	(1.07)	(-0.27)
Constant	-1.464***	-0.291	-3.033***	-0.099	-1.458***	0.016
	(-3.15)	(-0.45)	(-8.29)	(-0.19)	(-5.88)	(0.05)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	641	322	641	184	641	396
Pseudo R2	0.105	0.034	0.425	0.060	0.110	0.024
Chi-square	87.764***	12.693	367.933***	13.948	97.414***	11.539
Number of matched firms		161		92		198

Panel B: Mean values and t-test for the difference in means across our control variables				
Variables	Firms with High CEO Power $_t$ (N=161 $_t$)	Firms with Low CEO Power (N=161 $_t$)	Difference	t-value
Firm Age$_x$	8.317	10.242	-1.925	-1.502
Firm Size $_x$	3.763	4.097	-0.333	-1.491
Leverage $_x$	0.265	0.299	-0.033	-0.727
Return on Assets $_x$	-0.485	-0.303	-0.182	-1.509
Risk$_x$	0.577	0.600	-0.023	-0.205
Variables	Firms with High VC Power (N=92 $_t$)	Firms with Low VC Power (N=92 $_t$)	Difference	t-value
Firm Age$_x$	8.804	6.380	2.424	1.593
Firm Size$_x$	3.498	3.057	0.441	1.587
Leverage$_x$	0.209	0.154	0.055	1.420
Return on Assets$_x$	-0.382	-0.553	0.171	1.236
Risk$_x$	0.647	0.913	-0.267	-1.513
Variables	Firms with High NED Power (N=198 $_t$)	Firms with Low NED Power (N=198 $_t$)	Difference	t-value
Firm Age$_x$	7.909	7.456	0.454	0.410
Firm Size$_x$	3.361	3.192	0.168	0.791
Leverage$_x$	0.208	0.175	0.033	1.003
Return on Assets$_x$	-0.437	-0.394	-0.044	-0.416
Risk$_x$	0.583	0.611	-0.029	-0.279

Table 2.10 PSM Analysis for CEO Power and Board Diversity

This table replicates the OLS regressions in Table 2.6 using the matched sample of treated and untreated firms to analyse the impact of CEO power in the boardroom and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 relate to professional expertise diversity. *Gender Diversity* is defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and*, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	x=-1	x=0	x=2	x=-1	x=0	x=2
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity$_x$	0.858***	0.691***	0.280***			
	(18.90)	(12.72)	(3.36)			
Prof. Exp. Diversity$_x$				0.719***	0.807***	0.250**
				(13.37)	(16.17)	(2.30)
CEO No of Positions$_x$	-0.204	0.796	1.530	0.004	0.021	-0.014
	(-0.35)	(1.18)	(1.17)	(0.29)	(1.44)	(-0.45)
CEO Duality$_x$	-0.724	-2.504**	-3.272	0.033	-0.006	0.001
	(-0.90)	(-2.16)	(-1.57)	(1.56)	(-0.32)	(0.01)
CEO Board Tenure$_x$	0.079	0.056	0.276	0.004*	-0.002	-0.001
	(0.96)	(0.61)	(1.64)	(1.69)	(-1.00)	(-0.21)
Founder CEO$_x$	0.052	-0.055	0.297	-0.025	-0.007	0.033
	(0.07)	(-0.06)	(0.19)	(-1.49)	(-0.45)	(0.88)
CEO Board Connections$_x$	0.103	0.551*	0.105	-0.004	-0.009*	0.000
	(0.51)	(1.74)	(0.23)	(-0.72)	(-1.96)	(0.00)
CEO Critical Expertise$_x$	-0.412	-1.924	0.150	0.000	0.006	0.060
	(-0.50)	(-1.63)	(0.07)	(0.00)	(0.34)	(1.45)
CEO Financial Expertise$_x$	-0.345	-2.738	-0.752	0.051*	0.026	0.045
	(-0.37)	(-1.62)	(-0.16)	(1.86)	(1.08)	(0.87)
CEO Voting Share Ownership$_x$	0.002	0.013	-0.029	-0.001*	0.000	-0.002
	(0.12)	(0.49)	(-0.60)	(-1.73)	(0.64)	(-1.11)
CEO Gender Dummy$_x$	3.938***	8.679*	9.459***	-0.006	0.042	0.019
	(2.83)	(1.71)	(2.76)	(-0.14)	(1.19)	(0.18)
Board Size$_x$	0.431***	-0.148	-0.377	0.024***	0.009*	0.005
	(2.84)	(-0.54)	(-0.88)	(4.43)	(1.89)	(0.41)
Board Independence$_x$	1.370	0.002	0.014	0.099*	0.000	0.001
	(0.90)	(0.05)	(0.28)	(1.94)	(0.42)	(0.52)
Leverage$_x$	0.994	0.892	0.883	0.019	-0.036	-0.084
	(1.48)	(0.85)	(0.50)	(0.95)	(-0.97)	(-1.21)
Firm Size$_x$	-0.435*	0.526	2.070***	-0.013**	-0.008	-0.002
	(-1.82)	(1.57)	(3.20)	(-1.98)	(-1.04)	(-0.10)
Firm Age$_x$	0.003	-0.036	-0.096*	-0.000	-0.000	0.000
	(0.10)	(-1.24)	(-1.86)	(-0.05)	(-0.10)	(0.33)
Return on Assets$_x$	0.040	-0.965	-2.487	0.001	-0.031	-0.106
	(0.15)	(-0.72)	(-0.92)	(0.18)	(-0.79)	(-1.47)
Risk$_x$	-0.465	-1.444***	0.879	-0.005	-0.013	-0.007
	(-1.20)	(-2.60)	(0.52)	(-0.46)	(-0.93)	(-0.16)
Dual Class Dummy$_x$	-0.372	1.789	-0.664	-0.042*	-0.011	-0.035
	(-0.33)	(1.40)	(-0.34)	(-1.67)	(-0.34)	(-0.50)
Constant	0.962	2.806	-7.013	-0.072	0.095	0.389**
	(0.28)	(0.67)	(-1.06)	(-0.88)	(1.28)	(2.11)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	322	278	172	322	278	172
Adjusted R^2	0.727	0.564	0.120	0.661	0.601	0.188
F-value	35.865***	11.167***	3.396***	34.781***	15.445***	6.628***

Table 2.11 PSM Analysis for Venture Capitalist Director Power and Board Diversity

This table replicates the OLS regressions in Table 2.7 using the matched sample of treated and untreated firms to analyse the impact of venture capitalist director power in the boardroom and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 relate to professional expertise diversity. *Gender Diversity is* defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and $^{*, **, ***}$ represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	x=-1	x=0	x=2	x=-1	x=0	x=2
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity$_x$	0.723***	0.649***	0.358**			
	(8.72)	(8.91)	(2.42)			
Prof. Exp. Diversity$_x$				0.690***	0.601***	0.167
				(4.36)	(7.09)	(1.30)
VC No of Positions$_x$	3.890	5.375	8.079	0.008	0.201	-0.015
	(1.24)	(0.89)	(0.59)	(0.16)	(1.28)	(-0.07)
VC Board Tenure$_x$	0.145	-0.421	-0.143	0.003	0.002	0.008
	(0.92)	(-1.29)	(-0.25)	(0.95)	(0.39)	(0.80)
Founder VC$_x$	-1.785	-1.288	9.033	0.032	0.040	-0.167
	(-0.69)	(-0.29)	(0.97)	(0.64)	(0.55)	(-1.29)
VC Board Connections$_x$	0.230	0.353	1.501**	0.004	0.006	0.012
	(0.78)	(1.16)	(2.05)	(0.83)	(0.99)	(1.16)
VC Critical Expertise$_x$	-0.696	3.318*	0.373	0.014	-0.055**	-0.043
	(-0.54)	(1.98)	(0.12)	(0.89)	(-2.28)	(-1.00)
VC Financial Expertise$_x$	-2.057	-1.857	0.181	-0.015	0.023	-0.082
	(-1.37)	(-0.79)	(0.03)	(-0.72)	(0.66)	(-1.06)
VC Voting Share Ownership$_x$	0.030*	0.003	-0.027	-0.001*	0.001	0.001
	(1.92)	(0.12)	(-0.36)	(-1.85)	(1.21)	(0.61)
VC Gender Dummy$_x$	7.137***	11.353***	13.941***	0.001	0.017	0.035
	(3.91)	(5.87)	(3.20)	(0.05)	(0.83)	(0.80)
Board Size$_x$	0.354	-0.314	-0.349	0.006	0.000	-0.001
	(1.40)	(-1.01)	(-0.43)	(1.21)	(0.06)	(-0.13)
Board Independence$_x$	1.212	-0.025	0.034	-0.037	-0.001	0.000
	(0.40)	(-0.36)	(0.37)	(-0.40)	(-1.02)	(0.22)
Leverage$_x$	1.009	-1.072	-5.235	-0.009	-0.161*	-0.166
	(0.69)	(-0.24)	(-0.60)	(-0.36)	(-1.85)	(-1.37)
Firm Size$_x$	-0.134	-0.059	-0.004	-0.006	0.014	0.026
	(-0.38)	(-0.07)	(-0.00)	(-1.01)	(0.82)	(0.98)
Firm Age$_x$	-0.002	0.035	-0.032	0.001	0.001	0.000
	(-0.04)	(0.57)	(-0.32)	(0.99)	(1.03)	(0.35)
Return on Assets$_x$	0.389	0.181	-0.069	0.002	-0.026	-0.055
	(0.89)	(0.07)	(-0.02)	(0.27)	(-0.82)	(-0.88)
Risk$_x$	-0.085	-0.956	-0.355	-0.003	0.005	0.022
	(-0.24)	(-1.38)	(-0.14)	(-0.35)	(0.46)	(0.59)
Dual Class Dummy$_x$	1.851	-0.946	-2.985	0.018	0.061*	0.074
	(1.03)	(-0.29)	(-0.48)	(0.47)	(1.85)	(1.00)
Constant	-2.851	1.584	-0.735	-0.047	0.309***	0.362**
	(-1.22)	(0.36)	(-0.12)	(-0.33)	(2.95)	(2.36)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	184	144	103	184	144	103
Adjusted R^2	0.816	0.686	0.231	0.490	0.517	-0.064
F-value	111.052***	5836.467***	849.536***	6.426***	250.491***	71.298***

Table 2.12 PSM Analysis for Non-Executive Director Power and Board Diversity

This table replicates the OLS regressions in Table 2.8 using the matched sample of treated and untreated firms to analyse the impact of non-executive director power in the boardroom and the measures of board diversity at the IPO, by year 2 post-IPO, and by year 5 post-IPO. There are 641 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 561 observations in year 2 post-IPO and 357 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 relate to professional expertise diversity. *Gender Diversity is* defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. All board and firm controls are defined in appendix 1. Robust t-statistics are in parentheses and$^{*, **, ***}$ represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	(1)	(2)	(3)	(1)	(2)	(3)
Independent Variables	x=-1	x=0	x=2	x=-1	x=0	x=2
Gender Diversity$_x$	0.824***	0.559***	0.319***			
	(14.65)	(8.69)	(3.59)			
Prof. Exp. Diversity$_x$				0.838***	0.721***	0.250***
				(21.36)	(15.17)	(3.63)
NED No of Positions$_x$	1.768	0.871	-7.378	0.028	-0.029	0.218**
	(1.10)	(0.08)	(-0.60)	(0.90)	(-0.36)	(1.98)
NED Board Tenure$_x$	0.085	0.013	-0.005	0.001	0.001	0.006
	(1.21)	(0.12)	(-0.03)	(0.75)	(0.52)	(1.58)
Founder NED$_x$	0.559	-1.266	-2.079	0.004	0.017	0.038
	(0.92)	(-1.14)	(-1.35)	(0.21)	(0.88)	(1.27)
NED Board Connections$_x$	0.021	-0.408	-0.347	0.003	-0.010*	-0.017
	(0.09)	(-1.42)	(-0.71)	(0.84)	(-1.87)	(-1.45)
NED Critical Expertise$_x$	-0.263	-1.122	0.423	-0.024*	-0.002	-0.033
	(-0.42)	(-1.35)	(0.31)	(-1.83)	(-0.12)	(-0.91)
NED Financial Expertise$_x$	-0.287	0.362	0.353	0.005	0.015	0.057**
	(-0.45)	(0.51)	(0.29)	(0.41)	(0.99)	(2.16)
NED Voting Share Ownership$_x$	-0.024*	-0.021	-0.007	0.000	-0.000	-0.001
	(-1.87)	(-1.36)	(-0.19)	(0.80)	(-0.60)	(-1.11)
NED Gender Dummy$_x$	5.615***	8.007***	6.333***	0.005	0.001	-0.022
	(4.29)	(5.40)	(3.62)	(0.53)	(0.06)	(-0.76)
Board Size$_x$	0.083	-0.320	-0.648*	0.019***	0.006	0.008
	(0.50)	(-1.40)	(-1.67)	(3.65)	(1.38)	(0.75)
Board Independence$_x$	1.075	-0.041	-0.127**	0.111***	0.000	0.001
	(0.76)	(-1.34)	(-2.29)	(2.62)	(0.47)	(0.72)
Leverage$_x$	-0.097	-0.136	-1.030	0.036**	-0.025	-0.065
	(-0.16)	(-0.08)	(-0.32)	(2.07)	(-0.52)	(-0.87)
Firm Size$_x$	-0.094	0.031	0.877	-0.019***	-0.003	0.009
	(-0.56)	(0.09)	(1.52)	(-3.90)	(-0.38)	(0.64)
Firm Age$_x$	0.024	-0.005	-0.047	0.001	-0.001	-0.001
	(0.92)	(-0.20)	(-1.19)	(0.74)	(-1.52)	(-0.68)
Return on Assets$_x$	-0.205	0.453	-4.455*	0.015**	-0.052	-0.139**
	(-1.03)	(0.35)	(-1.88)	(2.14)	(-1.59)	(-2.31)
Risk$_x$	-0.243	-0.606	-1.418	-0.001	-0.018	0.008
	(-1.00)	(-1.36)	(-0.94)	(-0.09)	(-1.41)	(0.28)
Dual Class Dummy$_x$	-2.319**	-0.287	-0.529	-0.013	0.007	0.003
	(-2.54)	(-0.27)	(-0.29)	(-0.52)	(0.24)	(0.06)
Constant	-1.418	3.987	13.382**	-0.139***	0.068	0.234**
	(-1.19)	(0.86)	(1.98)	(-3.33)	(1.02)	(2.11)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	396	326	218	396	326	218
Adjusted R^2	0.735	0.616	0.207	0.668	0.598	0.212
F-value	60.302***	2.988***	4.759***	26.404***	23.444***	62.825***

Appendix

Appendix 2.1 Variable Definitions for the Determinants of Board Diversity

Dependent Variables (Measures of Diversity)	**Description**
Gender Diversity	Percentage of females in the boardroom
Age Diversity	The standard deviation of the board's ages divided by the mean age of the board. Using the coefficient of variation formula (SD of Board Age/ Mean of Board Age). Larger standard deviation (larger age differences between board members) and lower mean age (higher representation of young board members) would generate higher age diversity values. High scores indicate greater age diversity
Professional Expertise Diversity	An expertise index based on the Blau index using the proportion of expertise groups on each board. Professional Expertise includes the following fourteen categories: Academic, Accountant, Banker, Consultant, Dentist, Doctor, Engineer, Executive, Finance Expert, IT Expert, Investment Professional, Lawyer, Scientist, and Politician. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity. For example, if all 7 board members are categorised as executives, then the index value will be 0. $\boldsymbol{i.e.\ 1 - ((\frac{7}{7})^2)}$ A board of 7 members with 2 IT experts, 1 executive, 2 investment professionals, 1 accountant and 1 finance expert will have an index value of 0.775 i.e., $\mathbf{1 - ((\frac{2}{7})^2 + (\frac{2}{7})^2 + (\frac{1}{7})^2 + (\frac{1}{7})^2 + (\frac{1}{7})^2)}$. Thus, High scores indicate higher professional expertise diversity.
Independent Variables- Proxies of Power in the Boardroom (CEO Power, VC Power, NED Power)	
No. of Position(s) in the Firm	The average number of positions held in the firm by the board
CEO Duality	A dummy variable that takes the value of one if the CEO is also the chair of the board, and zero otherwise.
Board Tenure	The number of years the director has served on the board.
Founder	A variable that takes the value of one if the founder of the firm is present on the board, and otherwise zero.
Board Connections	This is the average number of prior and current board appointments of the board.
Critical Expertise	A dummy variable that takes the value of one if the board has industry experience critical to the operations of the firm, and otherwise zero. (e.g., a board member that has worked previously as a software engineer serving on the board of an IT firm)
Financial Expertise	A dummy variable that takes the value of one if the board has financial experience, and otherwise zero (e.g., a director with prior experience in financial institutions)
Voting Share Ownership (%)	The total percentage of voting shares owned by the board
Share ownership (%) (Replaced by voting share ownership due to high correlation)	The total percentage of shares owned by the board
Ivy League Education (This has been excluded from the regressions due to missing data)	A dummy variable that takes the value of one if the board has Ivy League education, and otherwise zero (Ivy League schools include Brown University, Columbia University, Cornell University, Dartmouth College, Harvard University, Princeton University, University of Pennsylvania, and Yale University) For directors from UK Universities, I use Universities from the Golden triangle to construct this variable. (Golden Triangle Universities include the University of Cambridge, the University of Oxford, University of London, Imperial College London, King's College London, London School of Economics and University College London)
Board and Firm Controls	
Board Size	The number of directors on the board
Board Independence	Percentage of independent directors on the board relative to board size. Director independence is measured in line with prior literature as a director who: is not a substantial shareholder of the firm up to 5%; had not been employed in any executive capacity by the company within the last 5 years; is not retained as a professional adviser by the company (either personally or through their firm); is not a significant supplier or customer of the company; has no significant contractual relationship with the company other than as a director.
Leverage	The ratio of the book value of long-term debt to total assets
Firm Size	The natural log of total assets
Firm Age	The number of years since incorporation
Return on Assets (ROA)	The ratio of net income to total assets
Risk	A rolling 3-year standard deviation of ROA starting in the year before the IPO.

Dual Class Share Dummy	A dummy variable that takes a value of one if an IPO firm issues dual-class shares (Class A and B), and otherwise zero.
Instrumental Variables for IV Estimation	
CEO in other firms	This is a dummy variable that takes a value of one if a CEO in another firm is present on the board, and otherwise zero.
No. of financial firms	This is the natural log of the number of financial firms in the state where the IPO firm is headquartered.
Industry proportion by US state	This is the proportion of firms in the industry of the IPO firm based on the total number of firms in the state where the IPO firm is headquartered.

Appendix 2.2 Auto Regressive Model Results for Board Diversity

This table shows the results for the AR(1) regression for prior period diversity on current period diversity for years -1 to 5 post-IPO. The OLS, fixed effects regression, Difference GMM regressions, and System GMM regressions are presented in the table below. Regressions for the Difference and System GMM use instruments of 3-year lags for equations in first differences and 4-year lags for the equation in levels. The Sargan and Hansen test values for over-identifying restrictions are reported below with p values in parentheses. The p values of the AR(1) and AR(2) tests are also reported. Time dummies are included in the model and as an exogenous instrument in line with Wintoki et al. (2012). t-statistics are in parentheses and*, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable=	OLS	FE	Sys GMM	Diff GMM	OLS	FE	Sys GMM	Diff GMM
	Gender Diversity				Professional Expertise Diversity			
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gender Diversity $_{t-1}$	0.875***	0.436***	0.858***	0.776***				
	(55.48)	(15.04)	(15.38)	(4.28)				
Prof. Exp Diversity $_{t-1}$					0.789***	0.385***	1.000***	0.485***
					(50.60)	(12.06)	(17.02)	(6.31)
Constant	1.378***	4.088***	4.441***		0.114***	0.313***	-0.013	
	(13.01)	(22.83)	(4.21)		(12.83)	(19.81)	(-0.33)	
No. of observations	3136	3136	3136	2465	3136	3136	3136	2465
Adjusted. R^2	0.733	0.196			0.681	0.188		
F-value	3078.03***	226.09***			2560.18***	145.40***		
Hansen test			9.933	6.797			3.769	4.319
			0.270	0.147			0.877	0.365
Sargan test			31.833	26.708			2.501	3.416
			0.000	0.000			0.962	0.491
AR (1)			0.000	0.000			0.000	0.000
AR (2)			0.974	0.913			0.293	0.445

Appendix 2.3. Instrumental Variable Estimation for CEO Power and Board Diversity

This table reports the 2SLS regression results for the measures of board diversity on the proxies of CEO power for years 0, 2 and 5. There are 641 observations for pre-IPO regressions, 561 observations relating to year 2 post-IPO and 357 observations relating to year 5 post-IPO. This table shows the results of the first and second stage in the 2SLS regressions after controlling for endogeneity arising from board connections, financial expertise, and critical expertise. In the first stage, these variables are instrumented using three variables: *CEOs in other firms*, *No. of financial firms* and *Industry proportion*. *CEOs in other firms* is a dummy variable that takes a value of one if a CEO in another firm is present on the board, and otherwise zero. *No. of financial firms* is the natural log of the number of financial firms in the state where the IPO firm is headquartered. *Industry proportion* is the proportion of firms in the industry of the IPO firm based on the total number of firms in the state where the IPO firm is headquartered. The estimated values of the board connections, financial expertise and critical expertise are extracted from the first step and included in the second step as independent variables. *Gender Diversity* is measured as the percentage of female board representation is the percentage of females on the board. *Professional Expertise Diversity* is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher prof expertise diversity and vice versa. *CEO No. of Positions* is measured as the average number of positions in the firm held by the CEO. *CEO Board Tenure* is measured as the number of years the CEO has served on the board. *CEO Board Connections* is measured as the average number of prior and current board appointments for each CEO, as stated in the prospectus and proxy statements. *CEO Voting Share Ownership* is measured as the percentage of voting shares owned by the CEO in the firm. *CEO Duality* is a dummy variable that takes the value of one if the CEO is also the chair of the board, and otherwise zero. *Founder CEO* is a dummy variable that takes the value of one if a founder CEO is present on the board, and otherwise zero. *CEO Critical Expertise* is a dummy variable that takes the value of one if the CEO has experience critical to the operations of the firm, and otherwise zero. *CEO Financial Expertise* is a dummy variable that takes the value of one if the CEO has financial experience, and otherwise zero. All board and firm controls are defined in Appendix 2.1. t-statistics are in parentheses and*, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	First stage year 0			**Second stage year 0**		First stage year 2			**Second stage year 2**		First stage year 5			**Second stage year 5**	
Dependent Variable	Board Connections for year 0	Financial Expertise for year 0	Critical Expertise for year 0	Gender Diversity in year 0	Prof. Exp Diversity in year 0	Board Connections for year 2	Financial Expertise for year 2	Critical Expertise for year 2	Gender Diversity in year 2	Prof. Exp Diversity in year 2	Board Connections for year 5	Financial Expertise for year 5	Critical Expertise for year 5	Gender Diversity in year 2	Prof. Exp Diversity in year 2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Independent Variable	x=-1	x=-1	x=-1	x=-1	x=-1	x=0	x=0	x=0	x=0	x=0	x=2	x=2	x=2	x=2	x=2
Gender Diversity$_x$				0.836***					0.660***					0.317***	
				(22.94)					(15.20)					(5.09)	
Prof. Exp. Diversity$_x$					0.772***					0.687***					0.257***
					(24.57)					(22.34)					(5.09)
Instruments															
CEO in other firms$_x$	-0.004					-0.009					0.009				
	(-0.58)					(-1.11)					(0.93)				
No. of financial firms$_x$		0.010					0.001					-0.007			
		(1.22)					(0.12)					(-0.49)			
Industry proportion by US state$_x$			0.004*					0.002					0.004		
			(1.88)					(0.95)					(1.10)		
Independent Variables															
CEO No of Positions$_x$	-0.047	0.008	-0.016	-0.302	0.004	0.047	-0.028	0.017	0.639	0.001	-0.109	-0.067**	0.015	0.997	-0.011
	(-0.46)	(0.42)	(-0.47)	(-0.54)	(0.34)	(0.43)	(-1.28)	(0.45)	(1.31)	(0.09)	(-0.81)	(-2.25)	(0.32)	(1.13)	(-0.60)
CEO Duality$_x$	0.340**	-0.022	0.029	-1.512	-0.005	-0.044***	-0.003	0.001	-0.071	-0.001	-0.028	-0.002	0.002	0.003	-0.001
	(2.32)	(-0.74)	(0.65)	(-0.62)	(-0.12)	(-2.97)	(-1.32)	(0.23)	(-1.15)	(-0.50)	(-1.47)	(-0.79)	(0.25)	(0.03)	(-0.49)
CEO Board Tenure$_x$	-0.031**	-0.004	-0.003	0.089	0.005	0.348**	0.027	0.022	-1.360*	0.031**	0.364*	0.069*	0.016	0.009	0.058**
	(-2.18)	(-1.59)	(-0.68)	(0.36)	(1.17)	(2.07)	(0.87)	(0.45)	(-1.78)	(2.30)	(1.79)	(1.70)	(0.25)	(0.01)	(2.11)
Founder CEO$_x$	-0.359***	0.006	0.081**	1.154	0.023	-0.250	-0.024	0.078*	1.156	-0.018	-0.104	-0.053	0.102*	2.050	-0.001
	(-2.91)	(0.20)	(2.06)	(0.50)	(0.61)	(-1.59)	(-0.81)	(1.76)	(1.50)	(-1.29)	(-0.55)	(-1.61)	(1.76)	(1.65)	(-0.02)
CEO Board Connections$_x$		0.007	0.001	3.063	0.073		0.012	-0.002	-3.997***	-0.108***		-0.015	-0.002	0.085	-0.142***
		(0.62)	(0.11)	(0.46)	(0.69)		(1.01)	(-0.15)	(-2.98)	(-4.30)		(-1.20)	(-0.11)	(0.03)	(-2.68)
CEO Critical Expertise$_x$	0.016	-0.165***		1.414	-0.005	0.149	-0.147***		-6.352	0.031	-0.078	-0.130***		-16.159*	-0.024
	(0.10)	(-4.41)		(0.34)	(-0.06)	(0.93)	(-3.80)		(-0.91)	(0.25)	(-0.34)	(-2.65)		(-1.76)	(-0.11)

CEO Financial	0.223		-0.366***	2.179	0.084	0.227		-0.291***	9.025***	0.336***	-0.571*		-0.232**	7.632	0.392***
Expertise$_x$	(0.70)		(-4.98)	(0.70)	(1.04)	(0.59)		(-3.67)	(2.72)	(5.40)	(-1.66)		(-2.01)	(1.06)	(2.95)
CEO Voting Share	0.003	0.000	-0.001	0.008	-0.001	0.007	0.001	0.000	0.032	0.000	0.003	-0.001	0.002	0.014	-0.001
Ownership$_x$	(0.96)	(0.73)	(-0.65)	(0.31)	(-1.25)	(1.58)	(0.75)	(0.21)	(1.53)	(1.07)	(0.71)	(-0.72)	(0.90)	(0.37)	(-1.49)
CEO Gender	0.123	-0.050	-0.083	6.480***	-0.003	0.190	0.072	0.002	6.046**	0.049*	-0.188	-0.056	-0.142	11.568***	-0.043
Dummy$_x$	(0.42)	(-0.92)	(-0.82)	(3.83)	(-0.10)	(0.44)	(0.73)	(0.02)	(2.17)	(1.69)	(-0.59)	(-0.77)	(-0.97)	(3.85)	(-0.86)
Constant	1.798***	0.073	0.796***	-2.769	-0.105	0.101	0.092	0.211**	10.540	0.021	-0.603	0.351**	0.463	11.588	0.187
	(3.47)	(0.91)	(8.19)	(-0.78)	(-1.28)	(0.30)	(1.24)	(2.20)	(1.61)	(0.17)	(-0.56)	(2.12)	(1.62)	(1.30)	(0.91)
Board Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	641	641	641	641	641	561	561	561	561	561	357	357	357	357	357
Adjusted R^2	0.165	0.040	0.103	0.745	0.671	0.059	0.039	0.113	0.596	0.628	0.057	0.049	0.090	0.221	0.270
F-value	3.806***	1.595***	2.639***	39.434***	28.517***	3.415***	1.462***	2.456***	18.308***	20.859***	1.511***	1.413***	1.864***	2.672***	3.912***
Cragg-Donald Wald Test- Critical Value (16.380)	0.511	0.526	3.058			1.464	0.005	2.842			0.683	1.620	3.413		

Appendix 2.4 Power in the Boardroom on Board Diversity (Including Ivy league education)

This table reports the OLS regressions testing all our hypotheses including Ivy league education as a proxy of power in the boardroom. There are 468 observations relating to the IPO, which is based on the proxies of power in the pre-IPO year, 396 observations in year 2 post-IPO and 242 observations in year 5 post-IPO. Columns 1 to 3 relate to gender diversity while columns 4 to 6 professional expertise diversity *Gender Diversity* is defined as the percentage of female board representation on the board. *Professional Expertise Diversity* is defined as is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher prof expertise diversity and vice versa. All proxies power, board and firm controls are defined in Appendix 2.1. Robust t-statistics are in parentheses and*, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Panel A: CEO Power and Board Diversity						
Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	(1)	(2)	(3)	(4)	(5)	(6)
Independent Variables	x=-1	x=0	x=2	x=-1	x=0	x=2
Gender Diversity$_x$	0.811***	0.688***	0.283***			
	(18.69)	(15.49)	(4.06)			
Prof. Exp. Diversity$_x$				0.825***	0.745***	0.217***
				(19.69)	(19.06)	(2.83)
CEO No of Positions$_x$	-0.856	0.760	0.673	0.005	-0.007	-0.043
	(-1.29)	(1.33)	(0.70)	(0.44)	(-0.60)	(-1.09)
CEO Duality$_x$	-0.439	-2.090**	-1.801	0.024*	0.022	0.051*
	(-0.68)	(-2.40)	(-1.18)	(1.66)	(1.40)	(1.72)
CEO Board Tenure$_x$	0.081	-0.023	0.121	0.001	-0.000	-0.000
	(1.23)	(-0.28)	(1.01)	(0.53)	(-0.18)	(-0.08)
Founder CEO$_x$	-0.159	1.460*	2.318*	0.005	-0.010	0.011
	(-0.29)	(1.83)	(1.79)	(0.43)	(-0.80)	(0.42)
CEO Board Connections$_x$	0.106	-0.038	-0.547	0.004	-0.001	0.009
	(0.73)	(-0.16)	(-1.51)	(0.83)	(-0.15)	(0.95)
CEO Ivy League Education$_x$	-0.296	0.523	1.420	0.009	0.024*	0.054**
	(-0.61)	(0.60)	(1.08)	(0.77)	(1.88)	(2.15)
CEO Critical Expertise$_x$	-0.013	-0.091	-0.346	-0.009	0.009	0.000
	(-0.02)	(-0.09)	(-0.19)	(-0.61)	(0.64)	(0.01)
CEO Financial Expertise$_x$	1.357*	-0.862	-1.166	0.007	-0.008	0.004
	(1.69)	(-0.64)	(-0.35)	(0.31)	(-0.43)	(0.10)
CEO Voting Share Ownership$_x$	0.008	0.009	-0.007	-0.000	-0.000	-0.003**
	(0.55)	(0.37)	(-0.18)	(-0.46)	(-0.48)	(-2.28)
Constant	-2.023	5.501*	-6.334	-0.091*	0.086*	0.421***
	(-1.47)	(1.82)	(-1.07)	(-1.86)	(1.74)	(2.99)
Board Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	468	396	242	468	396	242
Adjusted R^2	0.741	0.606	0.265	0.646	0.645	0.230
F-value	35.730***	107.219***	6.406***	36.342***	17.773***	11.453***
Panel B: Venture Capitalist Director Power and Board Diversity						
Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	(1)	(2)	(3)	(4)	(5)	(6)
Independent Variables	x=-1	x=0	x=2	x=-1	x=0	x=2
Gender Diversityx	0.775***	0.641***	0.357***			
	(14.36)	(16.57)	(5.08)			
Prof. Exp. Diversityx				0.758***	0.719***	0.333***
				(18.86)	(17.59)	(5.04)
VC No of Positions$_x$	-1.587	-0.786	5.323	0.049	0.044	-0.299**
	(-0.69)	(-0.14)	(0.78)	(1.14)	(0.22)	(-2.22)
VC Board Tenure$_x$	-0.009	-0.104	-0.373	0.001	0.003	0.009

	(-0.08)	(-0.51)	(-1.18)	(0.22)	(1.03)	(1.33)
Founder VC$_x$	0.302	0.586	0.886	0.024	0.012	0.015
	(0.28)	(0.33)	(0.37)	(1.03)	(0.95)	(0.87)
VC Board Connections$_x$	0.107	-0.084	0.116	-0.000	0.000	0.003
	(0.92)	(-0.47)	(0.29)	(-0.11)	(0.08)	(0.52)
VC Ivy League Education$_x$	-0.646	0.372	2.178	-0.025**	0.007	0.001
	(-1.02)	(0.47)	(1.33)	(-2.24)	(0.47)	(0.05)
VC Critical Expertise$_x$	-0.065	0.324	0.096	0.001	-0.017	-0.010
	(-0.13)	(0.46)	(0.07)	(0.17)	(-1.35)	(-0.45)
VC Financial Expertise$_x$	-0.346	-1.571	-1.277	0.057	0.057	0.248**
	(-0.22)	(-1.02)	(-0.34)	(1.20)	(1.60)	(2.33)
VC Voting Share Ownership$_x$	0.011	0.029*	-0.025	-0.001***	-0.000	0.000
	(1.14)	(1.82)	(-0.60)	(-3.33)	(-0.95)	(0.06)
Constant	-0.817	2.606**	4.358	-0.087***	0.051	0.205**
	(-1.32)	(2.09)	(1.27)	(-3.46)	(1.19)	(2.27)
Board Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	468	396	242	468	396	242
Adjusted R^2	0.736	0.652	0.256	0.640	0.606	0.256
F-value	35.451***	22.793***	10.206***	33.747***	12.337***	9.453***

Panel C: Non-Executive Director Power and Board Diversity

Dependent Variable	Gender Diversity in year 0	Gender Diversity in year 2	Gender Diversity in year 5	Professional Expertise Diversity in year 0	Professional Expertise Diversity in year 2	Professional Expertise Diversity in year 5
	(1)	(2)	(3)	(4)	(5)	(6)
Independent Variables	x=-1	x=0	x=2	x=-1	x=0	x=2
Gender Diversity$_x$	0.789***	0.562***	0.275***			
	(14.29)	(11.22)	(3.70)			
Prof. Exp. Diversity$_x$				0.776***	0.687***	0.192***
				(17.89)	(16.56)	(2.70)
NED No of Positions$_x$	0.189	-0.742	-8.416	0.060	-0.054	0.134
	(0.07)	(-0.09)	(-0.77)	(0.86)	(-0.62)	(0.94)
NED Board Tenure$_x$	-0.011	0.060	0.102	-0.001	0.001	0.005
	(-0.12)	(0.48)	(0.51)	(-0.31)	(0.55)	(0.89)
Founder NED$_x$	0.460	-0.201	-1.353	0.028*	0.007	-0.012
	(0.71)	(-0.21)	(-0.89)	(1.88)	(0.49)	(-0.43)
NED Board Connections$_x$	0.293	-0.474**	-0.082	0.000	-0.008*	-0.000
	(1.41)	(-1.97)	(-0.19)	(0.05)	(-1.75)	(-0.01)
NED Ivy League Education$_x$	-0.622	0.481	0.437	0.005	0.012	0.030
	(-1.29)	(0.82)	(0.40)	(0.44)	(1.10)	(1.19)
NED Critical Expertise$_x$	-0.006	-1.387*	-0.954	-0.006	-0.004	-0.049
	(-0.01)	(-1.83)	(-0.67)	(-0.52)	(-0.30)	(-1.58)
NED Financial Expertise$_x$	0.177	0.219	0.768	0.022**	0.019*	0.037
	(0.33)	(0.32)	(0.64)	(2.27)	(1.72)	(1.56)
NED Voting Share Ownership$_x$	-0.027*	-0.019	-0.012	-0.000	-0.001***	-0.002**
	(-1.91)	(-0.89)	(-0.33)	(-0.05)	(-2.65)	(-2.13)
Constant	-0.815	2.464*	2.483	-0.113***	-0.000	0.204*
	(-1.11)	(1.67)	(0.65)	(-4.34)	(-0.00)	(1.87)
Board Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	468	396	242	468	396	242
Adjusted R^2	0.754	0.648	0.277	0.663	0.633	0.243
F-value	45.342***	21.642***	6.825***	31.374***	18.367***	20.453***

Chapter 3: Boards and IPO Survival: Does Diversity Alone Matter?

3.1 Introduction

Going beyond the questions in the previous chapter on why diversity emerges and evolves in IPO firms, we now analyse the impact of board diversity on post-IPO survival. The consensus in prior literature is that diverse boards provide different perspectives by drawing on board members' experiences to improve the information available to the board for better decision-making. Nevertheless, greater diversity in the boardroom may also result in conflicts that slow down decision-making processes, which ultimately influence the survival prospects of the firm post-IPO. We argue that examining the impact of board diversity on IPO survival will improve the understanding of IPO firms on the aspects of diversity to focus resources in managing the unique challenges, tension, and conflicts that diversity creates. Board diversity refers to both human capital and social capital which capture the ability of the board to provide resources to the firm. Still, we incorporate board connections as external links relating to social capital may have reputational effects for IPO firms (Espenlaub et al. 2012) that are new to stock markets.[60] For this reason, the chapter analyses the impact of board diversity and board connections on the survival of newly listed firms. Board connections to other boards improve the firm's link to external contacts, board advising, facilitates the creation of business relationships and information sharing (Field et al. 2013). We argue that the value-added services provided by better-connected boards are vital for IPO survival. Accordingly, the fundamental question of this chapter is whether board diversity and board connections influence the likelihood of survival post-IPO.

Board diversity is defined in terms of gender, age, and professional expertise diversity, while board connections is defined as the average number of prior and current board appointments of the board at the IPO. IPO survival is categorised into two groups: survivors and non-survivors. Survivors are defined as firms that remain publicly traded and independent entities up to 5 years post-IPO or the last year of the sample period. Non-survivors are all firms that are not classified as survivors and exit the sample post-IPO due to mergers or delistings. Although non-survivors have a negative connotation, we acknowledge that not all types of exits

[60] Hillman et al. (2000) describe board capital as a composition of human and social capital that provides a valuable set of resources and improves economic outcomes for the firm.

post-IPO indicate firm failure. For example, in a merger the firm continues to operate, although not as an independent entity as survivors. Hence, from a shareholder's perspective, mergers are different to delisting. Mergers may not indicate firm failure as there are merger motivated IPOs whose objective at the point of listing is to take advantage of high post-IPO stock values and be involved in an acquisition (Hovakimian and Hutton 2010).[61] Therefore, mergers are firms that have been involved in a merger or are acquired after listing and lose their identity as independent entities post-IPO.[62] Delistings are firms that do not survive as independent entities after the IPO and exit the stock market regardless of the reasons for delisting.[63] Considering the differences between mergers and delistings, this chapter also examines the impact of board diversity and board connections on the likelihood of exit.

To date, research on IPO firms have linked board diversity and board connections to post-IPO events such as mergers and acquisitions, and post-IPO firm performance.[64] In terms of the board, studies on IPO survival focus on the impact of venture capitalist involvement (Jain and Kini 2000), board size (Chancharat et al. 2012) and board independence (Wilson et al. 2014).[65] The evidence from these studies show that the presence of venture capitalists, board size and independence are related with an increased likelihood of survival post-IPO. The implication of these findings is that aspects of board structure have important implications for IPO survival. However, there is no evidence to date on the potential impact of board diversity and board connections on IPO survival. This chapter provides first evidence on whether greater board diversity and more board connections in IPO firms improve the likelihood of survival until year 5 post-IPO. The hypotheses predicting the positive relationship between board

[61] Brau and Fawcett (2006) show that in some cases, the IPO is the preliminary phase of a sale as firms are usually valued within this process and facilitating potential acquisition transactions is one of the motivations for going public.

[62] Erel et al. (2015) show that target firms are financially constrained prior to acquisition, and with 97% of the mergers in our sample being target firms, we do not categorise mergers as survivors but as non-survivors. In this vein, IPO firms that are involved in mergers post-IPO, exit, and are no longer surviving as the same independent entities. Also, Jain and Kini (2000) justify this approach based on evidence that IPO firms acquired post-IPO experience declining stock price performance prior to acquisition.

[63] In terms of delisting, there are several reasons for delisting highlighted in CRSP including: price fell below acceptable level, insufficient capital or assets, company request, corporate governance violation, delisting by the SEC and bankruptcy. Delisting due to bankruptcy is typically more severe, however. However, there are only 20 such firms across our sample period which is too small to be explored as a separate event category.

[64] Levi et al. (2014) analyse the impact of board diversity on mergers and acquisitions. Their findings indicate that the presence of female board members influences acquisition decisions by creating shareholder value especially in bidder firms. Feng et al. (2019) analyse the impact of director networks on IPO firm performance. Their findings indicate that firms with better-connected directors at the IPO have a higher post-IPO stock performance.

[65] Other studies such as Anagnostopoulou et al. (2021) analyses the impact of earnings management by classification shifting on IPO survival while Gounopoulos et al. (2020) examines the impact of financial expert CEOs on IPO survival.

diversity, board connections and IPO survival rely on the resource dependency while the competing negative hypotheses rely on the diversity theory.[66]

The sample period starts from 1st January 1997 and tracks IPO firms until 31st December 2019 to determine whether the 661 randomly selected IPO firms are survivors or non-survivors. As the minimum survival window is 5 years post-IPO, the final sample of IPOs cover the period from 1st January 1997 to 31st December 2015.[67] The start of the sample period is influenced by data availability in the SEC Edgar database, while the end date allows us to track IPOs in the post-IPO period and analyse survival until year 5 post-IPO. There are 304 survivors and 357 non-survivors (236 mergers and 121 delistings) by year 5 post-IPO.[68] We analyse the impact of board diversity and board connections on IPO survival using four main specifications. In a broader sense, the logit estimator is used to analyse the impact of board diversity and board connections on the likelihood of survival post-IPO. Next, the multinomial logit estimator analyses the impact of the same variables of interest on the likelihood of exit relating to survivors, mergers and delistings by year 5 post-IPO. Both estimators allow us to predict the likelihood of the event, such as survival, merger or delisting occurring, which is the focus of this chapter, but do not predict the timing of the event.[69] We argue that an analysis estimating the timing of the event provides further context for understanding the impact of our primary variables of interest on the likelihood of survival post-IPO. To this end, we use the survival analysis model described by Cox (1972). The Cox proportional hazard model is appropriate for our analysis, as it estimates the duration of IPO survival. The model allows assessing the conditional probability of failure, given that the firm has survived up to the present time (called hazard rate or probability). We also use the accelerated failure time (AFT) model proposed by Lawless (1982), which estimates the time to failure to check the robustness of the Cox model.

[66] The resource dependency theory views directors as resources, linking the firms to the external environment. In Hillman et al.'s (2000) extension of this theory, the human capital lens explains the potential positive impact of board diversity on IPO survival while the social capital lens explains the potential positive impact of board connections on IPO survival. The diversity theory explains the negative impact of board diversity and board connections on IPO survival. According to the diversity theory, greater diverse views or connections to other boards may result in cognitive conflicts in the boardroom that inhibit board effectiveness in the decision-making process.
[67] We have also obtained data on IPO survival for year 10 post-IPO, which are discussed in the robustness section of the chapter.
[68] There are 23 firms involved in IPOs less than 5 years ago but surviving up to year 4 post-IPO, which are included as survivors in the sample and the results are upheld after dropping these firms in a robustness test.
[69] For example, the logit and multinomial logit regression do not differentiate between firms that fail after 1 year of listing and those that fail within 5 years.

The results indicate that greater board diversity has no influence on the likelihood of survival to year 5 post-IPO. However, IPO firms with better-connected boards are more likely to survive as independent entities post-IPO and these results are driven by firms with higher level of investment in innovation (R&D intensity). These results indicate that IPO firms use the social capital of better-connected directors, which relates to their external contacts, information, and skills to facilitate the survival of IPO firms as independent entities. Our results are robust to different specifications and sub-samples.

Considering the insignificant results for the impact of board diversity on IPO survival, we test whether there is a change in the impact of board diversity measures on IPO survival when interacted with board connections. The results suggest that greater professional expertise diversity or board connections improve the likelihood of IPO survival to year 5 post-IPO when the other is equal to zero. However, the interaction term reveals that the effect of professional expertise diversity on IPO survival is dampened by IPO firms with better-connected boards at the point of listing. This indicates that there is a substitution effect at play for the impact of professional expertise diversity and board connections on IPO survival. The results for professional expertise diversity extends our findings from Chapter 2 that professional expertise diversity emerging at the IPO improves the likelihood of survival post-IPO. Regarding gender diversity, there is some evidence that merger-motivated IPOs will benefit from greater female board representation in the boardroom at the IPO, but these results are not robust in all specifications. In terms of age diversity, our results consistently show that the survival prospects of IPO firms remain unaffected regardless of the level of board connections at the IPO.

This chapter contributes to the literature in three ways. First, in terms of IPO survival, the role of professional expertise diversity is more pronounced compared to gender and age diversity. Therefore, IPO firms should pay less attention to the gender or age of directors in appointment decisions, but focus on the professional expertise they bring to the board. Second, board connections improve the likelihood of survival post-IPO. However, there is a substitution effect between professional expertise diversity and board connections in terms of IPO survival. Thus, IPO firms should focus on first on improving professional expertise diversity as this has a larger positive impact on the likelihood of IPO survival. Third, IPO firms with better-connected boards will benefit more in terms of survival post-IPO if they have higher levels of investment in innovation. This implies that the external contacts, information, and skills of better-connected boards are invaluable for IPO firms committed to innovation.

This rest of this chapter is organised as follows: Section 3.2 discusses the theoretical framework, prior literature, and hypotheses tested in the chapter. Section 3.3 reviews the data source, sample selection, and the methodology. Section 3.4 reports and discusses the results from the descriptive analysis, multivariate analysis, and robustness tests, while the last Section 3.5 provides a conclusion to the chapter.

3.2 Theoretical Framework, Prior Evidence and Hypotheses Development

3.2.1 Theoretical Framework

Despite the extensive information disclosed in the prospectus before listing, IPO firms are often relatively unknown to the investing community, as they have limited data for potential investors to analyse and review. With this information gap in mind, IPO firms face the "liability of newness" around the time of listing, and the quality of these firms, specifically their ability to access resources, is imperative for survival post-IPO (Perrault and McHugh 2015). At the IPO, an increase in the level of board diversity shows the ability of the firm to attract directors from different backgrounds with salient experience. Moreover, IPO firms are subject to legitimacy pressures from their business environment and structure boards to improve access to resources (Uzunca et al. 2018), resources that better-connected boards can provide. Accordingly, this chapter argues that board diversity and board connections are related with improved access to resources, and both the former and the latter influence the likelihood of survival post-IPO. We draw on the resource dependency theory to predict the potential positive relationship between board diversity, board connections, and IPO survival. The diversity theory predicts the potential negative relationship between board diversity, board connections, and IPO survival.

According to the resource dependence theory, the firm is an open system, dependent on its external environment, and board members are resources linking the firm to this external environment. Hillman et al. (2000) extend the resource dependence theory to suggest that a more diverse board represents a valuable set of resources and improves economic outcomes for the firm. The authors describe an important element of the resource dependence theory, board capital, and categorise board capital into human capital and social capital. From a human capital lens, we argue that greater board diversity provides access to unique resources potentially improving the board's advising function, decision-making, and ultimately, the likelihood of survival post-IPO. For instance, a technology IPO firm with a mix of directors of different ages will be better informed of the emerging trends in the industry than a similar firm with an older board. In such a dynamic industry, keeping up with emerging trends is imperative for survival. Likewise, female directors may bring unique experiences, such as how product presentation will influence the purchase decision-making of potential female customers, to their board that would otherwise not be available in a homogenous board.[70] Such female directors experience and differing perspectives will facilitate the IPO firm in attaining a competitive advantage in the industry, improving the survival prospects. Similarly, IPO firms in the pharmaceutical industry, with boards largely dominated by scientists or doctors, may appoint patent lawyers with experience within the industry to their boards. Such appointments improve professional expertise diversity and the firms' access to information on patents within the pharmaceutical industry, which is essential for survival post-IPO. These examples show that greater diversity in terms of age, gender and professional expertise may improve the resources available to the firm and influence the likelihood of IPO survival. Hence, in line with the resource dependence theory, we expect that greater board diversity will improve the likelihood of IPO survival.

Moving on to discuss board connections from a social capital lens, we apply the resource dependency theory to predict the potential positive relationship with IPO survival. Pfeffer and Salancik (2003) suggest that the board provides counsel, legitimacy, and communication channels for the firm. With this in mind, we argue that better-connected boards have more links to the external environment and provide IPO firms with access to invaluable contacts, information, and skills. Although better-connected boards may be busier and less effective for monitoring, Field at al. (2013) show that in IPO firms, busier directors in the boardroom use their extensive connections to provide better advice to the board.[71] Consequently, greater board connections improve the information flow to the board, which facilitates innovative critical thinking in problem-solving (Hoitash and Mkrtchyan 2021). Therefore, we argue that IPO firms with better-connected boards are better equipped for future challenges, and have increased information access that streamlines decision-making, improving the likelihood of IPO survival. Considering the resource access benefits of better-

[70] Lin et al. (2019) show that there are gender differences in online consumer purchase decision-making relating to product presentation as male and female consumers process information differently. The authors suggest that e-commerce businesses need to structure their websites to cater for the respective audience (female, male) such as when they log in, as male consumers are mostly utilitarian (shopping to get it done) while females are hedonic (shopping because they love it). Thus, connecting with potential female consumers may require an emotive shopping experience and female board members can embody this view in the decision-making process.

[71] Busy boards are boards with three or more busy directors. Busy directors are board members who have over three other connections besides their seat on the board (Field et al. 2013). Field et al. (2013) show that IPO firms with better-connected boards considered as busy have higher firm value as their external contacts and experience makes them excellent advisors and IPO firms require a more advising oriented board around the IPO.

connected boards, we expect that better-connected boards at the IPO improve the likelihood of survival post-IPO.

Next, we focus our attention on the potential negative impact of board diversity and board connections on IPO survival. Since non-survivors comprise mergers and delistings, the following discussion explains how the diversity theory predicts the impact of board diversity and board connections on the likelihood of exit post-IPO. Forbes and Milliken's (1999) diversity theory suggests that an alternative effect of diverse views in the boardroom is cognitive conflicts that may inhibit board effectiveness in the decision-making process. We propose two arguments linked to the diversity theory on cognitive conflicts and board exposure to explain why greater board diversity may result in a higher likelihood of exit post-IPO.

First, more heterogeneous perspectives reduce groupthink on the board but may increase conflicts that further slowdown the decision-making process (Rao and Tilt 2016). Board members from diverse backgrounds may require additional effort and time to communicate their differing perspectives to the board efficiently (Malenko 2014). With time constraints on decision-making, such differing perspectives in the boardroom may require further deliberations that are detrimental to board effectiveness in the decision-making process. Charitou et al. (2007) show that firms with less effective boards are more likely to be involved in delistings.[72] Put together, greater cognitive conflicts may result in a less effective board in decision-making, consequently resulting in a higher likelihood of exit through delisting post-IPO. Therefore, we argue that greater board diversity increases the likelihood of exit post-IPO.

