The impact of director's heterogeneity on IPO underpricing

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Abstract

Purpose – The purpose of this paper is to investigate whether the Boardroom heterogeneity affects IPO underpricing for entrepreneurial firms, where Boardroom heterogeneity was classified in terms of functional background, educational background, age and length of tenure.

Design/methodology/approach – A national research design was conducted using data collected from 355 firms listed on China's Growth Enterprise Market from its start in 2009 to 2012.

Findings – The author found that IPO underpricing has a significant negative correlation with functional heterogeneity, a positive correlation with educational heterogeneity, a significant negative correlation with age heterogeneity, but it does not show significant correlation with heterogeneity in tenure. Board heterogeneity affects IPO underpricing of entrepreneurial firms partially, which means functional, educational and age heterogeneity conveys signals to potential investors regarding a firm's quality.

Research/limitations/implications – More entrepreneurial firms in more years for data and long-term performance research design in future research would be required for further understanding of the relationships among the variables in this study.

Practical/implications – This paper suggests that IPO firms may make use of such an influencing mechanism to determine the issue price or to control the IPO underpricing by showing the Boardroom heterogeneity.

Originality/value – This paper revealed the influence of the characteristics of board members of such firms on IPO underpricing, which is rare in recent studies comparing to the study for the top management team; also this study provides empirical support for such effect.

Keywords IPO, Heterogeneity, Underpricing, Director

Paper type Research paper

Introduction

Recently, research has focused on the firm's top management team which is recognized as an important determinant of strategic actions (Hambrick *et al.*, 1996) and neglected the important role of the board of directors although they are the members of the upper echelon (Finkelstein, *et al.*, 2009) because the governance theory has historically paid attention to the fiduciary responsibility of directors as monitors of management on behalf of shareholders (Dalton *et al.*, 2007). However, the directors also has showed their growing influence on firm strategy through their advice and counsel and provision of other critical resources (Golden and Zajac, 2001), even in the firm's strategic decisions making (Spencer Stuart, 2010).

As the result of a great strategic decision-making, IPOs are an important milestone for firms because they represent a fundamental transformation in their natures: changing from privately owned firms to public ownership (Certo, 2003). IPOs can take place even when firms are not yet large or established. The pricing of shares in an IPO represents an important threshold for a start-up because it signals the realization of the value derived from the entrepreneurial risks taken by the relevant firm's founders. IPO underpricing occurs because of the distinction between the market for a stock at issuance and the market for a

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stock during ordinary trading. Therefore, the difference between a stock's issue price and trading price represents "IPO underpricing". (board of directors or top management team).

Research on IPO underpricing has been relatively prolific in recent years because of an increased rate of IPO underpricing that has resulted in damage to the interests of IPO firms and shareholders. Although most studies originate in the financial sector, scholars of management practices have paid increasing attention to IPOs as an important area for research, especially in the context of newly listed entrepreneurial firms. According to the concept of signaling, firms engaged in an IPO will credibly convey a signal to potential investors to show that the firm is worth investing in. Specific firm characteristics are commonly used as signals; these could include ownership structure, board or manager characteristics, firm size, the presence of venture capital and underwriter reputation. Recent studies have prioritized the effect of key decision makers, namely, underwriters, chief executive officers or the senior management team, on issue price negotiations (Baker and Gompers, 1999; Daily *et al.*, 2003; Cohen and Dean, 2005; Zimmerman, 2008; Walters *et al.*, 2010; Chahine and Goergen, 2011) but few on the board of directors.

In the one-power regime, the China's chair of directors seems more powerful than CEOs, and the board of directors also occupies a more important position than the top management team in firm's decision-making, especially in the big decisions such as IPO. For example, the Chairman and Secretary of the Board are the key two persons in negotiation of IPO process in China. Although there are a lot of studies on top management team (Hambrick *et al.*, 1996; Carpenter, 2002; Hambrick *et al.*, 2004; Zimmerman, 2008), it seems meaningful to change our eyes on the firm's Board of Director, which yet related academic research is limited and has drawn few precise conclusions.

Generally, an organization may pay attention to the functionality and productivity of groups, promoting their heterogeneity if it believes that this would bring more resources and increase organizational competitiveness (Williams and O'Reilly, 1998). Conversely, it may be considered that heterogeneity could also result in increased communication inefficiencies (Lang, 1986; Arrow, 1998; Putnam, 2007), as well as higher rates of employee turnover. Diverse groups are often characterized by intra-group conflicts; this can result in the isolation of particular individuals that do not cohere with the majority view. O'Reilly *et al.* (1989) found that population heterogeneity results in greater numbers of conflicts and less communication, but, if the conflicts can be managed effectively, this can in fact lead to greater productivity.

This paper integrated the board research and firm valuation, as a theoretical contribution, utilizes empirical research on entrepreneurial firms to determine whether the Boardroom heterogeneity affects IPO underpricing with these firms in the context of China.

