POSITIVE AND NEGATIVE SYNERGIES BETWEEN THE CEO'S AND THE CORPORATE BOARD'S HUMAN AND SOCIAL CAPITAL: A STUDY OF BIO-TECHNOLOGY FIRMS

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Abstract

This paper contributes to the corporate governance literature by developing and testing theory regarding positive and negative synergies between the CEO's and the board's human and social capital. Using a sample of 360 biotechnology firms that went public between 1995 and 2010, we demonstrate that *accumulated* public company board experiences of the CEO and the board have positive synergistic effects on IPO performance whereas the *current* board appointments have negative effects. While scientific educational backgrounds have positive synergies, industry-specific experiences produce either positive or counter-productive effects depending on the age and profitability of the firm. Thus, our paper contributes to the corporate governance and human and social capital literatures by describing the *costs and benefits* of specific *types and combinations* of CEO and board capital.

Key words: Board of directors, corporate governance, initial public offering, human and social capital, bio-technology.

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Research on corporate boards has provided evidence that board members' human and social capital are indeed linked to board governance effectiveness (e.g., Arthurs *et al*., 2008; Carpenter and Westphal, 2001; Hillman and Dalziel, 2003; McDonald, Westphal, and Graebner, 2008). Human capital refers to directors' knowledge, abilities, and experiences acquired in various firms, boards and industry contexts (Becker, 1975; Sturman, Walsh, and Cheramie, 2008; Westphal and Fredrickson, 2001). Social capital refers to directors' ability to access resources through social linkages in various contexts (Burt, 1992). In particular, knowledge and information that can be gained through these linkages play an important role in the development of human and intellectual capital (Coleman, 1988; Nahapiet and Ghoshal, 1998).

Similarly, studies have demonstrated that the human and social capital of the CEO as a pivotal executive of the firm has positive impacts (e.g., Davidsson and Honig, 2003; Harris and Helfat, 1997). However, we have limited theoretical understanding and empirical knowledge about the performance and governance consequences of the *interactions* between the human and social capital of the board *and* that of the CEO's (Harris and Helfat, 2007). Extant research on the CEO-board relation mostly takes a control perspective with a focus on the power dynamics between the CEO and the board while giving limited attention to the advice and collaborative elements of this relationship (Hillman and Dalziel, 2003; Sundaramurthy and Lewis, 2003; Westphal, 1999). However, in order for the board to fulfill its monitoring and resource-provision roles, it is imperative that the CEO and the board have a constructive relationship and function in a context in which their respective expertise, opinions and networks are fully leveraged (McDonald, Khanna, and Westphal, 2008). In this respect, the interaction between the human and social capital of the CEO, a key executive of the top management team, and the board is relevant. In this domain, a number of critical questions remain unanswered. For example, does

the board's human and social capital always supplement and strengthen the CEO's human and social capital? Does a particular type of human and social capital have the same effect when possessed by the CEO versus the board? Is more of a specific form of capital always better as the CEO and the board accumulate this capital? Are there costs associated with the accumulation of specific forms of human and social capital similar to the idea that there are costs associated with governance mechanisms (Zajac and Westphal, 1994)? Responses to these issues can yield deep insights on board functioning and firm competitiveness.

To address these research questions, we submit that it is imperative to (1) *concurrently* examine the value added of *both* the board's and the CEO's bundles of experience and expertise and (2) capture the interactive effects of these human and social capital bundles to understand the costs and benefits of specific capital bases. Without the knowledge of these interactions, our theories of effective board governance and design are incomplete. Thus, rather than examining only the board's *or* the CEO's human and social capital, we study *human and social capital combinations* in the initial public offering context. Board capital is a powerful signaling mechanism that conveys the ability of the board to monitor and help the firm navigate the publicly traded arena (Chen, Hambrick, and Pollock, 2008; Certo, 2003).

By examining the interactions between specific human capital bases of the board and the CEO, our study provides key new insights on board governance effectiveness. It highlights the *balance of human and social capital sourcing,* and is one of the first studies to call attention to the *positive* and *negative synergies* between the human and social capital of the CEO and the board. We underscore the interplay between the human and social capital of the firm's key executive (the CEO) and that of the internal monitoring group (the board) in impacting critical

organizational outcomes. Further, in addition to uncovering *the benefits*, our study uncovers the *costs* of certain *types and combinations* of human and social capital.

HUMAN AND SOCIAL CAPITAL AND THE CORPORATE BOARD OF DIRECTORS

Human capital pertains to innate and learned abilities, and expertise and knowledge gained through education, training, and on-the-job experience (Becker, 1975). Human capital theorists use economic logic to study productivity-enhancing investments such as education, training and firm-specific knowledge acquisitions and the payoff from such investments (Becker, 1975; Gimeno *et al*., 1997). Individuals with more or higher quality human capital achieve higher performance and they provide firms with a competitive advantage (Hitt *et al*., 2001). Castanias and Helfat (1991; 1992) build on Becker's work and offer a managerial rents model indicating that managers through their education and experiences develop *a hierarchy of skills*: general skills that apply across industries; industry-specific skills that are transferable across firms in an industry; and firm-specific skills which entail a deep understanding of the dynamics of a particular firm's unique culture, strengths, vulnerabilities and tacit knowledge associated with the firm's social context.

Social capital refers to the resources that one is able to access through social relations and networks, which form the basis for action (Adler and Kwon, 2002). Of particular note is the access to information channels which is critical for the development of human and intellectual capital (Coleman, 1988; Nahapiet and Ghoshal, 1998). The source and the nature of social relations influence the types of information and advice that flow to specific networks and individuals, and this knowledge flow shapes the type of human capital that is developed and mobilized for action (Adler and Kwon, 2002; Fischer and Pollock, 2004). For example,

relationships within the organization provide firm-specific knowledge and resources; whereas, ties within the industry provide knowledge of industry conditions and resources, thereby contributing to the hierarchy of skills articulated by Castanias and Helfat (1991).

Within the management literature, the concept of human and social capital has been applied to both individual and group-level phenomena. At the individual level, scholars have looked at the CEO's human capital (firm-specific and industry-specific capital) and the rate of post-acquisition CEO departure (Buchholtz, Ribbens, and Houle, 2003), firm performance following an external succession and the successor's pay (Bailey and Helfat, 2003; Harris and Helfat, 1997), and multinational firms' performance and CEO pay (Carpenter, Sanders, and Gregersen, 2001). Studies found a link between an entrepreneur's human and social capital and the entry into nascent entrepreneurship activities (Davidsson and Honig, 2003), venture success (Haber and Reichel, 2007; Jain, Jayaraman, and Kini, 2008) and entrepreneurial exit (Gimeno, Folta, Cooper, and Woo, 1997).