Second, the range of diverse backgrounds and perspectives now available to the firm from greater board diversity may also serve as a potential gateway for exit post-IPO through a merger. For example, Bachmann and Spiropoulos (2021) show that target firms with female board representation are more likely to be selected by bidders with gender diversity for acquisition transactions. The authors mention that these findings support the idea that diversity in the boardroom, which can influence the success of post-acquisition integration, is considered in selecting target firms. Thus, IPO firms with greater board diversity may be more attractive as potential acquisition targets. Accordingly, we expect that greater board diversity at the IPO increases the likelihood of exit through a merger by year 5 post-IPO.

Following from the preceding discussion, the diversity theory also predicts the negative relationship between board connections and IPO survival. We propose two arguments linked

[72] Charitou et al. (2007) define board effectiveness based on board independence, board size and board meeting frequency. In this vein, firms with low board independence, smaller size and low board meeting frequency are more likely to be involved in delistings from the New York Stock Exchange.

to the diversity theory on board busyness and board exposure to explain why greater board connections in IPO firms may result in a higher likelihood of exit post-IPO. We have argued that greater board connections improve the information flow to the firm from the external environment. However, greater board connections may also result in boards with busier directors that are less effective monitors and as such, are related with weak corporate governance (Fich and Shivdasani 2012). Busy boards have directors that are more experienced, better-connected, and therefore better positioned, but such boards are unable to devote enough time and attention to decision-making. Prior literature has linked busy boards to lower firm performance and greater earnings management, with evidence suggesting that the latter increases the likelihood of exit through delisting post-IPO.[73] In this vein, we expect that IPO firms with greater board connections which alludes to busier boards have a higher likelihood of exit post-IPO.

Finally, we argue that IPO firms with better-connected boards may use their extensive external contacts to introduce the firm to a new customer base, improving the firms' visibility, and inherently exposing the firm as a potential acquisition target. Ishii and Xuan (2014) show that acquisitions are more likely to take place if board members of the target firm are connected to the board of the bidder. The authors argue that such board connections lead to a heightened sense of trust between firms introducing a familiarity bias in terms of decision-making. Thus, IPO firms with better-connected boards may be more exposed as potential acquisition targets and the consequence is a higher likelihood of exit through a merger post-IPO. Accordingly, we propose that greater board connections will increase the likelihood exit post-IPO, consistent with the diversity theory.

To sum up, this section has discussed the potential positive and negative effects of board diversity and board connections on IPO survival in line with the resource dependency and diversity theories. The theoretical framework for all the hypotheses is shown below in Figure 3.1. The following section discusses prior literature and develops the two competing hypotheses for the impact of board diversity and board connections on IPO survival.

[Insert Figure 3.1 about here]

[73] Cashman et al. (2012) find that busy boards negatively impact firm value while Fich and Shivdasani (2012) suggest that firms with busy boards have lower firm performance compared to their counterparts without busy boards. Furthermore, Ferris and Liao (2019) show that firms with busy boards are more likely to engage in earnings management while Anagnostopoulou et al. (2021) links earnings management in IPO firms to a higher likelihood of delisting post-IPO.

3.2.2 Empirical Evidence and Hypotheses Development

Board Diversity and Firm Outcomes

To the best of our knowledge, there is no prior literature directly analysing the potential relationship between board diversity and IPO survival. Nevertheless, a myriad of studies focus on the impact of board diversity on various firm outcomes, as director heterogeneity in the boardroom plays a key role in board functioning. The bulk of this literature relates to mature listed firms, while there are only a few studies on IPOs. As such, the following discussion first focuses on the literature for mature listed firms relating to board diversity more broadly and the impact of gender, age, and professional expertise diversity on various firm outcomes. Next, we discuss the IPO literature on the impact of board diversity on firm outcomes in IPO firms. Finally, we develop the hypotheses drawing on the resource dependency theory and diversity theory discussed in the theoretical framework.

Anderson et al. (2011) analyse the impact of board diversity on firm value by combining six dimensions of board diversity (education, experience, profession, gender, age, ethnicity). Their findings show that board diversity improves firm value. In detail, the measures relating to occupational diversity (education, experience, and profession) have a 50% greater effect on firm value as measured by Tobin's Q compared to the demographic diversity measures (gender, age, ethnicity). Upadhyay and Zeng (2014) examine the impact of board diversity – by combining gender and ethnicity in the boardroom – on the corporate information environment. The authors find that an increase in their diversity index promotes accountability, improves the firm's access to quality information, reduces the firm's cost of capital, and facilitates information dissemination as diverse boards are more transparent. Therefore, board diversity positively influences various aspects of the firm such as firm value, accountability, and the cost of capital, which ultimately influences the survival prospects of the firm.[74]

On a more granular level, extant literature on gender diversity focuses on mature US firms and refers to the impact on financial performance and firm risk (Adams and Ferreira 2009; Miller and Triana 2009; Sila et al. 2016). Although the findings from these studies show mixed results, there is evidence suggesting that female directors improve investment in innovation through R&D expenditure and the monitoring function of the board, compared to their male counterparts. A growing body of literature shows that increasing gender diversity is

[74] A limitation from these studies is that board diversity is measured as an index and thus, all types of diversity are viewed as having an equal impact on firm outcomes which is not the case. Though our focus is on the impact of board diversity, we analyse each of our measures of diversity separately to adequately capture the impact of each measure of board diversity on IPO survival.

related with a greater perception of quality for listed firms. In a qualitative study, Perrault (2015) finds evidence that gender diversity enhances perceptions of the board's moral, instrumental, and relational legitimacy. The authors mention that a consequence of greater gender diversity is an improved perception of the board's trustworthiness, which fosters shareholders' trust in the firm. Female board representation has been linked to the social values of the firm and symbolises career possibilities for prospective female directors (Hillman et al. 2007). Firms with female directors have a higher level of accountability toward shareholders (Tremblay et al. 2016) and are more sensitive to ethical and environmental issues, which improves the transparency and legitimacy of the firm. In terms of risk, gender diversity reduces the level of risk-taking in the firm, as female directors are more risk averse than their male counterparts (Perryman et al. 2016; Bernille et al. 2018). So far, these studies suggest that the benefits of the resources provided by greater female board representation relate to improved board monitoring, firm innovation, greater sustainability, transparency, accountability, and reduced risk-taking. We argue that these outcomes influence the survival prospects of the firm.

The literature on age diversity in mature firms is relatively scarce. The age of directors reflects their experience and cognitive abilities and prior literature links directors' age to their behaviour in the boardroom. Age diversity is related with improved financial performance (Ararat et al. 2015). Similar to gender diversity, there is evidence that firms with greater age diversity are also more sensitive to ethical and environmental issues and are more likely to improve sustainable practices in the firm (Post et al. 2011). Considering the increasing global movement towards more sustainable practices, such actions by a firm will improve the perceived quality of the firm, and inherently firm value (Griffin and Sun 2013). Accordingly, the literature suggests that age diversity is related with better firm performance and more sustainable firm practices, which ultimately influences the survival prospect of the firm.

Next, we focus on professional expertise diversity for which, to the best of our knowledge, there is limited research. Prior studies examine specific types of professional expertise and the impact on board committee appointments, debt capital, firm value, and financial performance. These studies include the role of accounting expertise in audit committees (Aldamen et al. 2012), the impact of banking expertise on debt capital (Güner et al. 2008), and the impact of financial expertise on appointment announcements (Davidson et al. 2004). Gray and Nowland (2017) is the first study to analyse different board professional expertise in mature firms and their impact on firm value and performance. The professional expertise categories in their study includes executives, accountants, bankers, lawyers, scientists, engineers, consultants, politicians, outside CEOs, academics, and medical doctors.

The authors' findings show that there is a positive relationship between professional expertise diversity and firm value, specifically when boards diversify their expertise within a subset of specialist professional expertise.[75]

The preceding discussion provides a coherent set of arguments supporting the view that board diversity in mature firms is related with improved firm value, performance, greater accountability, increased access to quality information, more sustainable practices, greater transparency, and less risk-taking. We argue that all these outcomes influence the survival prospects of the firm and may apply to IPO firms.

Moving forward, we discuss the IPO literature on the impact of board diversity on IPO firm outcomes. Prior literature on gender diversity only focuses on top management teams rather than the board of directors. Welbourne et al. (2007) show that the presence of females in top management teams of US IPO firms has a positive impact on firm value, as measured by Tobin's Q. Similarly, international evidence from McGuinness (2018) shows that females in top management teams are beneficial for stock performance post-IPO. Although the IPO studies relating to diversity do not focus on the board, they allude to improved firm value and financial performance post-IPO, which influence the likelihood of IPO survival.

To the best of our knowledge, there is no US evidence on age diversity in IPO firms. However, we expect that board members will be younger in age compared to mature listed firms, as these are entrepreneurial firms. Regarding professional expertise diversity in IPO firms, there is no evidence to the best of our knowledge of a relationship with firm outcomes. Nevertheless, Gounopoulos et al. (2020) show that IPO firms with financial expert CEOs have longer survival times post-IPO. The authors attribute their findings to the better access of CEOs with financial expertise to the equity market that contribute to shareholder value creation. These results indicate that aspects of professional expertise such as financial expertise improve IPO survival. In an extension of these findings, we expect that IPO firms with greater professional expertise diversity will have a range of expertise that contributes to shareholder value and consequently improves the likelihood of survival post-IPO.

Development of Hypotheses on Board Diversity and IPO Survival

Taken together, the literature discussed in the previous section suggests that firms with a diverse board are perceived to have better governance structures due to more active

[75] This subset relates to directors with professional expertise as lawyers, accountants, bankers, consultants and outside CEOs and the authors find evidence that, beyond this subset, firms experience a decline in firm value and performance.

monitoring, advising, innovation, sustainable practices, transparency, and accountability which improves the quality of the firm post-IPO. In terms of firm outcomes, the evidence also shows that board diversity improves firm value, firm performance and reduces risk-taking, which ultimately improves the likelihood of IPO survival. For IPO firms, stock market regulation, financial compliance rules, and accounting regulations are more complex compared to the requirements for private firms. Therefore, greater board diversity around the IPO improves access to salient resources through board members' experience and knowledge to interpret the relevant laws and regulations, ensuring the firm's compliance and survival post-IPO. Consistent with the resource dependence theory, we expect that greater board diversity at the IPO improves the likelihood of survival post-IPO. We develop the following hypothesis.

H1a. *IPO firms with greater board diversity at the time of listing are more likely to remain listed as independent entities by year 5 post-IPO.*

Consistent with the prior evidence for the negative impact of board diversity on firm outcomes, we develop a competing hypothesis suggesting that board diversity may also negatively influence the likelihood of survival post-IPO. As per the diversity theory, we argue that board diversity may be detrimental to survival until year 5 post-IPO. The premise lies in the notion that an increase in heterogenous perspectives results in cognitive conflicts and a more complex decision-making process. Consequently, a more diverse board may face a slower decision-making process causing the firm to miss time sensitive opportunities (Baranchuk and Dybvig 2009), damaging the firm's survival prospects post-IPO. For example, Adams and Ferreira (2009) show that greater gender diversity improves board monitoring, but the former negatively influences firm performance. We argue that with tougher monitors on the board due to greater diversity, decision-making processes are inherently slower, leading to negative firm outcomes. Ali et al. (2014) find evidence suggesting that greater age diversity is detrimental to firm performance.[76] The authors argue that although age diversity brings valuable differing perspectives to the board, at higher levels, age differences in the boardroom results in potential conflicts during decision-making. Therefore, we expect that greater board diversity increases the potential for cognitive conflicts in the boardroom and the outcomes of such conflicts damage the firm's survival prospects.

Although firms involved in acquisitions are not failures from the shareholders perspective, Erel et al. (2015) show that these firms may be financially constrained prior to

[76] To the best of our knowledge, there is no prior evidence suggesting a negative relationship between professional expertise diversity and firm performance.

acquisition, leading us to categorise mergers as non-survivors. In this vein, IPO firms that are involved in mergers post-IPO exit and are no longer surviving as the same independent entities. To this end, we argue that greater board diversity will result in an increased pool of directors with experience in acquisition transactions who may provide guidance on how the IPO firm may become an attractive target for acquisition. Bachmann and Spiropoulos (2021) find evidence that target firms with female board representation are more likely to be selected as acquisition interests for bidders with gender diversity in the boardroom. Thus, we expect that greater board diversity at the IPO will increase the likelihood of exit in the post-IPO period. We develop the competing hypothesis.

H1b. *IPO firms with greater board diversity at the time of listing are more likely to be involved in an exit by year 5 post-IPO.*

Board Connections and IPO Survival

There is a broad literature emphasising the benefits of better-connected boards. Coles et al. (2020) show that better-connected directors improve the board's advising role as they are mostly assigned to advising committees, implying that better-connected boards perform a better advising function.[77] Better-connected boards provide resources through their wealth of information on key market data, including regulatory changes, market conditions and industry trends resulting in a comparative advantage in strategic decision-making (Larcker et al. 2013). Larcker et al. (2013) also show that US mature listed firms with better-connected boards have a 5% higher average annual risk-adjusted return compared to other firms without such connections.[78] Nicholson et al. (2004) mention that firms may leverage relationships from board connections and gain new referrals for business relationships (e.g., clients, suppliers) or other economic benefits and resource exchange (e.g., personal and political favours). This reduces asymmetric information in designing collaboration contracts between firms. Moreover, better-connected boards are more likely to learn about effective corporate governance mechanisms, efficiency enhancing technology, and innovative compensation structures

[77] In Coles et al. (2020), advising committees include finance, investment, acquisitions, planning, strategic, executive, risk advisory, budget, environmental, corporate social responsibility (CSR) and compliance committees.

[78] According to Larcker et al. (2013), well-connectedness is multidimensional and refers to the degree of connectedness, the closeness of connectedness and the betweenness. Larcker et al. (2013) define the degree as the number of first-degree links to outside boards. Closeness represents how easily or quickly a board can reach an outside board through interlocking directorates. It is defined as the inverse of the average distance between a board and any other board. Betweenness is defined to be the average proportion of paths between two outside boards on which a board lies.

through the board's network (Renneboog and Zhao 2011). In this vein, better-connected boards expand business relationships that improve the firm's access to information, facilitating better decision-making and firm growth. Therefore, we expect that better-connected boards improve the firm's access to resources that influence the growth of the firm and ultimately, its survival.

For the case of IPOs, prospective investors face great uncertainty as these firms are new to the stock market with little financial disclosure prior to listing. Lui et al. (2014b) mention that although investment in IPOs is "attractive", some investors may never invest if they are not well informed or there is a high cost of information acquisition. However, if these potential investors are connected to the firm's directors, they may be more likely to pay attention to the IPO firm and acquire the requisite information for making their investment decision. We argue that board connections improve the image and trustworthiness of the IPO firm, consequently attracting potential investors' attention. Feng et al. (2019) show that better-connected boards have higher IPO market valuation and first-day returns, more positive offer price revisions, and superior post-IPO stock performance. The authors also show that IPO firms with better-connected boards have more pre-IPO media coverage, and argue that these influence perceptions of the firm's quality and ultimately, the ability to attract potential investors.[79] Field et al. (2013) show that busy boards improve the board's advising ability and are beneficial for firm value at the IPO.[80]

Put together, these studies suggest that better-connected boards improve the board's advising function, provide referrals for new business relationships, provide guidance on corporate strategies, facilitate information acquisition, and improve IPO performance. We argue that board connections equip IPO firms with resources that streamline decision-making processes and improve the likelihood of IPO survival. Consistent with the resource dependency theory, we develop the next hypothesis.

***H2a**. IPO firms with better-connected boards at the time of listing are more likely to survive as independent entities until year 5 post-IPO.*

Finally, we focus on the hypothesis for the negative impact of board connections on IPO survival in line with the diversity theory. Since non-survivors comprise mergers and delistings, the following discussion explains why we expect that IPO firms with better-

[79] Feng et al. (2019) measures board connections as the average of the board connections for all directors in the boardroom.

[80] Busy boards are boards with at least half of the board identified as having busy directors. Busy director is an indicator equal to one if a director serves on three or more boards, including IPO firm's board. Busy board indicator equal to one if at least half the directors are busy.

connected boards have a higher likelihood of exit post-IPO. The rationale consistent with the diversity theory suggest that better-connected boards are typically busier and thus less effective in decision-making. Firms with busy board have been related with lower firm value (Cashman et al. 2012) and lower firm performance (Fich and Shivdasani 2012). Furthermore, Ferris and Liao (2019) shows that busy boards have a higher likelihood of engaging in earnings management, and the latter is linked to a higher likelihood of delisting post-IPO (Anagnostopoulou et al. 2021). To sum up, busier boards negatively impact firm value and performance, and are more likely to engage in earnings management, that increases the likelihood of exit post-IPO. Thus, we expect that better-connected boards which are inherently busier are more likely to exit by year 5 post-IPO.

Another argument consistent with the diversity theory is that better-connected boards are more exposed to the external environment, and as such, may be potential acquisition targets, likely to exit by year 5 post-IPO. There is a broad stream of literature showing that board connections facilitate merger and acquisition transactions. However, most of these studies focus on the benefits of board connections from the bidder's perspective (Renneboog and Zhao 2014; Tao et al. 2019).[81] Ishii and Xuan (2014) study the impact of acquirer and target board connections on merger outcomes. The authors show that acquisitions are more likely to be completed between firms with connected boards. However, such acquisitions are more likely to be a divestiture due to a loss on the sale or unsatisfactory performance related to the assets acquired. Ishii and Xuan (2014) argue that board connections increase trust between firms introducing a familiarity bias in terms of decision-making. Thus, IPO firms with better-connected boards may increase the firm's exposure as a potential acquisition target and create a familiarity bias due to a heightened sense of trust. The consequence of such board connections may be a higher likelihood of exit through a merger post-IPO. This implies that better-connected boards at the IPO increase the likelihood of exit post-IPO. Accordingly, we develop the competing hypothesis for board connections.

H2b. *IPO firms with better-connected boards at the time of listing are more likely to be involved in an exit by year 5 post-IPO.*

[81] Renneboog and Zhao (2014) find supporting evidence that aside from connected directors in target firms, other directors in the target firm not connected to the bidder are more likely to be invited to the board of the combined firm. Renneboog and Zhao (2014) also show that connected boards more likely to complete takeover transactions. Tao et al. (2019) focus on the Chinese capital market and show that greater board network centrality is related to lower acquirer stock returns. Since 97% of IPO firms in our sample that exit through a merger post-IPO are targets, we focus on Ishii and Xuan (2014) that examines the impact of board connections from a target's perspective.

3.3 Methodology

3.3.1 Sample Selection and Data Sources

The sample period starts from 1st January 1997 and tracks IPO firms until 31st December 2019 to determine whether the 661 randomly selected IPO firms are survivors or non-survivors. The start date of the sample period is influenced by data availability in the SEC's Edgar database, while the end date allows the researcher to track the 5 years in the post-IPO survival window. As the minimum survival window is 5 years post-IPO, the final sample of IPO covers the period from 1st January 1997 to 31st December 2015. Similar to Chapter 2, we derive the initial sample of 2,641 IPOs following Boone et al. (2007) and Chahine and Goergen (2011) from the population of 5,222 IPO firms.[82] We randomly select the final sample of 661 IPO firms, which amounts to 25% of the initial sample. Director-level and firm-level data is manually collected from the offering prospectuses for the pre-IPO year and the IPO year, while data for years 1 to 5 and 10 post-IPO are obtained from the proxy statements. The Center for Research in Security Prices (CRSP) database provides data on IPO survival, while the Compustat database is the source of IPO financial data included in this chapter.

3.3.2 Methodological Choices

Logit and Multinomial Logit Regressions

This section discusses the methodologies used to analyse the relationship between board diversity, board connections, and the likelihood of survival post-IPO. With the focus of this chapter on the likelihood of IPO survival, we estimate logit regressions as the binary dependent variable (i.e., 0 or 1) predicts the conditional probability of IPO survival to year 5 post-IPO.[83] Notably, the coefficients generated from the logit are not as informative for interpretation since they measure the changes in the log odds that the dependent variable equals one, for one-unit increase in the independent variable.[84] Therefore, we report the marginal effects for the logit which estimates the amount of change in the dependent variable (IPO

[82] From the population of 5,222 IPOs, we excluded the following firms: American Depository Receipts (ADRs), Real Estate Investment Trusts (REITs), unit offerings, spin-offs, carve-outs, closed-end funds, financial firms with Standard Industrial Classification codes (SIC) codes 6000-6799, and IPOs with an offer price below \$5. This leads us to the initial sample of 2,641 firms from which we randomly select the final sample.

[83] Logit regressions are based on the cumulative probability function and estimated through the maximum likelihood method and predict the probability that (Hosmer and Lemeshow 1989). An alternative regression to the logit regression is the probit regression. Although the logit regression estimates probability using the natural log of the odds ratio and the probit regression uses the inverse standard normal distribution; in practise, both regressions arrive at similar conclusions.

[84] In the OLS, the regression coefficients is interpreted as the change in the expected value of the dependent variable, attributed to a one-unit increase in the independent variable.

survival) related with a one-unit change in the independent variables (measures of board diversity and board connections), while other variables are held constant.

IPO survival up to year 5 is based on two categories in the logit regressions, survivors, and non-survivors. Survivors is a dummy variable that takes a value of one if an IPO firm survived to year 5 post-IPO or the last year of the sample period, and zero otherwise (Feng et al. 2020).[85] Model 3.1 tests the validity of the four hypotheses proposed in Section 3.2 by estimating the following logit regression:

$$IPO\ Survival_{i,t} = \beta_0 + \beta_1 Board\ Diversity_{i,x} + \beta_2 Board\ Connections_{i,x} + \sum_{n=3}^{6} \beta_n\ Firm\ Characteristics_{i,x} + + \sum_{n=7}^{15} \beta_n\ Board\ Characteristics_{i,x} + \sum_{n=16}^{18} \beta_n\ IPO\ Characteristics_{i,x} + Industry\ Dummies + Year\ Dummies\ + \varepsilon_{i,x} \quad (3.1)$$

t relates to the year 5 post-IPO, x relates to the IPO year, while i is the firm.

- The dependent variable*, IPO Survival* takes a value of one in the logit regression if the IPO firm is categorised as a survivor up to year 5 and zero otherwise.[86]

The independent variables relate to the measures of board diversity and board connections and are defined below.

- *Gender diversity* is the percentage of females in the boardroom (Adams and Ferreira 2009; Sila et al. 2016).
- *Age diversity* is the standard deviation of the board's age divided by the mean age of the board (standard deviation of board age/mean of board age). Larger standard deviation (larger age differences between board members) and lower mean age (higher representation of young board members) generate higher age diversity values. High scores indicate greater age diversity (Ali et al. 2014).
- *Professional expertise diversity* is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on the board. Board expert categories are based on the fourteen expert categories as suggested by Gray and Nowland (2017). They are, academic, accountant, banker, consultant, dentist, doctor, engineer, executive, finance expert, IT expert, investment professional, lawyer, scientist, and politician.[87] The Blau index, which equally accounts for the differences in these expert categories, is calculated as follows:

[85] There are 23 firms involved in IPOs less than 5 years ago but surviving up to year 4 post-IPO, which are included as survivors in the sample. We test the robustness of our results by excluding these 23 firms from the sample and our findings are upheld in all specifications. See further details in Section 3.4.3.
[86] We test the robustness of our results by measuring IPO survival up to year 10 post-IPO see Section 3.4.3
[87] As part of the descriptive statistics in the results sections, we examine the impact of the individual expert categories on IPO survival to check whether our main analysis should focus on expert groups individually or as an index.

$$Blau\ Index\ (Professional\ Expertise) = 1 - \sum_{i=1}^{n} P_i^2 \quad (3.2)$$

Where Pi is the proportion of directors in each of the i (expert) categories.[88] High scores indicate higher professional expertise diversity.

- *Board connections* is the average number of prior and current board appointments of the board in each year. This definition of board connections is consistent with Feng et al. (2019) who refer to board connections as the degree of connectedness for the board. We focus on the average board connections rather than the sum, as the latter is a noisy measure of board connections due to interlocking directorships. About 18% of directorships within the sample possess interlocking memberships. Thus, taking the sum of board connections inflates the value of board connections.[89]

In accordance with prior literature, we control for firm characteristics including firm age, firm size, leverage, risk, return on assets, R&D intensity, and asset tangibility (Espenlaub et al. 2012). Board and CEO characteristics linked to IPO survival in previous studies are also included as control variables. These are, board size, board independence, board voting share ownership, CEO financial expertise, CEO tenure, founder CEO, CEO duality and venture capitalist board representation (Fischer and Pollock 2004; Jain and Tabak 2008; Gounopoulos et al. 2020). Considering the focus of this chapter on IPO survival, we also control for IPO characteristics highlighted in the literature, including IPO underpricing, IPO premium (Cirillo et al. 2017; Gounopoulos et al. 2020).[90] All variables are defined in Appendix 3.1.

We acknowledge that the classification of survivors and non-survivors in the logit regression is rigid, as IPO firms involved in a merger post-IPO are classified as non-survivors, which has a negative implication.[91] In this vein, the multinomial logit regression improves on

[88] Each board member is classified into one expertise category based on prior experience as shown in the prospectus. Expertise is classified based on the work experience of the director. For example, if a director has more than one expertise such as, with a chartered accounting qualification, is a Juris Doctor in Law but has served on the board of several pharmaceutical companies, we classify such director to hold executive expertise as this is their primary expertise which is largely board based. This method of classification is follows Gray and Nowland (2017).

[89] An alternative route to computing the board connections through unique connections of board members. However, this information is not available in our dataset.

[90] We also control for offer size and underwriters' prestige consistent with prior literature in the robustness section. However, these variables are excluded from the main results due to high correlation between the firm size and offer size, and 29% of the sample missing values for underwriters' prestige. Qualitatively similar results are obtained if we control for these additional IPO characteristics.

[91] We explore other definitions of survivors that include mergers as censored survivors if they rank above the median for four performance based measures consistent with Espenlaub et al. (2012). The four performance measures are cash to total assets, operating income total assets, total liabilities to total assets and current assets to current liabilities. Based on this classification, there are 17 mergers classified as censored survivors and included in the group of survivors. The results using this classification are similar to the main results and reported in Appendices 3.6 and 3.7.

the logit by differentiating between the types of exit. There are two potential reasons for differentiating between the types of exit. First, IPO firms that exit through mergers continue to operate, although not as independent entities, as survivors. Hence, from a shareholder's perspective, mergers are different to delisting. Second, IPO firms' involvement in delistings is detrimental to the directors' reputation and subsequent career prospects compared to mergers (Gomulya et al. 2019). Therefore, we decompose IPO survival into three categories, survivors, and differentiate non-survivors who are involved in mergers from delistings.

The multinomial logit regression estimates the respective conditional probabilities of board diversity and board connections influencing IPO survival for each pair of the IPO survival categories. IPO survival is defined based on survivors as in the logit regression and two-subcategories of non-survivors- mergers and delistings consistent with Jain and Kini (2000). Mergers are firms that have been involved in a merger or are acquired after listing and lose their identity as independent entities post-IPO.[92] Delistings are firms that do not survive as independent entities after the IPO and exit the sample regardless of the reasons for delisting. There are several reasons for delisting highlighted in CRSP, such as price fell below acceptable level, insufficient capital or assets, company request, corporate governance violation, delisting by the SEC and bankruptcy. There are 20 firms in our sample delisted due to bankruptcy during the sample period. However, we do not differentiate between bankruptcies and the other reasons for delisting even though the former is more severe, due to the small number of bankruptcies in the sample. The multinomial logit reports the probability of a firm being involved in merger compared to survivors or the probability of the firm delisting compared to survivors based on the measures of board diversity and board connections. This differs from estimating a series of logit regressions, as each regression will then be based on a different sample. Model 3.3 specifies how the conditional probability for variable comparing two groups (mergers to survivors; delistings to survivors; mergers to delistings) in the multinomial logit is computed.

$$Pr(IPO\ Survival = m|z) = \frac{exp(z\beta_{m|b})}{\sum_{k=1}^{k} exp(z\beta_{k|b})} \quad \text{for } m\text{=1 to } k \text{ groups} \qquad (3.3)$$

IPO survival in the multinomial logit regression takes a value of one if the IPO firm is a survivor, two if the IPO firm is involved in a merger, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. β is the vector of regression coefficients, *b* is the comparison group also known as the 'base' group , *k* refers to the number of groups while

[92] There are 236 firms involved in a merger by year 5 post-IPO. Data obtained from Edgar suggests that 97% of these firms are targets while only 3% are bidders.

z relates to the independent variables in the multinomial logit regressions introduced above in Model 3.1.

The limitations of both the logit and multinomial logit regressions is that in predicting the likelihood of the event occurring (survival, merger, or delisting), neither indicates the timing of this event. Hence, these regressions do not differentiate between firms that exit the sample after 1 year of listing from those that exit within 5 years. We argue that an analysis estimating the timing of the event provides further context for understanding the impact of our primary variables of interest on the likelihood of survival post-IPO. To address this issue, we estimate survival analysis models in semi-parametric, and parametric forms. The Cox proportional hazard (Cox) model is used to analyse the impact of board diversity and board connections on the survival time to year 5 post-IPO. We also estimate the accelerated failure time (AFT) model, which has been identified as a good alternative to the Cox model (Saikia and Barman 2017), in estimating the time to failure. The Cox (semi-parametric) and AFT (parametric) models are discussed in the following sections.

Survival Analysis Methodology: Cox Proportional Hazard Model

The Cox model does not directly test any of our hypotheses, but the focus of this model on duration offers an interesting perspective to this chapter beyond the logit and multinomial logit regressions. The latter predicts the likelihood of the event (survival, merger, or delisting) occurring, while the Cox model indicates the timing of this event. The advantage of the Cox model over the logit and multinomial logit regressions lie in its ability to account for time, and censored observations (LeClere 2000; Shumway 2001). We estimate the Cox model to assess the extent to which board diversity and board connections explain the timing and occurrence of exit from the sample post-IPO. The Cox model is beneficial, as it estimates the hazard ratio relating to the time of exit and evaluates right-censored observations.[93] Right-censored observations are IPOs that are still listed on 31st December 2019, did not experience the event-exit-whether through a merger or delisting, and are included in estimating the survival model. We specify the following Cox model to study IPO survival for firm i in year t as shown in model 3.4.

$$h_i(t, X_t) = h_0(t)e\big(X_{i,t}\beta\big) \tag{3.4}$$

[93] The Cox model is a combination of the hazard model and maximum partial likelihood estimation and imposes fewer restrictions compared to the AFT model since the assumption of this model is that the shape of the hazard function is unknown (Zhang 2016).

$h_0(t)$ is the baseline hazard function and reflects how the hazard function changes with survival time, while *t* is the time to exit (i.e., the duration in years to the date of exit from the sample through a merger or delisting). $e(X_{i,t}\beta)$ characterises how the hazard function changes with independent variables such that when X_t changes from X_0 to X_1 , the hazard ratio is computed in model 3.5 as follows:

$$h_i(t, X_1, X_0) = \frac{h_0(t)\ e(X_1\beta_1)}{h_0(t)\ e(X_0\beta_0)} = e^{\beta(X_1 - X_0)} \quad (3.5)$$

The hazard ratio is computed as the exponentiated coefficient for each independent variable, and it measures the increase in event risk for a one-unit increase in the value of the independent variable. If the hazard ratio is above one, then an increase in the covariate results in a corresponding increase in the failure rate and a decrease in survival time. For example, a hazard ratio of 1.2 for the gender diversity indicates that firms that increase female board representation at the IPO by 1% have a 20% decrease in survival time to year 5 post-IPO (i.e., they are less likely to survive up to year 5). A hazard ratio less than one indicates that an increase in the covariate decreases the failure rate and increases survival time.

Survival Analysis Methodology: Accelerated Failure Time Model

The AFT model is an alternative to the Cox model for survival time analysis. The AFT model assumes that the effect of the covariates (independent variables) accelerates the time to failure. This model estimates the direct effect of the covariates on survival time by a constant (acceleration) factor, which is a yearly time scale in this chapter. The AFT model is commonly expressed as a log-linear function regarding survival time (Bradburn et al. 2003) as follows:

$$Ln(T_j) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + \varepsilon_j \quad (3.6)$$

$Ln(T_j)$ is the natural log of the time to failure, $\beta_0 \ldots \beta_p$ are the parameters to be estimated, $X_1 \ldots X_p$ are covariates (independent variables) and ε_j is the error term with a specific distribution form which determines the regression model. As a parametric model, AFT requires specific underlying distribution which could be the exponential, weibull, lognormal or log logistic. We estimate the AFT model using all distributions and compare the Akaike's Information Criterion (AIC) statistics to determine which distribution is best for the AFT model. The AIC criterion is used to differentiate between non-nested parametric models (Allison 2010) and the distribution with the lowest AIC is the most appropriate model to specify the AFT model. The AIC value for the exponential distribution is 1478.38, for the weibull distribution, 1366.74, for the lognormal distribution,1371.72, and the log logistic distribution is 1387.81. Hence, the AFT model is estimated with the weibull distribution. Exponentiated coefficients called time ratios measure the marginal effect of the covariates in the AFT model. A time ratio greater than one indicates a shorter time to failure, while a time ratio less than one shows a longer time to failure. The results for the AFT model are discussed in Section 3.4.3 of this chapter. Next, we discuss the results for the descriptive statistics and univariate analysis and the main results in the logit and multinomial logit regressions.

3.4 Results

3.4.1 Descriptive Statistics and Univariate Analysis

Table 3.1 reports the IPO survivorship analysis for our sample. Panel A shows that about 46% of listed firms have survived until year 5 post-IPO while about 44% survived to year 10 post-IPO. These survival rates are congruent with other US IPO survival studies that partially cover our sample period between 1/1/1997 and 31/12/2019.[94] Panel B shows further details on survival in the post-IPO period by grouping firms into survivors, mergers, and delistings. Out of the 54% that exit the sample up to year 5 post-IPO, about 36% exit through a merger and the remaining 18% of firms are involved in delisting. The industry classification and survival rates to year 5 post-IPO are reported in Panel C. The industry with the largest IPO rate in the sample, the business equipment industry (34%) is ranked 8th out of the 11 industries in terms of survival rates.[95] This is unsurprising, as Bach and Smith (2007) show that firms in the technology industry are less likely to survive post-IPO due to the dynamic nature of the industry and may be involved in post-IPO acquisition transactions. The oil, gas, coal extraction and products, chemical and allied products, and healthcare industry have the highest survival rates by year 5 post-IPO of about 69%, 67% and 55% respectively. These survival rates are not unlike what is observed in Gounopoulos and Pham (2018) and are attributed to the capital-intensive nature of these industries, showing that such IPOs have a higher percentage of fixed assets.

Overall, the results from Table 3.1 show that the distribution of IPOs is sufficiently balanced between survivors and non-survivors to test the hypotheses. Furthermore, the results

[94] For example, Kooli and Meknassi (2007) find that 55% of US IPO firms listed between 1985 and 2005 survived to year 5 post-IPO. This proportion is slightly higher (63% and 65%) in the studies conducted by Gounopoulos and Pham (2018) and Gounopoulos et al. (2020) between 1999 and 2009 and 1999 and 2012, respectively. Hence, these survival rates are comparable with our study. Furthermore, 23 firms out of the 304 survivors in our study are involved in an IPO less than 5 years. However, these first survive up to year 4 post-IPO and therefore are included as survivors in the sample. We obtain similar results in the main analysis when these 23 firms are excluded from the sample.

[95] Untabulated statistics show that about 42% of IPOs in the business equipment industry survive while 44% are involved in mergers and 13% are involved in delistings by year 5 post-IPO.

in Table 3.1 also suggest that some industries (oil, gas, coal extraction and products, chemical and allied products, and healthcare industry) are more likely to survive as independent entities compared to other industries (business equipment). These results demonstrate the importance of accounting for industry classification in the main regression analyses.

[Insert Table 3.1 about here]

Table 3.2 reports the results for the descriptive statistics and univariate analysis for the sample. We test the hypotheses developed in Section 2.2 on the relationship between board diversity, board connections, and IPO survival in a univariate setting. The mean and median values for board diversity, board connections, and all control variables at the IPO are compared for survivors and non-survivors to year 5 post-IPO. The t-test and the Wilcoxon rank-sum test are used to test the mean and median differences accordingly, and these results are reported in the first two columns of Table 3.2.

Panel A shows that at the IPO, survivors have on average 5% female board representation compared to the 6% mean value on the board of non-survivors and the difference between both groups is insignificant. Furthermore, the median values of zero gender diversity indicate that at least half of the sample have no female directors on their boards at the IPO. These results suggest that gender diversity at the IPO is low in the boardroom and has an insignificant mean and median difference between survivors and non-survivors to year 5 post-IPO. For age diversity at the IPO, survivors have a slightly higher average of 0.176 compared to a mean of 0.175 for the non-survivors. Thus, survivors have marginally younger boards than non-survivors, although the mean difference is insignificant. The median values for age diversity are similar to the mean values for both groups, indicating that age diversity follows a normal distribution, and the impact of outliers in analysis is minimal. Accordingly, we do not find support for the argument that age diversity influences survival of IPO firms up to year 5 in a univariate setting. Next, we focus on professional expertise diversity. Panel A of Table 3.2 reports that survivors have higher mean values at 0.522 compared to the average value of 0.484 for non-survivors. The difference between these groups is significant at the 1% level. The median values of survivors and non-survivors are slightly higher than the mean values indicating that there are some outlier firms with low professional expertise diversity. To sum up the univariate results for board diversity, we find support for H1a regarding professional expertise diversity alone. This suggests that IPO firms with greater professional expertise diversity at the IPO are more likely to survive as independent entities to year 5 post-IPO. In terms of board connections in Panel A of Table 3.2, we find that survivors have higher mean values of 1.943 compared to non-survivors with 1.507. The difference between both groups is significant at the 1% level. An analysis of the median values for board connections also reveal that survivors are better-connected compared to non-survivors. Hence, we find support for H2a that firms with better-connected boards at the IPO are more likely to survive to year 5 post-IPO.

Next, we discuss the results in Panel B of Table 3.2, comparing the firm characteristics at the IPO for survivors and non-survivors in the sample. We find that IPO firms larger in size and investing more in innovation through R&D intensity are more likely to survive to year 5 post-IPO. The difference in the mean and median values for survivors and non-survivors in these results are significant at the 1% level. Consistent with prior literature, our findings indicate that larger IPOs and IPOs with higher investment in innovation are more likely to survive as independent entities in the post-IPO period (Guo and Zhou 2016; Cirillo et. al. 2017). Younger IPO firms and firms with higher risk exposure are more likely to exit by year 5 post-IPO as the difference in the mean and median values are significant at the 1% level. These findings are supported by Espenlaub et al. (2012) who show that younger IPO firms exit post-IPO, mainly through delistings. Additionally, our results are consistent with Mousa et al.'s (2014) evidence that firms with higher risk exposure at the IPO are less likely to survive to year 5 post-IPO. Finally, the results in Panel B show that leverage and asset tangibility have no influence on survival to year 5 post-IPO.

Panel C reports the results comparing the board and CEO characteristics at the IPO for survivors and non-survivors. Boards of survivors are larger than non-survivors and the mean and median differences between both groups are significant at the 1% level. This evidence is in line with prior literature that IPO firms with larger boards are more likely to survive (Chancharat et al.2012; Chahine and Goergen 2013).[96] On average, 75% of the board of survivors are independent directors while non-survivors have 5% less independent directors on their boards. The mean difference is significant at the 1% level. Although the median values are higher than the means, the difference in the median between survivors and non-survivors is also 5% and is significant at the 1% level. Hence, survivors have a more independent board of directors. Put together, the results reported in Panel C suggest that survivors have larger and more independent boards compared to non-survivors. However, there is no significant difference between survivors and non-survivors in terms of board voting share ownership, CEO financial expertise, CEO tenure, founder CEO, CEO duality, and VC board representation.

[96] Although the average of 7 board members in the sample is slightly higher than the 5 directors reported in Chancharat et al. (2012) and 6 directors in Chahine and Goergen (2013).

Finally, we report the descriptive statistics results for IPO characteristics in Panel D of Table 3.2. On average, survivors are undervalued less compared to non-survivors (25% compared to 27%) and there is no significant difference between both mean values. Regarding IPO premium, survivors have higher mean premiums of 88% compared to the 79% of non-survivors and the difference is significant at the 5% level. However, this difference disappears when we compare the median of IPO premium. Overall, these findings show that IPO characteristics do not explain the difference between survivors and non-survivors.

[Insert Table 3.2 about here]

Overall, the results for the descriptive statistics and univariate analysis are consistent with prior IPO literature on IPO survival. A preliminary conclusion to be drawn from the univariate analysis results is that IPO firms will benefit from greater professional expertise diversity and greater board connections in terms of survival post-IPO. This is consistent with Field et al.'s (2013) suggestions that IPO firms require more advice and appoint directors with salient knowledge, expertise and connections to their boards. There is no evidence supporting H1b or H2b on the potential negative effect of board diversity and board connection in relations to IPO survival.

Since professional expertise diversity relates to fourteen expertise categories, we explore whether the results reported in Table 3.2 are attributed to a particular expert category. Table 3.3 shows a detailed analysis of the impact of board professional expertise on survival to year 5 post-IPO. There are fourteen expertise categories including academic, accountant, banker, consultant, dentist, doctor, engineer, executive expertise, finance expert, IT expert, investment professional, lawyer, politician, and scientist. Panel A of Table 3.3 shows the t-test and Wilcoxon rank-sum test results for the difference in the mean and median values for survivors and non-survivors in each board professional expertise category. The results indicate that at the IPO, survivors have a lower percentage of doctors, engineers, financial experts, and scientists, but a higher percentage of directors with executive expertise on their boards at the 5% level of significance or better. Although the results suggest a significant difference in specific professional expertise categories between survivors and non-survivors; we explore whether this observed effect stems from natural selection within the industry or the specific professional expertise.

The argument in favour of natural selection is that IPO firms in different industries are more likely to appoint directors with professional expertise relevant to the industry. For example, IPO firms in the healthcare industry may appoint doctors to the board, whereas IPO firms in business equipment industry will appoint more IT experts. Thus, the effect of professional expertise diversity on IPO survival relates to the industry rather than a specific professional expertise category and the main analysis should focus on the overall professional expertise diversity of the board. The opposing argument is that regardless of the industry, specific professional expertise categories influence IPO survival. In this vein, we expect that industries with lower IPO survival rates have a significantly higher percentage of doctors, engineers, financial experts, and scientists linked to non-survivors in Panel A. Similarly, industries with higher IPO survival rates have a higher percentage of directors with executive expertise linked to survivors. The implication of such results in Panel B will be that specific professional expertise categories influence post-IPO survival. Thus, we will benefit more from analysing the impact of professional expertise on survival by category rather than as a professional expertise diversity index. This is the purpose of the t-tests performed in Panel B.

Panel B of Table 3.3 shows the distribution of board professional expertise by industry, and the t-tests results show the mean comparison for each professional expertise category between a specific industry and the remaining sample (excluding the former industry). The results show that across all industries, most IPO firms have directors with executive expertise (42% to 60%) indicating that experience at a managerial level is important in appointment decisions. In industries such as the oil, gas, coal extraction and products and chemical and allied products with the highest survival rates, (69% and 67%) as discussed in Table 3.1, the mean of executive expertise is not significantly different from the remaining sample. Rather, in the oil, gas, coal extraction and products industry, boards have on average a higher percentage of finance experts while in the chemical and allied products industry, boards have on average a higher percentage of scientists compared to the remaining sample at the 10% level of significance or better. Since both expertise groups are significantly higher for non-survivors in Panel A but significantly higher in industries that have the highest survival rate in Panel B, these results allude to a natural selection within the industry for professional expertise.

Turning to the consumer non-durables industry in Panel B with the lowest survival rate of 33%, we find that boards on average have a higher percentage of accountants and consultants compared to the remaining sample at the 5% level of significance. There is no significant difference in the mean and median values for the percentage of accountants and consultants comparing survivors to non-survivors in Panel A. However, these expertise groups have now been linked to the industry with the lowest survival rate. This suggests that professional expertise diversity across industries is by natural selection and IPO survival relates to the industry rather than specific professional expertise category. Finally, the results show that firms in business equipment industry have a higher percentage of engineers, IT experts, scientists and academics on their board compared to the remaining sample at the 1% level of significance. This is unsurprising, as this industry comprises technology firms and boards are structured with relevant professional expertise to the industry (Dass et al. 2014).

Overall, the results from Table 3.3 indicate that the increase in the level of board professional expertise in IPO firms is due to natural selection within the industry. Thus, in estimating the impact of professional expertise diversity on IPO survival, the focus is on diversity in terms of the number of different board expert categories on the board, regardless of the type of professional expertise.

[Insert Table 3.3 about here]

In the next section, we discuss the results testing our hypotheses in a multivariate setting. Prior to running the main regression analysis, we analyse the correlation between all our independent variables using the Pearson's correlation coefficients. The correlation matrix for all independent and control variables is reported in Table 3.4. The results show that the highest correlation is between the board size and board independence (0.395). This correlation value is at a moderate level and both variables are included in the main analysis.[97]

[Insert Table 3.4 about here]

3.4.2 Multivariate Analysis on the Impact of Board Diversity and Board Connections on IPO Survival

This section discusses the results testing the validity of all the hypotheses outlined in Section 2.2, which predict the relationship between the measures of board diversity, board connections and IPO survival. Survivors are defined as firms that remain publicly traded and independent entities up to 5 years post-IPO or the last year of the sample period. Non-survivors are all firms that are not classified as survivors and exit the sample post-IPO due to mergers or delisting. We report additional analysis for the impact of board diversity and board connections on the types of exit in the multinomial logit regressions by comparing mergers to survivors, delistings to survivors, and mergers to delistings. All variables are winsorised at the 1% and 99% level to mitigate outliers influencing the results and all regressions adjust for industry fixed effects, year fixed effects, and the control variables introduced in the methodology section. For each regression, we report the coefficients, t-statistics that are heteroscedasticity

[97] There is a high correlation of 0.803 between firm size, measured as the natural log of total assets, and IPO offer size, measured as the natural log of the gross proceeds raised from the offering estimated as the product of shares offered and offer price. Therefore, offer size is excluded from the main regression to avoid multicollinearity in the analysis. Subsequently, the offer size is included in the robustness section instead of the firm size and the results are upheld.

consistent, and the respective marginal effects.[98] Subsequently, we examine whether IPO firms with higher board diversity and board connections at the IPO will benefit more in terms of survival until year 5 post-IPO. This effect is tested in Tables 3.6 and 3.7 by analysing the impact of an interaction between board diversity and board connections on the IPO survival.

Table 3.5 reports the logit regressions testing the validity of hypotheses 1a, 1b, 2a and 2b on the impact of the board diversity and board connections on IPO survival and the multinomial logit regressions on the types of exit. The dependent variable for the logit regression in column 1 is a dummy variable that takes a value of one if a firm has survived until year 5 post-IPO and zero otherwise. The logit results in column 1 shows that greater gender, age or professional expertise diversity at the IPO has no impact on the likelihood of survival to year 5 post-IPO. These results do not provide support for hypothesis 1a that IPO firms with greater board diversity at the IPO are more likely to survive to year 5 post-IPO, or the competing hypothesis 1b that IPO firms with greater board diversity are more likely to exit by year 5 post-IPO. The multivariate results related to gender and age diversity are consistent with the univariate analysis. Regarding professional expertise diversity, the insignificant results in column 1 contrast with the univariate analysis, where we find that firms with higher professional expertise diversity are more likely to survive to year 5 post-IPO at the 1% level of significance. We attribute these different results to control variables now included in the multivariate analysis, which have a stronger significant influence on the probability of survival to year 5 post-IPO such as firm size, leverage, and R&D intensity.

The evidence for the impact of board connections in column 1 is consistent with the predictions of hypothesis 2a that better-connected boards are more likely to survive as independent entities to year 5 post-IPO and this result is consistent with the evidence from the univariate analysis. Particularly, IPO firms with higher board connections at the IPO are more likely to survive to year 5 post-IPO at the 5% level of significance. The marginal effects in column 2 show that a one-unit increase in the standard deviation of board connections (1.2) at the IPO increases the likelihood of survival by approximately 4.4%. Since the measure of board connections is based on the average board connections, to put our result into context, in a board with seven members at the IPO, one additional connection for each member of the board will increase the likelihood of survival to year 5 post-IPO by 4.4%. Considering better-connected

[98] The robust command produces unbiased t-statistics of the logit and multinomial logit coefficients under heteroscedasticity. Heteroscedasticity arises where the variance of the residuals is unequal over a range of measured values and violates the assumption that residuals are drawn from a population with a constant variance. Thus, using the robust command corrects for this issue.

boards alludes to busier boards, the results extend Field et al.'s (2013) findings that busier boards in IPO firms improve firm value, to a greater likelihood of survival post-IPO. Furthermore, the evidence extends Feng et al.'s (2019) findings that not only do better-connected boards influence higher IPO market valuation, higher first-day returns, and medium-term post-IPO performance, but they also improve the likelihood of survival to year 5 post-IPO. Consistent with the social capital lens of the resource dependency theory, our findings indicate that the information flow to the board through board connections provides access to invaluable contacts and experience for board members that improves the likelihood of survival post-IPO.

The in-depth multinomial logit regressions for the impact of board diversity and board connections on the types of exit are reported in columns 3 to 8 of Table 3.5. The base case in columns 3 and 5 is survivors, compared to the other categories (mergers and delistings) by year 5 post-IPO, while in column 7 we compare delistings to mergers. The results for all measures of board diversity across columns 3 to 8 are similar to those discussed above in column 1, suggesting that there is no relationship between board diversity and the likelihood of survival to year 5 post-IPO. However, the results in column 3 suggests that better-connected boards have a lower likelihood of merger compared to survivors at the 5% level of significance or better. These results indicate IPO firms with better-connected boards are more likely to survive than be involved in a merger. The marginal effects in column 4 indicate that increasing board connections by one standard deviation at the IPO will result in a lower likelihood of a merger by 4.2%.[99] We find no significant relationship between better-connected boards at the IPO and the likelihood of exit through a delisting compared to survivors in column 5 or merger compared to delisting in column 7. This indicates that there is no significant difference between board connections of delistings compared to survivors or mergers compared delistings. In summary, board diversity alone has no influence on the types of exit, but better-connected boards are more likely to survive post-IPO and these results are driven by survivors compared to mergers.

Our findings are consistent with the results in the logit regression model that better-connected boards improve the likelihood of survival post-IPO. Unreported results potentially explain that this effect on IPO survival is driven by better-connected boards in IPO firms with

[99] The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. Columns 4 and 8 show the marginal effects for the probability that a firm is involved in a merger by year 5 post-IPO while column 6 shows the marginal effects for the probability that a firm is involved in a delisting by year 5 post-IPO.

higher level of investment in innovation (R&D intensity) as the effect disappears in firms with a lower level of investment in innovation.[100] Thus, the social capital of better-connected directors, which relates to their external contacts, information, and skills, facilitate the survival of IPO firms as independent entities.

[Insert Table 3.5 about here]

The results for control variables in Table 3.5 (column 1) show that larger IPO firms, firms with higher R&D intensity and IPOs that are perceived to be of higher value, as indicated by the IPO premium, have a higher likelihood of survival. These results are significant at the 10% level or better. On a more detailed level in columns 3 to 8, we find that the positive relationship between firm size and IPO survival is driven by delistings compared to survivors, as larger IPO firms have a lower likelihood of delisting at the 5% level of significance. The marginal effects indicate that increasing firm size by one standard deviation at the IPO will result in a lower likelihood of a delisting by 1.3% There is no difference in firm size when comparing mergers and survivors or mergers and delisting. These results are consistent with the prior IPO survival studies of Jain and Tabak (2008) and Feng et al. (2020) where they find larger firms have a higher likelihood of survival at the 1% level of significance.