Theoretical framework

Various theories have attempted to explain IPO underpricing; these include asymmetric information theory, signaling, investor irrationality hypotheses, dispersed ownership hypotheses and the underwriters risk aversion hypothesis (Ritter and Welch, 2002). Signaling has dominated these explanatory approaches (Certo *et al.*, 2001; Ross, 1977) because it captures the impact of informational asymmetry and uncertainty surrounding the IPO (Certo, 2003). Given the need to address asymmetric information, its proponents believe that specific factors or indicators with relevance to the real business value and future growth prospects will be turned into information that is provided to potential investors (Deeds *et al.*, 1997) because investors' assessments of the future value of IPO firms affects their willingness to purchase newly issued shares.

Signaling is premised on the assumption that IPO firms and their advisors have a better understanding of their own operations than potential investors. The two key points in this premise are that:

(1) predetermined signals must be detected and recognized in advance; such information about a firm's true value is then offered to potential investors in advance; and

(2) the cost of obtaining signals is high or the means of obtaining them is difficult to replicate, because managers usually have detailed information that is difficult for outside investors to obtain (Lawless *et al.*, 1998).

Therefore, managers communicate with potential investors in particular channels or mechanisms regarding the firm's quality. This reduces uncertainty during the IPO, thereby attracting a larger pool of potential investors, especially those who had no prior knowledge of the relevant firm's quality (Beatty, 1989; Carter and Manaster, 1990). One of the key communication mechanisms between issuers and investors is the prospectus document, in which managers make disclosures to potential investors. Regulatory requirements of supervisory bodies dictate that IPO firms disclose their information in a prospectus, which includes detailed descriptions of the firm's operations, management and other matters that may be used to analyze the firm's potential performance. IPO firms are legally accountable for any misleading or inaccurate disclosures, rendering the accuracy of disclosures of paramount importance, as well as the consistency of its format and content (Tinic, 1988; Welbourne and Cyr, 1999).

Specific characteristics used as signals include existing equity allocations, firm size, length of time it has operated, extent of venture capital equity and the backgrounds of its top management team (Certo, 2003; Daily *et al.*, 2003; Downes and Heinkel, 1982; Lester *et al.*, 2006; McBain and Krause, 1989). The literature pertaining to such firm's senior management has identified many salient characteristics. One characteristic of particular note has been team heterogeneity. Four measures of the team heterogeneity have been introduced: functional background, educational background, age and tenure. These factors have been studied extensively (Bantel, 1993; Murray, 1989; Pegels and Song, 2000; Zimmerman, 2008). In the context of entrepreneurial firms, especially in China, some members of senior management teams may also be board members. Therefore, directors may often be involved directly or indirectly in operational decision-making; this has the potential to impact IPO pricing.

The basic characteristics of Board members disclosed in the prospectus may also be considered as a signal by the issuer that reflects the firm's value. Heterogeneous Boards may bring a variety of perspectives and talents that enable enhanced oversight and advisory contributions that would benefit shareholders through improved resource utilization, problem solving and strategy formulation capabilities (Jensen, 1993). However, the costs of heterogonous Boards, with dissimilar or disparate backgrounds, may be greater in terms of communication and coordination. Directors with varied perspectives may increase the scope for conflict during Board deliberations and protract the decision-making process (Anderson *et al.*, 2011). I consider that like the heterogeneity of a top management team, the heterogeneity of a Board of Directors may also be viewed as a signal that can affect potential investor judgments of the real value of firms, thereby affecting IPO pricing.

Board heterogeneity can arise from differences in many areas, such as education, experience, profession, gender, ethnicity and age. Beyond the influence of gender diversity, however, limited academic research or evidence supports the notion that director heterogeneity influences Board efficacy or firm performance (Anderson *et al.*, 2011).

Furthermore, in my sample, there is no ethnic heterogeneity. Therefore, in this paper, I borrow the four measures of team heterogeneity from Zimmerman (2008) and consider director heterogeneity in terms of functional background, educational background, age and tenure.

Greater heterogeneity of Board members offers greater oversight and recommendations to firms' senior management teams. Roure and Maidique (1986) found that the breadth of functions fulfilled by founding teams was an important factor in accessing venture capital; specifically, newly founded technology firms received more venture capital funding when they had teams that covered the complete range of corporate functions, including marketing, finance, operations and technical. Ucbasaran *et al.* (2003) argued that the functional background of a founding team indicates the heterogeneity of "human capital necessary for venture development". However, as previously mentioned, greater heterogeneity may increase communication and collaboration costs negatively impairing performance of newly founded firms (Ensley *et al.*, 1998).