More recently, studies have also drawn distinctions between the general and specific competencies of the group (Dimov and Shepherd, 2005; Hitt *et al.*, 2001; Kor and Mesko, 2013). The collective human and social capital of corporate board members, also referred as board capital and seen as a proxy for the ability of the board to govern the corporation, is associated with firm performance (Hillman and Dalziel, 2003) and shown to be significant in the board's ability to monitor and to advise top management teams (e.g., Arthurs *et al*., 2008; Kor and Sundaramurthy, 2009; Kroll, Walters, and Le, 2007). Specific board capital in the form of context-based expertise and experience also enables directors to monitor and give advice more effectively (Carpenter and Westphal, 2001). However, potential positive and negative synergies between the human and social capital bases of the CEO and the board remain under-explored.

THE CORPORATE BOARD OF DIRECTORS, THE IPO CONTEXT AND UNDERPRICING

The interaction between the individual and collective human and social capital can be critical for board functioning particularly in the initial public offering (IPO) context which is a significant transition point in the life of a firm. An IPO moves the firm from the private arena to the public market creating multiple, novel demands on the firm. The firm has to comply with regulations of the Securities and Exchange Commission including issuing financial statements and disclosing detailed information in the prospectus (Fischer and Pollock, 2004; Kroll *et al*., 2007). In meeting new expectations from regulatory authorities and the financial community, the firm deals with increased complexity and uncertainty. The IPO firm has to make critical resource allocation decisions with the money raised, adjust its time horizons to match that of the new investors, and develop new growth strategies that can change its boundaries and take the firm to less familiar terrains (Filatotchev and Bishop, 2002; Fischer and Pollock, 2004).

Gearing up for the IPO, a firm faces pressure to establish and signal its ability to cope with the new demands of financial and competitive markets. This pressure partly builds up because of the information asymmetry between current (pre-IPO) owners of the firm and the potential (post-IPO) investors, wherein potential investors have much less knowledge about the value and future prospects of the company (Cohen and Dean, 2005; Leland and Pyle, 1977). Hence, in order to effectively raise financial capital, a key reason for going public (Deeds, DeCarolis, and Coombs, 1997), the IPO firm makes structural changes to enhance its ability to succeed in the *public* domain and signals to the market its capability to meet the new demands (Carter and Manaster, 1990; Certo, 2003).

To convince the capital markets and investors about its long-term prospects, an IPO firm makes compositional changes in its boards of directors, because the board's human and social

capital provides the firm with the critical knowledge and network access needed to succeed in the public market (Hillman and Dalziel, 2003). Board capital is also an important indicator of prestige (D'Aveni, 1990) and the market's reactions to firms' decisions depend on directors' characteristics (Sundarmurthy, Mahoney, and Mahoney, 1997). Thus, compositional changes to the board can be credible signals of the firm's capabilities to navigate the public market (Certo, *et al*., 2001, Nelson, 2003). In addition, strong team collaboration between the board and the CEO is needed for the firm to handle the significant competitive, product market, and regulatory challenges posed by the IPO event (Jain *et al*., 2008). An IPO is a transition stage in the life of the firm when both the individual and the collective human and social capital are equally significant in reducing information asymmetry and accurately signaling the future of the firm. Further, because information regarding the CEO's and board's human and social capital profiles is included in the prospectus, these profiles constitute an effective signal and impact the ability of the firm to effectively raise capital in the public market through reduced underpricing in the first day of trading (Daily, *et al*., 2005).

Underpricing occurs as the stock price goes up during the first day of trading, creating a gap between the offer price and first day closing stock price (Ritter, 1991). A small gap reflects superior ability of the firm to raise capital, because it means that the offer price closely reflects the market value of the firm's stock, which is assessed on the first day of trade (Filatotchev and Bishop, 2002). A small gap indicates that the firm captures more of the value created, rather than it being appropriated by buyers who purchase stock at the offer price and later sell it at a premium (Certo *et al*., 2001; Ritter and Welch, 2002). The IPO firm prefers an offer price that is closer in value to the market price (a smaller discount) because this affects the amount of capital that will be raised in the IPO—capital which is a key source of funding for pursuing growth

opportunities (Ritter, 1991; Daily, Certo and Dalton, 2005). Thus, managers must find ways of communicating the firm's capabilities and its future value so that the ex-ante level of uncertainty about the firm is reduced (Daily, Certo, Dalton and Roengpitya, 2003; Deeds *et al*., 1997). With effective signaling, the need to discount the stock price to attract new investors is mitigated. Thus, reduced underpricing is viewed positively; it is a performance indicator and a metric of the IPO firm's success as it reflects the firm's ability to effectively raise capital (Arthurs *et al*., 2008; Higgins and Gulati, 2006; Megginson and Weiss, 1991; Loughran and Ritter, 1995).

In our study, we examine the combinative value of human and social capital variables of the CEO and the board in serving as an effective signal and enhancing the ability of the entrepreneurs and original investors to extract more of the market value of the firm by reducing underpricing. More specifically, we develop theory about the interactive effects of the CEO's and the board's human and social capital on IPO underpricing in the bio-tech industry, an industry in which such capital can be significant from investors' standpoint (Pukthuanthong 2006). We focus on two key forms of human and social capital: The CEO's and directors' expertise in serving on the boards of publically traded firms and their industry-specific expertise (via science-based education and managerial industry experience). Experience on public company boards is critical for an IPO firm entering the public equity market as directors bring with them the knowledge of management and governance of firms in the public domain (Certo *et al*., 2001; Fischer and Pollock, 2004; Nelson, 2003). Industry-specific expertise is also particularly significant in knowledge-intensive industries where tacit understanding of the emerging technologies is central to astute investment decisions and competitive positioning (e.g., Barker and Mueller, 2001; Hitt and Tyler, 1991; Tyler and Steensma, 1998). Previous studies have examined the effects of these experiences at the CEO or board level (e.g., Barker and

Mueller, 2001; Carpenter and Westphal, 2001); however, no other study has investigated the impact of these forms of human capital *concurrently* for both the CEO and the board.