In terms of the firm's investment in innovation, column 5 shows that the positive relationship between R&D intensity and IPO survival is attributed to delistings compared to survivors, as there is a lower likelihood of delisting at the 1% significance level. This suggests that IPO firms that invest more in innovation are more likely to survive than delist by year 5 post-IPO consistent with Guo and Zhou (2016). The marginal effects suggest that the lower likelihood of delisting compared to survivors is 2.3% for every one-unit increase in the standard deviation of R&D intensity. Despite the evidence that firms with higher R&D intensity at the IPO are more likely to survive, we find that in comparing mergers and delistings in column 7, such firms are more likely to be involved in a merger at the 5% significance level. However, in comparing mergers to survivors, R&D intensity is insignificant. A conclusion to be drawn from the results for R&D intensity is that firms with higher investment in innovation at the IPO are more likely to survive to year 5 post-IPO but may be involved in a merger as well rather than delisting. Finally, the positive relationship observed in the logit model for the impact of IPO premium on IPO survival does not extend to the multinomial model, which is unsurprising as these results are weak and significant only at the 10% level.

[100] We re-estimate the logit and multinomial logit regressions in subsamples comparing firms with high R&D intensity to firms with low R&D intensity. R&D intensity is divided into high and low groups based on the median value of R&D intensity at the IPO.

We also find that IPO firms with higher leverage have a lower likelihood of survival at the 10% level of significance. This indicates that IPO firms with higher leverage are more likely to be involved in an exit post-IPO and column 3 indicates that this exit is through a merger compared to survivors at the 5% level of significance. The marginal effects suggest that a one-unit increase in the standard deviation of leverage will result in a 24.2% increase in the likelihood of exit through a merger by year 5 post-IPO. These findings support Field and Karpoff's (2002) results that IPO firms with higher leverage are more likely to be involved in takeovers post-IPO as they are more vulnerable.[101]

Finally, the results of the multinomial regression in columns 3 to 8 for the control variables show strong evidence that IPO firms with venture capitalist director involvement have a 17% higher likelihood of exit through a merger compared to survivors or delisting by year 5 post-IPO. These results are in line with Arikan and Capron (2010) who find that markets react more favourably to acquisitions involving venture capitalist backed IPOs with venture capitalist directors as such backing signals the quality of the firm. Furthermore, Wang et al. (2017) suggest that venture capital-backed IPOs have a higher likelihood of becoming targets, as venture capital firms have limited investment horizons and view the IPO as a staged sale of their pre-IPO stakes. In our context, 78% of firms that are involved in a merger by year 5 post-IPO are targets in the acquisition process with venture capitalist backing and venture capitalist directors. Thus, venture capital backed IPOs are more likely to exit through a merger by year 5 post-IPO and be the target firms within this process. All other control variables are insignificant in the logit and multinomial regression models.

To sum up, the regression results reported in Table 3. 5 show that there is no relationship between gender, age and professional expertise diversity at the IPO and the likelihood of survival to year 5 post-IPO. Hence, we do not find support for hypotheses 1a or 1b which expect a positive or negative relationship respectively, between board diversity and the likelihood of survival to year 5 post-IPO. In terms of the impact of board connections on IPO survival, the evidence suggests that better-connected boards are more likely to survive until year 5 post-IPO, which supports the predictions of hypotheses 2a. The results reported in Table 3.5 suggest that on its own, board diversity does not matter for IPO survival up to year 5, but board connections explain the likelihood of survival post-IPO.[102] Therefore, we report the

[101] Considering that 97% of mergers in the sample are targets, these findings are consistent with prior literature.
[102] The main logit and multinomial logit regressions are re-estimated based on IPO survival to year 10 post-IPO. The results reported in Appendix 3.4 show support for the main results reported in Table 3.5. In untabulated results, we exclude the 20 bankrupt firms and re-estimate the logit and multinomial logit regressions and the results are upheld.

results of a further analysis introducing an interaction term to test whether the effect of board diversity on IPO survival changes when board connections at the IPO are considered simultaneously.

The Impact of the Interaction Term Between Board Diversity and Board Connections on IPO Survival

In this section, we test whether there is a change in the impact of board diversity measures on IPO survival when interacted with board connections. The results for these analyses are reported in Tables 3.6 and 3.7 for gender diversity and professional expertise diversity respectively, while the results for age diversity are reported in Appendix 3.2, as they are insignificant.[103] Notably, the results for the control variables in Tables 3.6 and 3.7 are on par with those discussed in Table 3.5. To avoid repetition, we have only discussed the results for the primary variables of interest in this section.

Table 3.6 reports the logit and multinomial logit regressions for the impact of the interaction between gender diversity and board connections on IPO survival. The logit regression results in columns 1 and 2 show that the individual effects for greater gender diversity and greater board connection when the other is zero is insignificant in relation to the likelihood of survival to year 5 post-IPO. Furthermore, we find that gender diversity still does not explain the likelihood of IPO survival to year 5 post-IPO if board connections simultaneously increases by one unit. The results suggest that the survival prospect of an IPO firm with greater gender diversity remain unaffected regardless of the level of board connections. To sum up, the results in the logit regression show no relationship between the interaction term of gender diversity and board connections, or the individual effects for both on IPO survival to year 5 post-IPO. Thus, in terms of survival, IPO firms should focus on other measures of board diversity in the boardroom.

A more detailed analysis in the multinomial logit regressions in columns 3 to 8 show that firms which increase gender diversity with zero board connections at the IPO are more likely to be involved in mergers compared to survivors or delisting by year 5 post-IPO. The marginal effect in column 4 indicates that IPO firms with a 1% increase in female board representation and zero board connections at the IPO are 0.8% more likely to be involved in a

[103] Across the logit and multinomial logit regressions in Appendix 3.2, there is no evidence of a significant relationship for the individual effects for age diversity and board connection or the interaction term and IPO survival to year 5 post-IPO. This indicates that age diversity has no effect on survival post-IPO when board connection increases by one-unit. Therefore, in terms of age diversity, the survival prospect of an IPO firm is unaffected even if the board is better-connected.

merger at the 5% level of significance. Since our data shows that 97% of the IPO firms involved in a merger post-IPO are targets, these results suggests that increasing female board representation and keeping board connections at zero level at the IPO increases the likelihood of IPO firms to become targets for acquisition post-IPO. The results reported in column 5 show that there is no difference between delistings and survivors. Regarding the interaction term, column 7 shows that gender diversity still has a positive impact on the likelihood of a merger compared to a delisting, when board connections increase by one unit at the IPO at the 5% level of significance. These results show that increasing gender diversity at the IPO when board connections are equal to zero increases the likelihood of a merger. However, this effect is dampened by an increase in board connections. For example, the marginal effects reported in column 8 shows that the positive impact of gender diversity on the likelihood of survival compared to a delisting decreases by 0.3% when board connections increases by 1% (i.e., from 0.8% to 0.5%). This result is significant at the 10% level.

[Insert Table 3.6 about here]

Overall, the results in Table 3.6 show that greater gender diversity at the IPO increases the likelihood of exit through a merger compared to survivors and delisting by year 5 post-IPO. However, this effect is dampened by IPO firms with better-connected boards at the point of listing. The implications of our results is that merger-motivated IPOs will benefit from greater female board representation in the boardroom at the IPO, but this effect is reduced in better-connected boards. These results provide a new perspective on the impact of gender diversity in IPO firms and they contribute to Bachmann and Spiropoulos (2021) who find that bidders with gender diversity on their boards select target firms with female board representation. Another important pattern emerging in the results is that better-connected but homogenous boards in terms of gender have no significant impact on IPO survival. This goes a step further from the main results where greater board connections improves the likelihood of IPO survival to show that this effect relates to IPO firms with female directors on the board.

Table 3.7 reports the regression results with the interaction term between professional expertise diversity and board connections. The logit regressions in columns 1 and 2 show IPO firms with greater professional expertise diversity and zero board connections are 44% more likely to survive to year 5 post-IPO while. However, this effect is reduced by 26% (i.e., from 44% to 18%) if board connections increase by one-unit. IPO firms with greater board connections and zero professional expertise diversity have a 17% higher likelihood of IPO survival to year 5 post-IPO. These results indicate an overall positive effect of professional expertise diversity and board connections on IPO survival, significant at the 5% level or better.

Furthermore, the results suggest a potential substitution effect between professional expertise diversity and board connections as the overall effect of the interaction is positive, though smaller. To sum up, the logit results provide new evidence on the positive impact of professional expertise diversity on IPO survival. Accordingly, in terms of survival, IPO firms may focus their resources on either improving professional expertise diversity or board connections as both increase the likelihood of survival to year 5 post-IPO. However, the larger positive effect relates to professional expertise diversity.

In the multinomial logit regressions in Table 3.7, columns 3 to 6 show that the results in the logit regression is driven by both mergers and delisting compared to survivors. IPO firms with greater professional expertise diversity and zero board connections have a 38% lower likelihood of exit through a merger or delisting compared to survivors at the 10% significance level. Similarly, IPO firms with greater board connection and zero professional expertise diversity have a 15% lower likelihood of exit through a merger or delisting compared to survivors at the 5% significance level. The overall effect of professional expertise diversity is dampened by 17% (i.e., from 38% to 21%) when board connections increases by one unit. There is no evidence in columns 7 to 8 of a relationship between the interaction of professional expertise diversity and board connections, and the likelihood of exit through mergers compared to delistings. In summary, there is an overall negative effect of the interaction term on the likelihood of exit through mergers or delistings compared to survivors. This negative effect in the interaction term is smaller than the individual effects of professional expertise diversity or board connections on IPO survival to year 5 post-IPO. Therefore, despite the substitution effect observed in the logit regression, professional expertise diversity leads to a greater likelihood of survival post-IPO. Our result also extends Gray and Nowland's (2017) finding that greater professional expertise diversity in IPO firms improves post-IPO firm value and performance to survival post-IPO.

[Insert Table 3.7 about here]

Overall, the results in Table 3.7 show that greater professional expertise diversity or board connections improve the likelihood of IPO survival to year 5 post-IPO when the other is equal to zero, indicating a substitution effect. However, the results are stronger in terms of professional expertise diversity. Following from Chapter 2, where we find that IPO firms focus more on improving professional expertise diversity at the IPO, the results in Table 3.7 show that such steps are beneficial for survival post-IPO.[104] An important conclusion from the analysis in Tables 3.6 and 3.7 is in terms of board diversity, IPO firms with the objective of surviving to year 5 post-IPO should focus on improving professional expertise diversity while merger-motivated IPOs will benefit from greater gender diversity. Finally, board connections are beneficial for IPO survival, but only in firms with a gender diverse board. In the next section, we discuss the results for the impact of board diversity and board connections on survival time using the Cox proportional hazard and the accelerated failure time models.

3.4.3 Further Analysis and Robustness Test

Survival Analysis: Impact of Board Diversity and Board Connections on Survival Time

The Cox and accelerated failure (AFT) models do not directly test any of our hypotheses, but the focus of these models on duration to the event offers an interesting perspective to the chapter. These models indicate the timing of the event (i.e., survival, merger, or delisting) occurring rather than predict the likelihood. We argue that an analysis estimating the timing of the event provides further context for understanding the impact of our primary variables of interest on the likelihood of survival post-IPO. In the Cox model, the dependent variable is the survival time, while the dependent variable in the accelerated failure time model is the time to failure. The estimations for the Cox and AFT models are reported in Tables 3.8 to 3.11. There are 661 firm observations of which 357 (54%) IPO firms experience failure (exit) up to year 5 post-IPO. Compared to other studies such as Chancharat et al. (2012) and Gounopoulos et al. (2020) who apply the Cox and AFT models, our sample is larger as they analyse survival time regarding 25% and 36% exits, respectively.

Table 3.8 focuses on the impact of board diversity and board connections on survival time to year 5 post-IPO, while Table 3.9 reports the results after including an interaction term between these two variables in the regression. Tables 3.10 and 3.11 report the result for a sub-sample survival analysis comparing survivors to mergers, survivors to delistings and mergers to delistings. The rationale for the sub-sample analysis in Table 3.10 is to check the robustness of the main multinomial logit regression results reported in Table 3.5. Table 3.11 is a robustness analysis for the multinomial model on the interaction between the measures of board diversity and board connections reported in Tables 3.6 and 3.7. In all the tables discussed in this section, we report the average survival time, which provides a baseline in interpreting our results.

[104] We have also analysed the impact of excessive board diversity and excessive board connections by using the squared values on IPO survival to year 5 and 10 post-IPO. The results from all specifications are insignificant not reported in this chapter.

For each estimation in Tables 3.8 to 3.10, we report the coefficients, robust t-statistics, hazard ratios, and the time ratios. In the current empirical context, a negative (positive) coefficient indicates that a predictor decreases (increases) the likelihood of exit from the sample or improves (worsens) IPO survival. If the hazard ratio is greater (less) than one, it implies that the non-survivor firm has a shorter (greater) time to the event-exit from the sample. Conversely, if the time ratio is less (greater) than one, it implies that the non-survivor firm has a greater (shorter) time to failure-exit from the sample. A hazard/time ratio, which equals to one shows that there is no difference between survivors and non-survivors. All regressions adjust for industry and year fixed effects and include the control variables introduced in the methodology section.

In columns 1 to 4 of Table 3.8, there is no evidence that the three measures of board diversity (i.e., gender, age, and professional expertise) increase or decrease the likelihood of survival to year 5 post-IPO. The hazard ratio for gender diversity (1.004) indicates that IPO firms with greater gender diversity have a shorter time to exit, while those with greater age (0.722) and professional expertise diversity (0.968) have a longer time to exit. However, these hazard ratios and the time ratios from the AFT model show no significant influence of the measures of board diversity on survival time and time to failure, respectively. Across all columns in Table 3.8, similar to the logit regressions in the main results, we find weak evidence that board connections decrease the likelihood of exit at the 10% level of significance. The hazard ratio reported in column 2 suggests that increasing board connection by one unit at the IPO increases survival time by 9.6%. Similarly, the time ratio in column 4 suggests that increasing board connections by one unit decreases time to failure by 10.5% implying a lower likelihood of exit.[105] The average survival time for non-survivors is 3.9 years post-IPO. Since the measure of board connections is based on the average board connections, in a board with seven members, one additional connection for each board member at the IPO will increase average survival time from 3.9 years to 4.3 years (3.9*1.096). This shows that better-connected boards at the IPO have longer survival times. Similar to our main results, the results of the Cox and AFT models show that board diversity alone does not affect the survival of an IPO, but board connections have explanatory power.

[105] The likelihood of exit is computed based on the hazard ratio as 100(1-HR) %.and it is measured in percentages. For example, the likelihood of exit for board connections in Table 3.8 is calculated as 100*(1-0.904) %= 9.6% consistent with Sashegyi and Ferry (2017). The likelihood of failure is computed from the time ratio as follows (TR-1) %.and it is measured in percentage.

Regarding the control variables, the results are similar to the main results in Table 3.5 that larger IPO firms, IPO firms with higher firm risk and greater R&D intensity have an 8% to 32% longer survival times, respectively. This implies a lower likelihood of exit for such firms by year 5 post-IPO. There is also evidence that firms with higher leverage and VC board representation have 27% to 29% shorter survival times implying a higher likelihood of exit by year 5 post-IPO. These results are consistent with the logit and multinomial logit regressions. Overall, the results in Table 3.8 show that results for the Cox model is robust to the AFT model and we provide further support for hypothesis 2a, which is consistent with the findings in the logit regressions.[106]

[Insert Table 3.8 about here]

Survival Analysis: Impact of the Interaction Term Between Board Diversity and Board Connections on Survival Time

Moving forward, Table 3.9 reports the results for the Cox and the accelerated time failure model for the impact of the interaction between the measures of board diversity and board connections on survival time to year 5 post-IPO.[107] This analysis is used to check the robustness of the logit regression results reported in Tables 3.6 and 3.7. There is no evidence in columns 1 and 2 for the Cox model or columns 5 and 6 for the AFT model of a relationship between gender diversity, board connections, and IPO survival similar to the results in the logit regressions for Table 3.6. In columns 3 and 4, we find greater professional expertise diversity or greater board connections when the other is equal to zero result in longer survival time by 51% and 28% respectively. At this rate, survival time for IPO firms increases to 5.8 years (3.9*1.51) while in firms with greater board connections but zero professional expertise diversity, survival time increases to 4.9 years (3.9*1.28).

The results for the interaction term indicates that IPO firms with professional expertise diversity decrease the survival time by 15% (66%-51%) when board connections increase by one unit at the 5% level of significance. This implies that when IPO firms focus on both professional expertise diversity and board connections simultaneously, survival time decreases from 5.8 years to 4.9 years post-IPO. The implication of these results is that there is a

[106] We re-estimate the Cox and ATF model for survival time to year 10 post-IPO and our results from Table 3.8 are robust. These further results are reported in Appendix 3.5.

[107] Age diversity has been excluded from Table 3.9 but is reported in Appendix 3.3 as the results are insignificant. The results in Appendix 3.3 indicate that there is no relationship between age diversity and survival time post-IPO when board connections increase by one-unit at the IPO. This is consistent with the findings in the logit and multinomial logit regressions. Therefore, in terms of age diversity, the survival time of an IPO firm is unaffected even if the board is better-connected.

substitution effect between professional expertise diversity and board connections, as observed in the logit model. The individual effects of professional expertise diversity or board connections on IPO survival to year 5 post-IPO are positive and greater than the overall effect of the interaction term on survival time. This shows boards with both heterogenous professional expertise and greater board connections at the IPO have shorter survival times compared to boards that focus on either. These results discussed for the Cox model are robust in the AFT model reported in column 5 to 8 and consistent with the main results reported in Table 3.7.

[Insert Table 3.9 about here]

To conclude, Table 3.9 shows that professional expertise diversity only matters on its own if the board is not connected to other boards for post-IPO-survival up to year 5. Hence, the focus of IPO firms and regulators should not be just on diversity in isolation but in conjunction with other board characteristics such as the overall board connections.

Alternative Definition of IPO Survival

We also test the robustness of our results using alternative definitions of IPO survival from prior literature. As mentioned earlier, mergers are not always an indication of firm failure. To this end, we explore another definition of survivors that includes mergers as censored survivors if they rank above the median for four performance based measures consistent with Espenlaub et al. (2012). The four performance measures are cash to total assets, operating income to total assets, total liabilities to total assets and current assets to current liabilities. The rationale for using these measures in the classification of mergers into censored survivors is to distinguish between poorly performing firms and well performing firms that are acquired. Based on this classification, there are 17 mergers classified as censored survivors and included in the group of survivors. This new classification yields a sample of 321 survivors and 340 non survivors (219 mergers and 121 delistings). Based on this classification, we re-run the logit and multinomial logit regression for the impact of board diversity and board connections on IPO survival, individually and in interactions (see Appendix 3.6 and 3.7). The results using this classification are similar to the main results and reported in Tables 3.5 to 3.7 discussed in the main results. In summary, firms with greater professional expertise diversity or greater board connections at the IPO have a higher likelihood of survival to year 5 post-IPO. However, there is no evidence of a relationship between gender, age diversity and IPO survival. Therefore, IPO firms will benefit from focusing on board characteristics relating to professional expertise and board connections in board appointments around the IPO.

Sub-sample Survival Analysis for Impact of Board Diversity and Board Connections on Survival Time

Table 3.10 reports the results using the Cox model and the AFT model in sub-samples. The rationale for this sub-sample analysis is to check the robustness of the main multinomial logit regression results reported in Table 3.5. Columns 1 to 4 compare mergers to survivors, columns 5 to 8 compare delisting to survivors, while columns 9 to 12 compares mergers to delisting. All our measures of board diversity are insignificant in Table 3.10, indicating that increasing board diversity alone at the IPO has no impact on survival time to year 5 post-IPO.

However, in line with our multinomial model, the results reported in columns 1 to 4 of Table 3.10 show that better-connected boards are more likely to survive to year 5 post-IPO and the results are at the 10% level of significance. In terms of the hazard ratio/ time ratio, the results for board connections indicate that increasing board connection by one unit at the IPO leads to a longer survival time by 11% to 13% when comparing mergers to survivors. This shows better-connected boards at the IPO have a lower likelihood of exit/failure through a merger compared to survivors by year 5 post-IPO. In comparing mergers to survivors, the average survival time is 3.1 years, and our results indicate that better-connected boards increase survival time to about 3.5 years. Thus, better-connected boards improve the survival prospects of IPO firms. The results reported in columns 5 to 8 show that there is no difference in board connections between survivors and delistings firms, while columns 9 to 12 show similar results for mergers compared to delistings firms. Overall, the results from Table 3.10 are consistent with our main results.

[Insert Table 3.10 about here]

Sub-sample Survival Analysis for Impact of the Interaction Term for Board Diversity and Board Connections on Survival Time

Finally, we check the robustness of the main multinomial logit regression for the impact of the interaction between board diversity and board connections on the types of exit, reported in Tables 3.6 and 3.7.[108] Table 3.11 reports the results using the Cox model and the AFT model in sub-samples, comparing mergers to survivors, delistings to survivors, and mergers to delistings. Panel A shows the results for the impact of the interaction between gender diversity and board connections on the types of exit. The main results in Table 3.6 relating to the

[108] The results for age diversity are similar to the multinomial model in Appendix 3.2 showing that there is no significant relationship between the individual or interaction term and the types of exit. For brevity, these results are not reported in Table 3.1.

interaction of gender diversity and board connections are not robust to the Cox and AFT models reported in Panel A of Table 3.11. In Table 3.6, the results indicate that greater gender diversity at the IPO in firms with zero board connections increases the likelihood of exit through a merger compared to survivors and delisting by year 5 post-IPO, however in Panel A, this effect disappears. Therefore, our findings suggest that there is no robust significant individual or overall interaction effect for gender diversity and board connections on IPO survival.

Panel B shows the results for the impact of the interaction between professional expertise diversity and board connections on the types of exit. All results from Table 3.7 are robust in Panel B of Table 3.11 expect for the individual effect of professional expertise diversity when comparing mergers to survivors, which is now insignificant. Across the Cox and AFT models, we find that IPO firms with greater professional expertise diversity are less likely to exit through delistings compared to survivors by year 5 post-IPO when board connections is equal to zero. The hazard ratio indicates that increasing professional expertise diversity by one unit when board connections is zero leads to a 78% longer survival time (i.e., from 2.9 years to 5 years) when comparing delistings to survivors. There is no significant relationship for the individual effect of professional expertise diversity when comparing mergers to survivors or mergers to delistings. IPO firms with better-connected boards are less likely to exit through mergers or delistings compared to survivors by year 5 post-IPO when professional expertise diversity is equal to zero. These results are significant at the 5% level and the hazard ratios indicates that better-connected boards improve survival time compared to mergers by 30% (i.e., from 3.1 years to 4 years) and compared to delistings by 39% (i.e., from 2.9 years to 4 years). The overall effect of professional expertise diversity on survival time to year 5 post-IPO is dampened by 39% (i.e., from 78% to 39%) when board connections increase by one unit, which alludes to a substitution effect. With an average survival time of 2.9 years for delistings, the implication of our findings is that IPO firms who focus on both professional expertise diversity and board connections simultaneously will decrease average survival time from 5 years to 4 years.

In summary, there is an overall negative effect of the interaction term for professional expertise diversity and board connections on the likelihood of exit through delisting compared to survivors. This implies that IPO firms with greater professional expertise diversity and board connections are less likely to exit due to delisting post-IPO. These negative results are larger for the individual effects of professional expertise diversity when board connections is zero. on the likelihood of exit post-IPO. Therefore, despite the dampening effect of board connections observed in the multinomial logit regressions, professional expertise diversity leads to a greater likelihood of survival post-IPO. In summary, the main results are robust to the Cox and ATF models.

[Insert Table 3.11 about here]

3.5 Conclusion

This chapter analyses the relationship between board diversity, board connections, and IPO survival. Board diversity is measured based on gender, age, and professional expertise. We do not find evidence of a relationship between the measures of board diversity and the likelihood of survival post-IPO. The results indicate that IPO firms with better-connected boards are more likely to survive as independent entities post-IPO and these results are driven by IPO firms with higher level of investment in innovation (R&D intensity). Therefore, IPO firms use the social capital of better-connected directors, which relates to their external contacts, information, and skills to facilitate the survival of IPO firms as independent entities. Our results are robust to when using survival analysis models, such as Cox and AFT models.

Next, we test whether there is a change in insignificant effect of the board diversity measures when interacted with board connections. We find consistent results that diverse boards, in terms of professional expertise with greater board connections explain the likelihood of survival post-IPO. Particularly, greater professional expertise diversity or board connections improve the likelihood of IPO survival to year 5 post-IPO when the other is equal to zero. However, the interaction term reveals that the effect of professional expertise diversity on IPO survival is dampened by IPO firms with better-connected boards at the point of listing, indicating a substitution effect. Although the results for the positive impact of professional expertise diversity on IPO survival are stronger compared to board connections, IPO firms seeking to grow and survive will also benefit from a better-connected board. The results for professional expertise diversity extends our findings from Chapter 2 that the focus of IPO firms on heterogenous professional expertise at the IPO works towards improving the likelihood of survival post-IPO. There is some evidence that merger-motivated IPOs will benefit from greater female board representation in the boardroom at the IPO, but these results are not robust in all specifications. In terms of age diversity, our results consistently show that the survival prospect of an IPO firm remain unaffected regardless of the level of board connections.

The main contribution of this chapter to the literature is four fold. First, we show that in terms of IPO survival, the role of professional expertise diversity is more pronounced compared to gender or age diversity. Hence, the focus of IPO firms and potential issuers should be on improving professional expertise diversity in board appointments. Second, better-connected boards improve IPO survival, but when interacted with professional expertise diversity, there is a substitution effect at play. Accordingly, IPO firms will benefit in terms of survival post-IPO from a better-connected board and a board with a diverse range of professional expertise. Since professional expertise diversity has a larger positive impact on the likelihood of IPO survival, our results suggest that IPO firms should focus more on this aspect of board diversity. Third, better-connected boards are invaluable for survival post-IPO, particularly in IPO firms who have higher levels of investment in innovation.

To conclude, this chapter provides guidance to IPO firms on board characteristics to consider in appointment decisions in terms of diversity and connections that influence the likelihood of survival post-IPO. Although recent regulations such as the NASDAQ board diversity listing standard requires greater board diversity and disclosure, this standard focuses on demographic attributes of board members. Our findings in this chapter show that incorporating professional expertise diversity in such listing standards works towards improving the survival prospect of IPO firms after listing. Thus, IPO firms who incorporate professional expertise diversity into their commitment to greater diversity are more likely to survive post-IPO. In the next chapter, we examine how board diversity influences innovative activity and innovative efficiency.

Figures and Tables

Figure 3.1 Summary of Theoretical Framework for the Impact of Board Diversity and Board Connections on IPO Survival

This figure summarises the theoretical framework discussed in section 3.2. The potential positive impact of board diversity and board connections on IPO survival is predicted through the human capital and social capital lens of the resource dependency theory. The negative impact of board diversity and board connections is predicted in line with the diversity theory.

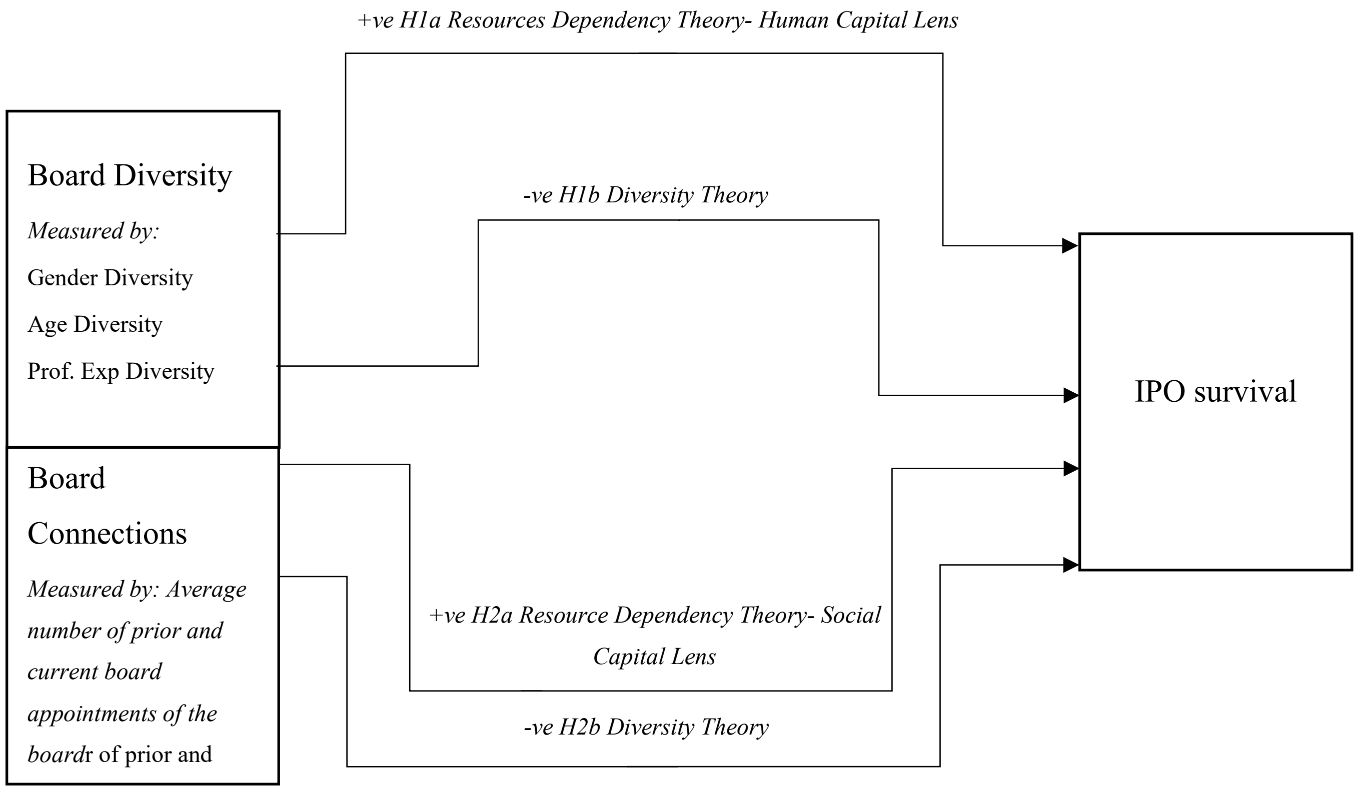


Table 3.1 IPO Survivorship Analysis

This table shows the distribution of IPO survivorship for the sample period. There are three main survivorship categories: Survivors, Mergers and Delistings. Panel A shows the percentage of firms that survived in the post-IPO period up to years 5 and 10 post-IPO, where year 0 is the IPO year. Panel B shows the distribution of IPOs by survivorship category. Survivors are defined as firms that remains publicly traded as an independent entity up to year 5 post-IPO or the last year of the sample period. 23 firms involved in IPOs less than 5 years ago but surviving up to year 4 post-IPO are also included as survivors in the sample. Mergers are firms that are involved in a merger or are acquired after listing and they lose their identity as independent entities post-IPO. Delistings are firm that do not survive as independent entities after the IPO and exit the stock market regardless of the reason for delisting. There are only 20 bankruptcies in the sample and hence we do not differentiate between bankruptcies from the other reasons for delisting. Panel C shows the industry distribution of firms at the IPO (year 0) and five years post-IPO (year 5) as well as the survival rates for each industry.

Panel A: Post-IPO Survival Relative to IPO Year

Years After IPO	IPOs	Percentage
0	661	100.00
1	565	85.48
2	508	76.85
3	466	70.50
4	431	65.20
5	304	45.99
10	288	43.57

Panel B: Post-IPO Survival by Category

Years After IPO	Survivors	%	Merger	%	Delistings	%
1	565	85.48	64	9.68	32	4.84
2	508	76.85	99	14.98	54	8.17
3	466	70.50	124	18.76	71	10.74
4	431	65.20	144	21.79	86	13.01
5	304	45.99	236	35.70	121	18.31
10	288	43.57	241	36.46	132	19.97

Panel C: Fama-French Industry Classification for Surviving Firms to Year 5 post-IPO

Industry	Year 0	Percentage	Year 5	Percentage	IPO Survival Rate (Year5/Year 0)
Consumer non-durables	21	3.18	7	2.30	33.33
Consumer durables	10	1.51	5	1.64	50.00
Manufacturing	35	5.30	19	6.25	54.29
Oil, gas, coal extraction and products	16	2.42	11	3.62	68.75
Chemical and allied products	6	0.91	4	1.32	66.67
Business equipment	226	34.19	96	31.58	42.48
Telephone and television transmission	33	4.99	11	3.62	33.33
Utilities	4	0.61	2	0.66	50.00
Wholesale, retail, and some services	79	11.95	35	11.51	44.30
Healthcare, medical equipment and drugs	132	19.97	72	23.68	54.55
Other	99	14.98	42	13.82	42.42
Total	661	100.00	304	100.00	45.99

Table 3.2 Descriptive Statistics and Univariate Analysis Comparing Survivors and Non-Survivors

This table provides descriptive statistics in year 0 for the 661 IPOs in the sample. Consistent with the hypotheses, the independent and control variable are grouped based on survival. Survivors are defined as firms that remain publicly traded and independent entities up to year 5 post-IPO or the last year of the sample period. Non-Survivors relate to all other firms that are not classified as survivors and exit the sample post-IPO due to a merger or delisting. t-test results show the differences in the means between survivors and non-survivors in year 0. Wilcoxon rank-sum test on the difference in medians is conducted. The Wilcoxon rank-sum test is used to test the equality of medians for the unmatched data when survivors are compared to non-survivors. This table shows the significant results from the t-test in the columns relating to survivors. Gender Diversity is the percentage of females on the board. Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). High scores indicate greater age diversity. Prof Exp. Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. Board Connections is the average number of connections the board has to other boards in terms of board seats. Firm Age is the difference between the year of incorporation of the firm and the year of the IPO. Firm Size is the natural log of total assets. Leverage is the ratio of long-term debt to the total asset. Risk is the standard deviation of the daily holding period return annualised reported in CRSP. Return on Assets is the ratio of earnings before taxes, depreciation and amortisation divided by total assets. R&D Intensity is the log of one plus the ratio of research and development expenses to total assets. Asset Tangibility is the ratio of property, plant and equipment to total assets. Board Size is the average number of directors on the board in the year of the IPO. Board Independence is the percentage of independent directors on the board relative to board size. Board Voting Share Ownership is the total percentage of voting shares held by the board. VC Board Representation is a dummy variable that takes a value of one if a Venture Capitalist Director is present on the board in year 0, and zero otherwise. CEO Financial Expertise is a dummy variable that takes the value of one if the CEO has financial experience, and otherwise zero CEO Tenure is the number of years the CEO has served on the board in year 0. Founder CEO is a dummy variable that takes a value of one if the CEO is also the founder of the firm in year 0, and zero otherwise. CEO Duality is a dummy variable that takes a value of 1 if the CEO is also the board chair, and zero otherwise. IPO Underpricing is the difference between the price at the end of the first day of trading and the offer price expressed as a fraction of the offer price. IPO Premium is the difference between the offer price and the book value per share expressed as a fraction of the offer price. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

	Survivors N=304					Non-Survivors N=357				
	Mean	Median	St Dev	Min	Max	Mean	Median	St Dev	Min	Max
Panel A: Board Diversity and Board Connections										
Gender Diversity (%)	5.396	0.000	8.693	0.000	50.000	5.973	0.000	10.287	0.000	66.667
Age Diversity	0.176	0.172	0.055	0.037	0.362	0.175	0.176	0.059	0.042	0.446
Prof. Exp.Diversity	0.522***	0.571***	0.183	0.000	0.857	0.484	0.494	0.168	0.000	0.780
Board Connections	1.943***	1.667***	1.349	0.000	8.000	1.507	1.333	1.049	0.000	7.444
Panel B: Firm Characteristics										
Firm Age (years)	11.225	8.000***	12.196	0.000	87.000	9.991	6.000	13.591	0.000	97.000
Firm Size	5.247***	4.973***	1.537	0.000	10.333	4.742	4.716	1.401	-0.761	8.875
Leverage	0.157	0.013	0.242	0.000	1.691	0.156	0.017	0.311	0.000	3.828
Risk	4.543***	3.834***	2.587	0.155	19.785	5.292	4.451	2.954	0.779	22.877
Return on Assets	-0.113	-0.011*	0.292	-2.408	0.276	-0.144	-0.050	0.290	-1.837	0.276
R&D Intensity	1.733***	1.828***	1.578	0.000	5.543	1.291	1.024	1.360	0.000	4.465
Asset Tangibility	0.260	0.145	0.293	0.000	1.540	0.237	0.136	0.259	0.000	1.413
Panel C: Board and CEO Characteristics										
Board Size	7.243***	7.000***	1.829	2.000	15.000	6.737	7.000	1.801	2.000	13.000
Board Independence (%)	74.973***	80.000***	16.559	0.000	100.000	70.230	75.000	19.312	0.000	100.000
Board Voting Share Ownership (%)	41.361	43.876	25.125	0.000	94.635	41.564	43.299	22.853	0.000	100.000
CEO Financial Expertise	5.908	4.000	5.564	0.000	39.000	5.429	4.000	4.662	0.000	31.000
CEO Tenure (years)	0.359	0.000	0.480	0.000	1.000	0.375	0.000	0.485	0.000	1.000
Founder CEO	0.461	0.000	0.499	0.000	1.000	0.476	0.000	0.500	0.000	1.000
CEO Duality	0.747	1.000	0.436	0.000	1.000	0.720	1.000	0.450	0.000	1.000
VC Board Representation	0.072	0.000	0.260	0.000	1.000	0.073	0.000	0.260	0.000	1.000
Panel D: IPO Characteristics										
IPO Underpricing	-0.248	-0.092	0.525	-4.750	0.996	-0.270	-0.105	0.525	-4.417	0.278
IPO Premium	0.884**	0.808	0.698	-0.634	7.428	0.788	0.783	0.359	-0.707	3.892

Table 3.3 Board Professional Expertise Analysis

This table shows a detailed analysis of board professional expertise in year 0 separately for survivors and non-survivors. Panel A shows the average percentage of board professional expertise for each category comparing survivors to non-survivors. There are fourteen categories of professional expertise identified on the board of IPO firms and represented as percentages in the table below. These categories are consistent with Gray and Nowland (2017). *Academic* is the percentage of directors on the board with experience in academia such as a university appointment. *Accountant* is the percentage of directors on the board who are chartered accountants or have accounting experience such as, as a CPA). *Banker* is the percentage of directors that have experience in the banking industry. *Consultant* is the percentage of directors who have experience in consulting regardless of the industry. *Dentist* is the percentage of dentists on the board. *Doctor* is the percentage of medical doctors on the board. *Engineer* is the percentage of directors with engineering experience in the boardroom. *Executive* is the percentage of directors on the board that are executives in the firm or in other firms. *Finance Expert* is the percentage of directors with experience in the finance industry such as mutual funds or other financial firms. *IT Expert* is the percentage of directors with experience in technological firms. *Investment Professional* is the percentage of directors with experience as a venture capitalist or in private equity. *Lawyer* is the percentage of directors that are lawyers with experience in legal firms. *Politician* is the percentage of directors who have political experience and have occupied a government position. *Scientist* is the percentage of directors with experience as scientific researchers. The last column of Panel A reports the t-tests results for the differences in means between survivors and non-survivors in year 0 for each professional expertise category. Panel B compares the average percentage of a specific professional expertise within an industry with the average in the sample across the fourteen professional expertise categories. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: Board Professional Expertise and IPO survival

Board Professional Expertise	Survivors	Non-Survivors	t values/z values
Academic	1.603	1.308	0.749/0.185
Accountant	1.629	1.943	-0.723/-0.948
Banker	0.732	1.054	-1.003/-1.348
Consultant	4.089	3.170	1.481/0.964
Dentist	0.128	0.000	1.189/1.306
Doctor	1.161	2.671	-3.086***/-2.961**
Engineer	0.597	1.629	-2.204**/-3.458***
Executive Expertise	54.552	50.333	2.398**/2.657**
Finance Expert	2.386	3.508	-2.200**/-1.989**
IT Expert	0.945	1.111	-0.476/-0.671
Investment Professional	29.570	28.664	0.536/0.519
Lawyer	1.919	2.217	-0.663/-0.860
Politician	0.031	0.113	-0.999/-0.723
Scientist	0.712	2.231	-3.092***/-3.597***

Panel B: Professional Expertise by Industry

	Full Sample	Business Equipment	Chemical and Allied Products	Consumer Durables	Consumer Non-Durables	Healthcare	Manufacturing	Oil, Gas, Coal extraction and products	Other I.e., Construction, hospitality	Telephone and Television Transmission	Utilities	Wholesale
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Academic	1.467	0.920**	0.000	0.000	0.926	2.739***	0.408	1.823	2.421**	0.770	0.000	0.915
Accountant	1.774	1.728	0.000	1.429	4.773**	1.561	1.796	0.000	1.477	0.000	0.000	3.193**
Banker	0.880	1.124	1.667	0.000	0.433	0.494	0.317	1.935	0.524	0.000	4.545*	1.659*
Consultant	3.667	3.953	3.598	8.952**	6.187**	2.124**	3.514	2.969	3.262	3.029	2.273	5.146*
Dentist	0.070	0.000	0.000	0.000	0.000	0.253*	0.000	0.000	0.126	0.000	0.000	0.000
Doctor	1.855	0.301	1.667	0.000	0.000	7.702***	0.476	0.000	0.702	0.673	3.571	0.115
Engineer	1.072	2.127***	0.000	2.857	0.000	0.582	0.408	2.604	0.303	0.673	0.000	0.181
Executive Expertise	53.175	52.617	49.718	53.143	56.168	42.061***	59.193*	58.237	59.908***	55.932	51.926	54.884
Finance Expert	2.902	3.157	0.000	4.345	2.629	2.840	2.899	5.737*	2.346	2.523	10.051**	2.309
IT Expert	1.022	2.456***	1.667	0.000	0.000	0.189	0.000	0.000	0.455	0.379	0.000	0.352
Investment Professional	29.154	29.471	31.684	27.274	26.743	31.824	26.767	25.030	24.814	33.287	21.284	30.473
Lawyer	2.065	1.797	1.667	2.000	2.141	1.843	3.078	1.667	3.662	2.060	6.349	0.563**
Politician	0.069	0.112	0.000	0.000	0.000	0.000	0.571***	0.000	0.000	0.000	0.000	0.000
Scientist	1.411	0.327***	8.333***	0.000	0.000	5.597***	0.571	0.000	0.000	1.010	0.000	0.211

Table 3.4 Pearson's Correlation Matrix for Board Diversity, Board Connections, and Control Variables

This table shows the Pearson's correlation matrix for all the explanatory variables included in our analysis.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
(1) Gender Diversity	1.000																			
(2) Age Diversity	-0.083	1.000																		
(3) Prof. Exp. Diversity	0.092	0.099	1.000																	
(4) Board Connections	0.047	-0.023	0.156*	1.000																
(5) Firm Age	-0.018	-0.003	0.014	0.005	1.000															
(6) Firm Size	0.019	0.036	0.095	0.265*	0.220*	1.000														
(7) Leverage	0.011	-0.011	0.030	0.158*	0.202*	0.357*	1.000													
(8) Risk	-0.021	0.005	-0.083	-0.085	-0.206*	-0.295*	-0.281*	1.000												
(9) Return on Assets	0.045	0.011	-0.128*	-0.047	0.180*	0.350*	0.052	-0.346*	1.000											
(10) R&D Intensity	0.026	-0.065	0.225*	0.156*	-0.059	0.064	-0.145*	0.136*	-0.234*	1.000										
(11) Asset Tangibility	-0.086	0.013	-0.054	-0.048	0.169*	0.244*	0.297*	-0.262*	0.163*	-0.321*	1.000									
(12) Board Size	0.035	0.083	0.204*	0.237*	0.047	0.344*	0.117*	-0.127*	-0.025	0.169*	0.024	1.000								
(13) Board Independence	0.005	0.031	0.256*	0.293*	-0.017	0.252*	0.086	-0.069	-0.017	0.234*	-0.009	0.395*	1.000							
(14) Board Voting Share Ownership	0.086	0.131*	0.095	0.071	0.037	-0.005	0.027	-0.026	0.092	0.038	-0.027	-0.020	-0.050	1.000						
(15) CEO Financial Expertise	-0.022	0.020	0.063	0.058	-0.007	-0.084	0.050	0.051	-0.125*	-0.002	-0.046	-0.014	-0.057	0.011	1.000					
(16) CEO Tenure	0.042	0.027	-0.039	-0.077	0.168*	-0.055	0.001	-0.154*	0.181*	-0.050	0.065	-0.050	-0.019	0.133*	-0.064	1.000				
(17) Founder CEO	0.041	0.075	-0.058	-0.144*	-0.150*	-0.220*	-0.160*	0.152*	-0.038	0.022	-0.129*	-0.090	-0.089	0.136*	-0.032	0.344*	1.000			
(18) CEO Duality	-0.054	0.001	-0.017	-0.070	-0.041	-0.045	0.012	-0.054	0.116*	-0.139*	0.063	-0.104*	-0.102*	0.101*	-0.041	0.197*	0.258*	1.000		
(19) VC Board Representation	0.093	0.073	0.385*	0.237*	-0.027	0.225*	-0.000	0.037	-0.033	0.290*	-0.066	0.255*	0.353*	0.216*	0.024	-0.107*	-0.042	-0.089	1.000	
(20) IPO Underpricing	-0.036	-0.066	-0.021	0.045	0.092	-0.022	0.126*	-0.327*	0.080	-0.147*	0.117*	0.043	0.019	-0.082	0.009	0.070	-0.103*	0.011	-0.137*	1.000
(21) IPO Premium	-0.008	0.074	0.110*	0.158*	0.109*	0.072	0.193*	-0.010	-0.131*	0.049	-0.017	0.095	0.053	0.042	-0.007	-0.023	-0.029	-0.023	0.081	-0.012

Table 3.5 Regressions for the Impact of Board Diversity and Board Connections on the Likelihood of Survival Post-IPO

This table reports the logit and multinomial logit regression results for the impact of board diversity and board connections on IPO survival to year 5 post-IPO. In columns 1 and 2, survivors is a dummy variable that takes a value of one if a firm remains publicly traded as an independent entity to year 5 post-IPO or the last year of the sample period and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a survivor up to year 5, two if the IPO firm is involved in a merger up to year 5, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. Gender Diversity is the percentage of females on the board. Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). High scores indicate greater age diversity. Prof. Exp. Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. Board Connections is the average number of connections the board has to other boards in terms of board seats. All control variables are defined in Appendix 3.1 ME stands for marginal effects on the likelihood of IPO survival. The marginal effects in columns 4 and 6 relate to the probability of an IPO firm exiting through a merger or delisting only and is not compared to survivors as in the multinomial logit. t statistics are heteroscedasticity consistent and reported in the parentheses.*, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Gender Diversity$_t$	-0.012	-0.003	0.013	0.003	0.007	0.000	0.006	0.003
	(-1.238)		(1.345)		(0.492)		(0.476)	
Age Diversity$_t$	0.612	0.152	-0.273	-0.034	-1.198	-0.066	0.925	-0.034
	(0.382)		(-0.153)		(-0.553)		(0.418)	
Prof. Exp. Diversity$_t$	0.222	0.055	-0.312	-0.069	-0.225	-0.006	-0.087	-0.069
	(0.367)		(-0.479)		(-0.281)		(-0.115)	
Board Connections$_t$	0.175**	0.044**	-0.187**	-0.042*	-0.114	-0.002	-0.073	-0.042*
	(2.010)		(-1.998)		(-0.832)		(-0.530)	
Firm Age$_t$	0.000	0.000	-0.001	-0.001	0.007	0.000	-0.008	-0.001
	(0.009)		(-0.154)		(0.650)		(-0.715)	
Firm Size$_t$	0.165*	0.041*	-0.115	-0.021	-0.261**	-0.013**	0.145	-0.021
	(1.756)		(-1.152)		(-2.207)		(1.324)	
Leverage$_t$	-0.953*	-0.237*	1.065**	0.242**	0.544	0.005	0.521	0.242**
	(-1.838)		(2.101)		(0.927)		(1.243)	
Risk$_t$	-0.044	-0.011	0.023	0.003	0.096	0.005	-0.073	0.003
	(-0.936)		(0.413)		(1.561)		(-1.190)	
Return on Assets$_t$	0.540	0.134	0.107	0.061	-1.345**	-0.085***	1.452***	0.061
	(1.292)		(0.208)		(-2.304)		(2.732)	
R&D Intensity$_t$	0.209**	0.052**	-0.137	-0.022	-0.434***	-0.023***	0.296**	-0.022
	(2.389)		(-1.507)		(-2.986)		(2.062)	
Asset Tangibility$_t$	0.478	0.119	-0.560	-0.126	-0.330	-0.005	-0.231	-0.126
	(1.185)		(-1.261)		(-0.577)		(-0.388)	
Board Size$_t$	0.067	0.017	-0.047	-0.008	-0.111	-0.006	0.064	-0.008
	(1.204)		(-0.777)		(-1.392)		(0.779)	
Board Independence$_t$	0.005	0.001	-0.004	-0.001	-0.003	-0.000	-0.001	-0.001
	(0.799)		(-0.604)		(-0.382)		(-0.145)	
Board Voting Share	-0.003	-0.001	0.000	-0.000	0.009	0.001*	-0.008	-0.000
Ownership$_t$	(-0.700)		(0.050)		(1.619)		(-1.568)	
CEO Financial	0.125	0.031	-0.106	-0.023	-0.110	-0.004	0.004	-0.023
Expertise$_t$	(0.368)		(-0.280)		(-0.235)		(0.008)	
CEO Tenure$_t$	0.015	0.004	-0.006	-0.000	-0.038	-0.002	0.032	-0.000
	(0.757)		(-0.288)		(-1.218)		(1.010)	
Founder CEO$_t$	0.034	0.008	0.043	0.015	-0.161	-0.011	0.204	0.015
	(0.163)		(0.191)		(-0.554)		(0.679)	
CEO Duality$_t$	0.103	0.026	-0.085	-0.018	-0.094	-0.004	0.009	-0.018
	(0.550)		(-0.412)		(-0.377)		(0.036)	
VC Board	-0.363	-0.090	0.709**	0.172***	-0.074	-0.023	0.783**	0.172***
Representation$_t$	(-1.504)		(2.528)		(-0.239)		(2.429)	
IPO Underpricing$_t$	-0.125	-0.031	-0.014	-0.015	0.464	0.029	-0.478	-0.015
	(-0.694)		(-0.075)		(1.160)		(-1.203)	
IPO Premium$_t$	0.360*	0.089*	-0.342	-0.070	-0.448	-0.018	0.107	-0.070
	(1.867)		(-1.600)		(-1.543)		(0.328)	
Constant	-2.919***		1.841*		2.463**		-0.622	
	(-3.209)		(1.926)		(2.047)		(-0.553)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.116		0.146		0.146		0.146	
Chi-square	93.486***		2818.774***		2818.774***		2870.809***	
Log Likelihood	-402.979		-584.509		-584.509		-584.509	

Table 3.6 Regressions for the Interaction of Gender Diversity and Board Connections on the Likelihood of Survival Post-IPO