Heterogeneity of Board members' functional backgrounds will, therefore, be focused on by investors and represents important information that may affect the future prospects of an entrepreneurial firm. Anderson (2011) demonstrated that investors placed a premium on heterogeneous Boards in complex firms but discounted the perceived benefit of heterogeneity in less complex firms. As a firm transfers to a public ownership model, it faces many new challenges and opportunities. A functionally heterogeneous Board may signal to outside investors that the firm will be successful going forward; investors generally expect firms to maintain a high level of growth following an IPO. Eisenhardt and Schoonhoven (1990) argued that a more functionally heterogeneous founding team would be better equipped to address strategic opportunities and enable the firm to grow. Thus, it appears that a functionally heterogeneous Board might provide a signal regarding the quality of an IPO firm, not only to potential investors but also to the issuers themselves. Their reactions to this signal, however, are different; issuers know that a functionally heterogeneous Board may be helpful to future performance and, therefore, take the view that it justifies a higher issue price. Outside investors who are non-professionals, however, may not recognize whether a functionally heterogeneous Board is beneficial to a firm's ongoing development. They may be concerned about possible conflicts among Board members arising from heterogeneity and offer a lower IPO price. On this basis, IPO firms with a more functionally heterogeneous Board may receive a lower IPO underpricing on the first day of listing. Based on the above analysis, I propose the following:

H1. For entrepreneurial firms, a functionally heterogeneous Board is negatively associated with the level of IPO underpricing.

Social science research has shown that different educational backgrounds are related to different social statuses, interpersonal networking opportunities and professional development progression (Useem and Karabel, 1986). Hambrick and Mason (1984) demonstrated that the type of education undertaken by senior managers influences their strategic decision-making. Boeker (1988) extended this argument in the context of new firms by arguing that highly educated entrepreneurs are more likely to emphasize technical innovation.

Heterogeneous educational backgrounds entail different perspectives and cognitive modes on the Board. The heterogeneity of educational background may also result in conflict (Jehn *et al.*, 1997) that will nonetheless increase the quality of decision-making and arrive at a higher level of commitment. Hope Pelled, *et al.* (1999) found that there was a significant positive correlation between the heterogeneity of educational background and the performance of the overall team. Heterogeneous educational backgrounds arguably

provide directors with different perspectives and cognitive paradigms that affect career development and social contacts (Anderson, 2011).

Under normal circumstances, greater heterogeneity in a Board's educational background indicates a wider range of social networks and the development of perspective that can produce increased creativity, benefiting the future development of firms. Accordingly, it appears heterogeneity in a Board's educational backgrounds may provide a signal to potential investors regarding the quality of an IPO firm. External, non-professional investors can identify educational heterogeneity and can understand or imagine that heterogeneity in a Board's educational background could positively contribute to the future development of entrepreneurial firms. Therefore, outside investors may offer a higher market pricing; such IPO firms with more educationally heterogeneous Boards may result in a higher level of IPO underpricing. Based on the above analysis, I propose the following:

H2. For entrepreneurial firms, heterogeneity in a Board's educational background is positively associated with the degree of IPO underpricing.

According to Richard and Shelor (2002), age is a delegator for perspectives, belief systems, networks and affiliations. Age differences allow team members to form diverse perspectives, thus improving the quality of decisions. Wiersema and Bantel (1992) proposed that as people age, their flexibility decreases and rigidity and resistance to change increases. Firms with younger managers were less likely to experience crises than firms managed by older managers (Mudambi and Zimmerman Treichel, 2005). Boeker (1988) argued that younger entrepreneurs are better able to understand recent innovations. Some scholars also argue that heterogeneity in a team's demographic characteristics may promote the effectiveness of organizational decision-making and performance. Williams and O'Reilly (1998) presented age heterogeneity as potentially providing greater access to a broader set of information and perspectives, thereby enhancing group decision-making processes. It may, however, also make communication more difficult and complicated, which could also have an impact on growth.

Greater heterogeneity among the ages of Board member's potentially introduces a broader range of ideas. Older directors may lend greater stability and experiential wisdom to deliberations, whereas younger directors may bring greater energy and less risk aversion to decision-making (Anderson, 2011). However, for a new firm, differences in age among Board members can also cause irreconcilable cognitive and affective conflict, thereby causing delayed decision-making and consequently affecting business performance.

A Board's heterogeneity in age may also provide a positive signal to potential investors because this characteristic is associated with better performance by firms (Kilduff *et al.*, 2000; Richard and Shelor, 2002; Wiersema and Bantel, 1992). Furthermore, the variety of perspectives and creativity provided by age heterogeneity means that a firm is better able to address strategic issues and, therefore, can perform better than less heterogeneous firms. Because age is also viewed as a proxy for particular perspectives, belief systems, networks and affiliations (Richard and Shelor, 2002), age heterogeneity should provide a broader set of perspectives, belief systems, networks and affiliations, which Board members can utilize in addressing the challenges faced by firms that have recently gone public. It, therefore, appears that age heterogeneity could provide a signal to potential investors regarding the potential performance of the IPO firm. From an internal perspective, age heterogeneity is an institutional arrangement that reflects the firm's long-term development strategy. Because it is helpful to future performance, issuers will require a higher issue price. Non-professional outside investors, however, despite placing emphasis on firm's long-term value may still take a short-term view in terms of their investment decisions. They may ignore long-term benefits of age heterogeneity and be unwilling to offer a higher market price. Therefore, IPO

firms with great age heterogeneity may receive a lower IPO underpricing on the first day of listing. Based on the above analysis, I propose the following:

H3. For entrepreneurial firms, age heterogeneity is negatively associated with the degree of IPO underpricing.