IPO-context Specific Human and Social Capital: Expertise on Public Company Boards

Directors with experience on the boards of public companies are a key addition to the IPO firm board because their public board expertise and network access are instrumental when a firm lacks organizational knowledge and institutional processes of how to operate in the public domain (Arthurs *et al*., 2008). Board members who have *accumulated* experience on public company boards are particularly attuned to the needs of the public equity market, and thus will be able to shift the firm's approach accordingly. Their exposure to the unique problems of the public equity context provides them with the ability to spot and respond quickly to governance challenges that arise as the firm develops its history in the market (Nelson, 2003). These members can also draw on their wide network of public company board members to obtain novel information and solve problems in an effective and efficient manner (Geletkanycz and Hambrick, 1997; Kor and Sundaramurthy, 2009). Based on their accumulated experience on public company boards, they can provide keen insights on managing the image of the firm in the eyes of potential investors. Thus, their addition to an IPO firm's board will serve as a credible signal of the firm's ability to procure resources and compete in the public domain (Chen *et al*., 2008; D'Aveni, 1990; Zimmerman and Zeitz, 2002).

However, how does the *CEO's expertise* on the functioning of boards of public companies matter with respect to the impact of this aspect of the board capital? Would the CEO's experience on the boards of public companies make board members' expertise less or more valuable? Would the signaling effect become stronger or weaker?

We theorize that board members' experience on public company boards will be more impactful if it is coupled with the CEO's experience on public company boards. Accumulated experience on corporate boards will enable the CEO to be cognizant of the challenges of managing a public company and therefore be more open to advise-seeking. This shared understanding will serve as a common ground for communication, which is likely to engender collective mental models, language, and narratives associated with governing and navigating the firm in the public equity context (Carter and Lorsch, 2004). It will also encourage the CEO to welcome questioning, feel more comfortable in seeking the board's input, and be more receptive to the board's advice even if the feedback is somewhat critical (Westphal, 1999). Put differently, experience gained serving on public company boards will sensitize the CEO to the value of the board's perspective given that the CEO has played this governance role in a different firm. This alternate role will enable the CEO to see things not just from the management's perspective, but also from a governance perspective, fostering convergent expectations and allegiances (Harris and Helfat, 2007). The CEO will also be more cognizant of problems that arise when corporate management is not open or transparent in communicating with the board, and this awareness will stimulate a two-way flow of information. Individuals with multiple roles tend to have response flexibility; they can see an issue from multiple points of view and show tolerance for differing opinions (Hillman, Nicholson, and Shropshire, 2008).

When there are convergent expectations, there is greater likelihood of achieving mutual trust between the CEO and the board and reduced need for impression management and ingratiation tactics by management (Forbes and Milliken, 1999; Westphal, 1998). When the CEO is more receptive of scrutiny and board involvement in strategy development, the board can develop a more positive attitude and respect for the CEO's abilities. This mutual respect for each

other's expertise can foster debate and discussions and enhance the cooperation within the board in a healthy way (Forbes and Milliken, 1999). Premised on trust in competencies and judgment, this synergistic team climate can enable the firm to tackle IPO transition challenges without the CEO or the board resorting to counter-productive defenses which can otherwise result in dysfunctional governance cycles (Sundaramurthy and Lewis, 2003). Thus, CEO's public company board service is likely to enhance the contribution of board members' accumulated public board experience, resulting in reducing underpricing and enhanced success of the IPO.[1]

*Hypothesis 1: The higher the **accumulated** (past) experience of the CEO in serving on public company boards, the stronger the effect of the **accumulated** (past) public company board experience of the directors in **reducing** IPO underpricing.*

IPO-context Specific Human and Social Capital: Multiple Public Company Board Appointments

While accumulated experience on the boards of public companies can be a significant asset, serving on multiple boards simultaneously can pose significant costs. Board commitments *within a particular time frame* have time costs associated with the development of this human and social capital (Oh, Labianca, and Chung, 2006). Specifically, board membership in public companies involves significant time commitments in terms of attending several board meetings each year, preparing for the meetings, and chairing one or more board sub-committees (Carter and Lorsch, 2004; Rindova, 1999). Due to the significance of the strategic and governance issues facing public companies, the quality of the directors' contribution hinges on their thorough preparation and regular attendance of board meetings (McNulty and Pettigrew, 1999). These

[1] There may be reduced benefits from increased CEO's directorships when board members have extensive past board experience (i.e., substitution effects). However, we argue that positive interaction effect is stronger in light of prior research that indicates that board involvement in strategy often takes the form of CEO-solicited advice and counsel from the board rather than independent board control (e.g., Westphal, 1999). A CEO's past external board experience will promote more advise-seeking from the board given the CEO's awareness of the challenges of governing public companies and the need for such counsel. Therefore, we posit a positive synergistic effect. We thank the Editor and a reviewer of this paper for alerting us to this line of thought.

meetings tend to be packed with tasks and assignments to be completed in a time-sensitive manner; thus, board members' full attention and engagement in any given board meeting is critical (Tuggle, Schnatterly, and Johnson, 2010). Given the high prestige of serving on corporate boards, directors may accept more board invitations than they can handle (Useem, 1982). These directors can under-deliver as extensive commitments take a toll on their limited time and attention (Carpenter and Westphal, 2001; Finkelstein and Mooney, 2003). When over-commitment is a problem affecting multiple directors, the firm is likely to suffer from lack of proper advising and governance (Baysinger and Hoskisson, 1990; Conger *et al*., 2001). Concerns about the board's ability to function effectively during critical junctures such as an IPO have risen in recent years. Because the cost of distraction can be particularly high in such critical transitions, external constituents are increasingly concerned about over-committed directors (Jiraporn, Davidson, DaDalt, and Ning, 2009).

This notion invites a new set of questions. If the over extension of the board via board membership in multiple firms can have negative effects, what would be the consequences of *coupling that with an overcommitted CEO*? Would it increase the negative effects?

We argue that the problem of over-extended directors will be further exacerbated if the CEO also has multiple public company board appointments. CEO's distraction from the core activities and business can directly hurt the firm especially at the IPO stage when the firm goes through a major undertaking and transition. While the infusion of capital allows expansion of the firm's activities, significant level of uncertainty remains about the future success of the firm. The intensity of the transition experience and the increased competitive threat in the public domain require undisturbed attention of the CEO to the firm's affairs. Benefits from expertise on public company boards may not materialize if the CEO's focus on the firm is compromised.