This table focuses on the impact of interacting gender diversity and board connections on IPO survival to year 5 post-IPO. This table does not test our hypothesis, but further explores the impact of our key independent variables when interacted together. In detail, this table reports the impact of greater gender diversity in a board with connections to other boards at the IPO, on survival to year 5 post-IPO. The results for age diversity are insignificant and are not reported in this analysis. In columns 1 and 2, survivors is a dummy variable that takes a value of one if a firm remains publicly traded as an independent entity to year 5 post-IPO or the last year of the sample period and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a survivor up to year 5, two if the IPO firm is involved in a merger up to year 5, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. All measures of board diversity and other control variables are defined in Appendix 3.1. ME stands for marginal effects. The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Gender Diversity$_t$	-0.022	-0.005	0.035**	0.008**	-0.004	-0.001	0.039*	0.008**
	(-1.350)		(1.974)		(-0.173)		(1.698)	
Gender Diversity$_t$* Board Connections$_t$	0.006	0.001	-0.013	-0.003*	0.008	0.001	-0.021**	-0.003*
	(0.733)		(-1.485)		(0.833)		(-2.015)	
Board Connections$_t$	0.141	0.035	-0.112	-0.022	-0.160	-0.007	0.048	-0.022
	(1.425)		(-1.036)		(-1.081)		(0.317)	
Firm Age$_t$	0.000	0.000	-0.001	-0.001	0.007	0.000	-0.008	-0.001
	(0.003)		(-0.155)		(0.697)		(-0.755)	
Firm Size$_t$	0.171*	0.042*	-0.123	-0.022	-0.266**	-0.014**	0.143	-0.022
	(1.809)		(-1.207)		(-2.209)		(1.274)	
Leverage$_t$	-0.991*	-0.246*	1.123**	0.255**	0.522	0.003	0.600	0.255**
	(-1.882)		(2.128)		(0.862)		(1.337)	
Risk$_t$	-0.046	-0.011	0.026	0.004	0.090	0.005	-0.065	0.004
	(-0.974)		(0.462)		(1.491)		(-1.060)	
Return on Assets$_t$	0.526	0.131	0.110	0.063	-1.335**	-0.088***	1.445***	0.063
	(1.255)		(0.213)		(-2.302)		(2.729)	
R&D Intensity$_t$	0.208**	0.052**	-0.141	-0.022	-0.419***	-0.023***	0.277*	-0.022
	(2.378)		(-1.544)		(-2.855)		(1.901)	
Asset Tangibility$_t$	0.476	0.118	-0.547	-0.122	-0.323	-0.006	-0.224	-0.122
	(1.185)		(-1.228)		(-0.564)		(-0.375)	
Board Size$_t$	0.071	0.018	-0.054	-0.010	-0.113	-0.006	0.059	-0.010
	(1.278)		(-0.889)		(-1.421)		(0.721)	
Board Independence$_t$	0.005	0.001	-0.004	-0.001	-0.004	-0.000	0.000	-0.001
	(0.827)		(-0.556)		(-0.494)		(0.000)	
Board Voting Share Ownership$_t$	-0.003	-0.001	-0.000	-0.000	0.008	0.001*	-0.008	-0.000
	(-0.635)		(-0.002)		(1.586)		(-1.568)	
CEO Financial Expertise$_t$	0.115	0.028	-0.098	-0.019	-0.163	-0.008	0.066	-0.019
	(0.333)		(-0.256)		(-0.350)		(0.142)	
CEO Tenure$_t$	0.015	0.004	-0.007	-0.001	-0.037	-0.002	0.031	-0.001
	(0.778)		(-0.326)		(-1.234)		(0.998)	
Founder CEO$_t$	0.043	0.011	0.033	0.011	-0.125	-0.009	0.158	0.011
	(0.207)		(0.144)		(-0.428)		(0.517)	
CEO Duality$_t$	0.101	0.025	-0.080	-0.016	-0.110	-0.005	0.031	-0.016
	(0.543)		(-0.388)		(-0.440)		(0.117)	
VC Board Representation$_t$	-0.340	-0.085	0.690**	0.169***	-0.122	-0.027	0.812**	0.169***
	(-1.455)		(2.523)		(-0.409)		(2.573)	
IPO Underpricing$_t$	-0.133	-0.033	-0.005	-0.014	0.461	0.030	-0.466	-0.014
	(-0.748)		(-0.028)		(1.180)		(-1.203)	
IPO Premium$_t$	0.369*	0.092*	-0.343	-0.070	-0.449	-0.019	0.106	-0.070
	(1.890)		(-1.577)		(-1.531)		(0.323)	
Constant	-2.735***		1.599*		2.312**		-0.713	
	(-3.061)		(1.704)		(1.975)		(-0.670)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.116		0.148		0.148		0.148	
Chi-square	93.535***		2605.741***		2605.741***		2612.528***	
Log Likelihood	-402.915		-582.998		-582.998		-582.998	

Table 3.7 Regressions for the Interaction of Professional Expertise Diversity and Board Connections on the Likelihood of Survival Post-IPO

This table focuses on the impact of interacting professional expertise diversity and board connections on IPO survival to year 5 post-IPO. This table does not test our hypothesis but goes further to analyse the impact of our independent variables when interacted together. In detail, this table reports the impact of greater professional expertise diversity in a board with connections to other boards at the IPO, on survival to year 5 post-IPO. In columns 1 and 2, survivors is a dummy variable that takes a value of one if a firm remains publicly traded as an independent entity to year 5 post-IPO or the last year of the sample period and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a survivor up to year 5, two if the IPO firm is involved in a merger up to year 5, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. All measures of board diversity and other control variables are defined in Appendix 3.1. ME stands for marginal effects. The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Prof. Exp. Diversity$_t$	1.756**	0.436**	-1.798*	-0.378*	-1.961*	-0.076	0.163	-0.378*
	(2.000)		(-1.846)		(-1.732)		(0.148)	
Prof. Exp. Diversity$_t$* Board Connections$_t$	-1.035**	-0.257**	0.987**	0.205*	1.185**	0.048	-0.198	0.205*
	(-2.379)		(2.041)		(2.040)		(-0.342)	
Board Connections$_t$	0.697***	0.173***	-0.687**	-0.146**	-0.703**	-0.026	0.017	-0.146**
	(2.920)		(-2.512)		(-2.358)		(0.054)	
Firm Age$_t$	-0.000	-0.000	-0.001	-0.001	0.008	0.001	-0.009	-0.001
	(-0.015)		(-0.152)		(0.738)		(-0.801)	
Firm Size$_t$	0.181*	0.045*	-0.129	-0.023	-0.283**	-0.015**	0.154	-0.023
	(1.947)		(-1.300)		(-2.372)		(1.357)	
Leverage$_t$	-1.001**	-0.248**	1.106**	0.250**	0.579	0.007	0.527	0.250**
	(-1.996)		(2.247)		(1.008)		(1.258)	
Risk$_t$	-0.042	-0.010	0.020	0.002	0.096	0.006	-0.075	0.002
	(-0.901)		(0.371)		(1.572)		(-1.230)	
Return on Assets$_t$	0.471	0.117	0.179	0.078	-1.267**	-0.086***	1.446***	0.078
	(1.153)		(0.350)		(-2.249)		(2.762)	
R&D Intensity$_t$	0.214**	0.053**	-0.142	-0.022	-0.439***	-0.024***	0.297**	-0.022
	(2.440)		(-1.547)		(-2.997)		(2.026)	
Asset Tangibility$_t$	0.581	0.144	-0.662	-0.148	-0.416	-0.008	-0.246	-0.148
	(1.441)		(-1.486)		(-0.730)		(-0.413)	
Board Size$_t$	0.073	0.018	-0.052	-0.009	-0.118	-0.006	0.066	-0.009
	(1.299)		(-0.857)		(-1.491)		(0.817)	
Board Independence$_t$	0.003	0.001	-0.002	-0.000	-0.001	0.000	-0.001	-0.000
	(0.471)		(-0.301)		(-0.076)		(-0.182)	
Board Voting Shares Ownership$_t$	-0.002	-0.001	-0.000	-0.000	0.008	0.001*	-0.008	-0.000
	(-0.601)		(-0.030)		(1.520)		(-1.543)	
CEO Financial Expertise$_t$	0.147	0.037	-0.129	-0.027	-0.134	-0.005	0.004	-0.027
	(0.447)		(-0.350)		(-0.290)		(0.009)	
CEO Tenure$_t$	0.017	0.004	-0.008	-0.001	-0.041	-0.002	0.033	-0.001
	(0.863)		(-0.381)		(-1.295)		(1.043)	
Founder CEO$_t$	0.020	0.005	0.061	0.019	-0.158	-0.012	0.219	0.019
	(0.098)		(0.268)		(-0.548)		(0.726)	
CEO Duality$_t$	0.111	0.028	-0.100	-0.022	-0.089	-0.003	-0.011	-0.022
	(0.593)		(-0.481)		(-0.355)		(-0.041)	
VC Board Representation$_t$	-0.362	-0.090	0.717**	0.174***	-0.082	-0.025	0.799**	0.174***
	(-1.483)		(2.520)		(-0.262)		(2.450)	
IPO Underpricing$_t$	-0.116	-0.029	-0.025	-0.019	0.455	0.030	-0.480	-0.019
	(-0.650)		(-0.137)		(1.151)		(-1.222)	
IPO Premium$_t$	0.353**	0.088**	-0.336*	-0.068	-0.447	-0.019	0.111	-0.068
	(1.968)		(-1.717)		(-1.557)		(0.347)	
Constant	-3.654***		2.613***		3.165**		-0.553	
	(-3.765)		(2.581)		(2.527)		(-0.481)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.121		0.149		0.149		0.149	
Chi-square	94.731***		2557.569***		2557.569***		2558.836***	
Log Likelihood	-401.051		-582.591		-582.591		-582.591	

Further Analysis

Table 3.8 The Impact of Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO

This table reports the Cox proportional hazard estimation for the impact of board diversity and board connections on survival time. There are 661 observations for IPOs from which 357 firms are non-survivors. The average survival time for IPOs is 3.9 years. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of exit post-IPO whether through a merger or delisting. Gender Diversity is the percentage of females on the board. Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). High scores indicate greater age diversity. Prof. Exp. Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. Board Connections is the average number of prior and current board appointments of the board in year 0. Models 1 and 2 focus relate to the Cox model, while models 3 and 4 relate to the AFT model. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	COX model t=0		Accelerated Failure Time Model t=0	
Independent Variables	(1)	HR (2)	(3)	TR (4)
Gender Diversity$_t$	0.004	1.004	-0.004	0.996
	(0.832)		(-0.839)	
Age Diversity$_t$	-0.326	0.722	0.274	1.316
	(-0.364)		(0.317)	
Prof. Exp. Diversity$_t$	-0.032	0.968	0.030	1.031
	(-0.103)		(0.100)	
Board Connections$_t$	-0.101*	0.904*	0.100*	1.105*
	(-1.819)		(1.869)	
Firm Age$_t$	-0.001	0.999	0.001	1.001
	(-0.287)		(0.172)	
Firm Size$_t$	-0.081*	0.922*	0.080*	1.083*
	(-1.672)		(1.728)	
Leverage$_t$	0.254*	1.290*	-0.274*	0.760*
	(1.742)		(-1.956)	
Risk$_t$	0.043*	1.044*	-0.040*	0.961*
	(1.850)		(-1.753)	
Return on Assets$_t$	-0.392*	0.676*	0.356*	1.427*
	(-1.899)		(1.802)	
R&D Intensity$_t$	-0.162***	0.850***	0.155***	1.168***
	(-3.185)		(3.188)	
Asset Tangibility$_t$	-0.312	0.732	0.328	1.388
	(-1.338)		(1.484)	
Board Size$_t$	-0.029	0.971	0.029	1.029
	(-0.870)		(0.897)	
Board Independence$_t$	-0.003	0.997	0.003	1.003
	(-0.919)		(0.888)	
Board Voting Share Ownership$_t$	0.001	1.001	-0.001	0.999
	(0.625)		(-0.530)	
CEO Financial Expertise$_t$	-0.079	0.924	0.092	1.097
	(-0.375)		(0.462)	
CEO Tenure$_t$	-0.013	0.987	0.011	1.011
	(-1.069)		(0.922)	
Founder CEO$_t$	0.030	1.030	-0.021	0.979
	(0.241)		(-0.179)	
CEO Duality$_t$	0.024	1.025	-0.017	0.983
	(0.224)		(-0.168)	
VC Board Representation$_t$	0.241*	1.273*	-0.247*	0.781*
	(1.778)		(-1.895)	
IPO Underpricing$_t$	0.140	1.151	-0.138	0.871
	(1.412)		(-1.462)	
IPO Premium$_t$	-0.148	0.863	0.142	1.152
	(-1.184)		(1.152)	
Constant	-		0.727*	
			(1.680)	
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
No. of observations	661		661	
No. of failures	357		357	
Pseudo R^2	0.020		-	
Chi-square	112.347***		112.213***	

Table 3.9 The Impact of the Interaction Between Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO

This table reports the Cox proportional hazard model, and the accelerated failure time model for the impact of the interaction for board diversity and board connections on survival time and time to failure. Columns 1 to 4 relate to the Cox model, while columns 5 to 8 relate to the AFT model. The average survival time for non-survivors is 3.9 years and provides a baseline in interpreting the results in this table. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of exit whether through merger or delisting. All the measures of board diversity, board connections and control variables are defined in Appendix 3.1. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Gender Diversity*Board Connections Model t=0		Prof. Exp. Diversity*Board Connections t=0		Gender Diversity*Board Connections Model t=0		Prof. Exp. Diversity*Board Connections t=0	
	COX model t=0				Accelerated Failure Time Model t=0			
Independent Variables	(1)	HR (2)	(3)	HR (4)	(5)	TR (6)	(7)	TR (8)
Gender Diversity$_t$	0.007	1.007			-0.006	0.994		
	(0.790)				(-0.794)			
Gender Diversity $_t$* Board Connections$_t$	-0.001	0.999			0.001	1.001		
	(-0.272)				(0.275)			
Prof. Exp. Diversity$_t$			-0.720*	0.487*			0.681*	1.975*
			(-1.726)				(1.689)	
Prof. Exp. Diversity$_t$* Board Connections$_t$			0.509**	1.664**			-0.484**	0.617**
			(2.237)				(-2.208)	
Board Connections$_t$	-0.092	0.912	-0.345***	0.708***	0.091	1.096	0.333***	1.395***
	(-1.465)		(-2.848)		(1.515)		(2.820)	
Firm Age$_t$	-0.001	0.999	-0.001	0.999	0.001	1.001	0.001	1.001
	(-0.264)		(-0.222)		(0.152)		(0.111)	
Firm Size$_t$	-0.082*	0.922*	-0.091*	0.913*	0.081*	1.084*	0.088*	1.092*
	(-1.689)		(-1.869)		(1.747)		(1.908)	
Leverage$_t$	0.262*	1.299*	0.275*	1.316*	-0.280**	0.755**	-0.292**	0.746**
	(1.807)		(1.891)		(-2.015)		(-2.099)	
Risk$_t$	0.045*	1.046*	0.045*	1.046*	-0.041*	0.959*	-0.042*	0.959*
	(1.939)		(1.947)		(-1.832)		(-1.839)	
Return on Assets$_t$	-0.387*	0.679*	-0.350*	0.705*	0.352*	1.422*	0.315	1.370
	(-1.871)		(-1.690)		(1.780)		(1.587)	
R&D Intensity$_t$	-0.162***	0.851***	-0.169***	0.844***	0.155***	1.167***	0.161***	1.174***
	(-3.163)		(-3.290)		(3.170)		(3.282)	
Asset Tangibility$_t$	-0.309	0.734	-0.357	0.700	0.326	1.385	0.372*	1.451*
	(-1.326)		(-1.539)		(1.476)		(1.701)	
Board Size$_t$	-0.031	0.970	-0.032	0.969	0.030	1.030	0.031	1.031
	(-0.914)		(-0.956)		(0.937)		(0.976)	
Board Independence$_t$	-0.003	0.997	-0.003	0.997	0.003	1.003	0.002	1.002
	(-0.940)		(-0.705)		(0.902)		(0.690)	
Board Voting Share Ownership$_t$	0.001	1.001	0.001	1.001	-0.001	0.999	-0.001	0.999
	(0.591)		(0.484)		(-0.501)		(-0.396)	
CEO Financial Expertise$_t$	-0.083	0.920	-0.092	0.912	0.095	1.100	0.104	1.109
	(-0.389)		(-0.436)		(0.472)		(0.522)	
CEO Tenure$_t$	-0.013	0.987	-0.014	0.986	0.011	1.011	0.012	1.012
	(-1.077)		(-1.216)		(0.931)		(1.060)	
Founder CEO$_t$	0.025	1.026	0.028	1.029	-0.017	0.983	-0.021	0.979
	(0.205)		(0.229)		(-0.147)		(-0.179)	
CEO Duality$_t$	0.027	1.028	0.031	1.032	-0.020	0.980	-0.021	0.979
	(0.254)		(0.291)		(-0.194)		(-0.207)	
VC Board Representation$_t$	0.237*	1.267*	0.242*	1.274*	-0.243*	0.784*	-0.248*	0.780*
	(1.793)		(1.776)		(-1.916)		(-1.892)	
IPO Underpricing$_t$	0.145	1.156	0.131	1.140	-0.142	0.867	-0.131	0.877
	(1.461)		(1.330)		(-1.514)		(-1.401)	
IPO Premium$_t$	-0.151	0.860	-0.160	0.852	0.145	1.156	0.152	1.164
	(-1.210)		(-1.318)		(1.172)		(1.264)	
Constant	-	-			0.782*		0.410	
					(1.831)		(0.902)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
No. of failures	357		357		357		357	
Pseudo R^2	0.020		0.021		-		-	
Chi-square	112.753***		115.922***		112.887***		114.745***	

Table 3.10 Sub-sample Survival Analysis for the Impact of Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO

This table reports the Cox proportional hazard model, and the accelerated failure time model for the impact of board diversity on survival time and time to failure. Columns 1 to 4 compare survivors to mergers and there are 540 observations for this sample of which 304 firms are survivors and 236 firms are mergers. Columns 5 to 8 compares survivors to delistings and there are 425 observations for this sample of which 304 firms are survivors and 121 firms are delistings. Columns 9 to 12 compares merger to delistings and there are 357 observations for this sample of which, 236 firms are mergers while 121 are delistings firms.The average survival time for mergers is 3.1 years, while the average survival time for delistings is 2.9 years. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of merger or delisting. All the measures of board diversity, board connections and control variables are defined in Appendix 3.1. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively. Unreported results for survival time to year 10 post-IPO yield similar results to the below.

	Survivors compared to Mergers				Survivors compared to Delistings				Mergers compared to Delistings			
	COX model t=0		Accelerated Failure Time Model t=0		COX model t=0		Accelerated Failure Time Model t=0		COX model t=0		Accelerated Failure Time Model t=0	
Independent Variables	(1)	HR (2)	(3)	TR (4)	(5)	HR (6)	(7)	TR (8)	(9)	HR (10)	(11)	TR (12)
Gender Diversity$_t$	0.007	1.007	-0.006	0.994	0.005	1.005	-0.004	0.996	-0.002	0.998	0.002	1.002
	(1.025)		(-0.987)		(0.405)		(-0.402)		(-0.189)		(0.239)	
Age Diversity$_t$	-0.163	0.849	0.126	1.134	-0.268	0.765	0.320	1.377	-1.121	0.326	0.820	2.270
	(-0.137)		(0.107)		(-0.164)		(0.201)		(-0.615)		(0.510)	
Prof. Exp. Diversity$_t$	-0.010	0.990	0.014	1.014	-0.482	0.617	0.467	1.594	0.432	1.540	-0.301	0.740
	(-0.024)		(0.033)		(-0.918)		(0.920)		(0.726)		(-0.572)	
Board Connections$_t$	-0.121*	0.886*	0.124*	1.132*	-0.121	0.886	0.119	1.127	0.072	1.075	-0.052	0.950
	(-1.801)		(1.888)		(-0.999)		(1.014)		(0.688)		(-0.545)	
Firm Age$_t$	0.000	1.000	-0.001	0.999	-0.000	1.000	-0.000	1.000	0.004	1.004	-0.005	0.995
	(0.052)		(-0.096)		(-0.008)		(-0.036)		(0.543)		(-0.780)	
Firm Size$_t$	-0.054	0.947	0.058	1.060	-0.126	0.882	0.115	1.122	-0.084	0.919	0.083	1.087
	(-0.928)		(1.004)		(-1.461)		(1.389)		(-0.881)		(1.018)	
Leverage$_t$	0.376**	1.456**	-0.384**	0.681**	0.185	1.203	-0.192	0.826	-0.424	0.654	0.302	1.352
	(2.183)		(-2.304)		(0.317)		(-0.338)		(-1.377)		(1.056)	
Risk$_t$	0.022	1.022	-0.019	0.981	0.113***	1.120***	-0.110***	0.896***	0.103**	1.108**	-0.086**	0.918**
	(0.673)		(-0.610)		(3.101)		(-3.131)		(2.196)		(-2.123)	
Return on Assets$_t$	-0.083	0.920	0.068	1.070	-1.009***	0.364***	0.982***	2.669***	-0.829**	0.436**	0.700**	2.014**
	(-0.249)		(0.207)		(-3.500)		(3.595)		(-2.528)		(2.512)	
R&D Intensity$_t$	-0.121**	0.886**	0.114*	1.121*	-0.353***	0.703***	0.350***	1.420***	-0.260**	0.771**	0.244**	1.277**
	(-2.012)		(1.956)		(-3.038)		(3.118)		(-2.235)		(2.387)	
Asset Tangibility$_t$	-0.360	0.698	0.365	1.441	-0.321	0.725	0.337	1.401	-0.125	0.882	0.141	1.151
	(-1.174)		(1.219)		(-0.712)		(0.784)		(-0.326)		(0.419)	
Board Size$_t$	-0.012	0.988	0.017	1.018	-0.102*	0.903*	0.096	1.101	0.030	1.030	-0.021	0.979
	(-0.280)		(0.411)		(-1.690)		(1.644)		(0.467)		(-0.379)	
Board Independence$_t$	-0.004	0.996	0.004	1.004	-0.001	0.999	0.000	1.000	-0.002	0.998	0.001	1.001
	(-0.826)		(0.822)		(-0.097)		(0.028)		(-0.375)		(0.197)	
Board Voting Share	-0.001	0.999	0.001	1.001	0.007*	1.007*	-0.007*	0.993*	0.007	1.007	-0.005	0.995
Ownership$_t$	(-0.195)		(0.288)		(1.676)		(-1.712)		(1.602)		(-1.474)	
CEO Financial Expertise$_t$	-0.022	0.979	0.019	1.019	-0.400	0.670	0.407	1.502	0.061	1.063	-0.000	1.000
	(-0.077)		(0.069)		(-1.054)		(1.110)		(0.163)		(-0.002)	
CEO Tenure$_t$	-0.006	0.994	0.005	1.005	-0.032	0.968	0.030	1.031	-0.043	0.958	0.027	1.028
	(-0.407)		(0.356)		(-1.297)		(1.251)		(-1.640)		(1.166)	
Founder CEO$_t$	0.052	1.054	-0.046	0.955	0.082	1.085	-0.069	0.933	-0.050	0.951	0.097	1.102
	(0.330)		(-0.301)		(0.349)		(-0.302)		(-0.196)		(0.428)	

CEO Duality$_t$	0.024	1.024	-0.020	0.980	-0.083	0.920	0.087	1.091	0.184	1.202	-0.103	0.903
	(0.176)		(-0.151)		(-0.392)		(0.427)		(0.835)		(-0.549)	
VC Board Representation$_t$	0.506***	1.659***	-0.506***	0.603***	0.243	1.275	-0.233	0.792	-0.367	0.693	0.321	1.379
	(2.598)		(-2.636)		(1.021)		(-1.005)		(-1.576)		(1.569)	
IPO Underpricing$_t$	0.048	1.049	-0.052	0.949	0.470	1.601	-0.450	0.638	0.507	1.661	-0.473	0.623
	(0.414)		(-0.465)		(1.622)		(-1.626)		(1.297)		(-1.301)	
IPO Premium$_t$	-0.159	0.853	0.157	1.170	-0.293	0.746	0.285	1.330	0.129	1.138	-0.119	0.888
	(-1.047)		(1.036)		(-1.215)		(1.209)		(0.257)		(-0.282)	
Constant	-		1.046*		-		1.250		-		1.968**	
			(1.850)				(1.627)				(2.491)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	540		540		425		425		357		357	
No. of failures	236		236		121		121		121		121	
Pseudo R^2	0.023		-		0.086		-		0.066		-	
Chi-square	79.565***		79.797***		1782.270***		2504.688***		177.089***		2163.317***	

Table 3.11 Sub-sample Survival Analysis for the Impact of the Interaction Between Board Diversity and Board Connections on Survival Time to Year 5 Post-IPO

This table reports the Cox proportional hazard model, and the accelerated failure time model for the impact of the interaction of board diversity and board connections on survival time and time to failure. Panel A reports the results for the interaction of gender diversity and board connections, while Panel B reports the results for the interaction of professional expertise diversity and the former. Columns 1 to 4 compare survivors to mergers and there are 540 observations for this sample of which 304 firms are survivors and 236 firms are mergers. Columns 5 to 8 compares survivors to delistings and there are 425 observations for this sample of which 304 firms are survivors and 121 firms are delistings. Columns 9 to 12 compares merger to delistings and there are 357 observations for this sample of which, 236 firms are mergers while 121 are delistings firms.The average survival time for mergers is 3.1 years, while the average survival time for delistings is 2.9 years. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of merger or delisting. All the measures of board diversity, board connections and control variables are defined in Appendix 3.1 . t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Panel A: The Impact of the Interaction of Gender Diversity and Board Connections on Survival Time to year 5 post-IPO.												
	Mergers compared to Survivors				Delistings compared to Survivors				Mergers compared to Delistings			
	COX model t=0		Accelerated Failure Time Model t=0		COX model t=0		Accelerated Failure Time Model t=0		COX model t=0		Accelerated Failure Time Model t=0	
Independent Variables	(1)	HR (2)	(3)	TR (4)	(5)	HR (6)	(7)	TR (8)	(9)	HR (10)	(11)	TR (12)
Gender Diversity$_t$	0.015	1.015	-0.015	0.985	-0.009	0.991	0.009	1.009	-0.019	0.981	0.022	1.022
	(1.472)		(-1.446)		(-0.465)		(0.486)		(-0.966)		(1.242)	
Gender Diversity $_t$* Board Connections$_t$	-0.006	0.994	0.006	1.006	0.009	1.009	-0.008	0.992	0.013	1.013	-0.014	0.986
	(-0.904)		(0.926)		(0.994)		(-1.018)		(1.300)		(-1.619)	
Board Connections$_t$	-0.088	0.916	0.092	1.096	-0.160	0.852	0.159	1.172	0.005	1.005	0.025	1.025
	(-1.141)		(1.213)		(-1.278)		(1.300)		(0.047)		(0.242)	
Firm and Board Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	540		540		425		425		357		357	
No. of failures	236		236		121		121		121		121	
Pseudo R^2	0.023		-		0.086		-		0.066		-	
Chi-square	84.836^{***}		84.561^{***}		1152.270^{***}		2695.097^{***}		671.089^{***}		1907.240^{***}	
Panel B: The Impact of the Interaction of Professional Expertise Diversity and Board Connections on Survival Time to year 5 post-IPO												
Prof. Exp. Diversity$_t$	-0.746	0.474	0.745	2.106	-1.505^{**}	0.222^{**}	1.429^{**}	4.176^{**}	0.304	2.515	-0.214	0.807
	(-1.257)		(1.268)		(-2.006)		(1.972)		(0.399)		(-0.315)	
Prof. Exp. Diversity$_t$* Board Connections$_t$	0.491^{*}	1.634^{*}	-0.487^{*}	0.614^{*}	0.775^{*}	2.170^{*}	-0.732^{*}	0.481^{*}	0.068	0.807	-0.037	0.964
	(1.749)		(-1.769)		(1.882)		(-1.822)		(0.138)		(-0.082)	
Board Connections$_t$	-0.360^{**}	0.698^{**}	0.362^{**}	1.436^{**}	-0.488^{**}	0.614^{**}	0.466^{**}	1.594^{**}	0.047	1.048	-0.038	0.962
	(-2.342)		(2.382)		(-2.159)		(2.113)		(0.178)		(-0.158)	
Firm and Board Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	540		540		425		425		357		357	
No. of failures	236		236		121		121		121		121	
Pseudo R^2	0.023		-		0.086		-		0.066		-	
Chi-square	79.100^{***}		79.676^{***}		1081.106^{***}		2398.359^{***}		1727.152^{***}		2406.403^{***}	

Appendix

Appendix 3.1 Variable Definitions

Dependent Variables	**Description**
Survivors (Logit/Multinomial logit)	Survivors is a dummy variable that takes a value of one if IPO firms remains publicly traded as an independent entity up to year 5 post-IPO or the last year of the sample period, and zero otherwise. Firms involved in IPOs less than 5 years ago but are surviving up to year 4 post-IPO are also included as survivors in the sample.
Mergers (Multinomial logit)	Mergers is a dummy variable that takes a value of one if IPO firms are involved in a merger or are acquired after listing and lose their identity as independent entities post-IPO, and zero otherwise.
Delistings (Multinomial logit)	Delistings is a dummy variable that takes a value of one if IPO firms do not survive as independent entities after the IPO and exit the stock market regardless of the reasons for delisting, and zero otherwise.
Survival Time/ Time to Failure (Cox/AFT Model)	This is the length of time (measured in relative years) from the IPO year to the year of merger, delisting, or year 5 post-IPO for firms that survived up to year 5 or remain listed at the end of the sample period.
Non-survivors (event variable in Cox/AFT Model)	Non-survivors is a dummy variable that takes a value of one if a firm is classified as a merger or delisting up to year 5 post-IPO, and zero otherwise.
Independent Variables	
Gender Diversity	Percentage of females on the board of directors.
Age Diversity	The standard deviation of board age divided by the mean age of the board. Using the coefficient of variation formula (SD of Board Age/ Mean of Board Age). Larger standard deviation (larger age differences between board members) and lower mean age (higher representation of young board members) would generate higher age diversity values. High scores indicate greater age diversity
Professional Expertise Diversity	An expertise index based on the Blau index using the proportion of expertise groups on each board. Professional Expertise includes the following 14 categories: Academic, Accountant, Banker, Consultant, Dentist, Doctor, Engineer, Executive, Finance Expert, IT Expert, Investment Professional, Lawyer, Scientist, and Politician. It is computed as follows: $$1-\sum_{i=1}^{n} P_i^2$$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity.
Board Connections	This is the average number of prior and current board appointments of the board in each year.
Control Variables	
Firm Age	The number of years since incorporation of the firm.
Firm Size	The natural log of total assets.
Leverage	The ratio of the book value of long-term debt to total assets.
Risk	The return variance is measured as the standard deviation of the daily stock return annualised as computed in CRSP using the formula below: $r_t = \left(\frac{p_t * f_t + d_t}{p_{t'}}\right) - 1$ where r_t = return on purchase at t, p_t= last sale price or closing bid/ask average at time t; d_t= cash adjustment for t; f_t = price adjustment factor for t; $p_{t'}$= last sale price or closing bid/ask average at time of last available price < t.
Return on Assets (ROA)	Earnings before interest, taxes, depreciation, and amortisation divided by total assets.
R&D Intensity	The natural log of one plus the ratio of research and development expenditures to total assets.
Asset Tangibility	The net property, plant and equipment scaled by total assets
Board Size	The number of directors on the board

Board Independence	Percentage of independent directors on the board relative to board size. Director independence is measured in line with prior literature as a director who: is not a substantial shareholder of the firm up to 5%; had not been employed in any executive capacity by the company within the last 5 years; is not retained as a professional adviser by the company (either personally or through their firm); is not a significant supplier or customer of the company; has no significant contractual relationship with the company other than as a director.
Board Voting Share Ownership	The total percentage of voting shares owned by the board.
CEO Financial Expertise	A dummy variable that takes the value of one if the CEO has financial experience, and otherwise zero (e.g., a CEO with prior experience in financial institutions)
CEO Tenure	The number of years the CEO has served on the board.
Founder CEO	A variable that takes a value of one if the founder of the firm is the CEO, and zero otherwise.
CEO Duality	A dummy variable that takes a value of one if the CEO is also the board chair, and zero otherwise.
VC Board Representation	A dummy variable that takes a value of one if a Venture Capitalist Director is present on the board, and zero otherwise.
IPO Underpricing	The difference between the price at the end of the first day of trading and the offer price expressed as a fraction of the offer price.
IPO Premium	The difference between the offer price and the book value per share expressed as a fraction of the offer price.
Offer Size *(excluded due to high correlation with firm size)*	The natural log of the gross proceeds raised from the offering estimated as the product of shares offered and offer price.
Underwriters Prestige *(excluded due to missing values)*	The updated Carter et al. (1998) measure of underwriter reputation (see http://bear.cba.ufl.edu/ritter/Rank.htm).

Appendix 3.2 Regressions for the Interaction of Age Diversity and Board Connections on the Likelihood of Survival Post-IPO

This table focuses on the impact of interacting age diversity and board connections on IPO survival to year 5 post-IPO. This table does not test our hypothesis but goes further to analyse the impact of our independent variables when interacted together. In detail, this table reports the impact of greater age diversity in a board with connections to other boards at the IPO, on survival to year 5 post-IPO. In columns 1 and 2, survivors is a dummy variable that takes a value of one if a firm remains publicly traded as an independent entity to year 5 post-IPO or the last year of the sample period and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a survivor up to year 5, two if the IPO firm is involved in a merger up to year 5, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. Age diversity and other control variables are defined in Appendix 3.1. ME stands for marginal effects. The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Age Diversity$_t$	-1.003	-0.249	1.019	0.218	1.054	0.037	-0.035	0.218
	(-0.403)		(0.356)		(0.330)		(-0.010)	
Age Diversity$_t$* Board Connections$_t$	1.303	0.324	-1.099	-0.219	-1.728	-0.076	0.630	-0.219
	(0.920)		(-0.689)		(-0.883)		(0.310)	
Board Connections$_t$	-0.045	-0.011	0.001	-0.004	0.173	0.010	-0.172	-0.004
	(-0.180)		(0.005)		(0.485)		(-0.470)	
Firm Age$_t$	0.001	0.000	-0.002	-0.001	0.006	0.000	-0.008	-0.001
	(0.097)		(-0.237)		(0.588)		(-0.725)	
Firm Size$_t$	0.159*	0.040*	-0.110	-0.020	-0.250**	-0.012*	0.141	-0.020
	(1.689)		(-1.094)		(-2.067)		(1.250)	
Leverage$_t$	-1.005*	-0.250*	1.109**	0.252**	0.577	0.006	0.532	0.252**
	(-1.908)		(2.145)		(0.969)		(1.263)	
Risk$_t$	-0.048	-0.012	0.026	0.004	0.099	0.005	-0.073	0.004
	(-0.997)		(0.466)		(1.608)		(-1.217)	
Return on Assets$_t$	0.502	0.125	0.154	0.072	-1.332**	-0.085***	1.486***	0.072
	(1.219)		(0.303)		(-2.289)		(2.782)	
R&D Intensity$_t$	0.214**	0.053**	-0.143	-0.023	-0.438***	-0.023***	0.295**	-0.023
	(2.448)		(-1.562)		(-3.035)		(2.068)	
Asset Tangibility$_t$	0.485	0.120	-0.577	-0.131	-0.314	-0.004	-0.264	-0.131
	(1.193)		(-1.289)		(-0.545)		(-0.443)	
Board Size$_t$	0.064	0.016	-0.045	-0.008	-0.108	-0.005	0.062	-0.008
	(1.155)		(-0.748)		(-1.353)		(0.764)	
Board Independence$_t$	0.005	0.001	-0.005	-0.001	-0.003	-0.000	-0.001	-0.001
	(0.909)		(-0.716)		(-0.453)		(-0.175)	
Board Voting Shares Ownership$_t$	-0.003	-0.001	0.000	-0.000	0.009*	0.001*	-0.009	-0.000
	(-0.783)		(0.106)		(1.688)		(-1.581)	
CEO Financial Expertise$_t$	0.128	0.032	-0.119	-0.026	-0.092	-0.002	-0.028	-0.026
	(0.382)		(-0.317)		(-0.197)		(-0.059)	
CEO Tenure$_t$	0.013	0.003	-0.004	-0.000	-0.037	-0.002	0.032	-0.000
	(0.694)		(-0.212)		(-1.205)		(1.042)	
Founder CEO$_t$	0.017	0.004	0.062	0.019	-0.152	-0.011	0.214	0.019
	(0.083)		(0.271)		(-0.524)		(0.711)	
CEO Duality$_t$	0.132	0.033	-0.125	-0.027	-0.108	-0.003	-0.016	-0.027
	(0.714)		(-0.609)		(-0.431)		(-0.062)	
VC Board Representation$_t$	-0.358	-0.089	0.696***	0.170***	-0.091	-0.024	0.786**	0.170***
	(-1.553)		(2.587)		(-0.306)		(2.512)	
IPO Underpricing$_t$	-0.118	-0.029	-0.021	-0.017	0.455	0.028	-0.476	-0.017
	(-0.651)		(-0.112)		(1.135)		(-1.204)	
IPO Premium$_t$	0.355*	0.088*	-0.336	-0.069	-0.446	-0.018	0.110	-0.069
	(1.846)		(-1.592)		(-1.531)		(0.340)	
Constant	-2.586***		1.575		1.957		-0.383	
	(-2.627)		(1.515)		(1.480)		(-0.311)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.115		0.146		0.146		0.146	
Chi-square	93.915***		2860.049***		2860.049***		2847.753***	
Log Likelihood	-403.394		-585.000		-585.000		-585.000	

Appendix 3.3 Survival Analysis for the Interaction of Age Diversity and Board Connections on Survival Time to Year 5 Post-IPO

This table reports the Cox proportional hazard estimation for the impact of age diversity and board connections on survival time. There are 661 observations for IPOs from which 357 firms are non-survivors. The average survival time for IPOs is 3.9 years. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of exit post-IPO whether through a merger or delisting. Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). High scores indicate greater age diversity. Board Connections is the average number of prior and current board appointments of the board in year 0. Models 1 and 2 focus relate to the Cox model, while models 3 and 4 relate to the AFT model. t statistics are heteroscedasticity consistent and reported in the parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	COX model t=0		Accelerated Failure Time Model t=0	
Independent Variables	(1)	HR (2)	(3)	TR (4)
Age Diversity$_t$	0.265	1.304	-0.255	0.775
	(0.195)		(-0.193)	
Age Diversity$_t$* Board Connections$_t$	-0.515	0.598	0.467	1.595
	(-0.622)		(0.579)	
Board Connections$_t$	-0.013	0.987	0.020	1.020
	(-0.090)		(0.140)	
Firm Age$_t$	-0.002	0.998	0.001	1.001
	(-0.340)		(0.223)	
Firm Size$_t$	-0.074	0.928	0.074	1.077
	(-1.524)		(1.586)	
Leverage$_t$	0.256*	1.291*	-0.276*	0.759*
	(1.738)		(-1.954)	
Risk$_t$	0.045*	1.046*	-0.042*	0.959*
	(1.906)		(-1.807)	
Return on Assets$_t$	-0.392*	0.676*	0.354*	1.424*
	(-1.898)		(1.791)	
R&D Intensity$_t$	-0.165***	0.848***	0.158***	1.171***
	(-3.254)		(3.254)	
Asset Tangibility$_t$	-0.315	0.730	0.331	1.393
	(-1.357)		(1.511)	
Board Size$_t$	-0.029	0.972	0.028	1.028
	(-0.856)		(0.879)	
Board Independence$_t$	-0.004	0.996	0.003	1.003
	(-0.968)		(0.942)	
Board Voting Share Ownership$_t$	0.002	1.002	-0.001	0.999
	(0.742)		(-0.641)	
CEO Financial Expertise$_t$	-0.081	0.922	0.095	1.100
	(-0.386)		(0.478)	
CEO Tenure$_t$	-0.013	0.988	0.010	1.010
	(-1.067)		(0.915)	
Founder CEO$_t$	0.037	1.038	-0.028	0.972
	(0.301)		(-0.239)	
CEO Duality$_t$	0.019	1.020	-0.011	0.989
	(0.180)		(-0.112)	
VC Board Representation$_t$	0.241*	1.272*	-0.247**	0.781**
	(1.835)		(-1.963)	
IPO Underpricing$_t$	0.138	1.148	-0.136	0.873
	(1.384)		(-1.431)	
IPO Premium$_t$	-0.150	0.860	0.144	1.155
	(-1.197)		(1.160)	
Constant	-		0.823*	
			(1.722)	
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
No. of observations	661		661	
No. of failures	357		357	
Pseudo R^2	0.020		-	
Chi-square	111.067***		110.785***	

Appendix 3.4 Regressions for the Impact of Board Diversity and Board Connections on the Likelihood of Survival to year 10 post-IPO

This table reports the logit and multinomial logit regression results for the impact of board diversity and board connections on IPO survival to year 10 post-IPO. In columns 1 and 2, survivors is a dummy variable that takes a value of one if a firm remains publicly traded as an independent entity to year 10 post-IPO or the last year of the sample period and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a survivor up to year 10, two if the IPO firm is involved in a merger up to year 10, and three if the IPO firm is involved in a delisting from the stock exchange up to year 10. All independent and control variables are defined in Appendix 3.1. ME stands for marginal effects on the likelihood of IPO survival. The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. t statistics are reported in the parentheses and heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Gender Diversity$_t$	-0.013	-0.003	0.014	0.003	0.010	0.000	0.005	0.003
	(-1.337)		(1.432)		(0.705)		(0.378)	
Age Diversity$_t$	-1.360	-0.333	1.271	0.242	1.710	0.096	-0.440	0.242
	(-0.821)		(0.690)		(0.795)		(-0.205)	
Prof. Exp. Diversity$_t$	0.139	0.034	-0.177	-0.033	-0.267	-0.016	0.090	-0.033
	(0.222)		(-0.265)		(-0.327)		(0.119)	
Board Connections$_t$	0.170*	0.042*	-0.183*	-0.040*	-0.110	-0.002	-0.073	-0.040*
	(1.917)		(-1.937)		(-0.805)		(-0.537)	
Firm Age$_t$	0.000	0.000	-0.002	-0.001	0.007	0.001	-0.009	-0.001
	(0.000)		(-0.172)		(0.694)		(-0.806)	
Firm Size$_t$	0.218**	0.053**	-0.163	-0.027	-0.329***	-0.021**	0.166	-0.027
	(2.171)		(-1.519)		(-2.674)		(1.523)	
Leverage$_t$	-0.960*	-0.235*	1.095**	0.241**	0.616	0.010	0.480	0.241**
	(-1.776)		(2.044)		(1.006)		(1.174)	
Risk$_t$	-0.042	-0.010	0.020	0.001	0.097	0.007	-0.077	0.001
	(-0.845)		(0.348)		(1.540)		(-1.292)	
Return on Assets$_t$	0.689	0.169	-0.022	0.053	-1.515**	-0.127***	1.494***	0.053
	(1.600)		(-0.040)		(-2.456)		(2.787)	
R&D Intensity$_t$	0.207**	0.051**	-0.127	-0.014	-0.444***	-0.033***	0.317**	-0.014
	(2.270)		(-1.344)		(-3.039)		(2.229)	
Asset Tangibility$_t$	0.689*	0.169*	-0.702	-0.144	-0.680	-0.031	-0.022	-0.144
	(1.705)		(-1.569)		(-1.249)		(-0.038)	
Board Size$_t$	0.046	0.011	-0.035	-0.006	-0.070	-0.005	0.035	-0.006
	(0.797)		(-0.556)		(-0.901)		(0.449)	
Board Independence$_t$	0.008	0.002	-0.007	-0.002	-0.006	-0.000	-0.001	-0.002
	(1.197)		(-1.028)		(-0.711)		(-0.193)	
Board Voting Share Ownership$_t$	0.002	0.000	-0.003	-0.001	0.001	0.000	-0.004	-0.001
	(0.441)		(-0.694)		(0.142)		(-0.720)	
CEO Financial Expertise$_t$	0.145	0.036	-0.062	-0.006	-0.244	-0.018	0.181	-0.006
	(0.409)		(-0.162)		(-0.490)		(0.385)	
CEO Tenure$_t$	0.003	0.001	-0.000	0.000	-0.012	-0.001	0.012	0.000
	(0.151)		(-0.013)		(-0.405)		(0.414)	
Founder CEO$_t$	0.105	0.026	0.008	0.014	-0.307	-0.026	0.314	0.014
	(0.498)		(0.033)		(-1.054)		(1.065)	
CEO Duality$_t$	0.264	0.065	-0.224	-0.043	-0.302	-0.017	0.078	-0.043
	(1.374)		(-1.059)		(-1.207)		(0.308)	
VC Board Representation$_t$	-0.439*	-0.108*	0.769***	0.184***	0.061	-0.024	0.708**	0.184***
	(-1.768)		(2.687)		(0.197)		(2.259)	
IPO Underpricing$_t$	-0.078	-0.019	-0.041	-0.023	0.343	0.030	-0.384	-0.023
	(-0.412)		(-0.206)		(1.045)		(-1.188)	
IPO Premium$_t$	0.499**	0.122**	-0.506**	-0.101*	-0.569*	-0.029	0.063	-0.101*
	(2.289)		(-2.021)		(-1.841)		(0.177)	
Constant	-3.653***		2.471**		3.417***		-0.946	
	(-3.798)		(2.441)		(2.796)		(-0.856)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.138		0.160		0.160		0.160	
Chi-square	105.348***		1512.195***		1512.195***		1536.396***	
Log Likelihood	-390.266		-583.860		-583.860		-583.860	

Appendix 3.5 Survival Analysis for the Impact of Board Diversity on Survival Time to Year 10 Post-IPO

This table reports the Cox proportional hazard model, and the accelerated failure time model for the impact of board diversity on survival time and time to failure. There are 661 observations for IPOs from which 373 firms are Non-Survivors. The average survival time for IPOs is 6.3 years. We do not use "survival time" directly as the dependent variable. Survival time is used to generate hazard rate, while the time to failure is used to generate the time ratio that influences the occurrence and timing of merger or delisting. All independent and control variables are defined in Appendix 3.1. t statistics are reported in the parentheses and heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	COX model t=0		Accelerated Failure Time Model t=0	
Independent Variables	Model 1	HR (2)	Model 2	TR (2)
Gender Diversity $_t$	0.005	1.005	-0.008	0.992
	(0.946)		(-1.275)	
Age Diversity $_t$	0.309	1.362	-0.284	0.753
	(0.359)		(-0.280)	
Prof. Exp. Diversity $_t$	0.004	1.004	0.021	1.021
	(0.012)		(0.059)	
Board Connections $_t$	-0.095*	0.909*	0.124**	1.132**
	(-1.753)		(1.982)	
Firm Age $_t$	-0.001	0.999	0.002	1.002
	(-0.287)		(0.260)	
Firm Size $_t$	-0.098**	0.907**	0.112**	1.119**
	(-2.062)		(2.038)	
Leverage $_t$	0.250*	1.285*	-0.362**	0.696**
	(1.700)		(-2.230)	
Risk $_t$	0.045*	1.046*	-0.044*	0.957*
	(1.941)		(-1.649)	
Return on Assets $_t$	-0.412**	0.663**	0.484**	1.623**
	(-2.161)		(2.226)	
R&D Intensity $_t$	-0.155***	0.857***	0.154***	1.166***
	(-3.091)		(2.593)	
Asset Tangibility $_t$	-0.368	0.692	0.390	1.477
	(-1.595)		(1.441)	
Board Size $_t$	-0.024	0.976	0.051	1.052
	(-0.744)		(1.337)	
Board Independence $_t$	-0.004	0.996	0.004	1.004
	(-1.104)		(0.939)	
Board Voting Shares $_t$	-0.000	1.000	0.001	1.001
	(-0.144)		(0.210)	
CEO Financial Expertise $_t$	-0.090	0.914	0.106	1.112
	(-0.431)		(0.439)	
CEO Tenure $_t$	-0.008	0.992	0.007	1.007
	(-0.742)		(0.528)	
Founder CEO $_t$	0.010	1.010	-0.020	0.980
	(0.084)		(-0.140)	
CEO Duality $_t$	-0.028	0.972	0.082	1.085
	(-0.267)		(0.648)	
VC Board Representation $_t$	0.250*	1.284*	-0.314**	0.730**
	(1.906)		(-2.019)	
IPO Underpricing $_t$	0.124	1.132	-0.137	0.872
	(1.309)		(-1.239)	
IPO Premium $_t$	-0.194	0.824	0.258*	1.294*
	(-1.528)		(1.696)	
Constant	-		0.560	-
			(1.118)	
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
No. of observations	661		661	
No. of failures	373		373	
Pseudo R^2	0.022		-	
Chi-square	131.832***		132.027***	

Appendix 3.6 Regressions with Alternative Definition of IPO survival

This table reports the logit and multinomial logit regression results for the impact of board diversity and board connections on IPO survival to year 5 post-IPO. We explore other definitions of survivors that include mergers as censored survivors if they rank above the median for four performance based measures consistent with Espenlaub et al. (2012). The four performance measures are cash to total assets, operating income total assets, total liabilities to total assets and current assets to current liabilities. Based on this classification, there are 17 mergers classified as censored survivors and included in the group of survivors. Accordingly, there are 321 survivors and 340 non-survivors (219 mergers and 121 delistings). The results using this classification are similar to the main results reported in Table 3.5. In columns 1 and 2, censored survivors is a dummy variable that takes a value of one if a firm is a survivor or merger that ranks above the median of the four performance measures and zero otherwise. In columns 3 to 8, the dependent variable is a categorical variable that takes a value of one, if the IPO firm is a censored survivor up to year 5, two if the IPO firm is involved in a merger up to year 5, and three if the IPO firm is involved in a delisting from the stock exchange up to year 5. All independent and control variables are defined in Appendix 3.1. ME stands for marginal effects on the likelihood of IPO survival. The marginal effects reported in columns 4, 6 and 8 are different to the main multinomial logit results, as they do not specify a base outcome but relate to the probability of an IPO firm exiting through a merger or delisting only. t statistics are reported in the parentheses and heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Gender Diversity$_t$	-0.010	-0.003	0.012	0.003	0.006	0.000	0.006	0.003
	(-1.121)		(1.218)		(0.422)		(0.446)	
Age Diversity$_t$	1.137	0.285	-0.870	-0.169	-1.444	-0.066	0.574	-0.169
	(0.712)		(-0.482)		(-0.670)		(0.256)	
Prof. Exp. Diversity$_t$	0.202	0.050	-0.308	-0.067	-0.214	-0.006	-0.094	-0.067
	(0.342)		(-0.478)		(-0.273)		(-0.122)	
Board Connections$_t$	0.148*	0.037*	-0.162*	-0.036*	-0.097	-0.002	-0.065	-0.036*
	(1.718)		(-1.734)		(-0.715)		(-0.465)	
Constant	-2.494***	0.077*	-0.274	-0.054	-0.424	-0.019	0.150	-0.054
	(-2.795)		(-1.460)		(-1.499)		(0.497)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.109		0.141		0.141		0.141	
Chi-square	90.544***		2742.798***		2742.798***		2708.029***	
Log Likelihood	-407.808		-408.032		-407.961		-407.043	

Appendix 3.7 Regressions for the Interaction of Board Diversity and Board Connections with Alternative Definition of IPO Survival.