Director's decision-making and deliberations are not only influenced by prior experience but also influenced by the length of their tenure on the firm's Board. Prior board experience provides directors an understanding of group dynamics, corporate culture, trust and the ability to collaborate, both with company insiders and other externally recruited directors. Furthermore, experience can enhance a director's reputation. While long tenure could also be taken to indicate a commitment to preserving the status quo, informational diversity and risk propensity, it therefore also has the potential to affect organizational outcomes (Finkelstein and Hambrick, 1990). Long-tenured groups have been associated with increased cognitive rigidity, commitment to the status quo (Bantel and Jackson, 1989), standardized communicative formats (Katz, 1982), rigid strategic approaches and conformity to typical industry practices (Finkelstein and Hambrick, 1990).

Variation in Board member's tenure helps to engender a broader perspective and more strategic options when solving problems, which helps to promote the organization's performance. Heterogeneity in tenure can enrich a Board's collective understanding of a problem. Limited exposure to environments and experiences can constrain cognitive abilities in the short term, but heterogeneity in tenure can arguably overcome this. However, if heterogeneity in tenure is very marked, it can also make it difficult to act cohesively to coordinate and to collaborate, which will affect the firm's performance. Conversely, less heterogeneity in tenure facilitates internal communication and integration between Board members, improving cohesion, coordination and collaboration.

Potential investors may perceive heterogeneity in tenure as a signal that indicates whether the firm's rigidity in terms of adhering to past strategies or the flexible of its likely strategic approaches. Greater heterogeneity in tenure may lead to greater strategic flexibility and, hence, an ability to address the challenges of transitioning from private to public ownership (Bantel and Jackson, 1989; Certo, 2003; Wiersema and Bantel, 1992). Alternatively, homogeneity in tenure may lead to strategic rigidity; hence, a firm with homogeneity in tenure may experience problems once an IPO is completed. Williams and O'Reilly (1998) also argue that groups with greater heterogeneity in tenure are less socially integration, exhibit a higher turnover and poorer communication than groups with less heterogeneity. Therefore, it appears that heterogeneity in tenure may provide a signal to potential investors about the quality of the IPO firm. Like age heterogeneity from a professional investor's perspective, heterogeneity in tenure helps future performance, and, therefore, the issuer may require a higher issue price. The unprofessional external investor, however, may ignore the long-term effects of heterogeneity in tenure and be unwilling to offer a higher market price. Therefore, IPO firms with greater heterogeneity in tenure may receive a lower IPO underpricing on the first day of listing. Based on the above analysis, I propose the following:

H4. For entrepreneurial firms, heterogeneity in tenure is negatively associated with the degree of IPO underpricing.

Methods

Samples and data

This paper selected a sample of 355 firms listed on China's Growth Enterprises Market (GEM). These firms were launched on dates from October 30, 2009 to December 31, 2012,

with stock codes from 300001 to 300356. Only one firm (with stock code 300060) was removed from the sample because it failed to launch its IPO successfully. The data are mainly derived from the prospectuses of listed entrepreneurial firms and the Wind Financial Terminal (WFT).

Dependent variable

The dependent variable considered in this paper is *IPO underpricing* of the relevant firms. Underpricing is an important but abnormal phenomenon in IPO activities, which is nonetheless found in the stock markets of all countries. I measure the scale of IPO underpricing dividing the difference between an IPO's issue price and its closing price on the first day of listing by the issue price. This provides a relative scale for measuring the extent of IPO underpricing and may also be expressed thus:

$$\text{IPO Underpricing} = \frac{(\text{Closing Price on the First Day of Listing} - \text{IssuePrice})}{\text{Issue Price}}$$

Independent variables

Functional heterogeneity. I use heterogeneity parameter ($1 - \Sigma i^2$) constructed by Blau (1977) to measure the functional heterogeneity, where i represents the proportion of a group in ith category. A higher score indicates greater functional heterogeneity, whereas a lower score represents lower functional heterogeneity (Smith *et al.*, 1994). Functions include the following categories: finance, human resources, general management, marketing/public relations, operations management, engineering/research/technical and development, strategic planning, legal and administrative, information technology and others (Boeker, 1988; Murray, 1989; Tihanyi *et al.*, 2000; Zimmerman, 2008).

Educational heterogeneity. This is also calculated using Blau (1977)'s heterogeneity parameter ($1 - \Sigma i^2$). I used eight kinds of educational background taken from Hambrick *et al.* (1996) to classify educational heterogeneity, including: engineering, science, business administration, economics, liberal arts, law, art, business and others.

Age heterogeneity. This is measured using the variance between each Board member's ages; a greater variance means greater age heterogeneity and a smaller variance indicates lower age heterogeneity.

Heterogeneity in tenure. This is measured using the variance between each Board member's lengths of tenure; greater variance means greater heterogeneity in tenure and a smaller variance score indicates a lower heterogeneity in tenure.

Control variables

Board size. The effect of Board size demonstrated by prior research is ambiguous. Certain scholars assert that Board participation is negatively associated with a Board's size in terms of topical depth but positively associated with board size in terms of topical breadth (Finkelstein and Hambrick, 1996). Zahra *et al.* (2000), in their sample of medium-size companies, identified a curvilinear relationship between Board size and corporate entrepreneurship that was initially positive but became negative when the number of directors was 11 or more. As such, I use Board size as a control variable with data number of directors extracted from the prospectuses of IPO firms.