Thus, a toxic combination is likely to occur when a distracted CEO works with a distracted board, both associated with multiple public company board memberships. In this combination, the board is likely to provide weak monitoring and advising services. When the board fails to show due diligence in governance including advisory and resource provision functions, the CEO will have diminished trust in the board's ability and effort. Likewise, observing a distracted CEO, the board would also have increasingly less confidence in the ability of the CEO to lead the firm through the transition into a different league of firms. Hence, this combination can result in an environment of fragile trust of each other's competence and commitment, damper communication and flow of information between the CEO and the board, and erode collaboration that is critical for the board's ability to harness the human capital of its members (Forbes and Milliken, 1999). This context presents a ripe situation for counter-productive defenses such as blaming each other in response to even minor set-backs, which in turn can result in problems not being addressed, further fueling dysfunctional governance cycles (Sundaramurthy and Lewis, 2003). Therefore, when the CEO and board members are over extended, there will be expectations of compromised board functioning, which will elevate the concerns and uncertainty about the IPO firm, resulting in increased underpricing of the IPO.

Hypothesis 2: The higher the level of CEO's ***current*** *memberships on public company boards, the stronger the effect of the board's* ***current*** *memberships on public company boards in* ***increasing*** *IPO underpricing.*

Scientific Educational Background and IPO Underpricing

The knowledge and ability to critically assess and understand the evolving industry conditions is particularly important in industries with a scientific and technical base, such as the pharmaceutical, bio-technology, and medical device industries (Castanias and Helfat, 2001; Cooper *et al*., 1994; Pukthuanthong, 2006; Gimeno *et al*., 1997). In these environments,

directors' *scientific* educational background can sharpen their ability to effectively identify and evaluate the technology-based opportunities and threats in the industry (Barker and Mueller, 2001). Scientific education provides a *strong foundation* to individuals' technology-based absorptive capacity through which individuals can more intuitively comprehend the industry's product and process technologies and assess the prospects of competing technology paths (Cohen and Levinthal, 1990; Tyler and Steensma, 1998). Directors with this absorptive capacity are equipped with scientific language skills and knowhow to question and evaluate technology proposals more competently than directors without scientific background (Hitt and Tyler, 1991; Finkelstein, Hambrick, and Cannella, 2009). Thus, a scientific understanding embedded in the board is likely to enable the IPO firm to better harness the external technological advancements and engage in strategic entrepreneurship (Ireland *et al*., 2003).

However, what would be the effect if both the CEO and the board have scientific educational backgrounds? Would the CEO's scientific educational background make board members' scientific education more valuable? Would the signaling effect become stronger or weaker? Extant research indicates that CEOs with a science-based education have a more complete understanding of technology innovation, and show a higher commitment to R&D investments (Barker and Mueller, 2001; Tyler and Steensma, 1998). However, the effects of a common science background of the CEO and board directors are unexamined.

We submit that there will be synergistic effects when both the CEO and a significant number of board members have a scientific background. A common scientific background is conducive for collaborative action because the CEO and the board will both have the science-based absorptive capacity for framing and tackling technology issues, such as deciding among competing trajectories and positioning the firm in the evolving technology space (Cohen and

Levinthal, 1990). With a common scientific lexicon and approach, the CEO and the board can more skillfully understand, appreciate, and welcome ideas from one another (Barker and Mueller, 2001). Shared language can also enhance the CEO and the board's ability to communicate and combine non-overlapping knowledge and insights (Grant, 1996).[2] Thus, *the knowledge exchange benefits* of common scientific-oriented educational background can foster productive collaboration between the CEO and the board, enabling the IPO firms to more effectively transition into the public domain and achieve reduced underpricing, enhancing the success of the IPO.

Hypothesis 3: After controlling for main effects, the interaction of the CEO's and the board's scientific educational background will reduce IPO underpricing. That is, when the CEO has a scientific educational background, the effect of the board's scientific educational background will be stronger in ***reducing*** *IPO underpricing.*

Industry-specific Human and Social Capital and IPO Underpricing

Experienced-based knowledge of the industry dynamics and connections to key industry players such as suppliers, distributors, and customers can be critical assets for a firm seeking resources and legitimacy (Cooper *et al*., 1994; Gimeno *et al*., 1997; Hitt and Ireland, 2002). Appointing directors with industry expertise can be a way in which the firm can boost its industry knowledge and signal strong credibility (Certo, 2003; Zimmerman and Zeitz, 2002). Industry-specific expertise also enables the board to critically influence and evaluate the options and strategies of the CEO (Carter and Lorsch, 2004; Kroll *et al*., 2007). Thus, industry-specific board capital can add vital value both from resource and monitoring standpoints.

[2] There may be reduced benefits received from scientific educational background when it is replicated both in the board and the CEO. However, this commonality provides an *additional knowledge exchange benefit* in the form of superior communication, collaboration and more efficient co-utilization and co-deployment of the CEO's and the board's overall human and social capital. Thus, the net interactive effect of this common background will be a **further reduction** in IPO underpricing even after controlling for the main effects.

However, how does the CEO's industry expertise factor into this resource provision and signaling effect of directors? Would the board's signaling effect become stronger or weaker when it collaborates with an industry-expert CEO? Does the firm incur costs if both the CEO and the board have industry-specific human and social capital?

We posit that when both the CEO and the board have extensive industry-specific expertise, this combination can have either synergistic or counter-productive effects depending on the specific contingency. The *IPO firm's age* and its *financial performance (i.e., profitability) at the time of the IPO* are likely to be particularly important contingencies, because they reflect the IPO firm's *exposure to the liability of newness* and thus vulnerability to market speculations about its future prospects. Liability of newness occurs when young firms lack resources, slack, and the legitimacy of older firms, and thus, struggle to develop business relationships with suppliers and customers (Stinchcombe, 1965; Zald, 1969). These firms operate at a disadvantage in acquiring the essential resources from external environment and in securing strategic partnerships in the industry (Morse, Fowler, and Lawrence, 2007). Similarly, firms that exhibit weaker performance at the time of the IPO relative to their peers are likely to be met by suspicion and receive additional scrutiny from investors and the stock market. These firms exhibit elevated uncertainty concerning their financial viability. Vulnerable to market speculations about their future prospects, they have a diminished ability to effectively raise capital in financial markets (Certo *et al*., 2001; Megginson and Weiss, 1991).