This table focuses on the impact of interacting board diversity and board connections on IPO survival to year 5 post-IPO. This table does not test our hypothesis but goes further to analyse the impact of our independent variables when interacted together. We explore the alternate definition of survivor to include censored survivors as in Appendix 3.6. t statistics are reported in the parentheses and heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Gender Diversity, Board Connections, and IPO Survival								
Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Gender Diversity$_t$	-0.018	-0.005	0.031*	0.008*	-0.007	-0.001	0.038*	0.008*
	(-1.137)		(1.789)		(-0.309)		(1.670)	
Gender Diversity$_t$* Board Connections$_t$	0.004	0.001	-0.012	-0.003	0.009	0.001	-0.021**	-0.003
	(0.547)		(-1.347)		(0.956)		(-1.978)	
Board Connections$_t$	0.122	0.031	-0.091	-0.018	-0.149	-0.007	0.059	-0.018
	(1.261)		(-0.849)		(-1.022)		(0.379)	
Constant	-2.265***	661	1.037		2.010*		-0.973	
	(-2.600)		(1.134)		(1.747)		(-0.921)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.109		0.143		0.143		0.143	
Chi-square	88.889***		2884.238***		2884.238***		2886.554***	
Log Likelihood	-408.032		-582.429		-582.429		-582.429	

Panel B: Age Diversity, Board Connections, and IPO Survival								
Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Age Diversity$_t$	-0.673	-0.168	0.722	0.148	0.867	0.035	-0.145	0.148
	(-0.268)		(0.247)		(0.271)		(-0.043)	
Age Diversity$_t$* Board Connections$_t$	1.441	0.360	-1.312	-0.264	-1.769	-0.075	0.457	-0.264
	(1.011)		(-0.807)		(-0.905)		(0.222)	
Board Connections$_t$	-0.095	-0.024	0.063	0.010	0.198	0.010	-0.135	0.010
	(-0.376)		(0.222)		(0.553)		(-0.368)	
Constant	-2.124**	661	1.006		1.664		-0.658	
	(-2.195)		(0.975)		(1.276)		(-0.531)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.109		0.140		0.140		0.140	
Chi-square	92.157***		2788.905***		2788.905***		2713.836***	
Log Likelihood	-407.961		-583.885		-583.885		-583.885	

Panel C: Professional Expertise Diversity, Board Connections, and IPO Survival								
Dependent Variables	Survivors to year 5		Mergers in year 5		Delistings in year 5		Mergers in year 5	
			Compared to Survivors				Compared to Delistings	
	Logit Model- t=0		Multinomial Logit Model- t=0					
Independent Variables	(1)	ME (2)	(3)	ME (4)	(5)	ME (6)	(7)	ME (8)
Prof. Exp. Diversity$_t$	1.404	0.351	-1.386	-0.283	-1.732	-0.071	0.346	-0.283
	(1.632)		(-1.424)		(-1.561)		(0.306)	
Prof. Exp. Diversity$_t$* Board Connections$_t$	-0.802*	-0.200*	0.701	0.139	1.046*	0.046	-0.346	0.139
	(-1.893)		(1.471)		(1.831)		(-0.590)	
Board Connections$_t$	0.550**	0.137**	-0.514*	-0.106*	-0.613**	-0.024	0.099	-0.106*
	(2.376)		(-1.921)		(-2.094)		(0.311)	
Constant	-3.004***	661	1.842*		2.744**		-0.901	
	(-3.187)		(1.858)		(2.240)		(-0.785)	
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	661		661		661		661	
Pseudo R^2	0.111		0.142		0.142		0.142	
Chi-square	89.808***		2794.497***		2794.497***		2717.479***	
Log Likelihood	-407.043		-582.716		-582.716		-582.716	

Chapter 4: Board Diversity and the Innovative Activity of IPO Firms

4.1 Introduction

Innovation has been identified as a key determinant of firm competitiveness and growth involving the exploration of new untested ideas or the improvement of existing products. For IPOs, the ability to compete effectively is imperative for firm performance post-IPO (Guo and Zhou 2016) and innovation plays a key role in gaining competitive advantage. Bernstein (2015) shows that the funds raised within the IPO process increase the firms' engagement in innovation.[109] Besides, at every stage of the innovative process, boards are expected to provide tacit knowledge and relevant information for strategic decision-making in their firms (Faleye et al. 2014). Prior literature for mature US-listed firms have linked board diversity to better innovation but there is still no clear picture on the nature of this relationship in IPO firms.[110] We argue that understanding the impact of board diversity on innovative activity provides guidance on the areas to allocate resources during director appointments, that facilitate the success of the IPO firms' innovative strategies. Therefore, this chapter provides first evidence in the field on the impact of board diversity on innovative activity of IPO firms. Innovative activity is examined on a broader scale relating to internally generated and externally generated innovation, as prior literature has mainly focused on internal innovation. Our first research question in this chapter is whether board diversity influences the innovative activity of IPO firms.

Board diversity is defined in terms of gender, age and professional expertise diversity in the same way as Chapters 2 and 3. Innovative activity is defined internally in terms of the innovative input (research and development intensity, henceforth referred to as R&D intensity)

[109] Bernstein (2015) finds an increase in the creation of internally generated innovation, a decrease in the productivity of individual inventors, and an increase the acquisition of external innovation around stock market listings. He measures internally generated innovation as research and development expenditure scaled by the firm's sales, productivity of individual inventors as the patent citations and the acquisition of external innovation as the number of patents granted to target firms, prior to acquisition.

[110] Corporate innovation has been found to be influenced by creditor rights (Acharya and Subramanian 2009), CEO overconfidence (Hirshleifer et al. 2012), analyst coverage (He and Tian 2013), and ownership structure (Ferreira et al. 2014). Miller and Triana (2009) show that corporate innovation mediates the relationship between board diversity and firm performance suggesting a direct link between board diversity and innovation for mature listed firms. Chen et al. (2018) go further to analyse this direct link and find that female board representation is linked to greater innovative activity based on the number of patents and citations in mature listed companies between 1998 and 2006.

and the innovative output (patent count and patent citation).[111] Externally, innovative activity is defined as the IPO firm's acquired intangible assets, henceforth known as IA investment.[112]

Building up to the second research question, extant literature suggests that firms investing more in innovative input (R&D Intensity) generate a higher level of innovative output (patents) (Mazzucato and Tancioni 2012; Tavassoli 2018). The firm's ability to convert innovative input into output has been coined as innovative efficiency (Hirshleifer et al. 2013). Griffin et al. (2021) examine the impact of board diversity on innovative efficiency in an international sample of mature listed firms. The authors find that firms with greater board diversity have higher innovative efficiency i.e., such firms are more likely to generate patents for each dollar of R&D capital. They attribute their findings to the argument that board diversity influences board effectiveness during the innovative process by improving the monitoring and advising functions of the board.[113] Despite the evidence suggesting a link between board diversity and innovative efficiency in mature listed firms, researchers are yet to analyse the impact of board diversity on the innovative efficiency of IPO firms. Greater board diversity provides firms with a range of experience, information access and knowledge that may influence board effectiveness in decision-making during the innovative process (An et al. 2021). Therefore, we argue that examining the impact of board diversity on innovative efficiency provides information to IPO firms on the aspects of board diversity to consider during the innovative process. This is especially important for IPO firms since innovation involves higher levels of risk at a time where the firm faces the liability of newness in stock markets.[114] Accordingly, the second research question in this chapter focuses on whether board diversity influences innovative efficiency in IPO firms.

To answer these research questions , we draw on two theoretical perspectives that inform our hypotheses: the resource dependency theory and the diversity theory.[115] The

---

[111] Our definition of internally generated innovative input and output is consistent with Chen et al. (2018) that study the impact of board diversity on innovation in mature firms.

[112] Stone et al. (2008) mention that externally acquired intangible assets are a source of innovative capital for firms. Although Bernstein (2015) measure external innovation as the number of patents granted to target firms, prior to acquisition by the bidder, we do not have data for this measure.

[113] The literature on mature firms indicates that board diversity improves board monitoring and advising as diversity increases the range of experience, information access and the knowledge base of the board (Adams and Ferreira 2009; An et al. 2021).

[114] The term "liability of newness" was first coined by Stinchcombe (1965) and revisited by Yang and Aldrich (2017) to apply to current firm constructs. This term refers to the fact that new firms, and in our context, IPOs face a constellation of problems in their early years that may result in a higher likelihood of failure. Such problems relate to their ability to access resources, establish strategies, and differentiate themselves from other firms in the industry in a bid to attract potential investors without prior public operational track records.

[115] The resource dependency theory sheds light on the board as a crucial source of resources, as directors draw on their prior experience to assist IPO firms in navigating the stock market. Thus, IPO firms with greater board diversity are more likely to benefit from a larger pool of experience, a broader spectrum of ideas, and access to

resource dependency theory informs the hypotheses on the potential positive impact of board diversity on innovative activity and innovative efficiency. The diversity theory informs the hypotheses on the potential negative effect of board diversity on innovative activity and innovative efficiency.

Besides the main research questions, we go further to test whether board diversity moderates the IPO firm's investment in external innovation. The rationale for this analysis is that IPO firms are typically smaller entrepreneurial firms that are more likely to rely on their internal components for innovative activity rather than invest largely in externally generated innovation. Thus, we expect that in IPO firms, there is a potential substitution between investing in internal innovation or external innovation. Since greater board diversity has been linked to improved board monitoring and advising (Adams and Ferreira 2009; Field et al. 2013), we argue that greater board diversity helps IPO firms to diversify their innovative portfolio beyond internal to external innovation. To this end, we develop a conjecture that greater board diversity moderates the firm's investment in external innovation.

Similar to Chapters 2 and 3, the sample period starts from 1st January 1997 until 31st December 2019 and tracks the 661 randomly selected IPO firms listed between 1st January 1997 to 31st December 2015 to year 5 post-IPO, resulting in 3,136 firm-year observations. The trend analysis for innovative activity shows that the levels of R&D intensity, patent count and patent citation increased over time from the IPO to year 5 post-IPO. In terms of IA investment, the trend analysis shows minute increases in the level of external innovation. Therefore, we analyse the impact of board diversity on innovative activity using OLS regressions with lagged dependent variables. Potential endogeneity issues may arise due to the focus on board diversity and innovative activity. Hence, we check the robustness of the OLS results using PSM, which adjusts for potential endogeneity.[116]

The main results suggest that greater professional expertise diversity in the boardroom improves R&D intensity. Thus, a diverse pool of professional experts in the boardroom bring unique experiences that improve the IPO firms' innovative input. Further analysis reveals that the positive effect of professional expertise diversity on R&D intensity is more pronounced in poorly governed firms, firms with better-connected boards and firms with VC board

---

resources to identify opportunities that influence decision-making on investment in innovative activities and the efficiency of the innovative process. According to the diversity theory, an increase in diverse views results in higher board cohesiveness. However, such diverse perspectives may inhibit board effectiveness in the decision-making processes on innovation due to cognitive conflicts in the boardroom.

[116] This chapter focuses on the OLS and PSM estimations for our main results. We also run an IV estimation which is discussed further in the methodology section.

representation. This indicates that professional expertise diversity complements other corporate governance characteristics in the boardroom to facilitate better board advising. These findings extend the results in Chapters 2 and 3 that the focus of IPO firms on professional expertise diversity not only improves IPO survival but also the firms' innovative input. In terms of innovative output, there is no evidence of a relationship between the measures of board diversity and patenting activity (patent count and patent citation). These results conflict with prior evidence in mature firms suggesting that greater board diversity improves patenting activity (Chen et al. 2018; An et al. 2021), and the implication is that in IPO firms, no such effect exists. Nevertheless, in analysing the impact of board diversity on the firm's ability to convert innovative input into output, we find a negative relationship between age diversity and innovative efficiency. Further analysis shows that the negative effect for age diversity is more pronounced in IPO firms that are well governed, poorly connected, and without VC board representation. These findings allude to the detrimental effects of cognitive conflicts arising due to greater age diversity on the efficiency of innovative processes

Finally, the results suggest that greater gender diversity has a negative impact on IA investment, although the moderating effect is smaller if the firm has R&D investments. This alludes to the negative impact of better monitoring in the boardroom causing a more cautious board in the acquisitions of intangible assets. Overall, the results for suggest that IPO firms with advising-oriented boards benefit more than a monitoring-oriented boards in terms of the engagement in innovative activity and innovative efficiency.

Our findings contribute to the literature in three ways. First, IPO firms at the initial investment phase of the innovative process will benefit more from professional expertise diversity in the boardroom than other aspects of diversity (gender and age). Second, greater board diversity in IPO firms has no direct effect on patenting activity, but age diversity is detrimental to the efficiency of the firm in generating patents for each dollar of R&D capital. Notably, the results indicate that there is a significant positive relationship between board independence and innovative efficiency. Therefore, in improving the efficiency of the innovative process IPO firms should focus on other board characteristics such as board independence, rather than diversity. Third, greater gender diversity is detrimental to IPO firms whose innovative strategy involves a diversified innovative portfolio comprising internal and external innovation.

The rest of this chapter is organised as follows: Section 4.2 discusses the theoretical framework, while Section 4.3 discusses prior literature and develops the hypotheses and conjecture for the chapter. In Section 4.4, we outline the data sources, sample selection, and discuss the methodology applied. Section 4.5 highlights the results from the regression analysis and Section 4.6 concludes the chapter.

4.2 Theoretical Framework

The consensus in the literature is that innovation is a complex process frequently ending in failure to produce outputs. In fact, Mazzucato and Tancioni (2012) find that listed US firms announcing their engagement in new and challenging R&D investments i.e., blue skies innovation are often penalised through lower stock returns due to the level of uncertainty surrounding the innovative process. In IPO firms, there is a greater need for improved board advising to ensure that the firm identifies innovative opportunities, as these firms already face the liability of newness to stock markets. The underlying argument in this chapter is that IPO firms with greater board diversity are more likely to benefit from a larger pool of experience, a broader spectrum of ideas and a wealth of information that improves decision-making on innovative activity. However, with greater board diversity comes the potential for cognitive conflicts in the boardroom due to the increase in differing perspectives, experiences, ideas and consequently, slower decision-making processes that may be detrimental to innovative activity. The first argument draws on the resource dependency while the second argument draws on the diversity theory to predict the potential positive or negative relationship between board diversity and innovative activity in IPO firms.

The resource dependency theory suggests that firms depend on the external environment to survive, and boards provide links to this environment through their access to resources (Pfeffer and Salancik 1978). From a resource dependency perspective, the impact of board diversity on innovative activity is based on board diversity as a tool for improved board advising. Prior literature suggests that IPO firms require more advising around the IPO to explore opportunities in stock markets and minimise the liability of newness (Boone et al. 2007; Field et al. 2013). Board diversity provides the board with directors who have gained experience externally and as a result have contacts in the firm's industry, in other firms, and government bodies. Thus, these external contacts and knowledge provide the firm with increased access to resources, and an improved board advising function that will influence decision-making processes. The advising function involves assisting top management to develop effective strategies and make business choices that enhance the competitive advantage, the long-term growth and success of the firm. Given that innovation is typically a long process involving enormous amounts of input (Hall and Lerner 2010) and significant risks, engaging in innovative activity may often require advice from the board. Accordingly, greater board diversity in IPO firms will provide a larger pool of directors from different backgrounds with resources and experience, resulting in better board advising and improved engagement in innovative activity. Therefore, we expect a positive relationship between board diversity and innovative activity in IPO firms.

In contrast, the Forbes and Milliken (1999) diversity theory explains the potential dark side of greater diversity in the boardroom. According to the diversity theory, an increase in diverse views results in higher board cohesiveness. However, such diverse perspectives may inhibit board effectiveness in the decision-making processes due to cognitive conflicts. Forbes and Milliken (1999) define cognitive conflict as "task-oriented differences in judgement among group members". They mention that though cognitive conflicts contribute to the quality of strategic decisions in uncertain environments, such conflicts cause the board to evaluate alternative processes, resulting in slower decision-making. Considering the high level of uncertainty surrounding IPO firms and innovative activity, we argue that greater board diversity may increase cognitive conflicts, impeding board effectiveness in decision-making. In this vein, more heterogeneous perspectives on the board result in conflicts that further slowdown the decision-making process (Rao and Tilt 2016). For example, if an IPO firm's current homogeneous board takes a more conservative approach to innovation, the differing perspectives from new female directors may be longer deliberations in the decision-making process. The ripple effect from this may cause the IPO firm to miss out on potential value-creating projects. Accordingly, we expect greater board diversity in IPO firms to be detrimental for innovative activity.

The preceding discussion established that greater board diversity may influence the level of the firm's engagement in innovative activity. Beyond this, we argue that board diversity may also influence the IPO firm's innovative efficiency, which is the IPO firm's ability to generate patents for each dollar of R&D capital. Investments in R&D are typically experimental research to gain new knowledge, applied research with objectives of potential outputs for the firm, and experimental development to create or improve the firm's products. The activities involved at the initial phase of the innovative process, and the potential to generate innovative output makes innovative processes rigorous. With this in mind, we argue that firms with more effective boards are better equipped to facilitate the efficiency of innovative processes. Since board diversity is related with better board monitoring and advising, that improves board effectiveness (Adams and Ferreira 2009; Field et al.2013), we argue that board diversity influences board effectiveness and ultimately, innovative efficiency.

On the one hand, we draw on the resource dependency theory to argue that greater diversity in the boardroom improves the board's effectiveness in decision-making due to better resource access from directors' knowledge and experience. Consequently, IPO firms with greater board diversity are better equipped to ensure that investment in R&D yields greater output (patents). Therefore, we expect that greater board diversity improves innovative efficiency. On the other hand, cognitive conflicts arising from greater diversity in the boardroom may impede board effectiveness, resulting in slower decision-making that is detrimental to innovative efficiency in the IPO firm. To this end, we expect that greater board diversity negatively influences innovative efficiency.

To sum up, the discussion in the theoretical framework leads to four predictions of the relationship between board diversity and innovative activity/innovative efficiency in IPO firms, based on the resource dependency and the diversity theories. The first two predictions relate to the level of the firm's engagement in innovative activity, while the last two predictions focus on innovative efficiency. According to the first two predictions, greater board diversity positively or negatively influences innovative activity of IPO firms. Similarly, greater board diversity improves innovative efficiency, or the former has a negative relationship with the latter. In the next section, we discuss the prior literature and build on these theories to develop the hypotheses. We also introduce the arguments leading to a conjecture on the potential moderating effect of board diversity on external innovation.

4.3 Prior Literature and Hypotheses Development

This section starts by highlighting how board diversity influences the advising and monitoring roles of the board of directors. We discuss the role of board diversity in influencing innovative activity, drawing on prior empirical evidence on mature US-listed firms and the theoretical framework to inform hypotheses 1a and 1b. Next, we focus on the literature for board diversity that will explain the potential effects on innovative efficiency. Several studies on mature listed firms have analysed the impact of board diversity on innovative input (R&D intensity) or innovative output (patent count and patent citation). Our study is the first one to evaluate the impact of board diversity on innovative efficiency in IPO firms and we develop hypotheses 2a and 2b based on the existing theories discussed in the previous section. Finally, this section develops conjecture 1 on the potential moderating effect of board diversity on external innovation.

4.3.1 The Influence of Board Diversity on the Monitoring and Advising Roles of the Board

Over the years, researchers have tried to disentangle the advising and monitoring roles of the board with little success, but have reached a consensus on the existence of a trade-off between the two roles. Prior literature suggests that boards are structured to be more monitoring or advising-oriented, based on the complexity of the firms' operations and their life cycle stage (Adams and Ferreira 2007; Faleye et al. 2011). On the one hand, mature listed firms with more complex operations may require a monitoring-oriented board to ensure the strategic decisions of the executive management are in the best interest of shareholders. On the other hand, newly listed firms, which are typically at the growth phase of their life cycle, benefit more from an advising-oriented board to minimise the liability of newness in the stock market. Board diversity advocates argue that appointing directors with different demographic and cognitive backgrounds equips the board with a broader range of perspectives. This results in an improved monitoring and advising function that streamlines decision-making processes.

Extant literature shows that board diversity influences the monitoring and advising roles of the board. Adams and Ferreira (2009) suggest that gender diverse boards are better monitors as female directors attended more meetings, joined monitoring board committees, and influenced the replacements of CEOs that performed poorly. However, the authors emphasise that their findings hold only for firms with weak governance systems as greater gender diversity in firms with stronger corporate governance will result in greater coordination problems. In other words, only firms with weak governance systems will benefit from greater gender diversity as improving gender diversity in firms with strong governance will result in conflicts in the boardroom. Xu et al. (2018) suggest that firms with greater age diversity are less likely to engage in corporate financial fraud since age diversity produces a board with a range of experience who have more to lose if they fail in their monitoring duties. Thus, greater age diversity in the boardroom may improve the board's monitoring function. Harjoto et al. (2018) findings indicate that firms with greater board diversity in terms of expertise are more effective at monitoring the corporate investment activities, including capital expenditure and acquisition spending of their firms. Regarding the board's advising role, Kim and Starks (2016) show that female board representation increases the expertise and unique skills in the boardroom, resulting in an enhanced advising function and consequently improved firm value. Consistently, Gray and Nowland (2017) find that shareholders benefit from an improved advising function when the board appoints directors with expertise as lawyers, accountants, consultants, bankers, and outside CEOs. These studies relate to mature listed firms and suggests that board diversity improves board monitoring and advising, consequently resulting in more effective decision-making.

So far, we have established that board diversity improves the monitoring and advising roles of the board; however, there are some downsides of greater diversity in the boardroom. Huse (2007) mentions that although greater diversity in the boardroom provides a range of experiences and ideas to the board, a potential downside is the resulting cognitive conflicts due to greater differences in board members perspectives during decision-making processes. The authors suggest that consequences of greater board diversity may be difficulties in maintaining coordination and building a common understanding in the decision-making process. In a qualitative study, Veltrop et al. (2021) show that when there are cognitive conflicts in the boardroom directors are less likely to be effective monitors.[117]

Overall, the above evidence suggests that board diversity influences both the monitoring and advising roles of the board. However, the concentrated nature of ownership of IPO firms means that conflicts between the owners and managers are less likely to occur, shifting the firm's focus from a monitoring-oriented towards a more advising-oriented board. Besides, a monitoring-oriented board may also reduce risk-taking, which is a critical factor for engagement in innovation. Prior literature shows that monitoring-oriented boards are less likely to engage in innovation as opposed to advising-oriented boards (Faleye et al. 2011; Faleye et al. 2014).[118] Moreover, Field et al. (2013) show that IPO firms require a more advising-oriented board as they suffer from the liabilities of newness and will benefit from the increased access to relevant information and resources. Thus, we expect that greater board diversity will be beneficial for innovation in IPO firms with advising-oriented boards but detrimental in monitoring-oriented boards.

4.3.2 The Role of Board Diversity in Influencing Innovative Activity

A myriad of corporate governance studies focus on the impact of board diversity on innovation and the evidence is mixed. Miller and Triana (2009) first identify a direct link between board diversity and innovation. They find a positive relationship between board diversity (gender and ethnicity) and firm innovation as measured by R&D intensity. Furthermore, Miller and Triana's (2009) findings suggest that firms benefit from board diversity as directors provide resources through their experiences during innovative strategy

[117] Veltrop et al. (2021) identify board psychological safety as an important element influencing board members ability to monitor the CEO in decision-making.

[118] Monitoring-oriented board is measured based on board independence while an advising-oriented board is measured based on board connections.

decisions. Chen et al. (2018) also study the impact of board gender diversity on innovation and firm performance. Similarly, they find that firms with greater female board representation spend more on R&D investments and generate more patents. Chen et al. (2018) attribute their findings to the notion that female directors improve the board's monitoring of managers, especially those that prefer a quiet life and dislike the costly efforts related with innovation. Furthermore, Atallah et al. (2021) also find supporting evidence that greater female board representation improves the firm's innovative input through increased investment in R&D, but there is no evidence that this effect persist in relation to innovative output, patents granted.

In terms of innovative output relating to patenting activity, Cumming and Leung (2021) show that board diversity facilitates innovation, although this differs across industry. For example, they find that firms in male-dominated industries benefit more from gender diversity, while firms in high-tech industries benefit more from professional expertise diversity specifically relating to scientific expertise. An et al. (2021), using their multidimensional board diversity index, find that firms with diverse boards are granted a higher number of patents, most of which have a high number of citations. Their findings suggest that board diversity improves not only the quantity of patents (patents granted) generated but also the quality (patent citations) as diverse boards are linked to more blue skies innovation. Although An et al. (2021) finding focuses on board diversity as a composite index, they go further to separate each aspect of diversity and find that educational and professional diversity are most important in relation to firm innovation.[119] This chapter differs from An et al. (2021) as we focus on board diversity in IPO firms rather than mature firms and explore for the first time the potential link between board diversity and innovative activity for such firms. On an international scale, Griffin et al. (2021) suggest that firms with diverse boards (gender) have more granted patents compared to homogeneous boards.

In this vein, the literature on mature firms discussed above indicates that board diversity improves the firm's engagement in innovative activity whether through higher investments in innovative inputs or a higher level and quality of innovative output. The empirical evidence shows that board diversity influences the firm's innovation strategies, whether through increased monitoring (Chen et al. 2018) or resources drawn from diverse experiences (Cumming and Leung 2021). However, board diversity in these studies is not analysed in an IPO context when the board first becomes visible to the public, but at a more mature point. For

[119] The other types of diversity indexes analysed by An et al. (2021) in relation to innovation include: demographic diversity, director experience diversity, managerial trait diversity and cultural diversity index.

IPO firms, directors are typically younger with less experience in navigating the stock market, leading the firm to appoint directors with a wealth of expertise to provide better advice to the board. Thus, this chapter explores whether board diversity influences the innovative activity in IPO firms.

In the boardroom, decision-making processes are largely influenced by the information available to the board. Boards advise on various issues, including strategies to enter market niches and compete effectively, and the less information is available to the board on the attractiveness of the market, the more innovation is perceived unfavourably (Gehrke and Firk 2019). The consensus for IPO firms is that they require more advising-oriented boards to explore opportunities in the stock market (Boone et al. 2007; Field et al. 2013). Consistent with the resource dependency theory, board diversity allows for a broader range of unique perspectives and increased information access resulting in a more thorough evaluation of innovative opportunities. Thus, greater levels of board diversity in IPO firms will result in better board advising and improved innovative activity. This leads to the first hypothesis.

H1a: *Greater board diversity increases innovative activity in IPO firms.*

Prior to listing, IPO firms may opt for a more homogeneous board as ownership is largely concentrated with the founder or such firms are simply unequipped to attract experienced directors to their boards due to their liability of newness. With increased firm visibility following the listing process, IPO firms are in a better position to attract a more diverse board. However, the move away from a homogeneous board may not necessarily be beneficial for IPO firms seeking to engage in innovative activity. Although board diversity improves the resources available to the firm, a consequence may be greater cognitive conflicts in the boardroom that slow down the decision-making process, consistent with the diversity theory. Torchia et al. (2015) show that board diversity results in a higher level of board creativity and a higher level of cognitive conflicts that slow down decision-making processes.

Similarly, we argue that IPO firms with diverse boards may also face difficulties reaching a consensus on critical decisions relating to innovation due to a larger knowledge base, external contacts, and access to information. The ripple effect from a potential resource overload of the board will be that the firms may miss out on viable, innovative projects. To the best of our knowledge, there is no empirical evidence to date suggesting a negative relationship between board diversity and innovative activity. However, Belkacemi et al. (2021) show mixed results for the impact of board diversity on innovative performance.[120] Belkacemi et al. (2021) focus on the world's top 100 innovative firms as established by Forbes in 2017 and study the impact of professional expertise diversity and educational diversity on innovative performance. The authors find that greater professional expertise diversity negatively influences innovative performance.[121] They attribute their findings to the notion that board members with different expertise are more likely to provide different viewpoints, ideas and opinions that increase the potential for conflicts during decision-making regarding innovation.

Accordingly, we expect that IPO firms with greater board diversity will experience more cognitive conflicts due to different perspectives, resulting in the longer deliberations in decision-making, consistent with the diversity theory. Consequently, such IPO firms will have a lower level of engagement in innovative activity. This leads to the competing hypothesis for the impact of board diversity on innovative activity.

H1b: *Greater board diversity decreases innovative activity in IPO firms.*

Board Diversity and Innovative Efficiency

The consensus in the literature is that firms investing more in innovative input (R&D intensity) generate a higher level of innovative output (patents) (Mazzucato and Tancioni 2012; Tavassoli 2018). In recent times, another stream of literature examines the firm's ability to convert innovative input into output, which has been coined as innovative efficiency, and the effect of the latter on firm outcomes.[122] Hirshleifer et al. (2013) analyse the impact of innovative efficiency on firm outcomes and find innovative efficiency has a positive impact on market value and firm performance. These results suggest that the innovative efficiency is beneficial to firm outcomes.

Building on these findings, two recent studies explore the impact of diversity of employment teams (Xie et al. 2020) and board diversity (Griffin et al. 2021) on innovative efficiency. Xie et al. (2020) take a different approach to prior innovation literature by analysing the impact of gender diversity in R&D employee teams on innovative efficiency. Xie et al. (2020) find that gender diversity within R&D teams improves the innovative efficiency of the

[120] Innovative performance is measured as the difference between the firm's market capitalisation and the net present value of cash flows.

[121] Belkacemi et al. (2021) also find positive results for the relationship between educational diversity and innovative performance

[122] Innovative efficiency is measured as the ratio of patents granted/filed in the current period to the 5-year cumulative lag of R&D capital to reflect the patent application process (Hirshleifer et al. 2013; Sinagl and Wang 2021). Hall et al. (2001) show that patents are granted on average within 2 years for the US patent office (USPTO) but Hirshleifer et al. (2013) mention that R&D expenses over the preceding 5 years contribute to patent filings.

firm. They explain their findings by suggesting that females in R&D teams provide informational benefits through their diverse knowledge base that result in high quality innovative projects. This indicates that gender diversity in R&D teams improves resource access and consequently innovative efficiency.

Griffin et al. (2021) establish a link between board diversity (gender) and innovative efficiency with an international sample of 45 countries. The authors find that firms with female board representation are more likely to generate patents for each dollar of R&D capital. In other words, greater gender diversity leads to improved innovative efficiency. Griffin et al. (2021) show that board diversity improves the resource base of the firm through more failure tolerant CEO incentives, a more innovative corporate culture and increased diversity among inventors. The authors argue that this provides a more conducive and efficient environment for innovative decision-making. While the preceding discussion of the literature relates to mature firms, it suggests that firms seeking to improve innovative efficiency will benefit from a diverse board. Board diversity improves the firm's resource base in a way that facilitates board effectiveness and ultimately, innovative efficiency, consistent with the resource dependency theory. To this end, we develop the next hypothesis as follows.

H2a: *Greater board diversity is positively related with the innovative efficiency of IPO firms.*

To the best of our knowledge, there is no empirical evidence to date suggesting a negative relationship between board diversity and innovative efficiency. Drawing on the previous discussion that board diversity leads to greater cognitive conflicts that impede board effectiveness (Huse 2007), we develop the competing hypothesis. This hypothesis predicts a potentially negative relationship between board diversity and innovative efficiency. Cognitive conflicts imply that directors have differing perspectives on important issues deliberated in the boardroom during decision-making processes (Torchia et al. 2015). One such issue is how the firm converts its investment in R&D from innovative projects into patents. For example, IPO firms with greater age diversity may have generational conflicts in decision-making on whether the outcome of innovative projects are patent worthy due to different interests and expectations. Similarly, IPO firms in the pharmaceutical industry, with boards largely dominated by scientists or doctors may appoint lawyers with patent experience within the industry improving professional expertise diversity. In this context, if board members who are scientists or doctors with critical expertise on the business operations of the firm have differing perspectives to the lawyers on whether the outcome of innovative projects are patent worthy, conflicts may arise in the boardroom. Such conflicts impede board effectiveness and slow down decision-making processes on patent filing.

Furthermore, the US observes a first inventor to file system in granting patents under the America Invents Act of 2011.[123] Therefore, conflicts arising due to greater board diversity in IPO firms may slow down decision-making on patent filing, causing the firm to miss out on viable innovation opportunities. Accordingly, we expect that greater board diversity impedes board effectiveness and ultimately, innovative efficiency consistent with the diversity theory. This leads to the competing hypothesis for the impact of board diversity on innovative efficiency.

H2b: *Greater board diversity is negatively related with the innovative efficiency of IPO firms.*

Board Diversity and External Innovation

In this section, we develop a conjecture rather than a hypothesis to examine the potential impact of board diversity on resource allocation towards external innovation due to the lack of theory. The main question here is whether IPO firms with diverse boards are able to create an innovative portfolio investing in external innovation. IPO firms are typically smaller entrepreneurial firms that are more likely to rely on their internal components for innovative activity rather than invest largely in externally generated innovation. Thus, we expect that in IPO firms, there is a potential substitution between investing in internal innovation or external innovation. External innovation relates to the acquired intangible assets of the IPO firm in each period. Intangible assets represent the knowledge and skills of the firm, and when acquired externally through a separate purchase or as part of a business combination (Stone et al. 2008), such knowledge is integrated into the innovative process. Andrews and Serres (2012) mention that acquired intangible assets provide potential for new business practices, an increase in knowledge management systems and the potential for the firm to expand into new markets. We argue that all these factors are sources of better innovation for the firm. Furthermore, Hunter et al. (2005) mention that the investment in intangible assets is prevalent at the earlier stages of the innovative process where research and experiments result in high sunk costs and the risk of failure is higher.

Considering the significant risks involved in the innovative process, we argue that investment in external innovation diversifies the risk portfolio of the firm and improves the firm's access to resources during the innovative process. In this vein, boards may allocate resources towards external innovation in a bid to improve the potential for success from

[123] The America Invents Act of 2011 also known as the Leahy-Smith America Invents Act can be found here.

innovative processes, while reducing risk exposure. Chen et al.'s (2019) findings indicate that greater diversity in the boardroom aligns the firm's risk exposure to risk strategy in a way that minimises reputation risk while enabling necessary financial risk exposure. Thus, board diversity influences the balancing of the firm's risk exposure. Accordingly, we expect greater board diversity moderates the efficiency of the board in allocating the IPO firm's resources beyond internal innovation towards externally generated innovation. This leads us to the following conjecture.

Conjecture 1: *Greater board diversity moderates IPO firms' investment in external innovation.*

4.4 Methodology

4.4.1 Sample Selection and Data Sources

Similar to Chapters 2 and 3, this chapter uses a sample of 661 IPO firms. The sample period starts from 1st January 1997 until 31st December 2019 and tracks the 661 randomly selected IPO firms listed between 1st January 1997 to 31st December 2015 to year 5 post-IPO.[124] This sample amounts to 25% of the initial population of 2,641 IPOs.[125] Board data for IPO firms are manually collected from the offering prospectuses for the IPO year and proxy statements for subsequent years post-IPO. Innovative activity data relating to R&D intensity and IA investment are collected from Compustat. For patent data, we combine the Darden School of Business Patent Database created by Bena et al. (2017) and the updated KPSS patent database created by Kogan et al. (2017).[126] The CRSP database is the source for IPO firm's financial data used in this chapter.

4.4.2 Methodological Choices

The section describes in greater detail the methodologies used in evaluating the relationship between innovative activity and board diversity in IPO firms. The sample comprises a panel including both time-series and cross-sectional variation in innovative activity, the measures of board diversity and the control variables. To begin our analysis, we examine the trend in innovative activity across the sample period to determine the most

[124] The sample period ends in 2019 as the data for the year 2020 was not available at the time of data collection.
[125] As discussed in Chapter 2, the initial sample of 2,641 is drawn from a population of 5,222 IPOs and excludes American Depository Receipts (ADRs), Real Estate Investment Trusts (REITs), unit offerings, spin-offs, carve-outs, closed-end funds, financial firms with Standard Industrial Classification codes (SIC) codes 6000-6799, and IPOs with an offer price below $5 consistent with Boone et al. (2007) and Chahine et al. (2011).
[126] Patent data regarding the number of patents is collected from the Darden School of Business Patent Database consisting of USPTO patent data from 1980-2017 used in Bena et al. (2017). The database can be found here. The KPSS database consists of USPTO patent data from 1926 to 2019 used in Kogan et al. (2017) and recently updated to 2020. This database provides data on the number of patents and patent citations and is available here.

appropriate method of analysis. In Figure 4.1, the measures of innovation show on average an increasing trend in the levels of R&D intensity, the number of approved patents i.e., patent count and patent citation. In terms of the IPO firms' investment in intangible assets, the trend analysis shows minute increases in the level and changes across time. This is unsurprising as IPO firms are typically smaller entrepreneurial firms that are more likely to rely on their internal components for innovative activity than externally generated innovation. To sum up, Figure 4.1 shows an increasing flow over time in the average levels of innovative activity, therefore we analyse the impact of board diversity on innovative activity using panel data analysis.

[Insert Figure 4.1 about here]

From a statistical point of view, the major source of variation for the measures of board diversity comes from the cross section, as the sample comprises 661 firms but only 5 years tracked post-IPO. Based on the trend analysis in Figure 2.3 of Chapter 2, the persistent nature of board diversity indicates a lack of within firm variation, which works against finding a significant relationship between board diversity and innovative activity in the fixed effect estimation.[127] Therefore, the OLS regression is estimated as the baseline regression to capture the board diversity-innovative activity relationship.

Main Regression Model for the Impact of Board Diversity on Innovative Activity

The OLS regression estimates the relationship between the measures of board diversity and the innovative activity of IPO firms. This estimation technique tests whether board diversity in IPO firms results in an allocation of a higher or lower level of resources towards innovative activity consistent with the hypotheses developed in Section 4.3. First, we test the validity of hypotheses 1a and 1b by regressing the levels of innovative activity to year 5 post-IPO on the lagged levels of board diversity. All independent variables are lagged one-year relative to the dependent variable as the information set available to the board for decision-making in the current period relates to prior occurrences. Furthermore, a one-year lag of the dependent variable, innovative activity (R&D intensity, patent count, patent citation, IA investment) is included in testing the validity of hypotheses 1a and 1b. This accounts for the dynamic nature of innovative activity and ensures that autocorrelation does not cause biased inferences. Model 4.1 relates to hypotheses 1a and 1b and is shown below.

[127] Unreported results test the assertion regarding the fixed effects estimation and the results indicate no relationship between innovative activity and board diversity. In unreported results, we also test the validity of our hypotheses using the two-step system GMM estimation, and the results indicate no relationship between innovative activity and board diversity.

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 Board\ Diversity_{i,t-1} + \sum_{n=3}^{9} \beta_n Firm\ Characteristics_{i,t-1} + \sum_{n=10}^{13} \beta_n Board\ Characteristics_{i,t-1} + Industry\ Dummies + Year\ Dummies + \varepsilon_{i,t} \quad (4.1)$$

t relates to the current period, i is the firm, while Y is the dependent variable, innovative activity. This chapter measures innovative activity through internal and external innovation. Internal innovation is captured by R&D intensity relating to innovative input and patent count, relating to innovative outputs. We also measure the quality of innovative outputs with patent citations while external innovation is captured by IA investment.

R&D intensity is defined as one plus the ratio of R&D expenditure to total assets; following the prior innovation literature (Guo and Zhou 2016), we set R&D to zero if it is missing.

Patent count is defined as the natural logarithm of one plus the total number of patents held by the IPO firm in each year (Chen et al. 2018).

Patent citation is defined as the natural logarithm of one plus the total number of citations received for the patents held by the IPO firm in each year (Chen et al. 2018).

IA investment is defined as the natural logarithm of the one plus the book value for acquired intangible assets scaled by total assets available in Compustat (Stone et al. 2008).[128]

Board diversity is measured in terms of gender, age, and professional expertise. *Gender diversity* is defined as the percentage of females in the boardroom (Adams and Ferreira 2009; Sila et al. 2016).

Age diversity is defined as the standard deviation of the board members' ages divided by the mean age of the board using the coefficient of variation formula. High scores indicate greater age diversity (Ali et al. 2014).

Professional expertise diversity is an expertise index based on the Blau heterogeneity index using the proportion of expertise groups on each board. The board expertise index is based on Gray and Nowland (2017) and includes the academic, accountant, army, banker, consultant, dentist, doctor, engineer, executive, finance expert, IT expert, investment professional, lawyer, scientist, and politician expertise groups. The Blau index for professional expertise diversity is appropriate, as there are fifteen expert categories, and this index accounts for the differences in each category equally. The expertise index is computed as follows: $1 -$

[128] Acquired intangible assets represent intangible assets, excluding goodwill acquired from business combinations that occurred during the current reporting period. This variable includes identifiable intangible assets and core deposits, servicing rights, customer relationships, and software.

$\Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in category i. High scores indicate higher professional expertise diversity.

We include in the model several firm characteristics following Chen et al. (2018) such as firm age, firm size, ROA, risk, leverage, asset tangibility and Tobin's Q.[129] We also account for board characteristics consistent with Balsmeier et al. (2017) and Chemmanur et al. (2014) by controlling for board size, board independence, board voting share ownership, VC board representation and board connections. All variables are defined in Appendix 4.1.

Next, we consider the effect of board diversity on the innovative efficiency predicted in hypotheses 2a and 2b. On the one hand, hypothesis 2a predicts that greater board diversity enhances board effectiveness as directors provide the firm with greater access to resources that improve the firm's innovative efficiency. On the other hand, hypothesis 2b predicts that greater board diversity leads to greater cognitive conflicts, resulting in slower decision-making, which is detrimental to the firm's innovative efficiency. The conversion of R&D capital into patents has been referred to as innovative efficiency in prior literature (Griffin et al. 2021; Sinagl and Wang 2021). We adopt Sinagl and Wang's (2021) sophisticated measure of innovative efficiency to analyse how firms turn R&D spending into innovation. The rationale behind this approach is that prior R&D capital is the IPO firm's investment in innovative activity at the initial phase and should feed forward into the number of patents generated. The authors measure is computed as the ratio of patents granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% as in Hirshleifer et al. (2013). Sinagl and Wang (2021) argue that it takes a firm 5 years to convert R&D capital into patents. Hall et al. (2001) show that patents are granted on average within 2 years for the US patent office but Hirshleifer et al. (2013) mention that R&D expenses over the preceding 5 years contribute to patent filings. Therefore, the 5-year cumulative R&D expenses start from year t-2, which allows us to account for the patent application process.[130] Thus, innovative efficiency is computed as follows:

$$Innovative\ Efficiency_{i,t} = \frac{Patents\ Granted_{i,t}}{R\&D_{\ i,t-2} + 0.8 * R\&D_{\ i,t-3} + 0.6 * R\&D_{\ i,t-4} + 0.4 * R\&D_{\ i,t-5} + 0.2 * R\&D_{\ i,t-6}} \quad (4.2)$$

[129] The measure of risk is an accounting-based measure defined as the standard deviation of the return on assets. We explored using a market-based measure of risk but as the data for this variable is not available in the pre-IPO year and considering our lagged model, we lose the IPO year observations hence, our focus on the accounting-based measure.

[130] We also create an alternative innovative efficiency measure using sales as the numerator. Ideally, to capture innovative efficiency as in Xie et al. (2020) we should use new product sales as the numerator. However, data on new product sales is not available for our sample of US firms'; hence, the focus on sales.

Model 4.3 presented below tests the validity of hypotheses 2a and 2b as follows and includes the same control variables in model 1 above:

$$Innovative\ Efficiency_{i,t} = \beta_0 + \beta_1 Board\ Diversity_{i,t-1} + \sum_{n=2}^{8} \beta_n Firm\ Characteristics_{i,t-1} + \sum_{n=9}^{12} \beta_n Board\ Characteristics_{i,t-1} + Industry\ Dummies + Year\ Dummies\ + \varepsilon_{i,t} \quad (4.3)$$

A statistically significant association between innovative activity/innovative efficiency of IPO firms and board diversity based on models 4.1 and 4.3 may not be interpreted as a causal relationship due to potential endogeneity concerns. For example, IPO firms seeking to improve innovative activity/innovative efficiency may select female directors, an older/younger director or a director with different professional expertise to facilitate innovative processes. In such cases, results indicating a positive relationship between board diversity and innovative activity/innovative efficiency may capture a selection effect rather than a treatment effect. In the section that follows, we attempt to address this issue using the PSM analysis.

Propensity Score Matching (PSM) Identification Strategy

With an observational dataset, PSM allows us to mimic the characteristics of randomised control trials usually performed on experimental data to estimate the effect of the treatment on the outcome (Austin 2011). In this chapter, the treatment refers to the measures of board diversity, while the outcome refers to the measures of innovative activity/innovative efficiency. Using the PSM, we reconstruct two groups: the treated and untreated groups to analyse the impact of the treatment on the outcome. The PSM mitigates potentially biased inferences in the OLS arising from a lack of distribution overlap and different density weightings by equating the distribution of the explanatory variables for IPO firms in both groups. The PSM uses predicted probabilities also known as propensity scores and a matching algorithm to estimate the effect of the treatment on the outcome.

To begin, we estimate the propensity score using logit regressions, as the probability that IPO firms received the treatment (board diversity), based on observable firm characteristics such as firm age, firm size, ROA, risk, leverage, asset tangibility and Tobin's Q. We create a board diversity dummy variable for the measures of board diversity which is the dependent variable in estimating the propensity scores. The treated group for gender diversity comprises firms with female directors, while the untreated group are firms without female directors. Regarding age and professional expertise diversity, we take a different approach by creating high(treated) and low(untreated) groups based on median values, as these variables range between 0 and 1. Model 4.4 estimates the propensity score and is shown below:

$$Board\ Diversity\ Dummy_{i,t} = \beta_0 + \beta_1 Firm\ Age_{i,t-1} + \beta_2 Firm\ Size_{i,t-1} + $$
$$+\beta_3\ Return\ on\ Assets_{i,t-1} + \beta_4 Risk_{i,t-1} + \beta_5 Leverage_{i,t-1} + +\beta_6 Asset\ Tangibility_{i,t-1} + $$
$$+\beta_7 Tobin's\ Q_{i,t-1} + Year\ Dummies\ + \varepsilon_{i,t} \quad (4.4)$$

Prior to matching, we generate an amended propensity score to account for industry differences as IPO firm's engagement in innovative activity will differ across industries (Cumming and Leung 2021).[131] Subsequently, the amended propensity scores for IPO firms in the treated group are matched to firms in the untreated group using the nearest-neighbour matching without replacements.[132] Furthermore, to ensure that there are no differences between both groups, the maximum calliper difference between the propensity score for the treated and untreated groups in our model is 0.1. The resulting sub-sample of matched pairs for gender diversity (191 matched, total firms of 382), age diversity (227 matched, total firms 454) and professional expertise diversity (187 matched, total firms 374) are then used to re-estimate the OLS regressions.

We conduct two diagnostic tests to ensure that the treated and untreated groups are indistinguishable. First, the logit regression is re-estimated based on the matched sample and none of the coefficients is significant, indicating that there is no difference between observable characteristics of treated and untreated firms' post-match. Second, we use t-tests for the mean difference in the firm characteristics between the treated firms and matched untreated firms.[133] These results suggest that our matching system is appropriate and OLS estimation based on the matched sample are more likely to mitigate endogeneity concerns. Thus far, we have discussed the main regression and estimation techniques adopted in analysing the relationship between innovative activity/innovative efficiency and board diversity. In the next section, the other estimation techniques we explore to address potential endogeneity are discussed.

Other Estimation Techniques

Endogeneity problems in our analysis may arise due to omitted variables and reverse causality. In this context, IPO firms have different unobservable factors that influence the innovative activity of the firm, for example their corporate culture. Regarding reverse causality, directors may be appointed to the board of a firm seeking to engage more in innovative activity, especially if these directors have access to essential resources. Directors may also self-select

[131] The amended propensity score is computed as follows: Fama-French 12 Industry Code * 100+Propensity Score.

[132] We do not match firms with replacement as the diagnostic tests from this method of matching reveal that the treated and untreated firms are still distinguishable in terms of risk which may introduce bias in the PSM.

[133] In the diagnostic t-tests for age diversity, there is a significant difference in firm age between firms that have high age diversity and those with low age diversity, but only at the 10% level which is weak.

into the boards of firms that engage in more innovative activity, as this might indicate the firm's quality, and ultimately improve the career prospect of directors. We explore two alternative estimation techniques highlighted in prior board diversity literature to address these endogeneity concerns and explain the relationship between board diversity and innovative activity. These estimation techniques include the instrumental variable estimation using the two stage least square (2SLS) regression and the difference-in-difference (DID) estimation technique.

Instrumental Variable Estimation

The two stage least square (2SLS) regression methodology addresses potential reverse causality issues by extracting the exogenous components of board diversity to explain the innovative activity of IPO firms. We explore several potential instruments for the measures of board diversity. The instrumental variable for gender diversity is *Industry Gender Diversity,* which is computed as the average gender diversity for each industry per year, excluding the IPO sample firm within that industry.[134] The rationale for this instrument is that IPO firms in the same industry are more likely to conform to the board gender diversity norms in their industry to ensure their firms are comparable to mature firms in the industry. For these IPO firms, the ability to attract female directors considering the shorter supply of competent female directors (golden skirt phenomenon), works towards improving the firm's legitimacy in their industry and the stock market (Rau et al. 2021).[135] While industry gender diversity influences the IPO firm's gender diversity, it does not directly influence the firm engagement in innovative activity or innovative efficiency as these decisions are firm specific and do not follow an industry trend. Therefore, both the relevance and exclusion restrictions criteria for instrumental variables are fulfilled.

The instrumental variable for age diversity is *Local Age Diversity,* which is defined as the average board age diversity for each state, excluding firms in the sample headquartered in that state.[136] We argue that the average age diversity for each state where the IPO firm is headquartered is more likely to influence age diversity on the boards of IPO firms, as board age reflects the state demographics characteristics which influence the supply of directors. In

[134] We explore other instruments relating to US state female demographics which do not pass the Craig Donald Wald weak instruments test including female participation ratio (Chen et al. 2018) and local gender diversity both suggesting that the instruments are weak and inappropriate for gender diversity.

[135] This suggests that firms focus on a niche of experienced female directors with prior or current board experience and transferable skills when appointing female directors leading to a lower supply of female directors compared to the demand.

[136] Other instruments for age diversity explored include the industry age diversity and board tenure. These instruments also fail the Craig Donald Wald weak instruments test.

the US, there are differences across each state in terms of the average age of the population that potentially influence the supply of directors, and this is reflected in the local age diversity measure. Thus, the expectation is that IPO firms headquartered in states with a higher local age diversity have more incentives to improve age diversity. This fulfils the relevance criterion for the instrumental variable. The exclusion criterion is also fulfilled as there is no direct link between the local age diversity of firms in the same state where the IPO firm is headquartered and the IPO firm's engagement in innovative activity or innovative efficiency.

In terms of professional expertise diversity, we use *Local Educational Attainment* defined as the percentage of the US civilian labour force with a BSc degree in each state where the IPO firm is headquartered. We expect that IPO firms are more likely to have a larger group of professional experts available to appoint if they are headquartered in a state with a higher population of BSc degree holders. This satisfies the relevance criterion. Regarding exclusion, the higher population of BSc holders per state does not directly influence the IPO firm's engagement in innovative activity or innovative efficiency.

Despite the rationale for instrumental variables for board diversity, the results from the Craig Donald Wald weak instrument identification test shows that the instruments for gender and age pass the weak instruments test. F statistics for these variables are 21.229 and 40.086 respectively, compared to the critical value of 16.380. Unfortunately, the instrument for professional expertise diversity does not pass this test with an F statistic of 12.299, much less than the critical value. Furthermore, the task to locate another appropriate instrument for professional expertise diversity proved ineffectual (See Appendix 4.2).[137] The results for IV estimation are discussed in the results section.