Firm size. I used the registered capital of firms pre-IPO to represent the firm's size, with RMB10m being represented by one unit.

Firm age. This helps to control for organizational maturity; older and larger firms suffer less from "liability of newness" (Singh *et al.*, 1986) and can acquire more information, resources and experience, as well as establishing larger numbers of relationships. I used the period from the establishment of a firm to its IPO on the GEM (Year of IPO − Year of Firm's Establishment). This information is obtained from prospectus of the IPO firms and WFT.

Issue size. In studies of IPO, the total size of issuance is often considered. Larger IPOs are generally issued by long-established corporations; this reduces the perceived risks associated with issuance (Dunbar, 2000); Beatty and Ritter (1986) called this phenomenon "empirical regularity". In comparison with large, established corporations, smaller firms generally face a greater level of uncertainty. This is measured as the multiple of the issue price and number of shares issued in the IPO. The data are obtained from WFT.

Year of IPO. This is extremely important as an impact variable because the stock market exhibits a wave phenomenon in response to the economic cycle and other exogenous factors. To reduce the impact of systematic factors, I regard the year of IPO as a control variable. I mark IPOs taking place in 2009 as 1, those taking place in 2010 as 2, those taking place in 2011 as 3 and those taking place in 2012 as 4.

Prior performance. When estimating the issue price of entrepreneurial firms when going public, I usually need to consider the firm's performance during previous years. There are many ways to measure a firm's performance. To demonstrate the influence of prior performance on IPO underpricing, I use the Compound Annual Growth Rate (CAGR) of operating profits before the IPO to measure the firm's prior performance; this is calculated using the square root of the year 3 operating profit divided by the year 1 operating profit, then taking away 1.

Underwriter reputation. The reputation of the underwriter has been shown to be beneficial to IPO performance (Zimmerman, 2008). Here, the underwriter's reputation is measured as the underwriter's ranking as listed in Bloomberg Limited Partnership's 2009 ranking of underwriters in the Chinese capital markets. If an underwriter ranked in the top ten, it is marked as 1; if not, it is marked as 0.

Industry. Baysinger and Hoskisson (1990) pointed out that there may be a higher risk associated with firms in the high-tech industry, so the high-tech industry should be controlled. A high-tech industry firm is labeled as 1; other types of firms are labeled as 0.

Statistical analysis

I used SPSS 21.0 statistical analysis software to carry out the corresponding research and analysis of results from all descriptive statistical analysis for variables to describe the mean and variance of the variables and correlation coefficients between the variables, as well as testing the skewness and kurtosis of variables. I then examined the hypotheses using ordinary least squares hierarchical regression models using IPO underpricing as a dependent variable, functional heterogeneity, educational heterogeneity, age heterogeneity and heterogeneity in tenure as the independent variables and board size, firm size, firm age, issue size, year of IPO, prior performance, underwriter reputation and type of industry as the control variables.

The model is as follows:

$$\begin{aligned}\text{IPO Underpricing}_i = {} & \alpha_{0i} + \alpha_{1i}\text{functional heterogeneity} + \alpha_{2i}\text{educational heterogeneity} \\ & + \alpha_{3i}\text{age heterogeneity} + \alpha_{4i}\text{heterogeneity in tenure} \\ & + \alpha_{5i}\text{board size} + \alpha_{6i}\text{firm size} + \alpha_{7i}\text{firm age} \\ & + \alpha_{8i}\text{issue size} + \alpha_{9i}\text{year of IPO} + \alpha_{10i}\text{prior performance} \\ & + \alpha_{11i}\text{underwriter reputation} + \alpha_{12i}\text{industry} + \varepsilon\end{aligned}$$

Results

Table I shows the descriptive statistics of the dependent variables, the independent variables and the control variables.

There are eight control variables, including Board size, firm size, firm age, issue size, year of listing, prior performance, underwriter reputation and industry type.

The minimum Board size is 5, the maximum is 14, the mean is between 8 and 9 and the standard deviation is 1.42. This relatively small standard deviation means that Board size settings are relatively similar. I used the firm's registered capital before the IPO to represent the firm size, and it can be seen from the descriptive statistics that the size gap between firms is relatively large. The firm's age figures show that the shortest time from launch to IPO on the GEM was two years and the longest was 25 years. The average of firm age at IPO was 11 years, slightly older than I had originally assumed. The lowest issue size was about RMB17m, and the largest was about RMB2.55bn. The average was about RMB65m.

I used the CAGR of operating profit disclosed in firm's reports for three years in advance of the IPO to measure the firm's prior performance. From the standard deviation and variance, I can see that the difference in firms' CAGR is relatively large, but the average is increasing rapidly. Underwriter reputation reached a relatively high average of 0.57, which demonstrates that IPO firms hire underwriters with better reputations to ensure the quality of underwriting services. This feature also confirms the transmission function served by the intermediary structure regarding quality information provided by IPO firms in accordance with signaling concepts considered in previous studies. In terms of the 355 firms' industry type, the average of the effective sample was 0.35, meaning that around 35per cent of the relevance firms belonged to high-tech industries.