In firms with these vulnerabilities, legitimacy and the capacity to operate as a public company can be signaled through both the firm's industry-expert board directors and the CEO who has extensive industry-specific experience (Certo, 2003; Goodstein and Boeker, 1991). Experiential knowledge of the industry dynamics and access to industry networks are vitally

needed resources for younger firms and for those that haven't yet achieved strong profitability (Filatotchev and Bishop, 2002; Kor and Misangyi, 2008). In the case of experienced directors, their willingness to serve on the board of an IPO firm is a strong signal of the quality of the firm and its future prospects. Similarly, an industry-expert CEO offers credibility and assures investors that the chief navigator of the firm's strategy is grounded in industry knowledge and networks. Because the CEO and the board play complementary, yet distinct roles in firm's management and governance (Carter and Lorsch, 2004), having both with industry expertise can provide synergistic benefits. Common knowledge-base and industry orientation also enhances their ability to acquire and integrate non-overlapping knowledge (Grant, 1996; Zahra and George, 2002). Thus, a concentration of industry-specific capital in the upper echelons is likely to be highly beneficial for the vulnerable--younger and weak performing--IPO firms.

*Hypothesis 4a: In **younger** IPO firms, the interaction of the CEO's industry-specific experience and the board's industry-specific experience will reduce IPO underpricing. That is, as the CEO's industry experience increases, the effect of the board's industry experience will become stronger in **reducing** IPO underpricing.*

*Hypothesis 5a: The interaction of the CEO's and the board's industry-specific experience will reduce IPO underpricing in firms with relatively **weak performance** at the time of the IPO. That is, as the CEO's industry experience increases, the effect of the board's industry experience will become stronger in **reducing** IPO underpricing.*

Further, we theorize that concentration of industry experience with both the CEO and the board may result in counter-productive effects (negative synergies) for older and well-performing IPO firms. Unlike their young and weak cousins, the older and highly profitable IPO firms are not as vulnerable to the liability of newness or uncertainty about future prospects (Morse *et al*., 2007). They possess more slack and resources, enjoy established ties to industry players, and have better credibility in the eyes of investors (Certo, 2003). While these firms can

still benefit from industry expertise and information networks, a *concentration* of these resources at both the CEO- and board-levels may prove to be harmful.

Specifically, when both the CEO and the board have extensive industry expertise, there could be *myopic effects* and *costs* associated with this human and social capital. Shared industry knowledge can result in tunnel vision or reinforcement of industry recipes (Spender, 1989). Similar views of industry conditions may contribute to groupthink tendencies (Janis, 1972) and deprive the group of the diversity of ideas and functional task conflict needed for effective governance (Sundaramuthy and Lewis, 2003). While depth of experience in a given industry has its virtues, it can interfere with the flow of new ideas and debates on strategic change which is integral to the IPO context (Haynes and Hillman, 2010). From a social capital perspective, research also indicates that intra-industry ties promote conformity to industry norms whereas inter-industry ties stimulate new thinking and change (Geletkanycz and Hambrick, 1997). At a time when the firm is entering a new phase with multiple demands from various stakeholders, the need for fresh knowledge and networks from other industries is critical in helping the firm navigate the new, more complex environment.

We theorize that the *myopic effects* of shared-industry experience are likely to be accentuated, and outweigh the *knowledge exchange benefits* in firms that are older and stronger in performance at the time of the IPO. Older and better-performing firms are likely to be more prone to complacency, inertia, groupthink and strategic persistence, instead of change and growth (Janis, 1982; Kisvalfi, 2000). For example, Audia, Locke, and Smith (2000) indicate that the top managements of firms with strong performance have considerable confidence in their strategies and high collective self-efficacy. Similarly, firms that have survived a longer period are likely to be more confident in their current strategies and base of knowledge, and thereby rely

more heavily on this knowledge base. Entrenchment in industry norms and practices can be particularly harmful when the firm has established business models and routines that have been successful (Finkelstein *et al*., 2009; Geletkanycz and Black, 2001). This strong conviction coupled with significant ease of knowledge exchange and cohesiveness associated with shared industry experience of the CEO and the board can fuel complacency, overconfidence, and reduced motivation for questioning current industry recipes, thereby providing an ideal basis for dysfunctional cycles of collaboration (Sundaramurthy and Lewis, 2003). Therefore, in these contexts, the *myopic* effects of the interaction between the CEO and board's industry-specific human and social capital are likely to have a detrimental effect on the success of the firm's IPO.

*Hypothesis 4b: In **older** IPO firms, the interaction of the CEO's industry-specific experience and the board's industry-specific experience will increase IPO underpricing. That is, as the CEO's industry experience increases, the effect of the board's industry experience will become stronger in **increasing** IPO underpricing.*

*Hypothesis 5b: The interaction of the CEO's and the board's industry-specific experience will increase IPO underpricing in firms with relatively **strong performance** at the time of the IPO. That is, as the CEO's industry experience increases, the effect of the board's industry experience will become stronger in **increasing** IPO underpricing.*

METHODS

Sample and Variables

Our sample consists of 360 bio-technology IPOs with the following primary SIC industry sector codes: 2833 (medicinal chemicals and botanical products), 2834 (pharmaceutical preparations), 2835 (in vitro and in vivo diagnostic substances), 2836 (biological products, except diagnostic substances), and 8731 (commercial physical and biological research). These IPOs were filed between January 1995 and December 2010. This sample of bio-technology firms was selected from the Securities Data Company's (SDC) New Issues Database and cross-

checked from the updated list on Professor Jay Ritter's website.[3] A total of 452 U.S. based scientifically oriented biotechnology firms went public from 1995 until the end of 2010. Foreign companies were excluded since tax laws may differ, and the data on board variables are difficult to obtain. In addition, as per prior research (i.e., Krigman, Shaw, and Womack, 1999; Ritter, 1991), equity carve-outs, unit offerings, ADRs of companies already listed in their home countries, limited partnerships, reverse LBOs, best effort IPOs, and issues priced at less than $5 were excluded. The final sample consists of 360 bio-technology firms that completed an IPO.

All IPO information including the proceeds, the offer price, the number of IPOs, and biotech sample identification were collected from SEC filings made available through the EDGAR database and from the SDC. Since errors were reported in SDC's data for pre-IPO outstanding shares (Ljungqvist and Wilhelm, 2003), we collected them directly from the prospectus filings. EDGAR makes available IPO prospectuses issued after May 1996; therefore, we requested prospectuses of IPOs issued between January 1995 and May 1996 directly from the firms or collected them from the Disclosure Global Access database.