Difference-in-Difference Analysis

The other approach we consider is the difference-in-difference (DID) analysis. The DID analysis uses two groups (the treated and control groups) to capture the effect of the treatment-appointment of board members that represent one of our three diversity traits on changes in the outcome-innovative activity/innovative efficiency. Using this approach, innovative activity and innovative efficiency for the treated and control groups is observed across two periods.

[137] We explore several other instruments for professional expertise which fail the Craig Donald Wald weak instrument test. Local Director Supply which is the log of the total number of directors on the boards of all firms in the state where the IPO firm is headquartered excluding the firms in the sample. Location dummies is a dummy variable that takes a value of 1 if an IPO firm is headquartered in a geographical region (West, Northeast, Midwest, South). Industry Director Supply is the log of the total number of directors on the boards of all firms in the same industry as the IPO firm excluding the sample IPO firms. Industry Professional Expertise is the industry average number of board expert categories for the firms in our sample. Industry Board Independence is the industry average percentage of board independence for each respective year excluding the firms in the sample.

The treated group is exposed to the treatment, in the second period only, while the control group remains unexposed. For gender, the treatment takes a value of one for the first female board member appointed to replace a male director departing the board. In terms of age, the treatment is a dummy variable that takes a value of one for the first board appointment of a director from another generation (20 years difference) compared to the average board age and otherwise zero. Regarding professional expertise, the treatment takes a value of one if a director with a different board professional expertise is appointed to the board and zero otherwise. The average innovative activity/innovative efficiency in the control group is subtracted from the average innovative activity/innovative efficiency in the treated group for the sample period. This addresses bias in the results arising from differences between groups, over time, and ensures that any difference in innovative activity/innovative efficiency will be due to the impact of the treatment rather than differences between the treated and control groups.

The DID mimics a natural experiment design by using an exogenous shock to board diversity, to estimate the difference before and after the shock to the treatment and control groups. Within our sample period, the only potential exogenous shock relates to the Sarbanes-Oxley Act of 2002 requiring greater board independence in listed firms starting in 2003.[138] Although this is not directly related to board diversity, we expect that this change in board structure due to the SOX will impact board diversity. The period for the DID estimation is 1999 to 2007 for IPO firms listed between 1st January 1999 to 31st December 2002. This leads to a sample of 191 IPO firms. From this sample, only 4% (8) received the treatment in terms of gender and there are no firms in the treatment group for age diversity relating to the first appointed directors from a different generation. Regarding professional expertise diversity, 11% (21) of sample firms lie in the treated group. Consistently, the resulting treatment and control groups are too small for further analysis of potential causal effects. Furthermore, we examine the time trend for board diversity around the SOX Act for the DID samples to determine whether the SOX Act indeed provides an exogenous shock to board diversity. Appendix 4.3 shows that the average levels of board diversity indicate small steady increases across time with no sudden jumps around 2003 after the SOX Act came into effect. This suggests that the SOX Act does not provide an exogenous shock to any of the measures of board diversity across the sample. Thus, using the SOX Act as an exogenous shock to the

[138] The recent board diversity law passed in California provides an appropriate exogenous shock but is outside the sample period. On 30 September 2020, Gavin Newsom, the governor of the state of California signed bill 979 into the law that requires all companies listed on US exchanges and headquartered in California to have a minimum of two females for a board with five members or three females for a board with six members no later than 31 December 2021.

treatment and control groups is not appropriate for the DID analysis.[139] Although the DID estimation has been employed in the board diversity literature, in this chapter, the DID estimator is inappropriate for the analysis.

4.5 Results

4.5.1 Descriptive Statistics and Univariate Analysis

Table 4.1 reports the descriptive statistics for the sample and the univariate analysis results comparing innovative activity and innovative efficiency in IPO firms with high levels of board diversity to those with low levels of board diversity. IPO firms with at least one female board member are compared to those without female board members, while firms with high age/professional expertise diversity are compared to those with low age/professional expertise diversity. For brevity, Table 4.1 only presents mean and median values for each measure of board diversity with the significance for the t-tests and the Wilcoxon rank-sum tests which test for the differences across high level versus low level board diversity groups.

Across the sample period, IPO firms with at least one female board member have on average, a slightly higher engagement in innovative input 0.102 (log (1+R&D intensity), and innovative internal output 0.515 (log (1+patent count)) compared to their counterparts without female directors, 0.096 and 0.497 respectively. However, the t-tests and rank-sum tests show that these differences are insignificant between the two groups. In terms of the quality of internal innovative output, the t-test results show that IPO firms with female board representation have on average lower quality patents (log (1+patent citations)) 0.938 compared to those without female directors 1.077, significant at the 5% level. These results are in contrast with Chen et al. (2018) where they find a significant positive difference in patenting activity between mature firms with at least one female director and those without female directors. Surprisingly, the average gender diversity for firms with at least one female director in Chen et al. (2018) is only 14% which is less than the 18% in the IPO firms and translates to one female director on boards with an average size of eight members in our sample. This suggests that although the average female board representation is slightly higher for IPO firms than the mature firms as in Chen et al. (2018), it has no impact on the firm's engagement in internal innovative input but negatively influences the quality of the internal output.

Beyond the firm's engagement in innovative activity, the t-test results show that IPO firms with at least one female director have on average lower innovative efficiency

[139] Another potential shock to board structure and ultimately board diversity could be the death of a director. However, data on the death of directors is unavailable for our IPO firms in the Board Ex database.

(Patents/5RDC) 0.016 compared to the 0.025 for firms without female directors. The difference between the means for both groups is significant at the 5% level, while the median for both groups is zero. These results are in contrast with Griffin et al. (2021) who report significant positive difference in innovative efficiency between firms with female directors and those without female directors for an international sample of mature listed firms. The implications of the results is that IPO firms with female board representation are less likely to generate patents for each dollar of R&D capital consistent with the diversity theory. In terms of external innovation, there is no difference between the means for IPO firms with female board representation and those without female directors.

To sum up, the results for gender diversity in Table 4.1 suggest that gender diversity has no significant influence on R&D intensity, patent count, and IA investment, but a negative impact on patent citation, and innovative efficiency. These results are consistent with the diversity theory discussed in Section 4.2 suggesting that greater board diversity increases cognitive conflicts in the boardroom and ultimately decreases innovative activity and innovative efficiency of IPO firms. Thus, we find some support for the predictions of H1b and H2b that greater board diversity decreases innovative activity and innovative efficiency of IPO firms.

Age diversity is 1.6 times higher for firms with high age diversity compared to the group of firms with low age diversity. IPO firms with high age diversity invest less on average in innovative input 0.089 (log (1+R&D intensity)), have a lower innovative internal output 0.425 (log (1+patent count)), and lower innovative efficiency 0.018 (Patents/5RDC) compared to their counterparts with low age diversity,0.109, 0.583, and 0.026 respectively.[140] These IPO firms with high age diversity also invest less on average in external innovation 0.003 (log (1+IA investment) compared to those with low age diversity 0.005. These differences between the means for firms with high age diversity and low age diversity are significant at the 5% level or better. In terms of the quality of innovative internal output, there is no significant difference between the means for firms with high and low age diversity.

Put together, the results for age diversity show a clear negative pattern, indicating that firms with higher age diversity will engage less in innovative activity and are less efficient in generating patents for each dollar of R&D capital spent. These firms with high age diversity have slightly younger boards with an average age of 53 years compared to the 54 years for

[140] The median values for (log (1+R&D intensity)) 0.016 is also lower for IPO firms with high age diversity compared to those with low age diversity 0.047, and the difference is significant at the 1% level.

firms with low age diversity. Therefore, the results suggest that younger boards experience greater cognitive conflicts while older boards draw on the more experienced board members' knowledge to steer the firm towards R&D investments that yield more patents. This is unsurprising, as we expect that a younger board is more knowledgeable about current trends and potential new niches the IPO firm can explore to compete effectively in their industry. However, in the boardroom, this broader knowledge base may be a source of conflicts slowing down the decision-making process and causing the firm to miss innovative opportunities. The findings are consistent with the predictions for H1b and H2b that greater board diversity decreases innovative activity and innovative efficiency.

Turning now to professional expertise diversity, IPO firms have a 1.6 times lower level of professional expertise diversity in the low group compared to the high group. IPO firms with high professional expertise diversity engage more in innovative activity evidenced by the higher average in R&D intensity of 0.116, patent count of 0.590, patent citation of 1.089, and IA Investment of 0.006, and the differences are significant at the 5% level or better.[141] In terms of innovative efficiency, there is no significant difference between the means for the high and low professional expertise diversity groups. These findings for professional expertise diversity are consistent with H1a. Hypothesis 1a relates to the resource-based explanation that greater board diversity in IPO firms will provide a larger pool of directors from different backgrounds with resources and experience to streamline the decision-making process, resulting in better board advising and improved innovative activity.

Moving on to consider the control variables, firms with female directors have on average higher firm age, firm size, leverage, asset tangibility, Tobin's Q, board size, board independence, proportion of VC board representation and board connections comparable to firms without female directors. These results are similar to those in Chen et al. (2018) and the t-tests and Wilcoxon rank-sum tests results for the difference between the diversity groups is significant at the 10% level or better. We find similar patterns for firms with high professional expertise diversity but contrasting results for firms with high age diversity.

[Insert Table 4.1 about here]

Before proceeding with the multivariate analysis, we analyse the correlation between all our variables using the Pearson's correlation coefficients to check for multicollinearity. The correlation matrix reported in Table 4.2 shows that the highest correlation in absolute terms is

[141] The median values for (log (1+R&D intensity)) 0.062 is also higher for IPO firms with high professional expertise diversity compared to those with low professional expertise diversity 0.011, and the difference is significant at the 1% level.

-0.636 between the return on assets and the log (1+R&D intensity). This value is on the high side and does not influence the results discussed below as we re-run the regressions with the return on assets and the results remain consistent.[142]

[Insert Table 4.2 about here]

4.5.2 Main Results for the Impact of Board Diversity on Innovative Activity

This section presents the OLS and PSM results for the impact of board diversity on innovative activity and innovative efficiency. To begin, the results testing the validity of hypotheses 1a and 1b predicting the relationship between board diversity and innovative activity are discussed. Next, we discuss the results for hypotheses 2a and 2b on the impact of board diversity on the innovative efficiency. Finally, we discuss the results for the impact of board diversity on external innovation. All variables are winsorised at the 1% and 99% level to mitigate outliers influencing the results. Furthermore, all regressions include the control variables introduced in the methodology section and adjust for year and industry fixed effects. The coefficients and t-statistics reported in the result tables are heteroscedasticity consistent.[143]

Table 4.3 reports the OLS results on the impact of board diversity on innovative activity, as predicted by H1a and H1b. The dependent variable is innovative activity and is measured by R&D intensity in column 1, patent count in column 2, patent citation in column 3, and IA investment in column 4. The one-year lag of the dependent variable is included on the right-hand side in each column, and the high value of the coefficients on the lags confirm the dynamic nature of our model. The regression coefficients for the lagged R&D intensity is 0.565, lagged patent count 0.834, and the lagged patent citation, 0.726, which are all significant at the 1% level. These coefficient values suggest that the measures of innovative activity generated internally are largely explained by their past values. However, the lagged coefficient for innovative activity generated externally, IA investment, is 0.079 and is insignificant in explaining the current period values. This is consistent with our expectations, as these values relate to acquired intangible assets for each period and an IPO firm may be involved in such acquisitions at time t-1 but not in time t.

[142] These tests are unreported in this chapter. We also check the variance inflation factor (VIF) which tests the inter-variables correlation for all our regressions and the values are around 2.8 while is quite low and suggests that multicollinearity is not a problem in our model.

[143] The robust command produces unbiased t-statistics of the OLS regression coefficients heteroscedasticity. Heteroscedasticity arises where the variance of the residuals is unequal over a range of measured values and violates the assumption that residuals are drawn from a population with a constant variance. Thus, using the robust command corrects for this issue.

Column 1 in Table 4.3 shows the results for the impact of the measures of board diversity on R&D intensity, which indicates the level of IPO firm's innovative input. There is no significant evidence of a relationship between gender or age diversity and R&D intensity, but there is a positive result relating to the coefficient of professional expertise diversity, which is statistically significant at the 1% level. This indicates that a one unit increase in professional expertise diversity leads to a 0.033 increase in IPO firms' R&D intensity. For more context, the results suggest that IPO firms appointing directors with different professional expertise to the board increase R&D intensity by 3.3%. Thus, IPO firms with greater professional expertise diversity invest more in R&D intensity post-IPO. A likely explanation for these results is that a more diverse group of professional expertise in the boardroom provides the IPO firm with a larger pool of information and experience, which is invaluable when the firm allocates funds to research and development. This result is consistent with the resource dependency theory. Furthermore, the results in column 1 are supported by Klarner et al. (2020) whose qualitative study on mature firms suggest that directors contribute their professional expertise at the earlier stage of the innovative process, through knowledge transfers.[144] Therefore, IPO firms focusing on improving innovative activity will benefit from a more diverse group of professional experts in the boardroom. These results provide support for H1a that board diversity increases innovative activity of IPO firms.

The control variables indicating a relationship with innovative activity are mainly significant in column 1 relating to R&D intensity. In terms of firm characteristics, older IPO firms, firms with high leverage and those with a large base of plant, property, and equipment (PPE) will invest less in R&D intensity, while larger firms, firms with higher risk and higher firm value invest more. These results are significant at the 5% level or better. In their study on the impact of board diversity on innovation in mature firms, Chen et al. (2018) find a similar positive result for firm size and negative result for asset tangibility in relation to R&D intensity. The authors do not find evidence of a significant relationship between the other firm characteristics (firm age, firm risk, Tobin's Q) and R&D intensity. We argue that higher leverage reduces managers flexibility, as creditors are less tolerant of risky projects compared to shareholders (Cooper et al. 2020). As such, IPO firms invest less in innovative input, hence the negative impact of leverage on R&D intensity. The implication of these results is that in

[144] Klarner et al. (2020) focus on pharmaceutical companies' innovative processes and the role of directors' expertise. They mention that directors with specialised scientific expertise interacted proactively with executive directors on their proposals for innovation, sharing their knowledge and providing advice to the firm.

IPO firms, firm characteristics have a larger influence on the firms' investment in innovative input.

In columns 2 and 3, we do not find evidence of a relationship between the measures of board diversity and patent count or patent citation, respectively. This suggests that board diversity has no influence on IPO firms' innovative internal output, or the quality of the output generated. The results are in contrast with prior evidence on mature firms linking greater board diversity to improved patenting activity (Chen et al. 2018; An et al. 2021). Therefore, in IPO firms, board diversity has no impact on patenting activity. In terms of the control variables, column 2 shows a negative relationship between firm age and patent count, and a positive relationship between firm size and the latter. These are significant at the 5% level or better, but all other control variables are insignificant. The result suggesting that larger firms have a higher patent count is consistent with An et al. (2021) who study the impact of board diversity on innovation in mature firms. In column 3, older IPO firms have lower quality patents while larger IPO firms, with higher firm value, board independence and VC board representation have higher quality patents. These results relating to patent citation are significant at the 10% level or better. Our findings in relation to patent citation are consistent with prior innovation studies relating to IPO firms (Chemmanur et al. 2014) and mature firms (Balsmeier et al. 2017).[145] Chemmanur et al. (2014) report a negative relationship between IPO firm age and patent citations, while both studies report a positive relationship between firm size, Tobin's Q, board independence, VC board representation, and patent citations. To sum up, the results for the control variables suggest that the number of patents granted is mainly influenced by firm characteristics. In terms of the quality of patents generated, we find that board characteristics such as independence and VC board representation play an important role.

Finally, column 4 reports the results relating to IA investment, the measure of innovative activity capturing external innovation. We find that greater gender diversity decreases IA investment by 0.001, significant at the 10% level. To put this result into context, in a board with seven members (five males two females), gender diversity is 29%, appointing a female director to replace an outgoing male director will increase gender diversity by 14%. The implication of a 14% increase in gender diversity is that IA investment decreases by 1.4% (0.001*14%) which is a small decrease in the acquisition of intangible assets. As the acquisition of intangible assets is costly (Ewens et al. 2019), these results allude to female board

[145] Chemmanur et al. (2014) study the impact of venture capital involvement in IPO firms on innovation while Balsmeier et al. (2017) study the impact of independent boards on innovation.

representation, improving the monitoring function of the board (Adams and Ferreira 2009). The control variables in column 4 shows that IPO firms with a larger asset base of plant, property, and equipment (PPE) and VC board representation will have lower IA investment. Furthermore, we find that a positive relationship between board voting share ownership and IA investment. The results for these control variables are significant at the 10% level or better.

Overall, the results in Table 4.3 suggest that while professional expertise diversity improves innovative input and gender diversity is detrimental to external innovation, age diversity has no effect on the level of engagement in innovative activity. For IPO firms, a likely explanation for this result is that professional expertise diversity provides firms with access to relevant expertise that contributes to debates regarding the firms' innovative strategies and new ideas to be tested in the innovative process. Moreover, the insignificant results for the later phases of the innovative process where we consider the innovative internal output (patent count) and the quality of such output (patent citation) suggest that board diversity does not explain the later stages of the innovative process. Based on these results, we accept hypothesis 1a that diversity in the boardroom increases innovative activity (R&D intensity) relating to professional expertise diversity. We also accept H1b that board diversity decreases innovative activity (IA investment) relating to gender diversity. These results are consistent with the findings in the univariate analysis.

[Insert Table 4.3 about here]

Board Diversity and Innovative Efficiency

Investments in R&D is at the starting point in the innovative process for firms seeking to produce a new product or improve on existing ones that require patents. In this section, we examine the impact of board diversity on the efficiency of this process. Table 4.4 reports the results testing the validity of hypotheses 2a and 2b. Simply put, Table 4.4 answers how board diversity influences the effectiveness of the board in generating patents for each dollar of R&D capital spent, referred to as innovative efficiency. The dependent variable innovative efficiency (Patents/5RDC) is measured as the ratio of patent granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% following Hirshleifer et al. (2013).[146] We do not include lagged dependent variables as this measure of innovative efficiency accounts for prior period R&D expenditure.

[146] In column 2, we have also included an innovative efficiency measure based on a the 3-year cumulative R&D expenses as a denominator. The rationale for this measure is that we focus on a sample of IPO firms who may be younger in age and not incorporated more than five years before the IPO. 39% of the sample are less than 5 years

The results in Table 4.4 show that there is no relationship between gender or professional expertise diversity and innovative efficiency. The insignificant results for gender diversity are conflicting with prior literature relating to mature firms that report a positive impact of gender diversity on innovative efficiency (Griffin et al. 2021). To the best of our knowledge, there is no prior evidence on the impact of professional expertise diversity on innovative efficiency. These results indicate that in IPO firms, gender and professional expertise diversity have no impact on the efficiency of the innovative process. We find evidence of a negative relationship between age diversity and innovative efficiency. This indicates that IPO firms with greater age diversity in the boardroom are less efficient in transforming R&D into patents. The results suggest that a one unit increase in age diversity results in 0.094 units decrease in innovative efficiency, significant at the 1% level. Since firms with higher age diversity have younger boards on average, as shown in the descriptive statistics, our interpretation is that such boards experience conflicts that impede board effectiveness in decision-making (Huse 2007) and are detrimental to innovative efficiency. Put together, the results for the impact of board diversity on innovative efficiency are consistent with the diversity theory and the predictions of hypothesis 2b.

In terms of the control variables, we find that larger IPO firms, IPO firms with higher risk and leverage have lower innovative efficiency and these results are significant at the 10% level or better. This indicates that boards in IPO firms that are larger in size and potentially have more complex operations are less effective within the innovative process, although they invest more in innovative input (see Table 4.3). The consensus in prior literature is that innovation involves higher levels of risk, high uncertainty and large resource commitments (Mazzucato and Tancioni 2012). Therefore, the negative impact of firm risk on innovative efficiency suggests that IPO firms become more cautious within the innovative process to avoid higher risk levels. Similarly, the negative relationship between leverage and innovative efficiency reflects creditors lower risk tolerance, as firms are less likely to engage in risky projects that may yield patents (Atanassov 2013). For board characteristics, greater board independence increases innovative efficiency while greater board voting share ownership decreases innovative efficiency, significant at the 1% level. The implications of these results is that a monitoring-oriented board is better during innovative processes to ensure that strategies are being implemented as planned (Balsmeier et al.2017). Besides, the control variables

in age at the point of listing. The main results using this variable are consistent with the results for the innovative efficiency measure using the 5-year cumulative R&D expenses.

discussed above, all other variables have no significant relationship with innovative efficiency in IPO firms.

[Insert Table 4.4 about here]

Overall, the main results in Tables 4.3 and 4.4 show that in IPO firms, different aspects of board diversity matter depending on the phase within the innovative process. At the earlier stage of the innovative process, IPO firms will benefit more from greater professional expertise diversity in terms of innovative input. However, if IPO firms are past the initial innovative phase and have R&D capital aimed at generating patents, greater age diversity in the boardroom will inhibit the efficiency of this process. Finally, greater gender diversity in the boardroom is detrimental to external innovation. Regarding the hypotheses, we find evidence to support H1a for professional expertise diversity and H1b for gender diversity. Our findings in relation to the impact of board diversity on innovative efficiency are consistent with the predictions of H2b. There is no evidence in the main results supporting hypothesis 2a.[147] In the next section, we test the robustness of our results using the PSM analysis.

4.5.3 Robustness Tests

PSM Analysis

As a robustness check for the main results, we adopt the PSM estimation to control for potential endogeneity in estimating the impact of board diversity on innovative activity and innovative efficiency. IPO firms with similar firm characteristics, without female board representation are matched to firms with female board representation. Firms with high age/professional expertise diversity are matched to those with low age/professional expertise diversity based on the median values. Firm characteristics used to match firms include firm age, firm size, return on assets, risk, leverage, asset tangibility and Tobin's Q. To ensure the treated and untreated groups are indistinguishable, we construct the groups without replacement using the nearest-neighbour method. Also, we require that the maximum difference between the propensity score of the treated and its matched untreated firm does not exceed 0.1 in absolute value.[148] We conduct two diagnostic tests to ensure that the treated and untreated groups are indistinguishable, which are reported in Table 4.5.

[147] In unreported results, we analysed the impact of excessive board diversity using the squared values on innovative activity (Table 4.3) and innovative efficiency (Table 4.4) of IPO firms, but the results are insignificant for all measures of board diversity.

[148] We do not match firms with replacement as the diagnostic tests from this method of matching reveal that the treated and untreated firms are still distinguishable in terms of firm risk which introduces bias in the PSM. In unreported results we match both groups to a calliper difference of 0.05 in propensity score, but we lose a large number of observations post-match using this method. Considering the sample size with only 661 firms, we stand

The first test in Panel A of Table 4.5 compares the pre-match and post-match logit regressions for gender, age, and professional expertise diversity to check the quality of matching. Coefficients and robust t-statistics are reported for the logit regressions. The dependent variable in the logit regressions reported in columns 1 and 2 is gender diversity dummy, in columns 3 and 4, the age diversity dummy, and in columns 5 and 6, the professional expertise diversity dummy.[149] The logit regression predicts the probability that IPO firms have female directors, a high level of age or professional expertise diversity in the boardroom.

Columns 1, 3 and 5 show the results for the pre-match logit regressions relating to gender, age and professional expertise diversity, respectfully. Column 1 shows a positive relationship for firm size and Tobin's Q, but a negative relationship for asset tangibility with the gender diversity dummy, significant at the 1% level. This indicates that larger IPO firms or IPO firms with higher firm value are more likely to have female board representation. Column 3 reports a positive relationship for firm size with the age diversity dummy, significant at the 1% level. This indicates that larger IPO firms have a higher level of age diversity in the boardroom. In terms of the professional expertise diversity dummy, the pre-match logit in column 5 indicates that IPO firms with higher levels of risk have low professional expertise diversity, significant at the 1% level.

The post-match results for gender (column 2), age (column 4) and professional expertise (column 6) show that the previously significant results discussed above disappear, and all firm characteristics are now insignificant. The implication of these findings is that between the treated and the untreated groups, there is no significant difference in observable firm characteristics, which confirms the quality of the match for all the measures of board diversity. Furthermore, we use the chi-square test to determine whether the proportion differences between the treated and untreated groups is statistically significant. Accordingly, the chi-square values which were previously significant in the pre-match logits for gender, age and professional expertise diversity are now insignificant post-match, confirming the quality of the match.

Panel B of Table 4.5 shows the results for the second diagnostic test. We employed t-tests on the matched samples to test the mean difference in firm characteristics between the

by the 0.1 calliper difference match as this passes the diagnostic tests, matches at least 27% of the sample and retains at least 54% of the sample (treated and untreated) for analysis.

[149] Gender Dummy takes a value of one if at least one female director is on the board and zero otherwise. Age Dummy takes a value of one if the firm's age diversity is higher than the median value for the sample and zero otherwise. Professional Expertise Dummy which takes a value of one if the firm's professional expertise diversity is higher than the median value for the sample and zero otherwise.

treated and untreated firms consistent with Chen et al. (2018). The results from the diagnostic tests in Panel B show that there is no significant difference between the mean values for firms with female board representation to those without. Similarly, there is no significant difference between the mean values for firms with high age/professional expertise diversity to those with low age/professional expertise diversity.[150] The untabulated results for the Wilcoxon rank-sum test, which tests the median difference between groups show similar results to the t-test. To sum up, these results suggest that the matching system employed is appropriate. Therefore, we expect that the OLS re-estimated on the matched sample will reflect the treatment effect (i.e., the effect of gender, age and professional expertise diversity on innovative activity/innovative efficiency) which mitigates endogeneity concerns.

[Insert Table 4.5 about here]

Moving forward, Table 4.6 reports the PSM results, testing the robustness of the results in Table 4.3 for the impact of board diversity on innovative activity. Innovative activity is captured by R&D intensity (innovative internal input), patent count (innovative internal output), patent citation (quality of innovative internal output), and IA investment (external innovation). The main results suggesting that IPO firms with greater professional expertise diversity allocate more resources to innovative input are robust to the PSM results reported in Table 4.6. Column 3 shows that a one unit increase in professional expertise diversity will result in an increase in R&D intensity by 0.030 units. This result is significant at the 5% level. The main results suggesting a negative relationship between gender diversity and IA investment disappears in the PSM, which is not surprising as these results are significant at the 10% level in Table 4.3. Following the same pattern as the main results in Table 4.3, we do not find evidence of a relationship between age diversity and the measures of innovative activity.

To sum up, the PSM results for the measures of board diversity in Table 4.6 suggests that professional expertise diversity improves the innovative input of IPO firms, but gender diversity and age diversity have no effect on the level of engagement in innovative activity. In terms of the hypotheses, the results from Table 4.6 are consistent with hypothesis 1a that greater diversity in the boardroom of IPO firms increases innovative activity but there is no evidence to support hypothesis 1b. The results for all control variables in Table 4.6 are on par with those discussed above for Table 4.3.

[Insert Table 4.6 about here]

[150] In the diagnostic t-tests for age diversity, there is a significant difference in firm age between firms that have high age diversity and those with low age diversity, but only at the 10% level which is weak.

Table 4.7 reports the PSM results, testing the robustness of the results in Table 4.4 on the impact of board diversity on innovative efficiency.[151] The dependent variable, innovative efficiency (Patents/5RDC) is measured as the ratio of patent granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% following Hirshleifer et al. (2013). Columns 1 to 3 report the results for the impact of gender, age and professional expertise diversity, respectively, on innovative efficiency. There is no evidence of a relationship between gender (column 1) or professional expertise diversity (column 3), and innovative efficiency consistent with the main results. Similar to the main results in Table 4.4, we find evidence of a negative relationship between age diversity and innovative efficiency in column 2. In particular, the results indicate that a one unit increase in age diversity results in a 0.099 unit decrease in innovative efficiency, and this result is significant at the 1% level. This suggests that IPO firms increasing age diversity in the boardroom are less efficient in transforming R&D investments into patents. These results are consistent with the diversity theory suggesting that greater board diversity increases cognitive conflicts that impede board effectiveness and the predictions of H2b. In terms of the control variables, the results in Table 4.7 are similar to those discussed above for Table 4.4.

[Insert Table 4.7 about here]

Overall, the PSM results are largely consistent with the main results discussed earlier. In terms of IPO firm's engagement in innovative activity, the results indicate that greater professional expertise diversity is beneficial for as such firms invest more in innovative input. In transforming R&D expenditure into patents, age diversity is detrimental to efficiency of this process in the boardroom. Moreover, gender diversity, which has been identified in the literature for mature firms as the aspect of diversity improving innovation (Chen et al. 2018; Griffin et al. 2021), has no effect on the innovative activity and innovative efficiency of IPO firms.

Instrumental Variable Estimation Technique

As discussed in the methodology section of this chapter, we also adopt the instrumental variables (IV) estimation technique to analyse the relationship between board diversity and innovative activity/ innovative efficiency. The two stage least square regression extracts the exogenous component of board diversity (gender, age and professional expertise) to explain the measures of innovative activity (R&D intensity, patent count, patent citation, and IA

[151] In unreported results, we have also used an innovative efficiency measure based on sales rather than patents and the results are robust.

investment) and innovative efficiency (Patents/5RDC). Gender diversity is instrumented by *Industry Gender Diversity*, we instrument age diversity by the *Local Age Diversity* while professional expertise diversity is instrumented by *Local Education Attainment*. Although all the instruments fulfilled the relevance and exclusion criteria, as discussed in Section 4.4.2, the instrument for professional expertise diversity fails the Craig Donald Wald weak instrument identification test. Thus, we do not discuss the results for professional expertise diversity. The IV estimation results are reported in Appendix 4.2.

In terms of the other two measures of board diversity, the results for gender diversity are different to those in the OLS and PSM as we find significant evidence that a one unit increase in gender diversity results in 0.005 units decrease in R&D intensity at the 5% significance level. The results are in contrast with prior literature relating to mature firms suggesting a positive impact of female board representation on R&D intensity (Chen et al. 2018). This alludes to the detrimental effect of increased board monitoring in IPO firms, as 85% of female directors in our sample are non-executive directors. Female board members who are usually non-executive directors have been identified as better monitors (Adams and Ferreira 2009) that improve the governance structure of the firm. However, IPO firms are typically at the growth phase of their life cycle and will benefit more from an advising-oriented board to minimise the liability of newness in the stock market (Field et al. 2013). Specifically, during the innovative process since experimentation and creativity involve high levels of risk and uncertainty.

For age diversity, there is no evidence of a significant relationship with the measures of innovative activity. This indicates that greater age diversity in the boardroom has no effect on the IPO firm's engagement in innovative activity. Therefore, in terms of the hypotheses on innovative activity, the results from the IV estimation provide support for hypothesis 1b in relation to gender diversity. These results are also consistent with the diversity theory that greater board diversity increases cognitive conflicts that impede board effectiveness. We also test hypotheses 2a and 2b on the relationship between board diversity and innovative efficiency. The results are different to those in the OLS and PSM, as we find no significant evidence of a relationship between any of the measures of board diversity and innovative efficiency. The implication of this result is that the measures of board diversity have no influence on innovative efficiency.

In summary, the results from the OLS and PSM are not robust to the IV estimation. Rather, we find new evidence that greater gender diversity decreases the IPO firm's investment in innovative input. Although the instruments for gender and age diversity are valid, we rely on the results from the PSM analysis as the main results accounting for endogeneity in this chapter.

4.5.4 Further Analysis

Board Diversity and External Innovation

In this section, we test whether board diversity moderates the allocation of resources towards external innovation consistent with the predictions of conjecture 1. Table 4.2 shows a negative correlation between R&D intensity and IA investment, which suggests a potential substitution between investing in internal versus external innovation.[152] The implication of this substitution is that IPO firms investing in internal innovation are less likely to allocate resources towards external innovation. Furthermore, the trend analysis in Figure 4.1 shows that there are minute changes in external innovation across the sample period. This is unsurprising as IPO firms are typically smaller entrepreneurial firms that are more likely to rely on their internal components for innovative activity rather than invest largely in externally generated innovation. External innovation relates to acquired intangible assets and is captured by IA investment. The analysis regresses IA investment on the one-year lagged interaction of board diversity and R&D intensity. The rationale behind this is to test whether such an interaction results in a higher resource allocation towards externally generated innovation.

Table 4.8 shows the OLS and PSM results for the relationship between board diversity and external innovation. All regressions include the control variables introduced in the main results section and adjust for year and industry fixed effects. The coefficient and t-statistics reported in the result tables are heteroscedasticity consistent. The results for the OLS regression in columns 1 to 3 show that there is no significant relationship between the measures of board diversity (gender, age and professional expertise) and external innovation. The individual effects for greater diversity in the boardroom when R&D intensity is zero is insignificant in relation to the firm's IA investment as is the interaction term. However, there is evidence in column 1 that greater R&D intensity in firms with no female board representation has a negative effect on IA investment. In detail, a one unit increase in R&D intensity results in a 0.007 unit decrease in IA investment, significant at the 10% level. This supports the argument that IPO firms rely more on internal components for innovative activity rather than invest externally.

[152] In unreported results, a scatterplot with a linear prediction suggests this effect exists between R&D intensity and IA investment for IPO firms.

The PSM in columns 4 to 6 are similar to the OLS but focus on the matched sample comparing firms with female directors to those without, and firms with high age and professional expertise diversity to those in the low group. The results in column 4 indicate that the individual effects for greater gender diversity and greater R&D intensity when the other is zero are negative in relation to IA investment, and significant at the 10% level or better. This suggests that IPO firms with female board representation or a one unit increase in R&D intensity invest 0.000 or 0.013 units less in external innovation, respectively. However, the interaction term indicates that this negative effect of gender diversity is dampened by 0.001, when R&D intensity increases by one unit, significant at the 5% level. Thus, there is an overall negative effect of the interaction term on IA investment, which is smaller than the individual effects of gender diversity or R&D intensity. The implications of these results is that IPO firms with R&D capital are less likely to diversify towards external innovation, but with greater gender diversity in the boardroom, this effect is lower. These results are consistent with the results in Table 4.3 suggesting a negative relationship between gender diversity and IA investment. Columns 5 and 6 show that there is no significant relationship between the age and professional expertise diversity and IA investment. Still, IPO firms with greater R&D intensity when professional expertise diversity is zero have 0.012 lower IA investment, significant at the 10% level. To conclude, the results in Table 4.8 provide support for conjecture 1 and show that greater diversity negatively moderates the firm's investment in external innovation.

[Insert Table 4.8 about here]

Sub-Sample Analysis Based on Corporate Governance Characteristics

This analysis investigates whether the main findings in Tables 4.3 and 4.4 vary across IPO firms depending on their corporate governance characteristics relating to board independence, board connections, and VC board representation. The rationale for the sub-sample analysis relating to board independence lies in prior literature suggesting a relationship between board independence and innovation (Lu and Wang 2018). Furthermore, Balsmeier et al. (2017) also show that firms with strengthened governance through board independence have stronger innovation performance. Essentially, board diversity and board independence have been identified in the literature as instruments to improve the monitoring function of the board (Kang et al. 2007; Adams and Ferreira 2009). We argue that there is a potential trade-off effect between board diversity and board independence depending on the monitoring needs of the firm and this effect will be apparent in poorly governed firms.[153] Sub-samples are created for well and poorly governed firms based on the median value of board independence.[154]

Moving on, we create sub-samples based on board connections as the latter is related with better board advising capacity (Cole et al. 2020) and innovation (Kang et al. 2018) in prior literature. Chang and Wu (2021) mention that better-connected boards have a positive impact on innovative activity and the effect is stronger in firms with a higher demand for advising. IPO firms with board connections above the median value for our sample are referred to as better-connected firms, while those below the median are poorly connected firms.[155] Accordingly, we argue that poorly connected IPO firms have less access to external resources and as such are more likely to benefit from greater board diversity during the innovative process, which improves the firms access to resources.

Finally, sub-samples differentiating between IPO firms with VC board representation and those without VC board representation are created.[156] In Chapter 2, we established that beyond providing finance to the firm, venture capitalist directors provide value-added services to the IPO process through their screening activities, decision support, and connecting the firm with potential suppliers and customers (Iliev and Lowry 2020). We argue that all these value-added services increase the venture capitalist directors' knowledge of their portfolio firms and consequently, their influence on decision-making regarding innovative activity. Chemmanur et al. (2014) provide evidence to support this argument as they find that VC board membership has been related with improved innovation in IPO firms, hence our comparison of the two groups. We expect that the impact of board diversity on innovative activity, innovative efficiency and external innovation is apparent in firms without VC board representation. The rationale for argument is that firms without VC board representation have less access to external resources and greater board diversity may provide such access that improve decision-making regarding innovative activity.

---

[153] Prior evidence on mature firms suggests that female directors are better monitors than their male counterparts and are usually non-executive directors that are independent of the firm (Adams and Ferreira 2009). Accordingly, it may be difficult to explain a trade-off between board diversity and board independence if female directors are also independent directors. However, our focus on IPO firms makes this argument possible for two reasons: we examine other measures of board diversity beyond gender and IPO firms may have greater difficulty attracting female directors due to the golden skirt phenomenon. IPO firms may face more difficulties in attracting female directors since they are new to stock markets, suffer from information asymmetry problems and there is a short supply of competent female directors.

[154] There are 1,598 observations in the well-governed group and 1,538 observations in the poorly governed group. The differences is due to firms with board independence equal to the median that are categorised as well governed.

[155] There are 1,567 observations relating to better connected boards and 1,569 observations relating to poorly connected boards.

[156] There are 2017 observations relating to IPO firms with VC board representation and 1119 observations for IPO firms without VC board representation.

The results for these sub-samples are reported in Tables 4.9 and 4.10 and relate to the main variables of interest for brevity.

Sub-Sample Analysis for the Impact of Board Diversity on Innovative Input

Table 4.9 reports the results for the impact of board diversity on innovative input (R&D intensity) in sub-samples.[157] Columns 1 and 2 compare well-governed to poorly governed IPO firms, columns 3 and 4 compare better-connected to poorly connected firms whiles columns 5 and 6 compare IPO firms with VC board representation to those without VC board representation, respectively. There is no significant relationship between age diversity and R&D intensity (innovative input), consistent with the main results discussed in the previous sections. An important highlight in the results across all sub-samples is that professional expertise diversity positively influences the firm's R&D intensity. The implication of these results is that greater professional expertise diversity complements other corporate governance characteristics to facilitate the IPO firm's investment in innovative input. Therefore, we can only differentiate between sub-samples based on the magnitude of the coefficients.

Comparing well governed to poorly governed firms in columns 1 and 2, we find that the magnitude of the positive effect of professional expertise diversity on R&D intensity is stronger for poorly governed firms, 0.038 compared to 0.034 in well-governed firms. Although the difference in the coefficients is small (0.004), both are significant at the 5% level. This indicates that poorly governed firms will benefit more from greater professional expertise diversity in the boardroom. Furthermore, the greater positive effect of professional expertise diversity in poorly governed firms suggests that such firms may benefit more from the advice provided by board members with different professional expertise (Gray and Nowland 2017). There is also evidence explaining the results from the IV estimation that greater gender diversity decreases the firm's R&D intensity and the negative effect of 0.001 is observed for poorly governed firms, significant at the 10% level. This alludes to the detrimental effect of better board monitoring by female directors (Adams and Ferreira 2009) on the IPO firm's investment in innovative input.

Next, we discuss the results in columns 3 and 4, comparing well connected to poorly connected firms, respectively. IPO firms with a better-connected boards benefit more from greater professional expertise diversity as the positive effect on R&D intensity is 0.051 units,

[157] In unreported results, we examine the impact of board diversity on other measures of innovative activity (patent count, patent citation and IA investment) in the sub-samples. The results are consistent with the main results that show no relationship between the measures of board diversity and these measures of innovative activity. Thus, we focus on innovative input in Table 4.10.

significant at the 1% level, compared to the 0.019 units for poorly connected firms, significant at the 10% level. This suggests that the complementary effect of professional expertise diversity is greater in firms that have more access to external resources and equipped with experienced directors through board connections. We argue that better-connected firms are more knowledgeable on how to utilise the different professional expertise of directors in the boardroom while investing in innovative input.

In columns 5 and 6, we compare IPO firms with VC board representation to those without VC board representation. The results suggest that firms with VC board representation benefit more from greater professional expertise diversity as R&D intensity increases by 0.050 units compared to 0.023 units for firms without VC board representation. These results are significant at the 5% level or better. Since venture capitalist directors have a larger exposure in terms of IPOs and provide value-added services to their portfolio firms (Iliev and Lowry 2020), professional expertise diversity complements the VCs experience in decisions regarding investments in innovative input. Besides, 85% of venture capitalist directors are financial experts and we argue that IPO firms require a more advising-oriented board with a variety of professional expertise to navigate the stock market. Hence, greater professional expertise diversity improves the firm's access to resources, information and contacts from the varied experiences of board members, which influences decision-making on investment in innovative input.

[Insert Table 4.9 about here]

Put together, the results in Table 4.9 show that greater professional expertise diversity complements the corporate governance characteristics of IPO firms to facilitate investment in innovative input, while greater gender diversity inhibits the latter. This complementary effect is more pronounced in poorly governed firms, firms with better-connected boards and firms with VC board representation. A likely explanation is that different board professional expertise results in better board advising as more knowledge transfers to the board occur with the larger group of external contacts increasing the firm's access to information (An et al. 2021). Although it is difficult to disentangle the effect of board diversity on the advising and monitoring roles of the board, in terms of the IPO firm's engagement in innovative activity, the results suggest that it is less about monitoring and more about advising.

Sub-Sample Analysis for the Impact of Board Diversity on Innovative Efficiency

Table 4.10 reports the results for the impact of board diversity on innovative efficiency in sub-samples. Innovative efficiency refers to the IPO firm's effectiveness in generating patents for each dollar of R&D capital spent. Columns 1 and 2 compare well-governed to poorly governed IPO firms while columns 3 and 4 compare better-connected to poorly connected firm. In columns 5 and 6, we compare IPO firms with VC board representation to those without VC board representation. There is no significant relationship between professional expertise diversity and innovative efficiency, consistent with the main results discussed in the previous sections. Across all sub-samples, age diversity has a negative effect on innovative efficiency. There is also evidence of a negative relationship between gender diversity and innovative efficiency, and these results are significant at the 5% level or better.

Columns 1 and 2 show that the magnitude of the negative effect is larger for well governed firms 0.131 compared to 0.054 in poorly governed firms, both significant at the 5% level or better. Greater age diversity results in a range of different age groups and experience levels in the boardroom, which may increase the potential for cognitive conflicts (Huse 2007). There is also new evidence of a negative effect of greater gender diversity on innovative efficiency and this effect is observed for well-governed firms with high board independence. This result is significant at the 5% level. Accordingly, the results allude to the detrimental effects of cognitive conflicts and greater monitoring on the efficiency of the innovative processes.

In comparing well-connected to poorly connected firms, columns 3 and 4 show that the negative effect of age diversity on innovative efficiency is more pronounced in poorly connected firms 0.133 compared to better-connected firms 0.050. These results are significant at the 5% level or better. We argue that in poorly connected IPO firms, the firm has less access to resources, information and contacts and are potentially at a disadvantage during the innovative process. The results indicate that cognitive conflicts arising due to greater age diversity in such firms impede board effectiveness in decision-making, and the outcome is less patents granted for each dollar of R&D capital spent.

The final two columns of Table 4.10 compare the effect of board diversity on innovative efficiency in firms with VC representation to those without VC board representation. The results indicate that the negative effect of age diversity on innovative efficiency is more pronounced in IPO firms without VC board representation; 0.117 compared to firms with VC board representation at 0.100. These results are significant at the 1% level and suggest that firms without VC board representation are less efficient in converting R&D capital into patents. We have established that venture capitalist directors have an extensive role beyond financing in IPO firms, as they provide value-added services and access to external contacts. Therefore, a likely explanation for these results is that in IPO firms without VC board representation, there is less access to information during the innovative process. Consequently, potential conflicts arising in such firms due to greater age diversity will impede board effectiveness in decision-making (Talavera et al. 2018).

[Insert Table 4.10 about here]

In summary, the results in Table 4.10 show that the negative effect of age diversity on innovative efficiency is more pronounced in well-governed, poorly connected, and IPO firms without VC board representation. Also, the negative effect of gender diversity on innovative efficiency relates to well governed IPO firms with high board independence. The implications of these results is that in terms of innovative efficiency, it is less about monitoring, and more about advising. Furthermore, the results allude to the detrimental effects of cognitive conflicts in the boardroom on the efficiency of the innovative process.

4.6 Conclusion

To date, the extensive literature on board diversity has not examined the impact of board diversity on the innovative activity in IPO firms. In this chapter, we explore this gap by analysing how board diversity (gender, age and professional expertise) influences innovative activity (R&D intensity, patent count, patent citation and IA investment). Additionally, this chapter examines whether board diversity influences the IPO firm's effectiveness in generating patents for each dollar of R&D capital spent, referred to as innovative efficiency. Finally, we investigate whether board diversity moderates the allocations of funds towards external innovation (IA investment).

The main findings suggest that greater professional expertise diversity in the boardroom facilitates R&D investments. This implies that IPO firms at the initial investment phase of the innovative process, will benefit more from professional expertise diversity in the boardroom than other aspects of diversity (gender and age). These findings extend the results in Chapters 2 and 3 that the focus of IPO firms on professional expertise diversity not only improves IPO survival but also their investment in innovation. In terms of innovative internal outputs, we find no evidence of a relationship between the measures of board diversity and patenting activity. The results are in contrast with prior evidence on mature listed firms suggesting that greater board diversity improves patenting innovative output and indicates that in IPO firms, no such effect exists. Still, in examining the impact of board diversity on innovative efficiency, we find that age diversity has a negative effect. This suggests that greater age diversity is detrimental during the innovative process and IPO firms should focus on other board characteristics such as independence rather than diversity. Finally, we find that firms with greater gender diversity invest less in external innovation, which alludes to the impact of better monitoring in the boardroom causing a more cautious board in the acquisition of intangible assets.

In the sub-sample analysis, we attempt to explain the reasons behind the main results by comparing IPO firms based on their corporate governance characteristics. The results show that the positive impact of professional expertise diversity on R&D intensity is more pronounced in poorly governed firms, firms with better-connected boards and firms with VC board representation. This implies that professional expertise diversity complements other corporate governance characteristics in the boardroom during the IPO firm's investment in innovative input. Regarding innovative efficiency, the sub-sample analysis shows that the negative effect for age diversity is more pronounced in IPO firms that are well governed, poorly connected, and without VC board representation. These findings allude to the detrimental effects of cognitive conflicts arising due to greater age diversity on the efficiency of innovative processes. Overall, the results suggest that IPO firms with advising-oriented boards benefit more in terms of the engagement in innovative activity and innovative efficiency than firms with monitoring-oriented boards.

Our results highlight the importance of professional expertise diversity and advising-oriented boards during the innovative process in IPO firms, which contributes to both the academic literature and practice. From an academic perspective, we provide first evidence on the impact of gender, age and professional expertise diversity on innovative activity in IPO firms thus broadening our understanding on the importance of board diversity. We also provide first evidence on the detrimental impact of age diversity on innovative efficiency in IPO firms. For practice, this chapter provides vital information to assist IPO firms in structuring their boards in a way that is consistent with the innovative strategies of the firm. IPO firms investing in research and development will benefit from greater professional expertise diversity in the boardroom. In IPO firms further along in the innovative process, greater age diversity is detrimental to the efficiency of such firms in generating patents. Finally, greater gender diversity is detrimental for IPO firms whose innovative strategy involves a diversified innovative portfolio comprising internal and external innovation. As such, in terms of innovation, IPO firms should focus on improving professional expertise diversity in board appointments.

Figures and Tables for the Impact of Board Diversity on Innovative Activity

Figure 4.1 Trend Analysis for Innovative Activity

The figure below shows the trend analysis for the measures of innovative activity across the sample period. The measures of innovative activity show on average an increasing trend in the levels of patenting activity as measured by the log (1+Patent Count) and the log (1+Patent Citation) as well as R&D intensity as measured by the log (1+R&D Intensity) though there is a small decrease prior to listing. In terms of investment in intangible assets, the log (1+ IA Investment) shows that the level and changes are small across time. As the measures of innovative activity show a flow rather than significant jumps, we analyse the impact of board diversity on the measures of innovative activity focusing on the panel of 661 IPO firms. From a statistical point of view, the main source of variation in the measures of board diversity likely comes from the cross section, as the sample comprises 661 firms but only 5 years post-IPO. The lack of within firm variation in board diversity works against finding a significant relationship between board diversity and the measures of innovative activity in models such as the fixed effect estimation. Thus, OLS regressions are estimated to capture the board diversity-innovative activity relationship.