Variables	*N*	Minimum	Maximum	Mean	SD
IPO underpricing	355	−0.17	2.1	0.34	0.37
Functional heterogeneity	355	0.2	0.92	0.69	0.1
Educational heterogeneity	355	0	0.84	0.68	0.11
Age heterogeneity	355	0.028	2.79	0.77	0.53
Heterogeneity in tenure	355	0	1.92	0.17	0.22
Board size	355	5	14	8.39	1.42
Firm size	355	2.6	45.8	7.19	4.98
Firm age	355	2	25	11	3.88
Issue size	355	17.1	255.3	65.08	42.21
Year of IPO	355	1	4	2.68	0.92
Prior performance	355	−75.52	954.87	309.96	83.68
Underwriter reputation	355	0	1	0.57	0.5
Industry	355	0	1	0.35	0.48

Table I.
Descriptive statistics

Table II shows that there were 36, 117, 128 and 74 firms listed on the GEM from 2009 to 2012. From descriptive statistical analysis, I can see that the minimum underpricing of the listed entrepreneurial firms in 2009 was 33 per cent, and the maximum underpricing was up to 210 per cent. The average was 93 per cent: a very high level. In the period 2010-2012, IPO underpricing showed a significant downward trend, with the lowest underpricing also appearing negative, with the closing price on the first day of listing being lower than the issue price. This could prompt investors to be more rational and give objective valuations to firms on the GEM. The mean IPO underpricing from the period 2010-2012 was 38, 23 and 21 per cent, respectively. The downward trend in IPO underpricing in year 4 was caused by macroeconomic fluctuations, the maturity of the GEM and increasing rational investors.

Table III below shows correlations between IPO underpricing and its four independent variables and the control variables. Mostly, correlations between various independent variables and control variables are significant, but with a small coefficient, or insignificant. Only the correlation coefficient for the control variables of issue size and prior performance is significant with a relatively large coefficient of over 0.5 (0.578). In accordance with the rules, this should have been considered one of the variables that alternate with another variable. Considering the absence of an interactive influence, I retain both for further detailed study. Nonetheless, this remains reasonable because the firm with the better prior performance may require more money to invest following an IPO, meaning the size will be bigger. Apart from this, there are no obvious correlations between the various independent variables and control variables or the correlation coefficients are less than 0.5. IPO underpricing is significantly correlated with firm age, issue size, year of IPO, prior performance, functional heterogeneity and age heterogeneity.

Some variables show a relatively bigger coefficient, which is close to ± 0.5. The reason for a significant negative correlation with a coefficient of 0.46 between IPO underpricing and year of IPO can be attributed to my definition of "Year of IPO", with the year of 2009 to 2012 defined as 1, 2, 3 or 4. At the end of October 2009, the GEM officially began its operations; this drew the capital markets' attention, and investors showed great interest and enthusiasm for investment on this new platform. With a large influx of funds into the GEM in 2009, shares in IPO firms show a high level of underpricing. Also in 2009, to stimulate economic growth, the Chinese government adopted a series of economic policies that resulted in increased IPO underpricing on the GEM. Following 2009, the GEM became more mature and investors gradually returned to rationality, so the level of underpricing is lower than that in 2009. The significant positive correlation between firm size and issue size is 0.449. This is because the larger the firm size, the more money it raised in an IPO, therefore, the larger the issue size. There was a significant correlation between functional heterogeneity and educational heterogeneity, which may be a result of the relationship between education and occupational choices.

Table IV shows that IPO underpricing is used as a dependent variable, whereas board size, firm size, firm age, issue size, year of IPO, prior performance, underwriter reputation

Year	*N*	Minimum	Maximum	Mean	SD	Variance
2009	36	0.33	2.1	0.93	0.41	0.165
2010	117	−0.1	1.52	0.38	0.3	0.087
2011	128	−0.17	2.1	0.23	0.32	0.099
2012	74	−0.17	0.94	0.21	0.27	0.073

Table II.
Descriptive statistics

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1 IPO underpricing	1	−0.109*	−0.031	−119*	−0.098	−0.024	−0.068	−0.118*	−0.172**	−0.460**	−0.143**	−0.063	−0.039
2 Functional heterogeneity		1	.341**	0.098	−0.031	0.049	0.08	0.011	−0.03	0.079	0.015	0.069	0.073
3 Educational heterogeneity			1	0.017	0.049	0.074	0.084	0.143**	−0.032	−0.196**	0.126*	0.029	0.034
4 Age heterogeneity				1	0.004	0	0.088	0.058	0.05	0.022	0.031	0.015	−0.047
5 Heterogeneity in tenure					1	−0.003	−0.101	0.179**	−0.088	−0.124*	−0.071	−0.056	−0.089
6 Board size						1	0.165**	0.137**	0.172**	−0.110*	0.191**	0.023	−0.146**
7 firm size							1	−0.015	0.449**	−0.024	0.442**	0.026	−0.166**
8 Firm Age								1	−0.064	0.118*	−0.053	−0.015	−0.082
9 Issue size									1	−0.198**	0.578**	0.112*	−0.091
10 Year of IPO										1	0.189**	−0.061	0.1
11 Prior performance											1	0.018	−0.094
12 Underwriter reputation												1	0.026
13 Industry													1