The dependent variable, *IPO underpricing* is computed as the percentage of the difference between the offer price and the first-day closing price (Ritter, 1991). The lower the difference, the more capital the firm is able to raise through the IPO. Underpricing is widely used as a metric of IPO success and of ability to raise capital effectively (Arthurs *et al*., 2008; Certo *et al*., 2001; Higgins and Gulati, 2006; Megginson and Weiss, 1991).

In terms of our independent variables, we capture expertise in serving on public company boards based on past and current appointments of the CEO and board directors (including non-executive and executive directors, and excluding the CEO). *Directors' cumulative public*

[3] http://bear.cba.ufl.edu/ritter/SDCCOR.PDF

company board experience is measured as the average number of public company boards the directors served on in the past as reported in the prospectus. *CEO's cumulative public board experience* is the number of public company boards the CEO served on in the past. In a similar vein, *directors' current public board experience* is the average number of public company boards the directors *currently* serve on at the time of the IPO. *CEO's current public board experience* is the number of public company boards the CEO serves on at the time of the IPO.

Directors' scientific educational background is measured as the proportion of directors (excluding the CEO) who have a bachelor's or above college degree in science, and the *CEO's scientific educational background* is a dummy variable that takes the value of 1 if the CEO has a bachelor's or above college degree in science. These metrics have been previously used in upper-echelons and human capital literatures (e.g., Barker and Mueller, 2001; Hitt and Tyler, 1991; Tyler and Steensma, 1998).

We capture the CEO and directors' industry-specific human and social capital based on their industry-specific experience. Past professional experiences within an industry context constitute strong indicators of industry-specific human capital (Bailey and Helfat, 2003; Carpenter and Westphal, 2001; Certo, 2003) because these experiences shape the CEO's and board directors' thinking and mental models (Huff, 1982), and allow them to develop specific skills and procedural knowledge about how a specific industry operates (Becker, 1993; Harris and Helfat, 1997; Nahapiet and Ghoshal, 1998). Also, the number of valuable links with key industry players rises with the duration of experience in the focal industry (Eisenhardt and Schoonhoven, 1996). *Directors' years of biotech experience* is measured as the average years of bio-tech experience of board members (excluding CEO). *CEO's years of biotech experience* is measured as the number of years of experience working in the bio-tech industry.

Based on the IPO and board governance literatures, we control for several variables that may influence IPO underpricing. We control for *underwriter rank* as the prestige of underwriters is shown to have an effect on IPO success (Beatty and Ritter, 1986; Megginson and Weiss, 1991; Michaely and Shaw, 1994). We utilize the most commonly used Ritter's (1991) rankings, which range from 0 (lowest) to 9.1 (highest). We also control for the *risk* of the offering, which is a dummy variable equal to one if IPO has a boldface risk warning in the IPO prospectus (Klein, 1996). IPO *proceeds* are controlled for as they indicate the level of funds raised in the IPO. Proceeds are calculated as the natural log of the number of shares offered in the IPO multiplied by the offer price (Pukthuanthong, 2006). Based on past board and IPO literatures (Certo, 2003; Hillman and Dalziel, 2003; Kor and Sundaramurthy, 2009), we also control for a number of board characteristics, such as board inside directors ratio, board size, board tenure, and directors' advanced education, all of which may influence board governance, signaling, and IPO success. *Inside directors ratio* is measured as the percentage of inside directors on the board (excluding CEO); *board size* is the total number of members on the board; *board tenure* is measured as the average number of years directors served on the focal firm's board; *directors' high degree education* is calculated as the percentage of directors with a masters or higher-level graduate degree. Further, we control for directors' and CEO's equity ownership as they may influence underpricing (Filatotchev and Bishop, 2002; Lowry and Murphy, 2007; Pukthuanthong, Roll, and Walker, 2007). *Directors' equity ownership* is measured as the percentage of shares owned by directors at the time of the IPO. *CEO equity ownership* is measured as the percentage of shares owned by the CEO at the time of the IPO.

Finally, we control for firm age, earnings per share, and the year effects. *Firm age* is controlled as a proxy for the firm's liability of newness and thus the uncertainty about the firm's

future prospects (Beatty, 1989; Clarkson, 1994). We included *earnings per share* as an indicator of IPO firm profitability. Lastly, we added the y*ear dummies* to control for time-series variation in underpricing (Loughran and Ritter, 2004).

Analysis and Results

We test our hypotheses using cross-sectional data on 360 biotech firms that completed an IPO. We used OLS cross-sectional regression analyses and controlled for heteroskedasticity using White (1980)'s standard errors. None of the variance inflation factors exceeds 2.80, which is well below 10, the value at which multicollinearity becomes a concern (Freund and Littell, 1991). Further, we performed the Hausman test of endogeneity to confirm that our eight CEO and board human capital variables are not endogeneous (Greene, 2000). To carry out the Hausman test, for each human capital variable, we ran two OLS regressions. In the first regression, we regress the suspect endogenous variable on all exogenous variables and instruments. For instrumental variables, we used institutional ownership percentage and financial leverage ratio, as they are both likely to influence the quality of CEO and directors a firm can attract (Certo, 2003; Megginson and Weiss, 1991). Institutional ownership signals credibility and may positively influence a firm's ability to recruit a CEO and directors with strong human and social capital (Kor and Sundaramurthy, 2009). High financial leverage increases the firm's bankruptcy risk and may reduce the willingness of highly qualified directors and executives to join the firm (Lee, 1981). After retrieving residuals from this first regression, we re-estimated the underpricing function including the residuals from the first regression as additional regressors. If the OLS estimates are consistent, then the coefficient on the first regression residuals should not be significantly different from zero. In all of eight regressions, the coefficient of the residual variable (and the corresponding t-test) was statistically insignificant.

Further, as an additional check for endogeneity, we performed the Durbin-Wu-Hausman test for all human capital regressors, and attained the same results. Thus, based on the Durbin-Wu-Hausman test and the Hausman test, we find that our human capital regressors are not subject to endogeneity problem. These tests confirm that our coefficient estimates for CEO's and board's human and social capital attributes are not the result of unobserved, firm-specific variables.