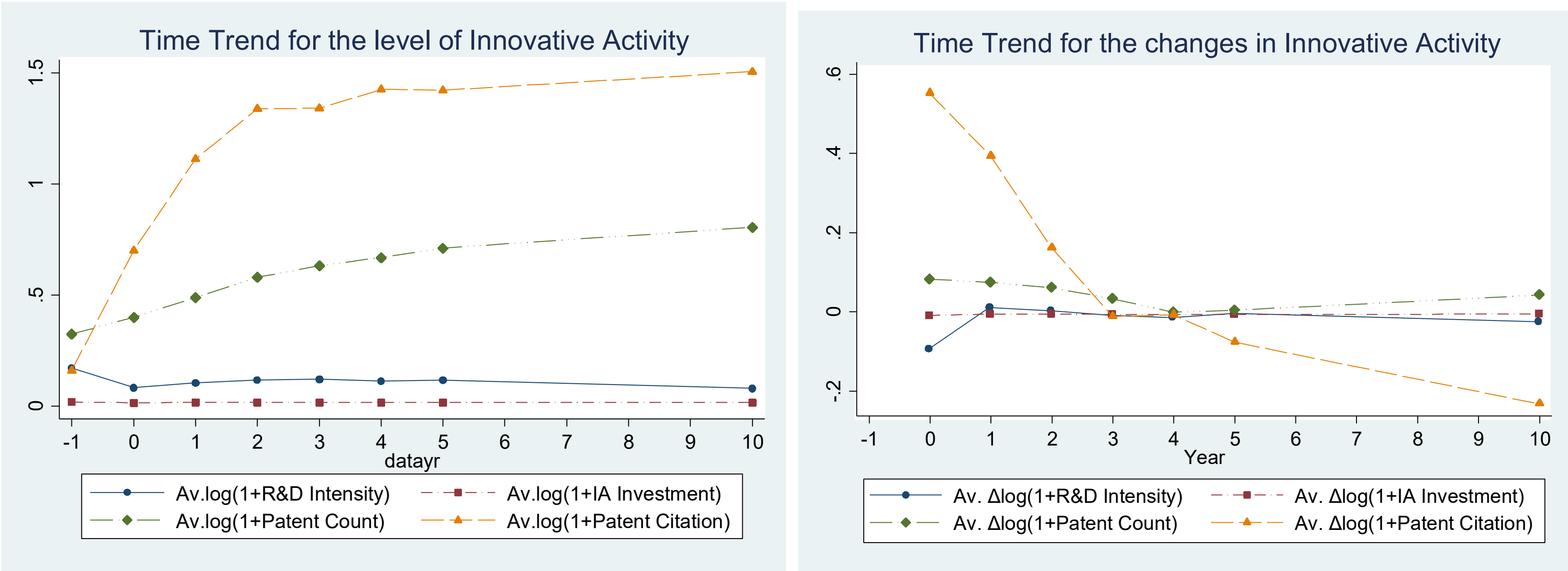


Table 4.1 Descriptive Statistics and Univariate Analysis Comparing Innovative Activity in IPO Firms with High Board Diversity to Low Board Diversity

This table provides descriptive statistics for 3,136 firm year observations relating to the 661 IPO firms in the sample between the IPO year and year 5 Post-IPO. t tests results show the differences in the means between firms with high and low diversity based on median values. Wilcoxon rank-sum test on the difference in medians is used to test the equality of medians for the unmatched data when IPO firms with high board diversity are compared to firms with low board diversity . Total Assets is the value of total assets for each firm. R&D Expenditure is the value of research and development expenditures for each firm. Intangible Assets is the value for acquired intangible assets available in Compustat for each IPO firm. R&D Intensity is the ratio of research and development expenditure to total assets for each firm. IA Investment is the ratio of intangible assets to total assets for each firm. Patent Count is the number of patents held by the IPO firm in each year. Patent Citation is the total number of citations received for the patents held by the IPO firm in each year. Gender Diversity is the percentage of females on the board Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). High scores indicate greater age diversity. Prof Exp. Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1-\Sigma_{i=1}^{n}P_i^2$ where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity and vice versa. Firm Age is the difference between the year of incorporation of the firm and the year of the IPO. Firm Size is the natural log of total assets. Return on Assets is earnings before interest, taxes, depreciation, and amortisation divided by total assets. Risk is the 3-year rolling standard deviation of the retun on assets. Leverage is the ratio of long-term debt to the total asset. Tobin's Q is the market value of equity plus total assets minus book value of equity, all divided by total assets. Board Size is the average number of directors on the board in the year of the IPO. Board Independence is the percentage of independent directors on the board relative to board size. Board Voting Share Ownership is the total percentage of voting shares held by the board. VC Board Representation takes a value of one if a Venture Capitalist Director is present on the board, and zero otherwise. Board Connections is the average number of prior and current board appointments of the board in each year. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

	Firms with Female Directors N=1176		Firms without Female Directors N=1960		Firms with High Age Diversity N=1610		Firms with Low Age Diversity N=1526		Firms with High Prof. Exp. Diversity N=1608		Firms with Low Prof. Exp. Diversity N=1528	
Panel A: Measures of Innovative Activity	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Total Assets ($b)	0.875	0.219	0.493	0.151	0.629	0.162	0.646	0.181	0.714	0.182	0.559	0.1599
R&D Expenditure ($b)	0.026	0.006	0.016	0.003	0.017	0.002	0.022	0.007	0.025	0.008	0.015	0.002
Acquired Intangible Assets($b)	0.007	0.000	0.006	0.000	0.004	0.000	0.008	0.000	0.005	0.000	0.007	0.000
R&D Intensity	0.121	0.043	0.114	0.026	0.105	0.017	0.128	0.048	0.138	0.064	0.095	0.011
IA Investment	0.005	0.000	0.004	0.000	0.003	0.000	0.005	0.000	0.006	0.000	0.002	0.000
Patent Count	2.092	0.000	2.055	0.000	1.668	0.000	2.471	0.000	2.545	0.000	1.573	0.000
Patent Citation	37.437***	0.000	64.857	0.000	63.630*	0.000	48.280	0.000	67.250**	0.000	44.451	0.000
Log (1+RD Intensity)	0.102	0.042	0.096	0.026	0.089***	0.016***	0.109	0.047	0.116***	0.062***	0.081	0.011
Log (1+Patent Count)	0.515	0.000	0.497	0.000	0.425***	0.000	0.583	0.000	0.590***	0.000	0.414	0.000
Log (1+Patent Citation)	0.938**	0.000	1.077	0.000	0.985	0.000	1.081	0.000	1.089**	0.000	0.974	0.000
Log (1+ IA Investment)	0.004	0.000	0.004	0.000	0.003**	0.000	0.005	0.000	0.006***	0.000	0.002	0.000
Innovative Efficiency=Patents/5RDC	0.016**	0.000	0.025	0.000	0.018**	0.000	0.026	0.000	0.020	0.000	0.024	0.000
Panel B: Measures of Board Diversity												
Gender Diversity (%)	17.548	14.286	0.000	0.000	5.718	0.000	7.589	0.000	6.999	0.000	6.291	0.000
Age Diversity	0.158	0.153	0.167	0.168	0.205	0.196	0.121	0.125	0.165	0.164	0.161	0.161
Professional Expertise Diversity	0.512	0.560	0.496	0.500	0.509	0.540	0.495	0.529	0.638	0.625	0.361	0.408
Panel C: Firm Characteristics												
Firm Age	13.415*	10.000***	12.587	9.000	12.589	9.000***	13.212	10.000	13.172	10.000***	12.618	9.000
Firm Size-Log (Total Assets)	5.454***	5.386***	4.987	5.015	5.130	5.094	5.197	5.197	5.260***	5.223***	5.064	5.049
Return on Assets	-0.202	-0.047	-0.211	-0.025	-0.218	-0.025	-0.198	-0.045	-0.229**	-0.061***	-0.186	-0.009
Risk	0.216***	0.067***	0.279	0.081	0.289***	0.081***	0.221	0.071	0.258	0.080	0.252	0.070
Leverage	0.183**	0.048**	0.162	0.021	0.182***	0.021	0.158	0.036	0.191***	0.053***	0.149	0.018
Asset Tangibility	0.290***	0.188***	0.349	0.206	0.348***	0.212***	0.305	0.189	0.322	0.188**	0.332	0.209
Tobin's Q	3.168***	2.325***	2.796	1.973	2.976	1.980***	2.897	2.229	2.970	2.182***	2.902	2.000
Panel D: Board Characteristics												
Board Size	7.800***	8.000***	6.900	7.000	7.256	7.000	7.225	7.000	7.481***	7.000***	6.991	7.000
Board Independence (%)	77.023***	80.000***	73.724	77.778	74.485*	77.778*	75.463	80.000	77.171***	80.000***	72.690	75.000
Board Voting Share Ownership (%)	27.441**	22.271***	29.478	25.526	30.760***	26.716***	26.646	21.680	29.240	25.559*	28.152	22.462
VC board representation	0.685***	1.000***	0.622	1.000	0.650	1.000	0.643	1.000	0.744***	1.000***	0.545	1.000
Board Connections	1.930***	1.750***	1.604	1.444	1.674***	1.500**	1.782	1.500	1.882***	1.667***	1.568	1.429

Table 4.2 Pearson's Correlation Matrix for Innovative Activity, Board Diversity, and Control Variables

This table shows the Pearson's correlation matrix for all variables used in our analysis .* shows significance at the 1% level . There is a high correlation of 0.636 between return on assets and R&D intensity, which may lead to multicollinearity in the analysis. Therefore, we have excluded this variable from the analysis. The researcher re-run the regressions with the return on assets and the results remain consistent.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Log (1+R&D Intensity)	1.000																	
(2) Log (1+IA Investment)	-0.028	1.000																
(3) Log (1+Patent Count)	0.261*	0.017	1.000															
(4) Log (1+Patent Citation)	0.186*	-0.012	0.791*	1.000														
(4) Gender Diversity	0.012	0.022	-0.021	-0.029	1.000													
(5) Age Diversity	-0.035	-0.046*	-0.108*	-0.077*	-0.079*	1.000												
(6) Prof. Exp. Diversity	0.150*	0.044*	0.102*	0.047*	0.044*	0.114*	1.000											
(7) Firm Age	-0.153*	0.020	0.045*	-0.015	0.032	-0.050*	-0.003	1.000										
(8) Firm Size	-0.338*	0.071*	0.119*	0.065*	0.075*	-0.066*	0.062*	0.244*	1.000									
(9) Return on Assets	-0.636*	0.017	-0.035	-0.041	0.022	-0.053*	-0.081*	0.176*	0.418*	1.000								
(10) Risk	0.298*	0.034	-0.042*	-0.025	-0.063*	0.078*	-0.004	-0.172*	-0.308*	-0.473*	1.000							
(11) Leverage	-0.125*	0.019	-0.063*	-0.103*	0.007	0.008	0.041*	0.157*	0.371*	0.039	-0.038	1.000						
(12) Asset Tangibility	-0.096*	-0.077*	-0.090*	-0.096*	-0.068*	-0.006	-0.043*	0.091*	0.141*	-0.033	-0.033	0.298*	1.000					
(13) Tobin's Q	0.381*	-0.005	0.096*	0.113*	0.069*	0.042*	0.076*	-0.129*	-0.094*	-0.324*	0.178*	-0.080*	-0.113*	1.000				
(14) Board Size	-0.051*	0.022	0.154*	0.095*	0.152*	0.027	0.230*	0.134*	0.393*	0.095*	-0.148*	0.153*	0.033	0.016	1.000			
(15) Board Independence	0.066*	0.023	0.171*	0.142*	0.088*	0.005	0.276*	0.063*	0.284*	0.055*	-0.117*	0.099*	0.028	0.052*	0.449*	1.000		
(16) Board Voting Share Ownership	-0.002	0.017	-0.117*	-0.145*	-0.042*	0.177*	0.030	-0.074*	-0.163*	0.011	0.042*	0.051*	-0.045*	0.013	-0.133*	-0.186*	1.000	
(17) VC board representation	0.124*	0.019	0.112*	0.099*	0.045*	0.085*	0.351*	-0.093*	0.123*	-0.009	-0.033	0.024	-0.085*	0.100*	0.200*	0.274*	0.162*	1.000
(18) Board Connections	0.107*	0.071*	0.090*	0.025	0.109*	-0.047*	0.150*	0.004	0.211*	-0.022	-0.017	0.144*	-0.087*	0.025	0.219*	0.265*	0.010	0.224*

Main Result Tables

Table 4.3 OLS Results for the Impact of Board Diversity on Innovative Activity

This table reports the OLS regression for the relationship between the measures of innovative activity and board diversity. The panel comprises 3,136 firm year observations covering the IPO year to year 5 post-IPO. R&D intensity is the log of one plus the ratio of research and development expenditure to total assets for each firm. Patent count is the log of one plus the number of patents held by the IPO firm in each year. Patent citation is the log of one plus the number of citations received for the patents held by the IPO firm in each year. IA Investment is the log of one plus the ratio of acquired intangible assets to total assets for each firm. Gender Diversity is the percentage of females on the board. Age Diversity is measured as the coefficient of variation (SD of Board Age/ Mean of Board Age). Prof. Exp. Diversity is an expertise index based on the Blau index using the proportion of expertise groups on each board. It is computed as follows: $1 - \Sigma_{i=1}^{n} P_i^2$ where Pi is the proportion of group members in category i. All measures of board diversity, innovative activity, and other control variables are lagged one year relative to the dependent variable. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	Log (1+R&D Intensity) $_t$	Log (1+Patent Count) $_t$	Log (1+Patent Citation) $_t$	Log (1+IA Investment) $_t$
Independent Variables	(1)	(2)	(3)	(4)
Log (1+R&D Intensity) $_{t-1}$	0.565***			
	(19.85)			
Log (1+Patent Count) $_{t-1}$		0.834***		
		(57.92)		
Log (1+Patent Citation) $_{t-1}$			0.726***	
			(41.13)	
Log (1+IA Investment) $_{t-1}$				0.079
				(1.60)
Gender Diversity $_{t-1}$	-0.000	-0.001	-0.003	-0.001*
	(-1.04)	(-0.75)	(-1.11)	(-1.71)
Age Diversity $_{t-1}$	-0.006	-0.174	-0.550	-0.012
	(-0.18)	(-1.20)	(-1.38)	(-1.52)
Prof. Exp. Diversity $_{t-1}$	0.033***	-0.024	-0.058	-0.001
	(3.85)	(-0.47)	(-0.41)	(-0.28)
Firm Age $_{t-1}$	-0.000***	-0.001**	-0.002*	-0.000
	(-2.66)	(-2.24)	(-1.67)	(-0.08)
Firm Size $_{t-1}$	0.007***	0.032***	0.041**	-0.000
	(4.85)	(3.89)	(2.03)	(-0.17)
Risk $_{t-1}$	0.008*	-0.002	-0.023	0.001
	(1.88)	(-0.13)	(-0.49)	(1.50)
Leverage $_{t-1}$	-0.056***	-0.078*	-0.137	-0.000
	(-5.47)	(-1.91)	(-1.19)	(-0.25)
Asset Tangibility $_{t-1}$	-0.020***	0.024	-0.006	-0.004***
	(-3.44)	(0.91)	(-0.08)	(-4.32)
Tobin's Q $_{t-1}$	0.002**	-0.000	0.029**	0.000
	(2.41)	(-0.09)	(2.22)	(0.21)
Board Size $_{t-1}$	0.001	0.002	0.010	0.000
	(1.30)	(0.36)	(0.71)	(0.00)
Board Independence $_{t-1}$	0.000	0.001	0.004***	-0.000
	(0.81)	(1.28)	(3.17)	(-0.19)
Board Voting Share Ownership $_{t-1}$	-0.000	-0.000	0.001	0.000*
	(-1.31)	(-0.10)	(1.27)	(1.87)
VC Board Representation $_{t-1}$	-0.005	0.026	0.194***	-0.002*
	(-1.21)	(1.20)	(3.23)	(-1.80)
Board Connections $_{t-1}$	0.000	-0.014	-0.012	-0.000
	(0.21)	(-1.52)	(-0.51)	(-0.32)
Constant	-0.043***	-0.074	-0.368**	0.004
	(-3.60)	(-1.19)	(-2.13)	(1.01)
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
No of observations	3136	3136	3136	3136
Adjusted R^2	0.620	0.709	0.560	0.081
F-value	77.017***	140.056***	82.955***	3.198***

Table 4.4 Regressions for the Impact of Board Diversity on Innovative Efficiency

This table reports the OLS regressions for the effect of board diversity on innovative efficiency. The dependent variable innovative efficiency (Patents/5RDC) is measured as the ratio of patent granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% following Hirshleifer et al. (2013). All independent and control variables are lagged one-year relative to the dependent variable and defined in Appendix 4.1. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	IE=Patent Count/5Year RDC $_t$	IE=Patent Count/3Year RDC $_t$
Independent Variables	(1)	(2)
Gender Diversity $_{t-1}$	-0.000	0.001
	(-1.03)	(0.50)
Age Diversity $_{t-1}$	-0.094***	-1.788***
	(-4.20)	(-4.97)
Prof. Exp. Diversity $_{t-1}$	-0.005	0.175
	(-0.70)	(1.28)
Firm Age $_{t-1}$	0.000	-0.003
	(1.53)	(-1.38)
Firm Size $_{t-1}$	-0.002**	0.123***
	(-2.12)	(6.35)
Risk $_{t-1}$	-0.005***	-0.039
	(-3.77)	(-1.29)
Leverage $_{t-1}$	-0.010*	-0.413***
	(-1.76)	(-3.60)
Asset Tangibility $_{t-1}$	0.008	-0.166**
	(1.61)	(-2.15)
Tobin's Q $_{t-1}$	-0.000	0.036***
	(-0.14)	(4.13)
Board Size	-0.000	0.033**
	(-0.04)	(2.42)
Board Independence $_{t-1}$	0.000***	0.004***
	(3.18)	(2.66)
Board Voting Share Ownership$_{t-1}$	-0.000***	-0.007***
	(-3.95)	(-7.91)
VC Board Representation $_{t-1}$	0.004	0.100*
	(1.05)	(1.87)
Board Connections $_{t-1}$	-0.002	-0.015
	(-1.08)	(-0.67)
Constant	0.016**	-0.158
	(2.03)	(-0.88)
Industry Dummies	Yes	Yes
Year Dummies	Yes	Yes
No of observations	3136	3136
Adjusted R^2	0.049	0.393
F-value	4.902***	59.327***

Table 4.5 Diagnostic Test Results - Propensity Score Matching Estimation for the Impact of Board Diversity on Innovative Activity

The results reported in this table refer diagnostic tests to check the quality of the propensity score matching, using the measures of board diversity as the treatment. Panel A reports the pre and post-match logit regressions to estimate the propensity score for board diversity. The dependent variables in the logit regressions reported in columns (1) and (2) is Gender Diversity Dummy, in columns (3) and (4) is Age Diversity Dummy, and in columns (5) and (6) is Professional Expertise Diversity Dummy. Gender Dummy takes a value of one if at least one female director is on the board and zero otherwise. Age Dummy takes a value of one if the firm's age diversity is higher than the median value for the sample and zero otherwise. Prof.Exp. Dummy which takes a value of one if the firm's professional expertise diversity is higher than the median value for the sample and zero otherwise. All the dependent variables are measured in year t, while independent variables are calculated in t-1. As independent variables are lagged to the pre-IPO year, we lose 20 observations for firm incorporated in the IPO year. The independent variables in this table are the firm controls used in main regressions. The t-values presented in parentheses are heteroscedasticity consistent. Panel B reports the result for the two-tailed t-tests on the differences in the means of firm characteristics for the treated and untreated sub-samples. All variables are defined in Appendix 4.1. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: Pre- and Post-matching logit regressions for measures of board diversity

Dependent Variables	Gender Diversity Dummy $_t$		Age Diversity Dummy $_t$		Prof. Exp. Diversity Dummy $_t$	
	Pre-match logit	Post-match logit	Pre-match logit	Post-match logit	Pre-match logit	Post-match logit
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Firm Age $_{t-1}$	-0.006	-0.000	0.001	-0.015	-0.000	0.007
	(-0.80)	(-0.01)	(0.12)	(-1.55)	(-0.01)	(0.78)
Firm Size $_{t-1}$	0.141***	-0.012	0.140***	-0.015	-0.027	0.019
	(1.91)	(-0.13)	(1.97)	(-0.18)	(-0.36)	(0.21)
Return on Assets $_{t-1}$	-0.077	-0.101	0.033	-0.133	-0.224	0.025
	(-0.43)	(-0.49)	(0.20)	(-0.70)	(-1.16)	(0.12)
Risk $_{t-1}$	0.018	-0.008	0.057	-0.061	-0.194***	-0.065
	(0.18)	(-0.06)	(0.59)	(-0.56)	(-1.73)	(-0.47)
Leverage $_{t-1}$	-0.534	-0.363	0.126	0.190	0.336	0.057
	(-1.56)	(-0.79)	(0.39)	(0.49)	(0.99)	(0.14)
Asset Tangibility $_{t-1}$	-0.684***	0.339	0.057	-0.312	-0.445	0.236
	(-2.20)	(0.82)	(0.19)	(-0.92)	(-1.36)	(0.63)
Tobin's Q $_{t-1}$	0.093***	-0.025	0.025	-0.010	0.046	-0.028
	(1.85)	(-0.50)	(0.57)	(-0.20)	(0.90)	(-0.37)
Constant	-1.067***	0.331	-0.501	0.442	-0.232	-0.168
	(-3.01)	(0.74)	(-1.53)	(1.17)	(-0.69)	(-0.41)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	641	382	641	454	641	374
Pseudo R^2	0.046	0.013	0.051	0.021	0.133	0.025
Chi-square	32.802	6.374	40.479**	11.763	92.491***	11.422
Number of matched firms		191		227		187

Panel B: Mean values and t-test for the difference in means across our control variables

Variables	Firms with female board members N=191 $_t$	Firms without female board members N=191 $_t$	Difference	t-statistics
Firm Age $_{t-1}$	9.359	9.034	0.325	0.288
Firm Size $_{t-1}$	4.048	3.880	0.168	0.856
Return on Assets $_{t-1}$	-0.383	-0.423	0.040	0.487
Risk $_{t-1}$	0.545	0.557	-0.011	-0.108
Leverage $_{t-1}$	0.239	0.213	0.026	0.839
Asset Tangibility $_{t-1}$	0.290	0.307	-0.017	-0.576
Tobin's Q $_{t-1}$	2.201	2.173	0.028	0.095
Variables	Firms with high age diversity N=227 $_t$	Firms with low age diversity N=227 $_t$	Difference	t-statistics
Firm Age $_{t-1}$	10.069	8.133	1.936	1.751*
Firm Size $_{t-1}$	3.820	3.703	0.116	0.666
Return on Assets $_{t-1}$	-0.359	-0.403	0.044	0.616
Risk $_{t-1}$	0.551	0.557	-0.006	-0.060
Leverage $_{t-1}$	0.227	0.234	-0.006	-0.223
Asset Tangibility $_{t-1}$	0.347	0.325	0.022	0.733
Tobin's Q $_{t-1}$	1.953	1.983	-0.030	-0.126
Variables	Firms with high prof. exp. diversity N=187 $_t$	Firms with low prof. exp. diversity N=187 $_t$	Difference	t-statistics
Firm Age $_{t-1}$	8.330	9.777	-1.447	-1.113
Firm Size $_{t-1}$	3.926	4.031	-0.105	-0.507
Return on Assets $_{t-1}$	-0.366	-0.318	-0.048	-0.636
Risk $_{t-1}$	0.508	0.426	0.083	0.853
Leverage $_{t-1}$	0.242	0.253	-0.012	-0.367
Asset Tangibility $_{t-1}$	0.332	0.352	-0.020	-0.614
Tobin's Q $_{t-1}$	1.714	1.559	0.155	0.839

Table 4.6 PSM Analysis for the Impact of Board Diversity on Innovative Activity

This table replicates the OLS regression reported in Table 4.3 using the matched sample of treated and untreated firms to analyse the impact of the measures of board diversity on innovative activity. Treated firms are matched to their nearest neighbour untreated firms in year 0 with a maximum calliper distance of 0.1 between propensity scores. There are 1883 firm-year observations for gender diversity relating to 191 matched firms, 2158 firm-year observations for age diversity relating to 227 matched firms, and 1825 firm-year observations for professional expertise diversity relating to 187 matched firms. All independent and control variables are lagged one-year relative to the dependent variable, are defined in Appendix 4.1. The t statistics presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+ Patent Count) $_t$	Log (1+ Patent Count) $_t$	Log (1+ Patent Count) $_t$	Log (1+Patent Citation) $_t$	Log (1+Patent Citation) $_t$	Log (1+Patent Citation) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log (1+R&D Intensity) $_{t-1}$	0.586***	0.570***	0.596***									
	(15.69)	(15.65)	(15.94)									
Log (1+ Patent Count) $_{t-1}$				0.796***	0.829***	0.826***						
				(37.98)	(45.47)	(38.68)						
Log (1+ Patent Citation) $_{t-1}$							0.702***	0.747***	0.692***			
							(27.94)	(36.56)	(27.54)			
Log (1+IA Investment) $_{t-1}$										0.091	0.036	0.239*
										(0.98)	(0.78)	(1.74)
Gender Diversity $_{t-1}$	-0.000			-0.001			-0.003			-0.000		
	(-0.37)			(-1.11)			(-1.10)			(-1.13)		
Age Diversity $_{t-1}$		0.026			-0.152			-0.548			-0.014	
		(0.65)			(-0.88)			(-1.18)			(-1.44)	
Prof. Exp. Diversity $_{t-1}$			0.030**			-0.002			-0.054			0.001
			(2.43)			(-0.02)			(-0.28)			(0.34)
Firm Age $_{t-1}$	-0.000***	-0.000	-0.000	-0.001	-0.001*	-0.001	-0.002	-0.003**	-0.002	0.000	-0.000	0.000
	(-2.68)	(-1.26)	(-0.53)	(-1.29)	(-1.88)	(-1.40)	(-1.15)	(-2.00)	(-0.76)	(0.75)	(-0.53)	(0.77)
Firm Size $_{t-1}$	0.010***	0.006***	0.006***	0.029**	0.035***	0.024**	0.047	0.036	0.017	0.000	-0.000	-0.001
	(4.43)	(3.06)	(2.97)	(2.58)	(3.42)	(2.26)	(1.64)	(1.53)	(0.63)	(0.33)	(-0.69)	(-1.20)
Risk $_{t-1}$	0.003	0.006	0.012**	-0.014	-0.002	-0.006	-0.029	-0.033	-0.034	0.002	0.000	-0.000
	(0.64)	(1.28)	(2.15)	(-0.72)	(-0.13)	(-0.33)	(-0.45)	(-0.67)	(-0.52)	(1.20)	(0.37)	(-0.30)
Leverage $_{t-1}$	-0.067***	-0.063***	-0.042***	-0.074	-0.086*	-0.070	-0.072	-0.048	-0.148	-0.002	0.003	0.001
	(-5.35)	(-4.82)	(-3.20)	(-1.26)	(-1.67)	(-1.36)	(-0.41)	(-0.32)	(-0.91)	(-0.75)	(1.29)	(0.75)
Asset Tangibility $_{t-1}$	-0.018**	-0.010	-0.031***	0.054	0.037	-0.009	0.009	-0.027	-0.143	-0.002**	-0.007***	-0.003***
	(-2.25)	(-1.22)	(-3.75)	(1.47)	(1.14)	(-0.26)	(0.08)	(-0.32)	(-1.35)	(-2.40)	(-3.83)	(-2.63)
Tobin's Q $_{t-1}$	0.002	0.003**	0.003***	-0.001	-0.003	0.000	0.035**	0.022	0.034*	-0.000**	0.000	0.000
	(1.33)	(2.07)	(2.61)	(-0.17)	(-0.62)	(0.06)	(2.09)	(1.28)	(1.82)	(-2.10)	(0.88)	(0.69)
Board Size $_{t-1}$	0.001	0.001	0.002	0.004	-0.001	-0.003	0.005	0.006	-0.007	0.000	-0.000	0.000
	(0.90)	(0.45)	(1.39)	(0.60)	(-0.09)	(-0.48)	(0.26)	(0.34)	(-0.33)	(0.54)	(-0.03)	(0.79)
Board Independence $_{t-1}$	0.000	0.000	0.000	0.000	0.000	0.001	0.005**	0.004**	0.005**	-0.000	-0.000	0.000
	(0.16)	(1.02)	(0.38)	(0.38)	(0.67)	(0.93)	(2.53)	(2.49)	(2.28)	(-0.77)	(-0.47)	(0.04)
Board Voting Share	-0.000	-0.000	-0.000	-0.001	0.000	-0.000	-0.000	0.002	-0.000	0.000	0.000	0.000**
Ownership $_{t-1}$	(-0.83)	(-1.38)	(-1.19)	(-1.22)	(0.63)	(-0.84)	(-0.20)	(1.60)	(-0.24)	(0.76)	(1.49)	(2.38)
VC Board Representation $_{t-1}$	0.003	0.003	-0.005	0.050*	0.040	0.043	0.197**	0.192***	0.247***	-0.001	-0.003***	-0.003***
	(0.64)	(0.65)	(-0.84)	(1.80)	(1.58)	(1.60)	(2.49)	(2.71)	(2.99)	(-0.88)	(-2.76)	(-2.90)
Board Connections $_{t-1}$	-0.001	0.001	0.000	-0.009	-0.010	-0.007	0.005	-0.010	0.012	0.000	-0.001	-0.001***
	(-0.25)	(0.61)	(0.00)	(-0.78)	(-0.81)	(-0.53)	(0.19)	(-0.38)	(0.34)	(0.08)	(-1.02)	(-2.88)

Constant	-0.032*	-0.033**	-0.046***	-0.162**	-0.124*	-0.021	-0.572***	-0.357*	-0.254	-0.000	0.009	-0.001
	(-1.83)	(-2.34)	(-3.08)	(-2.22)	(-1.80)	(-0.29)	(-2.71)	(-1.82)	(-1.26)	(-0.03)	(1.58)	(-0.49)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	1833	2158	1825	1833	2158	1825	1833	2158	1825	1833	2158	1825
Adjusted R^2	0.631	0.619	0.622	0.686	0.716	0.665	0.555	0.590	0.517	0.083	0.084	0.192
F-value	51.908***	62.370***	45.941***	76.549***	102.492***	66.382***	50.947***	69.719***	44.490***	2.019***	2.336***	2.331***

Table 4.7 PSM Analysis for the Impact of Board Diversity on Innovative Efficiency

This table reports the OLS regressions on the matched sample, for the impact of board diversity on the innovative efficiency. The dependent variable innovative efficiency (Patents/5RDC) is measured as the ratio of patent granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% following Hirshleifer et al. (2013). Treated firms are matched to their nearest neighbour untreated firms with a maximum calliper distance of 0.1 between propensity scores. There are 1883 firm-year observations for gender diversity relating to 191 matched firms, 2158 firm-year observations for age diversity relating to 227 matched firms, and 1825 firm-year observations for professional expertise diversity relating to 187 matched firms. All independent and control variables are lagged one-year relative to the dependent variable and defined in Appendix 4.1. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	IE=Patent Count/5RDC$_t$	IE=Patent Count/5RDC$_t$	IE=Patent Count/5RDC$_t$	IE=Patent Count/3RDC$_t$	IE=Patent Count/3RDC$_t$	IE=Patent Count/3RDC$_t$
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity $_{t-1}$	-0.000			0.001		
	(-0.19)			(0.34)		
Age Diversity $_{t-1}$		-0.099***			-2.163***	
		(-3.49)			(-4.67)	
Prof. Exp. Diversity $_{t-1}$			-0.001			0.285
			(-0.06)			(1.64)
Firm Age $_{t-1}$	0.000	0.000	0.000**	-0.004*	-0.008***	-0.003
	(0.43)	(1.29)	(2.43)	(-1.90)	(-3.11)	(-1.30)
Firm Size $_{t-1}$	-0.001	-0.003*	-0.004**	0.132***	0.104***	0.067***
	(-0.73)	(-1.76)	(-2.39)	(5.46)	(4.15)	(2.70)
Risk $_{t-1}$	-0.004**	-0.005***	-0.004**	-0.055	-0.092**	0.012
	(-2.16)	(-2.67)	(-2.17)	(-1.61)	(-2.28)	(0.31)
Leverage $_{t-1}$	-0.007	-0.006	-0.010	-0.577***	-0.263	-0.248
	(-1.07)	(-0.78)	(-1.38)	(-4.24)	(-1.63)	(-1.63)
Asset Tangibility $_{t-1}$	0.014**	0.008	-0.002	-0.061	-0.229**	-0.462***
	(2.20)	(1.33)	(-0.34)	(-0.67)	(-2.15)	(-4.88)
Tobin's Q $_{t-1}$	-0.000	0.000	-0.001	0.040***	0.028***	0.036***
	(-0.35)	(0.39)	(-1.61)	(3.53)	(2.59)	(3.15)
Board Size	-0.000	0.000	0.000	0.035**	0.019	0.007
	(-0.05)	(0.13)	(0.33)	(2.14)	(1.06)	(0.40)
Board Independence $_{t-1}$	0.000	0.000**	0.000***	0.002	0.005**	0.005***
	(1.41)	(2.21)	(2.94)	(1.33)	(2.49)	(2.69)
Board Voting Share	-0.000***	-0.000***	-0.000***	-0.006***	-0.009***	-0.006***
Ownership $_{t-1}$	(-3.17)	(-3.65)	(-3.46)	(-5.82)	(-7.95)	(-5.58)
VC Board Representation $_{t-1}$	0.002	0.005	0.002	0.081	0.196***	0.056
	(0.37)	(1.18)	(0.45)	(1.22)	(2.71)	(0.80)
Board Connections $_{t-1}$	-0.001	-0.002	-0.002	-0.004	-0.050*	-0.014
	(-0.40)	(-1.00)	(-1.01)	(-0.13)	(-1.77)	(-0.50)
Constant	-0.007	0.016	-0.005	-0.438**	-0.110	-0.136
	(-0.93)	(1.62)	(-0.60)	(-2.29)	(-0.51)	(-0.58)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	1833	2158	1825	1833	2158	1825
Adjusted R^2	0.040	0.047	0.056	0.393	0.415	0.366
F-value	2.892***	3.792***	3.004***	40.783***	44.120***	31.578***

Table 4.8 OLS Results for Impact of Board Diversity on External Innovation

This table reports the OLS regressions for the impact of board diversity on IA investment, the measure of external innovation. We test whether board diversity improves the efficiency of the board in allocating resources towards external innovation. In these regressions, IA investment, which relates to the value of acquired intangible assets, captures innovation generated externally. Although R&D intensity relates to internal innovation, being an input into the innovative process, we account for this as it relates to the firm's resources allocated to innovative activity and not as part of the process in generating IA investment. Initial correlation analysis in Table 4.2 suggests a substitution between R&D intensity and IA investment for IPO firms. For the OLS on the matched sample in columns 4 to 6, treated firms are matched to their nearest neighbour untreated firms with a maximum calliper distance of 0.1 between propensity scores. There are 1833 firm-year observations for Gender Diversity relating to 191 matched firms, 2158 firm-year observations for Age Diversity relating to 227 matched firms, and 1825 firm-year observations for Professional Expertise Diversity relating to 187 matched firms. All independent and control variables are lagged one-year relative to the dependent variable and defined in Appendix 4.1. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$	Log (1+IA Investment) $_t$
	OLS	OLS	OLS	OLS on matched sample	OLS on matched sample	OLS on matched sample
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity $_{t-1}$	-0.000			-0.000*		
	(-1.64)			(-1.78)		
Gender Diversity $_{t-1}$* Log (1+R&D Intensity) $_{t-1}$	0.000			0.001**		
	(0.34)			(2.33)		
Age Diversity $_{t-1}$		-0.011			-0.009	
		(-1.53)			(-1.07)	
Age Diversity $_{t-1}$* Log (1+R&D Intensity) $_{t-1}$		-0.012			-0.050	
		(-0.28)			(-0.89)	
Prof. Exp. Diversity $_{t-1}$			-0.002			-0.000
			(-0.50)			(-0.05)
Prof. Exp. Diversity $_{t-1}$* Log (1+R&D Intensity) $_{t-1}$			0.002			0.015
			(0.19)			(0.99)
Log (1+R&D Intensity) $_{t-1}$	-0.007*	-0.005	-0.008	-0.013***	0.002	-0.012*
	(-1.94)	(-0.61)	(-1.42)	(-2.95)	(0.16)	(-1.69)
Firm Age $_{t-1}$	-0.000	-0.000	-0.000	0.000	-0.000	0.000
	(-0.13)	(-0.14)	(-0.08)	(0.86)	(-0.55)	(0.94)
Firm Size $_{t-1}$	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001
	(-0.45)	(-0.49)	(-0.50)	(-0.07)	(-0.99)	(-1.52)
Risk $_{t-1}$	0.002*	0.002*	0.002*	0.003	0.000	-0.000
	(1.69)	(1.76)	(1.74)	(1.43)	(0.59)	(-0.29)
Leverage $_{t-1}$	-0.000	-0.000	-0.000	-0.002	0.003	0.002
	(-0.24)	(-0.16)	(-0.18)	(-0.77)	(1.27)	(0.89)
Asset Tangibility $_{t-1}$	-0.005***	-0.005***	-0.005***	-0.002**	-0.007***	-0.004***
	(-4.49)	(-4.40)	(-4.48)	(-2.32)	(-3.93)	(-3.62)
Tobin's Q $_{t-1}$	0.000	0.000	0.000	-0.000*	0.000	0.000
	(0.44)	(0.37)	(0.32)	(-1.72)	(1.15)	(0.82)
Board Size	-0.000	-0.000	-0.000	0.000	-0.000	0.000
	(-0.29)	(-0.32)	(-0.39)	(0.46)	(-0.09)	(0.71)
Board Independence $_{t-1}$	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
	(-0.27)	(-0.18)	(-0.21)	(-0.61)	(-0.49)	(0.25)
Board Voting Share Ownership $_{t-1}$	0.000*	0.000*	0.000*	0.000	0.000	0.000**
	(1.69)	(1.87)	(1.72)	(0.61)	(1.48)	(2.37)
VC Board Representation $_{t-1}$	-0.002**	-0.002**	-0.002*	-0.001	-0.003***	-0.003***
	(-2.20)	(-2.06)	(-1.82)	(-0.86)	(-2.59)	(-2.85)
Board Connections $_{t-1}$	-0.000	-0.000	-0.000	0.000	-0.001	-0.002***
	(-0.22)	(-0.27)	(-0.24)	(0.01)	(-0.93)	(-3.39)
Constant	0.003	0.004	0.003	0.001	0.010*	0.000
	(0.86)	(1.12)	(0.82)	(0.53)	(1.76)	(0.03)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	3136	3136	3136	1833	2158	1825
Adjusted R^2	0.075	0.075	0.074	0.077	0.083	0.165
F-value	3.255***	3.220***	3.219***	1.934***	2.302***	2.143***

Tables for Further Analysis

Table 4.9 Sub-sample Analysis for the Impact of Board Diversity on Innovative Input.

This table reports the OLS regressions for the impact of board diversity on innovative input in sub-samples. We compare well governed in column 1 to poorly governed firms in column 2, better connected to poorly connected in columns 3 and 4, and IPO firms with VC board representation to those without VC board representation in columns 5 and 6. Firm governance groups are based on the median values of board independence with firms below the median categorised as poorly governed firms and those above the median, well governed firms. IPO firms are categorised into better and poorly connected groups based on the median value of board connections. In these regressions, R&D Intensity is viewed as an input into the innovative process. All independent and control variables are lagged one year relative to the dependent variable resulting in the pre-IPO year and year 10 post-IPO exclusion from this analysis. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$	Log (1+R&D Intensity) $_t$
	Well Governed	Poorly Governed	Better Connected	Poorly Connected	VC Board Rep.	Non-VC Board Rep.
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Log (1+R&D Intensity) $_{t-1}$	0.552***	0.578***	0.540***	0.591***	0.530***	0.641***
	(14.32)	(13.50)	(13.95)	(13.98)	(17.21)	(11.26)
Gender Diversity $_{t-1}$	-0.000	-0.001*	-0.000	-0.000	-0.000	-0.000
	(-0.20)	(-1.78)	(-0.75)	(-0.87)	(-0.66)	(-1.34)
Age Diversity $_{t-1}$	0.022	-0.014	-0.028	-0.005	0.013	-0.044
	(0.41)	(-0.35)	(-0.47)	(-0.14)	(0.29)	(-0.90)
Prof. Exp. Diversity $_{t-1}$	0.034***	0.038***	0.051***	0.019*	0.050***	0.023**
	(2.60)	(3.35)	(3.50)	(1.68)	(3.65)	(2.42)
Constant	-0.082***	-0.028*	-0.090***	-0.022	-0.062***	-0.037**
	(-3.13)	(-1.83)	(-3.17)	(-1.51)	(-3.55)	(-2.01)
Firm & Board Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	1598	1538	1567	1569	2017	1119
Adjusted R^2	0.633	0.603	0.618	0.614	0.610	0.640
F-value	44.789***	42.375***	46.207***	41.754***	52.556***	26.678***

Table 4.10 Sub-sample Analysis for the Impact of Board Diversity on Innovative Efficiency.

This table reports the OLS regressions for the impact of board diversity on innovative efficiency in sub-samples. The dependent variable innovative efficiency (Patents/5RDC) is measured as the ratio of patent granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% following Hirshleifer et al. (2013). All independent and control variables are lagged one year relative to the dependent variable resulting in the pre-IPO year and year 10 post-IPO exclusion from this analysis. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	IE=Patent Count/5RDC $_t$	IE=Patent Count/5RDC $_t$	IE=Patent Count/5RDC $_t$	IE=Patent Count/5RDC $_t$	IE=Patent Count/5RDC $_t$	IE=Patent Count/5RDC $_t$
	Well Governed	Poorly Governed	Better Connected	Poorly Connected	VC Board Rep.	Non-VC Board Rep.
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gender Diversity $_{t-1}$	-0.000**	0.000	0.000	-0.000	-0.000	-0.000
	(-2.01)	(0.43)	(0.53)	(-1.60)	(-0.88)	(-0.37)
Age Diversity $_{t-1}$	-0.131***	-0.054**	-0.050**	-0.133***	-0.100***	-0.117***
	(-3.03)	(-2.41)	(-2.09)	(-3.59)	(-2.98)	(-3.41)
Prof. Exp. Diversity $_{t-1}$	-0.016	0.008	-0.007	-0.007	-0.001	-0.003
	(-1.31)	(0.69)	(-0.63)	(-0.63)	(-0.06)	(-0.35)
Constant	0.053**	0.011	0.021*	0.017	0.036**	0.002
	(2.31)	(1.15)	(1.92)	(1.41)	(2.26)	(0.19)
Firm & Board Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	1598	1538	1567	1569	2017	1119
Adjusted R^2	0.046	0.047	0.054	0.076	0.046	0.044
F-value	2.836***	2.507***	2.917***	2.923***	3.599***	1.871***

Appendix

Appendix 4.1 Variable Definitions

Dependent Variables	**Description**
Measures of Innovative Activity	
Log (1+R&D Intensity)	The natural logarithm of one plus the ratio of research and development expenditures to total assets of the IPO firm in each year.
Log (1+ Patent Count)	The natural logarithm of one plus the total number of patents held by the IPO firm in each year.
Log (1+ Patent Citation)	The natural logarithm of one plus the total number of citations received for the patents held by the IPO firm in each year.
Log (1+ IA Investment)	The natural logarithm of one plus the ratio of acquired intangible assets to the total assets for each IPO firm in each year. Acquired intangible assets represent intangible assets, excluding goodwill acquired from business combinations that occurred during the current reporting period. This variable includes identifiable intangible assets and core deposits, servicing rights, customer relationships, and software.
Independent Variables	
Measures of Board Diversity	
Gender Diversity	Percentage of females on the board of directors.
Age Diversity	The standard deviation of the board's age divided by the mean age of the board. Using the coefficient of variation formula (SD of Board Age/ Mean of Board Age). Larger standard deviation (larger age differences between board members) and lower mean age (higher representation of young board members) would generate higher age diversity values. High scores indicate greater age diversity
Professional Expertise Diversity	An expertise index based on the Blau index using the proportion of expertise groups on each board. Professional Expertise includes the following 14 categories: Academic, Accountant, Banker, Consultant, Dentist, Doctor, Engineer, Executive, Finance Expert, IT Expert, Investment Professional, Lawyer, Scientist, and Politician. It is computed as follows: $$\mathbf{1-\sum_{i=1}^{n} P_i^2}$$ Where Pi is the proportion of group members in each of the i categories. High scores indicate higher professional expertise diversity. For example, if all 7 board members are categorised as executives, then the index value will be 0. $\boldsymbol{i.e.\,1-((\frac{7}{7})^2)}$ A board of 7 members with 2 IT experts, 1 executive, 2 investment professionals, 1 accountant and 1 finance expert will have an index value of 0.775 i.e., $\mathbf{1-((\frac{2}{7})^2+(\frac{2}{7})^2+(\frac{1}{7})^2+(\frac{1}{7})^2+(\frac{1}{7})^2)}$. Thus, High scores indicate higher professional expertise diversity.
Instrumental Variables for Two Stage Least Square Regressions	
Industry Gender Diversity	This is computed as the average gender diversity for each industry excluding firms in the sample IPO firms within that industry. (Source of data- Board Ex database)
Local Age Diversity	This is defined as the average age diversity for all firms in the state where the IPO firm is headquartered excluding firms in the sample for the respective year. (Source of data- Board Ex database)
Local Educational Attainment	The percentage of the US civilian labour force with a BSc degree in each state where the IPO firm is headquartered. (Source of data- US Bureau of Labor Statistics available here)
Control Variables	
Firm Age	The number of years since incorporation of the firm.
Firm Size	The natural log of total assets.
Return on Assets (ROA)	Earnings before interest, taxes, depreciation, and amortisation divided by total assets.
Risk	3-year rolling standard deviation of the return on assets
Leverage	The ratio of the book value of long-term debt to total assets.
Asset Tangibility	The net property, plant and equipment scaled by total assets

Tobin's Q	This is the market value of equity plus total assets minus book value of equity, all divided by total assets. Market value of equity is calculated by multiplying the year-end closing price by the number of shares outstanding.
Board Size	The number of directors on the board
Board Independence	Percentage of independent directors on the board relative to board size. Director independence is measured in line with prior literature as a director who: is not a substantial shareholder of the firm up to 5%; had not been employed in any executive capacity by the company within the last 5 years; is not retained as a professional adviser by the company (either personally or through their firm); is not a significant supplier or customer of the company; has no significant contractual relationship with the company other than as a director.
Board Voting Share Ownership	The total percentage of voting shares owned by the board.
VC Board Representation	A dummy variable that takes a value of one if a Venture Capitalist Director is present on the board, and zero otherwise.
Board Connections	This is the average number of prior and current board appointments of the board in each year.

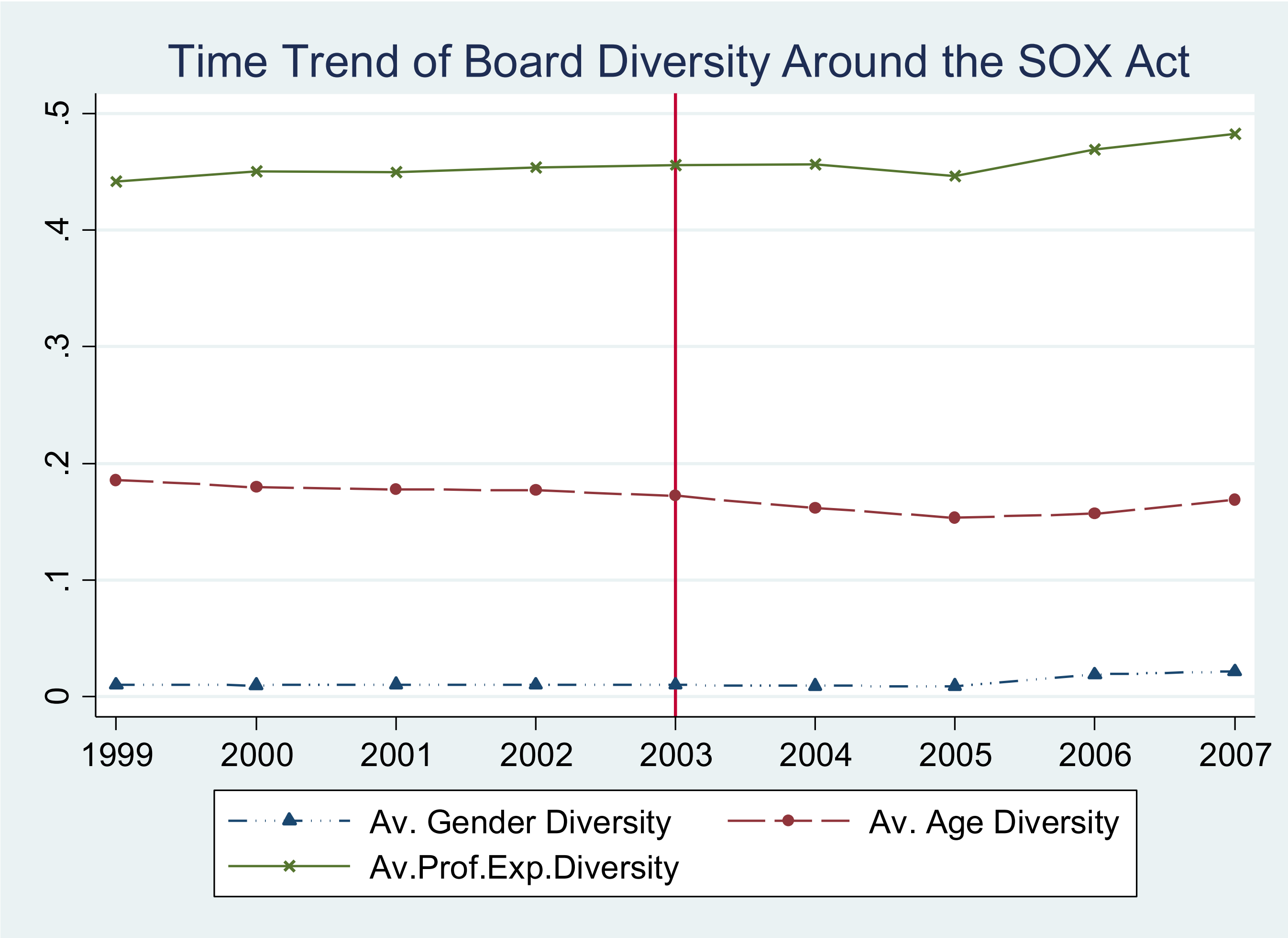
Appendix 4.2 Instrumental Variable Estimation for the Impact of Board Diversity on Innovative Activity

This table reports the 2SLS regressions on the relationship between board diversity and innovative activity/ innovative efficiency. Gender diversity is instrumented by Industry Gender Diversity, Age diversity is instrumented by Local Age diversity and Professional Expertise Diversity is instrumented by the Local Education Attainment. Industry Gender Diversity is computed as the average gender diversity for each industry excluding firms in the sample within that industry. Local Age Diversity is defined as the average age diversity for each state excluding firms in the sample headquartered in that state. Local Educational Attainment defined as the percentage of the US civilian labour force with a BSc degree in each state where the IPO firm is headquartered. Gender diversity, age diversity and professional expertise diversity are replaced by the predicted values estimated from the first stage regressions. All independent and control variables are lagged one year relative to the dependent variable and are defined in Appendix 4.1. The t-values presented in parentheses are heteroscedasticity consistent. *, **, *** represent significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	Gender Diversity $_t$	Age Diversity $_t$	Prof. Exp. Diversity $_t$	Log (1+R&D Intensity) $_t$	Log (1+ Patent Count) $_t$	Log (1+Patent Citation) $_t$	Log (1+IA Investment) $_t$	IE=Patent Count/5Year RDC $_t$
	First stage	First stage	First stage	Second stage	Second stage	Second stage	Second stage	Second stage
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Industry Gender Diversity $_{t-1}$	0.601***							
	(7.83)							
Local Age Diversity $_{t-1}$		0.665***						
		(5.89)						
Local Educational Attainment $_{t-1}$			-0.002***					
			(-4.08)					
Log (1+R&D Intensity) $_{t-1}$				0.579***				
				(18.06)				
Log (1+ Patent Count) $_{t-1}$					0.833***			
					(48.62)			
Log (1+Patent Citation) $_{t-1}$						0.726***		
						(30.79)		
Log (1+IA Investment) $_{t-1}$							0.078*	
							(1.68)	
Gender Diversity $_{t-1}$				-0.005**	0.027	0.062	0.001	0.003
				(-2.23)	(1.53)	(1.25)	(0.78)	(1.15)
Age Diversity $_{t-1}$				0.046	1.233	2.081	-0.018	0.230
				(0.18)	(1.00)	(0.61)	(-0.27)	(1.04)
Prof. Exp. Diversity $_{t-1}$				-0.005	0.535	0.752	-0.056	0.134
				(-0.03)	(0.72)	(0.38)	(-0.99)	(0.96)
Firm Age $_{t-1}$	-0.005	-0.000	0.000	-0.000*	-0.001**	-0.002	0.000	0.000*
	(-0.46)	(-1.21)	(0.31)	(-1.81)	(-2.17)	(-0.93)	(0.13)	(1.71)
Firm Size $_{t-1}$	0.036	-0.001	-0.007***	0.007***	0.035***	0.041	-0.000	-0.002
	(0.28)	(-1.02)	(-2.91)	(3.35)	(3.63)	(1.61)	(-0.76)	(-1.08)
Return on Assets $_{t-1}$	-0.664***	0.006***	0.011**	0.004	0.005	0.000	0.003**	-0.006**
	(-2.97)	(4.15)	(2.52)	(0.66)	(0.30)	(0.00)	(2.12)	(-2.16)
Leverage $_{t-1}$	-1.075	0.012***	0.047***	-0.065***	-0.091	-0.115	0.003	-0.016
	(-1.43)	(3.07)	(3.58)	(-4.37)	(-1.63)	(-0.71)	(0.87)	(-1.60)
Asset Tangibility $_{t-1}$	-1.445***	-0.001	-0.016	-0.027***	0.076**	0.101	-0.005***	0.015*
	(-2.72)	(-0.46)	(-1.35)	(-3.37)	(2.30)	(1.02)	(-2.59)	(1.70)
Tobin's Q $_{t-1}$	0.307***	0.000	-0.000	0.005***	-0.011*	0.005	-0.000	-0.001
	(4.37)	(0.19)	(-0.15)	(3.20)	(-1.72)	(0.27)	(-0.73)	(-1.11)
Board Size $_{t-1}$	0.355***	0.001***	0.006***	0.004*	-0.015	-0.025	0.000	-0.003*
	(3.42)	(2.61)	(3.13)	(1.89)	(-1.61)	(-1.04)	(0.13)	(-1.65)
Board Independence $_{t-1}$	-0.000	-0.000	0.000**	0.000	0.001	0.004**	0.000	0.000*
	(-0.02)	(-0.73)	(1.97)	(1.30)	(0.90)	(2.57)	(0.09)	(1.79)
Board Voting Shares $_{t-1}$	-0.003	0.000***	0.000*	-0.000	-0.000	0.000	0.000*	-0.000***
	(-0.48)	(7.78)	(1.86)	(-1.00)	(-0.89)	(0.29)	(1.70)	(-3.27)
VC board representation $_{t-1}$	0.407	0.006***	0.084***	0.001	-0.043	0.089	0.002	-0.011
	(1.07)	(2.65)	(10.84)	(0.06)	(-0.65)	(0.51)	(0.47)	(-0.90)
Board Connections $_{t-1}$	0.173	-0.002**	-0.007**	0.001	-0.012	-0.009	-0.001	-0.001
	(1.02)	(-2.40)	(-2.45)	(0.43)	(-1.08)	(-0.32)	(-0.95)	(-0.56)
Constant	5.151***	0.056***	0.408***	0.087	-0.937**	-2.298**	0.016	-0.113
	(4.47)	(3.03)	(12.41)	(0.92)	(-2.24)	(-1.97)	(0.66)	(-1.52)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	3136	3136	3136	3136	3136	3136	3136	3136
Adjusted R^2	0.110	0.116	0.189	0.621	0.707	0.560	0.079	0.046
F-value	15.486***	12.780***	18.393***	60.825***	131.763***	55.818***	4.087***	2.730***
Craig Donald Wald F-statistic (10% Critical Value 16.380)	21.139	35.793	10.518					
Kleibergen-Paap Test	19.100***	31.762***	17.619***					

Appendix 4.3 Trend Analysis for Board Diversity Around the Sox Act

The figure below shows the trend analysis for the measures of board diversity across the sample period for the difference in difference analysis. Since firms are tracked for 5 years post-IPO, we take a sub-sample of IPO firms listed between 1st January 1999 and 31st December 2002 to track these firms to year 5 post-IPO and examine the impact of the SOX Act as an exogenous shock to board diversity. For comparability, all the measures of board diversity lie between 0 and 1. Gender diversity and professional expertise diversity are measured using the Blau heterogeneity index, while age diversity is measured using the coefficient of variation formula. Values closer to 0 depict lower levels of diversity, while values closer to 1 indicate that the firms has a higher level of board diversity. As shown in the graph below, the Sox Act does not provide an exogenous shock to any of the measures of board diversity across the sample as the average levels of board diversity indicate small steady increases across time. Thus, using the Sox Act as an exogenous shock to the treatment and control groups is not appropriate for the difference in difference analysis.