Notes: *** correlation is significant at the 0.001 level (two-tailed); **, correlation is significant at the 0.01 level (two-tailed); *, correlation is significant at the 0.05 level (two-tailed); +. correlation is significant at the 0.1 level (two-tailed)

Table III.
Correlative coefficient of IPO underpricing with independent variables and control variables

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	1.122***	1.290***	1.184***	1.209***	1.217***
Board size	−0.013	−0.012	−0.013	−0.014	−0.014
Firm size	0.001	0.002	0.002	0.002	0.002
Firm Age	−0.006	−0.006	−0.007	−0.006	−0.006
Issue size	−0.003***	−0.004***	−0.003***	−0.003***	−0.003***
Year of IPO	−0.235***	−0.232***	−0.237***	−0.236***	−0.233***
Prior performance	0.001**	0.001**	0.001**	0.001**	0.001**
Underwriter reputation	−0.043	−0.039	−0.040	−0.040	−0.041
Industry	−0.006	0.000	−0.003	−0.005	−0.009
Functional heterogeneity		−0.274	−0.387*	−0.355*	−0.361*
Educational heterogeneity			0.342*	0.333****	0.339*
Age heterogeneity				−0.058****	−0.058****
Tenure heterogeneity					−0.080
R^2	0.317	0.322	0.329	0.336	0.338
F	20.027***	18.187***	16.902***	15.790***	14.566***

Notes: ****$p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table IV. Regression examination with IPO underpricing as the dependent variable

and industry are used as control variables, with functional heterogeneity, educational heterogeneity, age heterogeneity and heterogeneity in tenure being used as independent variables to test *H1, H2, H3* and *H4*.

In Model 1, only control variables are inputted, and the result of analysis is that issue size, year of IPO and prior performance are significantly correlated with IPO underpricing. However, the significant correlation between IPO underpricing and year of IPO can be explained by either investor enthusiasm or rationality.

In Model 2, functional heterogeneity is shown, with the result indicating no significant correlation with IPO underpricing; therefore, *H1* is left unverified.

In Model 3, the educational heterogeneity variable is added. This is significantly correlated with IPO underpricing, and the regression coefficient is 0.342 with $p < 0.05$. *H2* is therefore verified. Concurrently, functional heterogeneity is also significantly correlated with IPO underpricing, and the regression coefficient is 0.387 with $p < 0.05$. *H1* is therefore verified. This result is surprising compared to Model 2; however, when I consider the significant positive correlation with a coefficient of 0.341 between functional heterogeneity and educational heterogeneity, I find that educational heterogeneity plays a more important role because educational background generally leads to performing a related job function.

In Model 4, the age heterogeneity variable is added and the regression coefficient is 0.058 with $p < 0.1$. *H3* is therefore verified, with the R^2 increasing and an enhanced explanatory function.

In Model 5, the heterogeneity in tenure variable is added, and there is no significant correlation with IPO underpricing. *H4* is therefore not verified, whereas *H1, H2, H3* are all verified.

Meanwhile, the highest statistical value of the variance inflation factor in contributive statistics of the above models is 1.952, far below 10, which indicates that the problem of multicollinearity does not exist between the variables and variables.

Robustness test considering that IPO performance is also affected by the stock market environment, I use the alternative model to re-examine the relationship between the background heterogeneity of the directors and the IPO performance and replace the original explanatory variables with the price fluctuation of the listed companies after the index adjustment. The heterogeneity of functional heterogeneity was decreased, and the tenure

heterogeneity remained no significant explanatory power. I further validate the sub-samples of companies in different industries and find that the empirical results are still robust.

Discussion

Using hierarchical regression analysis, I identified a negative correlation between functional heterogeneity and IPO underpricing; this result supports my hypothesis. This also supports the following views: first, most entrepreneurial firms listed on the GEM that I studied are in a rapid development stage of their corporate life cycles. Their rapid growth and changing market conditions requires them to have effective decision-making capacities, technical level response capabilities and the ability to judge the development of their market sectors accurately. At the same time, the internal governance structures of these entrepreneurial firms are relatively simple. The directors of a firm fundamentally belong to the same body of interest, with most of the directors' attention focusing on their firm's rapid development. Lower functional heterogeneity means more homogeneous professional backgrounds, which will reduce communication barriers between directors, helping them to make decisions efficiently and rapidly, also with a high quality. Less functional heterogeneity gives a positive signal to potential investors as to the firm's quality, which induces them to give a higher valuation to the firm; this results in a higher level of IPO underpricing.