Table 1 provides descriptive statistics and correlations, and Tables 2-4 present results of the regression analyses. In Table 2, Model 1 presents the control variables, and Model 2 includes both the main effects and the control variables. In Models 3-5, the three interaction effects (H1-H3) are introduced one at a time, and in Model 6, they are entered into the regression simultaneously. In all models, *lower* underpricing is the desirable outcome as it indicates superior ability to raise capital and a more successful IPO (e.g., Arthurs *et al*., 2008; Certo, *et al.*, 2001; Loughran and Ritter, 1995; Megginson and Weiss, 1991).

Insert Tables 1-4 about here

Model 2 of Table 2 indicates that all *main* effects are statistically significant, and they are consistent with the theory presented in the paper (even though they are not hypothesized). Directors' and CEO's *cumulative* (past) board experiences are associated with reduced IPO underpricing whereas their *current* public firm board experiences are associated with increased IPO underpricing. Directors' and CEO's scientific educational background and biotechnology experiences are associated with diminished IPO underpricing.

Model 3 provides a test of Hypothesis 1 where we predict that, as the accumulated (past) experience of CEO gained from serving on public company boards goes up, there will be a more pronounced effect of the directors' accumulated public company board experience **in reducing**

IPO underpricing. Model 3 provides support for this hypothesis (β-interaction = -0.16, $p < 0.01$) and Figure 1 illustrates this effect.[4] Hypothesis 2 predicts that, as the level of the CEO's *current* memberships on the boards of public companies increases, an increase in the board directors' current memberships on public company boards will produce a stronger positive effect on IPO underpricing. This hypothesis is supported. The interaction effect is positive and it results in **increased** IPO underpricing (Model 4, β-interaction = 0.23, $p < 0.001$). The interaction effect is illustrated in Figure 2. In Hypothesis 3, we predict that the interaction of CEO's and board's scientific educational background will **reduce** IPO underpricing. As shown in Model 5, this hypothesis is supported. The CEO's and board directors' science education is a synergistic combination (β-interaction = -0.46, $p < 0.01$), and this interaction effect is illustrated in Figure 3. Model 6 of Table 2 presents these three interaction effects when they are entered into regression simultaneously. All three interaction effects remain statistically significant.

Insert Figures 1-3 about here

Tables 3 and 4 present the results of hypothesis testing for Hypotheses 4 and 5; that is, the interaction effects of the CEO's and directors' bio-tech experience depending on the two contingencies: the age and performance-level of the IPO firm. To test these effects, we divided the sample into two sub-samples for each contingency (young and old firms; low and high performance firms) based on whether the contingency variables were below or above the median in the sample. Hypothesis 4a predicts that *in younger IPO firms*, the interaction of the CEO's and board's industry-specific experience will **reduce** IPO underpricing. As shown in Model 3 of Table 3, this hypothesis is not supported (β-interaction = 0.12). Young firms benefit from

[4] The interaction effects in all the figures were graphed by holding the remaining predictors in the model at the mean values of the full sample.

CEO's and board's industry expertise as main effects, but we do not find an interaction effect. Hypothesis 4b predicts that, *in older IPO firms*, the interaction of CEO's and directors' industry-specific capital will **increase** IPO underpricing. This hypothesis is supported (β-interaction = 0.49, $p < 0.001$) as shown in Model 6 of Table 3 and the interaction is illustrated in Figure 4.

Table 4 presents the results for the contingency effect of performance. We use earning per share as the metric of profitability of the firm at the time of the IPO (Ritter and Welch, 2002). Hypothesis 5a predicts that the interaction of the CEO's and directors' bio-tech experience will **reduce** IPO underpricing *in firms with weak performance* at the time of the IPO. Model 3 of Table 4 indicates that this hypothesis is supported (β-interaction = -0.16, $p < 0.01$) and the interaction effect is illustrated in Figure 5a. Hypothesis 5b suggests that the interaction of the CEO's and the board's industry experience will **increase** IPO underpricing *in firms with high performance* at the time of the IPO. As shown in Figure 5b and as per Model 6 of Table 4, the results also confirm this hypothesis (β-interaction = 0.49, $p < 0.001$).[5]

Insert Figures 4, 5a and 5b about here

DISCUSSION

In this paper, we highlight the *positive* and *negative* synergies between the human and social capital of the CEO as the key executive in the firm, and that of the board as the key internal governing body. This interaction between the CEO's and the board's human and social

[5] We also tested our hypotheses with the alternative dependent variable of the natural log of net proceeds since by far the most important reason for going public is to generate investment capital (Arkebauer, 1991). Net proceeds reflect the total amount of capital raised by the IPO firm, and is calculated by subtracting the underwriter fees from the total value of the capital raised (Deeds, DeCarolis, and Coombs, 1997; Gulati and Higgins, 2003; Pollock and Rindova, 2003). With this dependent variable, we found support for H1, H2, H3, H4b, and H5b, but not for H4a and H5a; thus, the findings are highly comparable to IPO underpricing results (with the exception of H5a). We thank one of the reviewers of this paper for requesting this additional testing.

capital remain unexamined in the corporate governance literature even though they reveal key nuanced insights on effective board design. We explore the benefits and costs of these human and social capital interactions in the IPO context which is particularly appropriate because the IPO event marks an important transition point when the firm enters a stage of increased organizational complexity, and is exposed to higher public scrutiny and competitive rivalry (Filatotchev and Bishop, 2002; Pollock and Rindova, 2003). For successfully transiting into its new surroundings, the firm needs to reconfigure its human and social capital endowment at the upper ranks and effectively signal its new capabilities so that it can increase the capital raised in the IPO. Our findings indicate that the effective balance of the human and social capital configurations of the CEO and the board is contingent upon the type of specific capital and the idiosyncratic needs of the firm. Theoretical overview of the results is presented in Figure 6.

Public Company Board Experience and Underpricing

Our results indicated that the accumulated public company board experience of both the CEO and the board improve IPO success as main effects. Further, when both the CEO and board members have accumulated this experience, there are positive synergistic effects. These findings indicate that experience in serving on public company boards is a critical asset for the boards of IPO firms. The accumulated public-company board experience arguably enables the CEO to better relate to directors, which fosters the healthy dialog essential for shepherding an IPO firm into the public market where the strategy and governance challenges are significant. It is likely that such CEOs understand challenges of public companies, are more receptive to advice from directors, and are able to harness their collective insights into functioning effectively in the capital market. When directors who are experienced in governing public companies collaborate

with a CEO who is likewise knowledgeable, the two can more effectively communicate and act upon the needed changes and requirements to succeed in the post-IPO environment.