Chapter 5: Conclusion

This thesis contributes to our understanding of the dynamics surrounding the emergence and evolution of board diversity and the impact of the latter on IPO firm survival, innovative activity, and innovative efficiency. Although a large literature examining the impact of the board diversity on various firm outcomes exists, these studies focus on mature listed firms. We find major gaps in the board diversity literature for IPO firms. This thesis measures board diversity in terms of gender, age and professional expertise. The first gap is that prior research does not examine the factors inhibiting or facilitating the emergence and evolution of diversity in the boardroom, which we refer to as the determinants of board diversity. Chapter 2 attempts to fill this gap by examining the power of three director groups, the CEO, venture capitalist director and non-executive director as the determinants of board diversity. Board diversity in Chapter 2 is measured in relation to gender and professional expertise, as there is minimal change in age diversity for IPO firms.[158]

The results in Chapter 2 for the emergence of board diversity show that IPO firms focus on professional expertise diversity at the IPO, as there is on average no female director on the board at the IPO. In year 2 after listing, IPO firms appoint the first female director on average to the board. However, by year 5 post-IPO, professional expertise diversity evolves in board appointments. These results indicate that IPO firms focus more on professional expertise diversity in the director appointments. For the evolution of board diversity, the results show that in terms of female board representation, CEO structural power relating to duality and non-executive director control power relating to voting share ownership are inhibitors. However, venture capitalist director control power relating to voting share ownership facilitates gender diversity in the boardroom of IPO firms. With the lower voting share ownership (2%) on average of the non-executive director compared to the venture capitalist director (12%), the latter director has more influence during appointment decisions. Consistent with the bargaining model, the results suggest that there is a negotiation between the CEO and the venture capitalist director in female director appointments. The CEO is at the helm of affairs with discretion as the board chair and inhibits female board appointments since greater gender diversity has been linked to improved board monitoring (Adams and Ferreira 2009). However, powerful venture capitalist directors through voting share ownership facilitate female director appointments that

[158] Compared to the other measures of board diversity, age diversity changes at the smallest rate since director appointments do not occur annually but rather every three years on average, Therefore, we have excluded age diversity from any further analysis Chapter 2.

may improve board monitoring and foster gender balance. For the evolution of professional expertise diversity, we find that the venture capitalist director voting share ownership is the main inhibitor, while the non-executive director financial expertise is the main facilitator. The effects of venture capitalist director voting share ownership on gender diversity (positive) and professional expertise diversity (negative) at the IPO alludes to the venture capitalist director's preference in board appointments. The results for powerful non-executive director with financial expertise suggest that this group has an in-depth understanding of the expertise needs of the firm and influence director appointments to provide a range of professional expertise. These findings are in line with the predictions of the resource dependency theory. To sum up, Chapter 2 contributes new evidence to the stream of literature on the determinants of board structure which previously focused on board size (Bakers and Gompers 2003) and board independence (Boone et al. 2007). Our findings suggest that CEO duality, venture capitalist director voting share ownership and non-executive director financial expertise are the most important factors to consider in the boardroom as determinants of board diversity.

The second gap in the literature is that, to date, no researcher has linked board diversity or board connections to IPO survival. Drawing on the resource dependency and diversity theories for the predictions of the relationship between board diversity, board connections and IPO survival, we attempt to fill this gap in Chapter 3. Board diversity is measured based on gender, age, and professional expertise. We distinguish between two categories of IPO survival: survivors and non-survivors. Survivors are defined as firms that remain publicly traded and independent entities up to 5 years post-IPO or the last year of the sample period. Non-survivors are all firms that are not classified as survivors and exit the sample post-IPO due to mergers or delistings. In addition to our focus on IPO survival, we also examine the impact of board diversity and board connections on the likelihood of exit through mergers or delistings.

Our findings in Chapter 3 suggest that the role of professional expertise diversity is more pronounced compared to gender and age, in terms of IPO survival, while board connections is beneficial for survival post-IPO. We examined the impact of board diversity and board connections on IPO survival first independently, and then, through interaction terms. The results provide new evidence that professional expertise diversity increases the likelihood of IPO survival, but this effect decreases when interacted with board connections. Therefore, our findings indicate a substitution effect between professional expertise diversity and board connections on IPO survival. However, the dampening effect of board connections in the interaction term suggests that the larger positive effect relates to professional expertise diversity. In terms of gender diversity, there is some evidence that merger-motivated IPOs will benefit from greater female board representation in the boardroom at the IPO, but these results are not robust in all specifications. There are no robust results indicating that age diversity or its interaction with board connections influences the likelihood of survival post-IPO. We find robust evidence that IPO firms with better-connected boards are more likely to survive as independent entities post-IPO. These results appear to be driven by IPO firms with higher levels of investment in innovation (R&D intensity). To sum up, Chapter 3 contributes new evidence to the literature suggesting that aspects of the board such as board size, independence and venture capitalist involvement improve IPO survival (see Jain and Kini 2000; Chancharat et al. 2012; Wilson et al. 2014). The findings in Chapter 3 suggest that IPO firms will benefit more in terms of survival post-IPO from director appointments that focus on professional expertise diversity, rather than gender or age diversity. Furthermore, the results show that better-connected boards are invaluable for the survival of IPO firms, specifically for firms investing in innovation. These results are in line with the predictions of the resource dependency theory that diverse and better-connected boards provide resource through different perspectives by drawing on board members' expertise and external links.

Finally, in Chapter 4 we attempt to fill the third gap in the literature on whether board diversity in IPO firms influences innovative activity and innovative efficiency. We rely on the resource dependency and diversity theories, as in Chapter 3, for the predictions on the relationship between board diversity and innovative activity/innovative efficiency. Board diversity relates to gender, age and professional expertise, while innovative activity relates to R&D intensity, patent count, patent citations and IA investment. R&D intensity focuses on internal innovative input, whereas patent count and patent citations relate to internal innovative output, while IA investment captures external innovation. Innovative efficiency measures the IPO firm's effectiveness in generating patents for each dollar of R&D capital spent. Innovative efficiency is measured as the ratio of patents granted in the current period scaled by the 5-year cumulative R&D expenses, assuming a depreciation rate of 20% as in Hirshleifer et al. (2013). Finally, we investigate the role of board diversity in IPO firms whose innovative strategies focus on investing in both internal and external innovation. In this case, we examine the impact of the interaction for the measures of board diversity and internal innovative input on external innovation. We argue that IPO firms are more likely to rely on their internal components for innovative activity rather than invest largely in externally generated innovation, as they are usually smaller entrepreneurial firms.

The four main findings in Chapter 4 are as follows. First, IPO firms with greater professional expertise diversity have a higher level of R&D intensity at the initial phase of the innovative process, but no such robust effect exists for gender or age diversity. This result suggests that investment in innovation requires a range of professional expertise that provides strategic advice for decision-making in the boardroom, since innovation involves significant risks. These findings are consistent with the resource dependency theory and imply that at the initial investment phase in innovation, it is more about an advising-oriented board than a monitoring-oriented board. Second, there is no relationship between the measures of board diversity and internal innovative output (patent count and patent citation), which conflicts with the positive evidence for mature US listed firms (see Chen et al. 2018; An et al. 2021). Hence, in IPO firms, no such effect exists. Third, greater age diversity negatively influences innovative efficiency, but there are no significant results for gender or professional expertise diversity. The negative effect of age diversity on the efficiency of the innovative process is in line with the predictions of the diversity theory that more diverse perspectives may inhibit board effectiveness in the decision-making processes due to cognitive conflicts. Moreover, if we focus on board characteristics in a broader sense, there is evidence of a significant positive relationship between board independence and innovative efficiency. Therefore, to improve the efficiency of the innovative process, IPO firms should focus on board characteristics such as board independence that increase innovative efficiency rather than diversity. This alludes to the benefits of a monitoring-oriented board on the efficiency of the innovative process.

Finally, the results in Chapter 4 show that there is a negative relationship between gender diversity and external innovation (IA investment), which persists when we account for the IPO firms R&D intensity through an interaction term. However, there is no significant relationship between age or professional expertise diversity and external innovation. The results allude to the better monitoring of female directors resulting in a more cautious board during decision-making on the acquisitions of intangible assets. Accordingly, during the innovative process, IPO firms with the objective of efficiently generating patents or diversifying the innovative portfolio to include external innovation should consider age diversity and gender diversity in director appointment decisions.

In summary, the results reported in the three chapters contribute first evidence to the IPO and board diversity literature on the benefits of diversity in the boardroom of IPO firms. Despite global reforms focusing on gender quotas and mixed evidence on the importance of board diversity in mature listed firms, this thesis shows that the story is different for IPO firms.

The emerging pattern across all three empirical chapters is that professional expertise diversity in the boardroom is beneficial for IPO firms, while gender or age diversity may be detrimental or have no effect. First, IPO firms focus more on professional expertise diversity in director appointments with powerful non-executive directors facilitating such appointments. The ripple effects from greater professional expertise extends to the post-IPO period. Specifically, IPO firms with greater professional expertise diversity have a higher likelihood of survival post-IPO and a higher level of investment in innovative activity. We also find that better-connected boards at the IPO are more likely to survive post-IPO. The insignificant results for the impact of age and gender diversity on IPO survival, innovative activity, and innovative efficiency further support the assertion that for IPO firms, professional expertise diversity is beneficial. Furthermore, the negative effects of gender and age diversity on the external innovation and innovative efficiency respectively suggest that it is important to consider both aspects of diversity in appointment decisions. This thesis sheds light for the first time on professional expertise diversity as an invaluable aspect of diversity in the boardroom of IPO firms, which hitherto has been neglected in prior literature.

This thesis provides vital information to potential issuers on board characteristics to consider in structuring their boards around the IPO and post-IPO. To improve IPO survival and investment in innovation, the primary focus should be on improving professional expertise diversity via board appointments. However, to ensure the efficiency of the innovative process, IPO firms should focus on other board characteristics such as independence rather than diversity. The findings in this thesis also have implications for US regulators. Recent board diversity listing standards introduced in the NASDAQ market and approved by the SEC relate to the board demographic characteristics such as gender, sexual orientation, racial or ethnic attributes of board member. We argue that incorporating professional expertise diversity into such standards not only facilitates board diversity but also improves the IPO firm's survival prospects and engagement in innovative activity.

5.1 Limitations of the Thesis and Directions for Future Research

As with any research, the three preceding empirical chapters of this thesis have limitations. The first limitation of this thesis relates to the size of the sample. The smaller sample size is a consequence of poor coverage of information relating to diversity and power in the boardroom for IPO firms, in databases such as BoardEx, and the rigorous nature of hand collecting data. Although we have a proprietary dataset, this dataset only relates to 25% (661)

of the initial sample of 2,641 IPO firms. Second, we control for the potential endogeneity arising in examining the determinants of board diversity (Chapter 2) and the impact of board diversity on innovative activity (Chapter 4). In both chapters, endogeneity may arise due to selection bias or reverse causality. PSM attempts to mitigate selection bias. However, in attempting to mimic a randomised experiment to test for causality, King and Nielsen (2019) suggest that PSM may prune observations excessively and potentially increase imbalance in the analysis. In terms of reverse causality, none of the instruments used in the two stage least squares (2SLS) regressions for professional expertise diversity pass the weak instruments test in all chapters. Thus, in Chapter 2 (Section 2.3.4) we do not rely on the results from the 2SLS as the main results in this chapter but rely on the PSM, which addresses endogeneity. Similarly, in Chapter 4, the rigorous search leading to six potential instruments for professional expertise diversity in the 2SLS regressions (see section 4.4.2), proves futile as none of these instruments pass the weak instrument test. Therefore, in Chapter 4, we do not rely on the 2SLS results for professional expertise diversity but focus on the PSM results.

Finally, a notable limitation of this thesis is the measurement of board connections. Ideally, board connections should focus on board members' unique connections to other boards. However, we only have data on the total board connections, which is a noisy measure as 18% of directorships are interlocking and this inflates the value of board connections. To mitigate this issue, we focus on the average board connections, which alludes to the busyness of the board. Busy boards are boards with three or more busy directors. Busy directors are board members who have over three other connections besides their seat on the board (Field et al. 2013). Therefore, an increase in the average board connections implies that board members have more connections to other boards and as such, are busier.

To conclude this thesis, we provide several directions for future research. Researchers may benefit from incorporating the sources of power in the boardroom as moderators of the relationship between board diversity and firm outcomes. This will provide richer insights on the relationship between board diversity and firm outcomes established in prior literature. Another interesting direction for future research is to examine the impact of power in the boardroom for different director groups or aspects of diversity on innovation, since innovation involves significant risks and board members may have different risk appetites. At the time of writing this thesis, the first gender quota in the US, California bill 979, was signed into law on 30 September 2020. This law requires all companies listed on US exchanges and headquartered in California to have a minimum of two females for a board of five members or three females for a board with six members no later than 31 December 2021. Future research may use this law as an exogenous shock to gender diversity to examine causal effects of female board representation on various firm outcomes. Finally, it may be interesting to compare firms headquartered in other US states to those in California within this context.

References

Acharya, V.V. and Subramanian, K.V. 2009. Bankruptcy codes and innovation. *The Review of Financial Studies* 22(12), pp.4949-4988.

Adams, R.B., Almeida, H. and Ferreira, D. 2005. Powerful CEOs and Their Impact on Corporate Performance. *The Review of Financial Studies* 18(4), pp.1403–1432.

Adams, R.B. and Ferreira, D. 2007. A theory of friendly boards. *The Journal of Finance* 62(1), pp.217-250.

Adams, R.B. and Ferreira, D. 2009. Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics* 94(2), pp.291–309.

Adams, R.B. and Funk, P. 2012. Beyond the glass ceiling: Does gender matter? *Management Science* 58(2) pp.219-235.

Aldamen, H., Duncan, K., Kelly, S., McNamara, R. and Nagel, S. 2012. Audit committee characteristics and firm performance during the global financial crisis. *Accounting & Finance* 52(4), pp.971-1000.

Ali, M., Ng, Y.L. and Kulik, C.T. 2014. Board age and gender diversity: A test of competing linear and curvilinear predictions. *Journal of Business Ethics* 125(3), pp.497-512.

Allison, P.D. 2010. *Survival Analysis using SAS: A Practical Guide*. 2nd ed. Northern Carolina: SAS Institute Inc.

Amini, S. Mohamed, A., Schwienbacher, A. and Wilson, N. 2020. The Impact of Venture Capital Holding on the Firms' Life-cycle: Evidence from IPO Firms. *Available at SSRN* 3710522.

An, H., Chen, C.R., Wu, Q. and Zhang, T. 2021. Corporate Innovation: Do Diverse Boards Help? *Journal of Financial and Quantitative Analysis* 56(1), pp.155-182.

Anagnostopoulou, S.C., Gounopoulos, D., Malikov, K. and Pham, H. 2021. Earnings management by classification shifting and IPO survival. *Journal of Corporate Finance* 66, 101796.

Anderson, R.C., Reeb, D.M., Upadhyay, A. and Zhao, W. 2011. The economics of director heterogeneity. *Financial Management* 40(1), pp.5-38.

Andrews, D. and De Serres, A. 2012. Intangible assets, resource allocation and growth: A framework for analysis. *OECD Economics Department Working Papers Series* 989. Paris: OECD Publishing.

Anginer, D., Demagogic-Kunt, A., Huizinga, H. and Ma, K. 2018. Corporate governance of banks and financial stability. *Journal of Financial Economics* 130(2), pp.327-346.

Ararat, M., Aksu, M. and Tansel Cetin, A. 2015. How board diversity affects firm performance in emerging markets: Evidence on channels in controlled firms. *Corporate Governance: An International Review* 23(2), pp.83-103.

Arikan, A.M. and Capron, L. 2010. Do newly public acquirers benefit or suffer from their pre-IPO affiliations with underwriters and VCs? *Strategic Management Journal* 31(12), pp.1257-1289.

Atallah, G., De Fuentes, C. and Panasian, C.A. 2021. Ownership, Compensation and Board Diversity as Innovation Drivers: A Comparison of US and Canadian Firms. *International Journal of Innovation Management* 25(3), 2150025.

Atanassov, J. 2013. Do hostile takeovers stifle innovation? Evidence from antitakeover legislation and corporate patenting. *The Journal of Finance* 68(3), pp.1097-1131.

Austin, P.C. 2011. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research* 46(3), pp.399-424.

Bach, S.B. and Smith, A.D. 2007. Are powerful CEOs beneficial to post-IPO survival in high technology industries? An empirical investigation. *The Journal of High Technology Management Research* 18(1), pp.31-42.

Bachmann, R.L. and Spiropoulos, H. 2021. Do females on boards affect acquisition outcomes and target selection: a replication and extension of Levi, Li and Zhang (2014). *Accounting & Finance* 61(2), pp.3427-3441.

Bailey, B.C. and Peck, S.I. 2013. Boardroom strategic decision-making style: Understanding the antecedents. *Corporate Governance: An International Review* 21(2), pp.131-146.

Baker, M. and Gompers, P.A. 2003. The determinants of board structure at the initial public offering. *The Journal of Law and Economics* 46(2), pp. 569–598.

Baldenius, T., Melumad, N. and Meng, X. 2014. Board composition and CEO power. *Journal of Financial Economics* 112(1), pp.53-68.

Balsmeier, B., Fleming, L. and Manso, G. 2017. Independent boards and innovation. *Journal of Financial Economics* 123(3), pp.536-557.

Baranchuk, N. and Dybvig, P. 2009. Consensus in diverse corporate boards. *Review of Financial Studies* 22, 715–747.

Belkacemi, R., Bouzinab, K. and Papadopoulos, A. 2021. A cognitive approach to diversity: investigating the impact of board of directors' educational and functional heterogeneity on innovation performance. *International Journal of Business and Management* 16(2), pp.1833-1836.

Bena, J., Ferreira, M.A., Matos, P. and Pires, P. 2017. Are foreign investors locusts? The long-term effects of foreign institutional ownership. *Journal of Financial Economics* 126(1), pp.122-146.

Bernile, G., Bhagwat, V. and Yonker, S. 2018. Board diversity, firm risk, and corporate policies. *Journal of Financial Economics* 127(3), pp.588-612.

Bernstein, S. 2015. Does going public affect innovation? *The Journal of Finance* 70(4), pp.1365-1403.

Bertrand, M. and Schoar, A. 2003. Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics* 118(4), pp.1169-1208.

Blau, P.M. 1977. *Inequality and heterogeneity: A primitive theory of social structure*. New York: Free Press.

Blundell, R. and Bond, S.1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87(1), pp.115-143.

Bond, S.R. 2002. Dynamic panel data models: a guide to micro data methods and practice. *Portuguese Economic Journal* 1(2), pp.141-162.

Boone, A.L., Field, L.C., Karpoff, J.M. and Raheja, C.G. 2007. The determinants of corporate board size and composition: An empirical analysis. *Journal of Financial Economics* 85(1), pp. 66–101.

Borokhovich, K.A., Boulton, T.J., Brunarski, K.R. and Harman, Y.S. 2014. The incentives of grey directors: Evidence from unexpected executive and board chair turnover. *Journal of Corporate Finance* 28, pp.102-115.

Boutchkova, M., and Gonzalez, A., and Main, B. G. M., and Sila, V. 2020. Gender Diversity and the Spillover Effects of Women on Boards. *Corporate Governance: An International Review, Forthcoming*, Available at SSRN 2536887.

Bradburn, M.J., Clark, T.G., Love, S.B. and Altman, D.G. 2003. Survival analysis part II: multivariate data analysis–an introduction to concepts and methods. *British Journal of Cancer* 89(3), pp.431-436.

Brau, J.C. and Fawcett, S.E. 2006. Initial public offerings: An analysis of theory and practice. *The Journal of Finance* 61(1), pp.399-436.

Bruton, G.D., Filatotchev, I., Chahine, S. and Wright, M. 2010. Governance, ownership structure, and performance of IPO firms: The impact of different types of private equity investors and institutional environments. *Strategic Management Journal* 31(5), pp.491-509.

Calder-Wang, S. and Gompers, P.A. 2017. Diversity in innovation. *NBER Working Paper Series* 23082. Cambridge: National Bureau of Economic Research.

Carter, D.A., D'Souza, F., Simkins, B.J. and Simpson, W.G. 2010. The gender and ethnic diversity of US boards and board committees and firm financial performance. *Corporate Governance: An International Review* 18(5), pp.396-414.

Cashman, G.D., Gillan, S.L. and Jun, C. 2012. Going overboard? On busy directors and firm value. *Journal of Banking & Finance* 36(12), pp.3248-3259.

Certo, S.T. Daily, C.M. and Dalton, D.R. 2001. Signaling firm value through board structure: An investigation of initial public offerings. *Entrepreneurship Theory and Practice* 26(2) pp.33-50.

Certo, S.T. 2003. Influencing initial public offering investors with prestige: Signaling with board structures. *Academy of Management Review* 28(3), pp.432-446.

Chahine, S. and Goergen, M. 2011. venture capitalist board representation and performance of US IPOs. *Journal of Business Finance & Accounting* 38(3-4), pp.413-445.

Chahine, S. and Goergen, M. 2013. The effects of management-board ties on IPO performance. *Journal of Corporate Finance* 21, pp.153-179.

Chancharat, N., Krishnamurti, C. and Tian, G. 2012. Board structure and survival of new economy IPO firms. *Corporate Governance: An International Review* 20(2), pp.144-163.

Chang, C.H. and Wu, Q. 2021. Board networks and corporate innovation. *Management Science* 67(6), pp.3618-3654.

Charitou, A., Louca, C. and Vafeas, N. 2007. Boards, ownership structure, and involuntary delisting from the New York Stock Exchange. *Journal of Accounting and Public Policy 26*(2), pp.249-262.

Chemmanur, T.J., Loutskina, E. and Tian, X. 2014. Corporate venture capital, value creation, and innovation. *The Review of Financial Studies* 27(8), pp.2434-2473.

Chen, J., Leung, W.S. and Evans, K.P. 2018. Female board representation, corporate innovation and firm performance. *Journal of Empirical Finance* 48, pp.236-254.

Chen, L.H., Gramlich, J. and Houser, K.A. 2019. The effects of board gender diversity on a firm's risk strategies. *Accounting & Finance* 59(2), pp.991-1031.

Cirillo, A., Mussolino, D., Romano, M. and Viganò, R. 2017. A complicated relationship: Family involvement in the top management team and post-IPO survival. *Journal of Family Business Strategy* 8(1), pp.42-56.

Cirillo, A., Mussolino, D., Saggese, S. and Sarto, F. 2018. Looking at the IPO from the "top floor": A literature review. *Journal of Management and Governance* 22(3), pp.661-688.

Coles, J.L., Daniel, N.D., Durrani, F. and Naveen, L. 2020. Director Connections and Board Advising. Available at SSRN 2002250.

Cooper, M. J. and Knott, A. M. and Yang, W. 2020 RQ Innovative Efficiency and Firm Value (*forthcoming, Journal of Financial and Quantitative Analysis*), Available at SSRN 2631655.

Copley, P., Douthett, E. and Zhang, S. 2021. Venture capitalists and assurance services on initial public offerings. *Journal of Business Research* 131, pp.278-286.

Cox, D.R. 1972. Regression models and life-tables. *Journal of the Royal Statistical Society: Series B (Methodological)* 34(2), pp.187-202.

Croci, E., Hertig, G., Khoja, L. and Lan, L.L. 2020. The Advisory and Monitoring Roles of the Board-Evidence from Disruptive Events. *European Corporate Governance Institute–Finance Working Paper* 673. Belgium: ECGI

Cumming, D. and Leung, T.Y. 2021. Board diversity and corporate innovation: Regional demographics and industry context. *Corporate Governance: An International Review* 29(3), pp.277-296.

Dass, N., Kini, O., Nanda, V., Onal, B. and Wang, J. 2014. Board expertise: Do directors from related industries help bridge the information gap?. *The Review of Financial Studies* 27(5), pp.1533-1592.

Davidson III, W.N., Xie, B. and Xu, W. 2004. Market reaction to voluntary announcements of audit committee appointments: The effect of financial expertise. *Journal of Accounting and Public Policy* 23(4), pp.279-293.

DeBoskey, D.G., Luo, Y. and Zhou, L. 2019. CEO power, board oversight, and earnings announcement tone. *Review of Quantitative Finance and Accounting* 52(2), pp.657-680.

Doidge, C., Karolyi, G.A. and Stulz, R.M. 2017. The US listing gap. *Journal of Financial Economics* 123(3), pp.464-487.

Engel, E., Hayes, R.M. and Wang, X. 2007. The Sarbanes–Oxley Act and firms' going-private decisions. *Journal of Accounting and Economics* 44(1-2), pp.116-145.

Ensley, M.D., Pearson, A.W. and Amason, A.C. 2002. Understanding the dynamics of new venture top management teams: cohesion, conflict, and new venture performance. *Journal of Business Venturing* 17(4), pp.365-386.

Ensley, M.D., Hmieleski, K.M. and Pearce, C.L. 2006. The importance of vertical and shared leadership within new venture top management teams: Implications for the performance of startups. *The Leadership Quarterly* 17(3), pp.217-231.

Erel, I., Jang, Y. and Weisbach, M.S. 2015. Do acquisitions relieve target firms' financial constraints?. *The Journal of Finance* 70(1), pp.289-328.

Espenlaub, S., Khurshed, A. and Mohamed, A. 2012. IPO survival in a reputational market. *Journal of Business Finance & Accounting* 39(3-4), pp.427-463.

Ewens, M., Peters, R.H. and Wang, S. 2019. Acquisition prices and the measurement of intangible capital. *NBER Working Paper Series* 25960. Cambridge: NBER.

Faccio, M., Marchica, M.T. and Mura, R. 2016. CEO gender, corporate risk-taking, and the efficiency of capital allocation. *Journal of Corporate Finance* 39, pp.193-209.

Fairchild, R. 2004. Financial contracting between managers and venture capitalists: the role of value-added services, reputation seeking, and bargaining power. *Journal of Financial Research* 27(4), pp.481-495.

Faleye, O., Hoitash, R. and Hoitash, U. 2011. The costs of intense board monitoring. *Journal of Financial Economics* 101(1), pp.160-181.

Faleye, O., Kovacs, T. and Venkateswaran, A. 2014. Do better-connected CEOs innovate more?. *Journal of Financial and Quantitative Analysis* 49(5-6), pp.1201-1225.

Faleye, O., Hoitash, R. and Hoitash, U. 2018. Industry expertise on corporate boards. *Review of Quantitative Finance and Accounting* 50(2), pp.441-479.

Feng, Y., Song, K. and Tian, Y.S. 2019. Director networks and initial public offerings. *Journal of Banking & Finance* 106, pp.246-264.

Feng, C., Patel, P.C. and Xiang, K. 2020. The well-trodden path: Complementing market and entrepreneurial orientation with a strategic emphasis to influence IPO survival in the United States. *Journal of Business Research* 110, pp.370-385.

Ferreira, D., Manso, G. and Silva, A.C. 2014. Incentives to innovate and the decision to go public or private. *The Review of Financial Studies* 27(1), pp.256-300.

Ferris, S.P. and Liao, M.Y.S. 2019. Busy boards and corporate earnings management: an international analysis. *Review of Accounting and Finance* 18(4), pp. 533-556

Fich, E.M. and Shivdasani, A. 2007. Financial fraud, director reputation, and shareholder wealth. *Journal of Financial Economics* 86(2), pp.306-336.

Fich E.M., Shivdasani A. 2012 Are Busy Boards Effective Monitors?. In: Boubaker S., Nguyen B., Nguyen D. eds. *Corporate Governance.* Berlin: Springer, pp. 221-258.

Field, L., Lowry, M. and Mkrtchyan, A. 2013. Are busy boards detrimental? *Journal of Financial Economics* 109(1), pp.63-82.

Field, L.C. and Karpoff, J.M. 2002. Takeover Defenses of IPO firms. *The Journal of Finance* 57(5), pp.1857-1889.

Fields, M.A. and Keys, P.Y. 2003. The emergence of corporate governance from Wall St. to Main St.: Outside directors, board diversity, earnings management, and managerial incentives to bear risk. *Financial Review* 38(1), pp.1-24.

Finkelstein, S. 1992. Power in top management teams: Dimensions, measurement, and validation. *Academy of Management Journal* 35(3), pp.505-538.

Fischer, H.M. and Pollock, T.G. 2004. Effects of social capital and power on surviving transformational change: The case of initial public offerings. *Academy of Management Journal* 47(4), pp.463-481.

Forbes, D.P. and Milliken, F.J. 1999. Cognition and corporate governance: Understanding boards of directors as strategic decision making groups. *Academy of Management Review* 24(3), pp.489-505.

Frye, M.B. and Pham, D.T. 2018. CEO gender and corporate board structures. *The Quarterly Review of Economics and Finance* 69, pp.110-124.

Gao, N. and Jain, B.A. 2012. Founder management and the market for corporate control for IPO firms: The moderating effect of the power structure of the firm. *Journal of Business Venturing* 27(1), pp.112-126.

Garg, S., John Li, Q. and Shaw, J.D. 2019. Entrepreneurial firms grow up: Board undervaluation, board evolution, and firm performance in newly public firms. *Strategic Management Journal* 40(11), pp.1882-1907.

Gavin, D.J. 2012. Power in the corporate boardroom: A new dimension in measuring board power. *Journal of Business & Economic Studies* 18(2), pp. 1-25.

Gehrke, Y. and Firk, S. 2019. How advising and monitoring drive older CEOs towards digital innovation. In *Academy of Management Proceedings* 1, pp. 19344.

Gomulya, D., Jin, K., Lee, P.M. and Pollock, T.G. 2019. Crossed wires: Endorsement signals and the effects of IPO firm delistings on venture capitalists' reputations. *Academy of Management Journal* 62(3), pp.641-666.

Gounopoulos, D. and Pham, H. 2018. Financial expert CEOs and earnings management around initial public offerings. *The International Journal of Accounting* 53(2), pp.102-117.

Gounopoulos, D., Loukopoulos, G. and Loukopoulos, P. 2020. Do financial expert CEOs matter for newly public firms?. Available at SSRN 3729572.

Graham, J.R., Kim, H. and Leary, M. 2020. CEO-board dynamics. *Journal of Financial Economics* 137(3), pp.612-636.

Gray, S. and Nowland, J. 2017. The diversity of expertise on corporate boards in Australia. *Accounting & Finance* 57(2), pp.429-463.

Griffin, P.A. and Sun, Y. 2013. Going green: Market reaction to CSR wire news releases. *Journal of Accounting and Public Policy* 32(2), pp.93-113.

Griffin, D., Li, K. and Xu, T. 2021. Board gender diversity and corporate innovation: International evidence. *Journal of Financial and Quantitative Analysis* 56(1), pp.123-154.

Güner, A.B., Malmendier, U. and Tate, G. 2008. Financial expertise of directors. *Journal of Financial Economics* 88(2), pp.323-354.

Guo, R.J. and Zhou, N. 2016. Innovation capability and post-IPO performance. *Review of Quantitative Finance and Accounting* 46(2), pp.335-357.

Hall, B.H. and Ziedonis, R.H. 2001. The patent paradox revisited: an empirical study of patenting in the US semiconductor industry, 1979-1995. *Rand Journal of Economics*, pp.101-128.

Hall, B.H. and Lerner, J. 2010. The financing of R&D and innovation. In: Bronwyn H. Hall, Nathan Rosenberg eds. *Handbook of the Economics of Innovation.* North-Holland, pp.609-639.

Harjoto, M.A., Laksmana, I. and Lee, R. 2015. Board diversity and corporate social responsibility. *Journal of Business Ethics* 132(4), pp.641-660.

Harjoto, M.A., Laksmana, I. and Yang, Y.W. 2018. Board diversity and corporate investment oversight. *Journal of Business Research* 90, pp.40-47.

Hasan, I., Khurshed, A., Mohamed, A. and Wang, F. 2018. Do venture capital firms benefit from a presence on boards of directors of mature public companies?. *Journal of Corporate Finance* 49, pp.125-140.

He, J.J. and Tian, X. 2013. The dark side of analyst coverage: The case of innovation. *Journal of Financial Economics* 109(3), pp.856-878.

Hermalin, B.E. and Weisbach, M.S. 1998. Endogenously chosen boards of directors and their monitoring of the CEO. *American Economic Review,* pp.96-118.

Hillman, A.J., Cannella, A.A. and Paetzold, R.L. 2000. The resource dependence role of corporate directors: Strategic adaptation of board composition in response to environmental change. *Journal of Management Studies* 37(2), pp.235-256.

Hillman, A.J. and Dalziel, T. 2003. Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management Review* 28(3), pp.383-396.

Hillman, A.J., Shropshire, C. and Cannella Jr, A.A. 2007. Organizational predictors of women on corporate boards. *Academy of Management Journal* 50(4), pp.941-952.

Hirshleifer, D., Low, A. and Teoh, S.H. 2012. Are overconfident CEOs better innovators? *The Journal of Finance* 67(4), pp.1457-1498.

Hirshleifer, D., Hsu, P.H. and Li, D. 2013. Innovative efficiency and stock returns. *Journal of Financial Economics* 107(3), pp.632-654.

Hoitash, U. and Mkrtchyan, A. 2021. Internal governance and outside directors' connections to non-director executives. *Journal of Accounting and Economics* ,101436.

Hosmer, D. and Lemeshow, S. 1989. *Applied Logistic Regression*. New York, NY: John Wiley & Sons.

Hovakimian, A. and Hutton, I. 2010. Merger-Motivated IPOs. *Financial Management* 39(4), pp.1547-1573.

Hsu, W.H., Owen, S. and Suchard, J.A. 2020. The value of ongoing venture capital investment to newly listed firms. *Accounting & Finance* 60(2), pp.1327-1349.

Huang, J., Jain, B.A. and Shao, Y. 2019. CEO power, product market competition and the acquisition motive for going public. *Accounting & Finance* 59(4), pp.2479-2507.

Hunter, L.C., Webster, E. and Wyatt, A. 2005. “Measuring Intangible Investment”, *Melbourne Institute Working Paper Series* 15. Melbourne: Melbourne Institute of Applied Economic and Social Research.

Huse, M., 2007. *Boards, governance and value creation: The human side of corporate governance*. Cambridge, UK: Cambridge University Press.

Huse, M., Hoskisson, R., Zattoni, A. and Viganò, R. 2011. New perspectives on board research: Changing the research agenda. *Journal of Management & Governance* 15(1), pp.5-28.

Huse, M. 2016. The ‘golden skirts’: lessons from Norway about women on corporate boards of directors. In S. Groschi, J. Takagi eds. *Diversity Quotas, Diverse Perspectives*. Routledge. pp. 29-42.

Hutchinson, M., Mack, J. and Plastow, K. 2015. Who selects the ‘right’ directors? An examination of the association between board selection, gender diversity and outcomes. *Accounting & Finance* 55(4), pp.1071-1103.

Iliev, P. and Lowry, M. 2020. Venturing beyond the IPO: financing of newly public firms by venture capitalists. *The Journal of Finance* 75(3), pp.1527-1577.

Ishii, J. and Xuan, Y. 2014. Acquirer-target social ties and merger outcomes. *Journal of Financial Economics* 112(3), pp.344-363.

Jain, B.A. and Kini, O. 2000. Does the presence of venture capitalists improve the survival profile of IPO firms?. *Journal of Business Finance & Accounting* 27(9-10), pp.1139-1183.

Jain, B.A. and Tabak, F. 2008. Factors influencing the choice between founder versus non-founder CEOs for IPO firms. *Journal of Business Venturing* 23(1), pp.21-45.

Joseph, J., Ocasio, W. and McDonnell, M.H. 2014. The structural elaboration of board independence: Executive power, institutional logics, and the adoption of CEO-only board structures in US corporate governance. *Academy of Management Journal* 7(6), pp.1834-1858.

Kang, H., Cheng, M. and Gray, S.J. 2007. Corporate governance and board composition: Diversity and independence of Australian boards. *Corporate Governance: An International Review* 15(2), pp.194-207.

Kang, J.K., Liu, W.L., Low, A. and Zhang, L. 2018. Friendly boards and innovation. *Journal of Empirical Finance* 45, pp.1-25.

Kim, D. and Starks, L.T. 2016. Gender diversity on corporate boards: Do women contribute unique skills? *American Economic Review* 106(5), pp.267-71.

King, G. and Nielsen, R. 2019. Why propensity scores should not be used for matching. *Political Analysis* 27(4), pp.435-454.

Klarner, P., Probst, G. and Useem, M. 2020. Opening the black box: Unpacking board involvement in innovation. *Strategic Organization* 18(4), pp.487-519.

Kogan, L., Papanikolaou, D., Seru, A. and Stoffman, N. 2017. Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics* 132(2), pp.665-712.

Kooli, M. and Meknassi, S. 2007. The survival profile of US IPO issuers: 1985–2005. *The Journal of Wealth Management* 10(2), pp.105-119.

Krause, R., Semadeni, M. and Cannella Jr, A.A. 2014. CEO duality: A review and research agenda. *Journal of Management* 40(1), pp.256-286.

Krefting, L.A. 2002. Re-presenting women executives: valorization and devalorization in US business press. *Women in Management Review* 17(3-4), pp.104-119.

Larcker, D.F., So, E.C. and Wang, C.C. 2013. Boardroom centrality and firm performance. *Journal of Accounting and Economics* 55(2-3), pp.225-250.

Lawless, J.F. 1982. *Statistical models and methods for lifetime data*. Hoboken, New Jersey: John Wiley & Sons.

Lawless, J.F. 2011. *Statistical models and methods for lifetime data* 2nd ed. Hoboken, New Jersey: John Wiley & Sons.

LeClere, M.J. 2000. The occurrence and timing of events: Survival analysis applied to the study of financial distress. *Journal of Accounting Literature* 19, p.158-189.

Leuz, C. 2007. Was the Sarbanes–Oxley Act of 2002 really this costly? A discussion of evidence from event returns and going-private decisions. *Journal of Accounting and Economics* 44(1-2), pp.146-165.

Levi, M., Li, K. and Zhang, F. 2014. Director gender and mergers and acquisitions. *Journal of Corporate Finance* 28, pp.185-200.

Lewellyn, K.B. and Muller-Kahle, M.I. 2012. CEO power and risk taking: Evidence from the subprime lending industry. *Corporate Governance: An International Review* 20(3), pp.289-307.

Lewellyn, K.B. and Fainshmidt, S. 2017. Effectiveness of CEO power bundles and discretion context: Unpacking the 'fuzziness' of the CEO duality puzzle. *Organization Studies* 38(11), pp.1603-1624.

Lin, X., Featherman, M., Brooks, S.L. and Hajli, N. 2019. Exploring gender differences in online consumer purchase decision making: An online product presentation perspective. *Information Systems Frontiers* 21(5), pp.1187-1201.

Linck, J.S., Netter, J.M. and Yang, T. 2008. The determinants of board structure. *Journal of Financial Economics* 87(2), pp.308–328.

Liu, L.X., Sherman, A.E. and Zhang, Y. 2014b. The long-run role of the media: Evidence from initial public offerings. *Management Science* 60(8), pp.1945-1964.

Love, E.G., Lim, J. and Bednar, M.K. 2017. The face of the firm: The influence of CEOs on corporate reputation. *Academy of Management Journal* 60(4), pp.1462-1481.

Lu, J. and Wang, W. 2018. Managerial conservatism, board independence and corporate innovation. *Journal of Corporate Finance* 48, pp.1-16.

Malenko, N. 2014. Communication and decision making in corporate boards. *The Review of Financial Studies* 27(5), pp.1486-1532.

Mazzucato, M., and Tancioni, M. 2012. R&D, patents and stock return volatility. *Journal of Evolutionary Economics* 22(4):811–832.

McGuinness, P.B. 2018. IPO firm performance and its link with board officer gender, family-ties and other demographics. *Journal of Business Ethics* 152(2), pp.499-521.

Miller, T. and del Carmen Triana, M. 2009. Demographic diversity in the boardroom: Mediators of the board diversity–firm performance relationship. *Journal of Management Studies* 46(5), pp.755-786.

Mousa, F.T., Bierly, P.E. and Wales, W.J. 2014. Different strokes: IPO risk factors, investor valuation, and firm survival. *Journal of Management & Organization* 20(3), pp.348-364.

Muttakin, M.B., Khan, A. and Mihret, D.G 2018. The effect of board capital and CEO power on corporate social responsibility disclosures. *Journal of Business Ethics* 150(1), pp.41-56.

Nicholson, G.J., Alexander, M. and Kiel, G.C. 2004. Defining the social capital of the board of directors: An exploratory study. *Journal of Management & Organization* 10(1), pp.54-72.

Perrault, E. 2015. Why does board gender diversity matter and how do we get there? The role of shareholder activism in deinstitutionalizing old boys' networks. *Journal of Business Ethics* 128(1), pp.149-165.

Perrault, E. and McHugh, P. 2015. Toward a life cycle theory of board evolution: Considering firm legitimacy. *Journal of Management & Organization* 21(5), pp.627-649.

Perryman, A.A., Fernando, G.D. and Tripathy, A. 2016. Do gender differences persist? An examination of gender diversity on firm performance, risk, and executive compensation. *Journal of Business Research* 69(2), pp.579-586.

Pfeffer, J. and Salancik, G.R. 1978. Social control of organizations. In *The external control of organizations: A resource dependence perspective*. New York: Harper and Row, pp.39-22

Pfeffer, J. and Salancik, G.R., 2003. *The external control of organizations: A resource dependence perspective*. Stanford, California: Stanford University Press.

Post, C., Rahman, N., & Rubow, E. (2011). Green governance: Boards of directors' composition and environmental corporate social responsibility. *Business & Society* 50(1), pp.189–223.

Rao, K. and Tilt, C. 2016. Board composition and corporate social responsibility: The role of diversity, gender, strategy and decision making. *Journal of Business Ethics* 138(2), pp.327-347.

Rau, P. R., Sandvik, J. and Vermaelen, T. 2021 Are Women Undervalued? Board Gender Diversity and IPO Underpricing. *European Corporate Governance Institute – Finance Working Paper 756*, Belgium: ECGI .

Renneboog, L. and Zhao, Y. 2011. Us knows us in the UK: On director networks and CEO compensation. *Journal of Corporate Finance* 17(4), pp.1132-1157.

Renneboog, L. and Zhao, Y. 2014. Director networks and takeovers. *Journal of Corporate Finance* 28, pp.218-234.

Roberts, J., McNulty, T. and Stiles, P. 2005. Beyond agency conceptions of the work of the non-executive director: Creating accountability in the boardroom. *British Journal of Management* 16, pp.5-26.

Roberts, M.R. and Whited, T.M. 2013. Endogeneity in empirical corporate finance. In: George M. Constantinides, Milton Harris, Rene M. Stulz eds. *Handbook of the Economics of Finance*. Elsevier, pp.493-572.

Roosenboom, P. 2005. Bargaining on board structure at the initial public offering. *Journal of Management & Governance 9*(2), pp.171-198.

Saikia, R. and Barman, M.P. 2017. A review on accelerated failure time Columns. *International Journal of Statistics Systems* 12(2), pp.311-322.

Sashegyi, A. and Ferry, D. 2017. On the interpretation of the hazard ratio and communication of survival benefit. *The Oncologist* 22(4), pp.484-486.

Shen, W. 2005. Improve board effectiveness: The need for incentives. *British Journal of Management* 16, pp.81-89.

Shumway, T. 2001. Forecasting bankruptcy more accurately: A simple hazard model. *The Journal of Business* 74(1), pp.101-124.

Sila, V., Gonzalez, A. and Hagendorff, J. 2016. Women on board: Does boardroom gender diversity affect firm risk? *Journal of Corporate Finance* 36, pp.26–53.

Sila, V., Gonzalez, A. and Hagendorff, J. 2017. Independent director reputation incentives and stock price informativeness. *Journal of Corporate Finance* 47, pp.219-235.

Sinagl, P and Wang, J. 2021 Managerial Incentives to Innovate During Crises: The Schumpeterian View. Available at SSRN 3761498.

Stinchcombe, Arthur L. 1965. Social structure and organizations. In: March, J.G. eds. *Handbook of Organizations*. Chicago: Rand McNally, pp.142-193.

Stone, A., Rose, S., Lal, B. and Shipp, S. 2008. Measuring innovation and intangibles: A business perspective. *Institute for Defense Analysis, Science and Technology Policy Institute, Washington, DC 31*, pp.277-280.

Sun, X.S. and Bhuiyan, M.B.U. 2020. Board tenure: A review. *Journal of Corporate Accounting & Finance 31*(4), pp.178-196.

Talavera, O., Yin, S. and Zhang, M. 2018. Age diversity, directors' personal values, and bank performance. *International Review of Financial Analysis 55*, pp.60-79.

Tanikawa, T. and Jung, Y. 2019. CEO power and top management team tenure diversity: implications for firm performance. *Journal of Leadership & Organizational Studies* 26(2), pp.256-272.

Tao, Q., Li, H., Wu, Q., Zhang, T. and Zhu, Y. 2019. The dark side of board network centrality: Evidence from merger performance. *Journal of Business Research* 104, pp.215-232.

Tavassoli, S. 2018. The role of product innovation on export behavior of firms: Is it innovation input or innovation output that matters? *European Journal of Innovation Management* 21(2), pp.294-314.

Torchia, M., Calabrò, A. and Huse, M. 2011. Women directors on corporate boards: From tokenism to critical mass. *Journal of Business Ethics* 102(2), pp.299-317.

Torchia, M., Calabrò, A. and Morner, M. 2015. Board of directors' diversity, creativity, and cognitive conflict: The role of board members' interaction. *International Studies of Management & Organization* 45(1), pp.6-24.

Tremblay, M.S., Gendron, Y. and Malsch, B. 2016. Gender on board: deconstructing the "legitimate" female director. *Accounting, Auditing & Accountability Journal* 29(1), pp.165-190.

Upadhyay, A. and Zeng, H. 2014. Gender and ethnic diversity on boards and corporate information environment. *Journal of Business Research* 67(11), pp.2456-2463.

Upadhyay, A. and Triana, M. 2021. Drivers of diversity on boards: The impact of the Sarbanes-Oxley Act. *Human Resource Management* 60(4), pp.475-702.

Uzunca, B., Rigtering, J.C. and Ozcan, P. 2018. Sharing and shaping: A cross-country comparison of how sharing economy firms shape their institutional environment to gain legitimacy. *Academy of Management Discoveries* 4(3), pp.248-272.

Veltrop, D.B., Bezemer, P.J., Nicholson, G. and Pugliese, A. 2021. Too unsafe to monitor? How board–CEO cognitive conflict and chair leadership shape outside director monitoring. *Academy of Management Journal* 64(1), pp.207-234.

Wang, Q.S., Anderson, H.D. and Chi, J. 2017. The impact of VC backing on the corporate governance of Chinese IPOs. *Pacific Accounting Review* 29(3), pp.330-335.

Welbourne, T.M. Cycyota, C.S. and Ferrante, C.J. 2007. Wall Street reaction to women in IPOs: An examination of gender diversity in top management teams. *Group & Organization Management* 32(5), pp.524-547.

Wilson, N., Wright, M. and Altanlar, A. 2014. The survival of newly incorporated companies and founding director characteristics. *International Small Business Journal* 32(7), pp.733-758.

Wowak, A.J., Hambrick, D.C. and Henderson, A.D. 2011. Do CEOs encounter within-tenure settling up? A multiperiod perspective on executive pay and dismissal. *Academy of Management Journal* 54(4), pp.719-739.

Wu, C.Y.H. and Hsu, H.H. 2018. Founders and board structure: Evidence from UK IPO firms. *International Review of Financial Analysis* 56, pp.19-31.

Xie, L., Zhou, J., Zong, Q. and Lu, Q. 2020. Gender diversity in R&D teams and innovation efficiency: Role of the innovation context. *Research Policy* 49(1), 103885.

Xu, Y., Zhang, L. and Chen, H. 2018. Board age and corporate financial fraud: An interactionist view. *Long Range Planning* 51(6), pp.815-830.

Yang, T. and Zhao, S. 2014. CEO duality and firm performance: Evidence from an exogenous shock to the competitive environment. *Journal of Banking & Finance* 49, pp.534-552.

Yang, T. and Aldrich, H.E. 2017. “The liability of newness” revisited: Theoretical restatement and empirical testing in emergent organizations. *Social Science Research* 63, pp.36-53.

Zhang, Z. 2016. Semi-parametric regression column for survival data: graphical visualization with R. *Annals of translational medicine* 4(23), pp.461-470.

Zhou, X. 2001. Understanding the determinants of managerial ownership and the link between ownership and performance: comment. *Journal of Financial Economics 62*(3), pp.559-571.