Regression analysis also shows a positive correlation between educational heterogeneity and IPO underpricing. My hypothesis has been verified, suggesting that educational heterogeneity sends a positive signal to potential investors. I believe that diversity of educational backgrounds can increase the cognitive potential of Board members and widen their perspective. Therefore, high educational heterogeneity is beneficial for decision-making and, consequently, affects the firm's performance. Higher educational heterogeneity may send a positive signal to potential investors resulting in higher underpricing on the IPO market.

Age heterogeneity and IPO underpricing have a significant negative correlation at the level of $p < 0.1$. My hypothesis has therefore been verified. Age heterogeneity may make communication and collaboration more difficult between directors, even leading to more conflicts and damaging team cohesion; this affects the firm's performance. On the IPO market, investors take the view that a broader perspective and other positive features brought by age heterogeneity may not cover the negative effects of communication and collaboration barriers resulting from age differences. Therefore, age heterogeneity, as a signal of the firm's real value to investors, affects the firm's IPO underpricing.

The hypothesis regarding heterogeneity in tenure is not supported in my empirical model. The main reasons for this are the fact that in the sample I studied, the firms' average age was about 10 years; this is a relatively short time to study tenure differences among directors, especially with entrepreneurial firms just listed on the GEM. In preparation for an IPO, Board members may make major adjustments to comply with the listing rules. On this basis, heterogeneity in tenure would not be regarded as a signal to potential investors that would influence their judgment of the firm's value and, therefore, does not affect the IPO underpricing.

Two control variables have been identified as significantly negative correlated with IPO underpricing. These are issue size and year of IPO. The negative correlation between issue size and IPO underpricing shows that a larger issue size entails a greater number of shares in the IPO. When the shares are listed on the securities market, under circumstances of fixed demand, IPO underpricing is smaller. The negative correlation between the year of IPO and IPO underpricing is accounted for by a complex collection of factors. First, in terms of the macro-economy, the economic situation tends to fluctuate cyclically over time; this spreads

to the stock market and is reflected through the stock market index, affecting stock prices and the level of IPO underpricing. When the enthusiasm of investors is high, the impact of the IPO underpricing is higher. When the economy slows, the investment enthusiasm and IPO underpricing will return to a more rational mode of operations. In 2009, in response to world financial crisis in 2008, the Chinese government declared a series of economic stimulus policies that included the introduction of RMB4tn of investment. This led to a lot of cash entering the stock market, meaning that IPO underpricing was larger. After 2009, as the economy returned to normal levels, IPO underpricing also became more moderate. Meanwhile, the GEM was new in 2009. Investors generally believed that regulatory authorities would ensure the quality of IPO firms in the early stages of GEM; this will also affect investor judgments about the value of IPO firms in other years.

One control variable is shown to have significant positive correlations with IPO underpricing, namely, prior performance. The positive correlation between prior performance and IPO underpricing suggests that investors recognize a firm's potential future performance based on its prior performance, taking the view that a better prior performance indicates a higher-quality investment. The quality of the relevant signal is therefore magnified differently in the markets for issues and day-to-day trading. Poor prior performances also deliver a signal that a firm with lower quality would have a lower level of underpricing.

Conclusions

In this paper, I used descriptive statistics, correlation analysis and hierarchical regression analysis to investigate whether the Boardroom heterogeneity affects IPO underpricing for entrepreneurial firms based on collecting data from 355 firms listed on China's Growth Enterprise market from its start in 2009 to 2012, where Boardroom heterogeneity was classified in terms of functional background, educational background, age and length of tenure.

According to the empirical results of this study, I have found that Board heterogeneity affects IPO underpricing of entrepreneurial firms. The results of this research demonstrate that the effect of signaling on IPO underpricing is partially verified. From the perspective of IPO firms, functional, educational and age heterogeneity conveys signals to potential investors regarding a firm's quality.

So in theoretical implications, this paper determines that the Boardroom heterogeneity affects IPO underpricing, which integrated the board research and firm valuation as a theoretical contribution. In practical implications, this paper suggests that IPO firms may make use of such an influencing mechanism to set the issue price or to control the IPO underpricing by showing the Boardroom heterogeneity.

However, there are limitations in this study. The first, this conclusion is that GEM is still an emerging market; only 355 entrepreneurial firms went public on GEM in 4 years. Because the significant amount of preparation involved in launching on GEM, entrepreneurial firms that went public in 2009 achieved considerable attention from investors, so they experienced high levels of underpricing, which may result in biases in the results. The second limitation is that the R^2 is still small in the above models, which show levels at less than 0.4. Therefore, by only utilizing signaling my models are insufficient to explain the full reality of IPO underpricing given the complexity of this economic phenomenon.

The firms studied were entrepreneurial firms that undertook IPOs on the GEM; they possess relatively simple internal structures but face a more complicated external environment. They generally develop very fast and may be different from IPO firms in equivalent stock markets in other countries. In the future, scholars may pay greater

attention to international comparisons between IPOs in the GEM and equivalent markets overseas.

For entrepreneurial firms, the impact of Board heterogeneity should not be restricted merely to IPO underpricing. Future studies could focus on the implications for IPO investment, long-term performance and sustaining value resulting from Board heterogeneity. This will reveal the deeper levels of significance of Board heterogeneity on corporate governance standards.

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