Our results also support the argument that *currently held* multiple public-company board appointments have a downside. IPO underpricing was magnified when both the CEO and board members are preoccupied at the same time with service on the boards of several public companies. The implication of this finding is that when both the CEO and board members are stretched thin, governance and strategic decision making is likely to suffer. It indicates that the time and energy pressures curtail the abilities of both the CEO and the board to draw on this potential source of information and ties, resulting in weaker signaling and higher underpricing.

Our findings with respect to multiple board appointments lend credence to the objections of institutional investors and shareholder activists to firms appointing directors with several directorships primarily due to the fact that serving on public company boards requires a significant commitment of time. Indeed a survey of corporate directors conducted by Korn/Ferry finds that many directors believe that serving on many boards dissipates their energy and prevents them from effectively serving any one company (Ferris, Jagannathan, and Pritchard, 2003). Directors indicated that their primary reason for declining an additional board membership was lack of sufficient time and they also thought that there should be limits on CEOs and other management members serving on other boards. Board research also indicates that CEOs of high-growth potential firms accept fewer outsider director appointments (Booth and Deli, 1996). While the effect of multiple board appointments on firm value is mixed (Ferris *et al*. 2003; Fich and Shivdasani, 2006), prior research shows that multiple board membership is associated with increased executive compensation packages (Core, Holtthausen, and Larcker, 1999), a diversification discount (Jiraporn, Kim, and Davidson, 2008), and reduced attendance at

board meetings (Jiraporn *et al*., 2009). Our findings extend the results of the negative effects of multiple board appointments to the IPO context, and illustrate that even though directors with multiple board appointments may be considered as more prestigious additions to the board and may have IPO context-relevant experience, the stock market is cognizant of the fact that these members may not be able to effectively leverage this experience or actively engage in governing an IPO firm. Furthermore, our findings provide a key insight in that the costs of multiple board appointments are exacerbated when *both* the board and the CEO are distracted with such service. Including a CEO and board members with multiple board appointments may signal an overcommitted rather than a prestigious board.

These findings on the public company board experience shed light on two competing views of the value of board appointments (Jiraporn *et al*., 2008). One viewpoint highlights the benefits of appointing board members with extensive board experience because they bring valuable insights and prestige (Carpenter and Westphal, 2001). The alternative view underscores the fact that such directors may be too busy to dedicate sufficient time to any single board, which may hurt the effectiveness of boards they serve (Fich and Shivdasani, 2006). Examining both *past* experience and *current* board appointments of the CEO and board members allows us to tease out the positive and negative effects of board appointments, and reconciles these two competing views by illustrating the credibility of both perspectives.

Scientific Educational Background and IPO Underpricing

We have argued that, in environments with a technical base, scientific education provides a strong *foundation* to individuals' technology-based absorptive capacity. With this absorptive capacity, the CEO and directors can more intuitively comprehend the industry's technologies and evaluate the prospects of competing technology paths (Cohen and Levinthal, 1990; Tyler and

Steensma, 1998). Our results show that a common science educational background has a complementary, synergistic effect as it enables the CEO and the board to collaborate more successfully. With this human capital combination, IPO underpricing is lower than when only the CEO or the board has scientific educational background. Thus, in this case, more is better as this human-capital base has synergistic positive effects.

Industry-specific Experience and IPO Underpricing

We have argued that the CEO's and the board's industry-specific expertise can have either positive or negative synergistic effects depending on the age and the performance of the IPO firm. We hypothesized positive synergistic effects in relatively young and in firms with weaker performance as these firms suffer from liability of newness and receive more public scrutiny, respectively. In this context, the *dual presence* of the CEO's and board's industry expertise can be particularly effective in signaling the firm's future viability. This argument was supported in the sub-sample of weak-performing firms, but not in the sub-sample of young firms. Weak-performing firms experienced positive synergistic effects associated with the CEO's and board's industry experiences. For younger IPO firms, both the CEO and the board possessing deep bio-tech experience appear to be redundant (Kor and Misangyi, 2008). Similar to the notion that some governance mechanisms may have more impact in the absence of other mechanisms (Sundaramurthy, 1996), if the CEO *or* the board has industry experience, it provides an adequate signal of the ability of the IPO firm to succeed. The results suggest that weak performance may indicate stronger vulnerability than being a young firm; consequently, weak performers may need the additional signaling that they can get from both the CEO's and the board's industry experience.

On the other hand, in older and well-performing IPO firms, as hypothesized, we found support for *myopic effects* and consequently there exists *negative synergies* from the CEO and the board possessing deep industry-specific experience. As older and stronger-performing firms are more prone to complacency, inertia, and strategic persistence (Janis, 1972; Kisvalfi, 2000), the shared and heavily-used industry knowledge and intra-industry ties may be resulting in tunnel vision or reinforcement of industry recipes. Therefore, in older and high-performing firms, more industry-specific experience is not just redundant, but it actually hurts the firm.

In summary, our findings support the idea that bio-tech experience on the board is important, but also points to the need for diversity of experience on the board. A similarity-attraction bias may result in a CEO and the board members with matching industry experience (Westphal and Fredrickson, 2001). Therefore, our findings with respect to the interaction between the bio-tech industry experience of the CEO and the board supports the notion that concentrated form of *intra-industry* experience can be dysfunctional in certain firm contexts, and *inter-industry* experiences and social capital may enable the board to develop more open knowledge structures needed to navigate the new, more complex environments. Thus, firms that have been in business longer and are performing well prior to the IPO will be better off seeking board members from outside the industry, if the CEO has industry experience.

Implications and Future Research

There are several implications of our findings and avenues for future research. First, the study's findings underscore the critical interaction effects between the experience sets of the CEO and the board. Bundling the human and social capital of board members and of the CEO *without the knowledge of* individual and interactive effects of each of their specific human capital

bases can mask critical insights on effective board composition. For instance, while industry-specific experience of the CEO and that of the board individually have positive effects, their combined effect is negative in older and better performing IPOs, providing evidence of negative synergistic returns. This is a case where more of a good attribute is not more beneficial, but actually detrimental to the firm. Thus, just as there are costs associated with monitoring and incentive mechanisms (Zajac and Westphal, 1994), this effect reflects the *costs* of accumulating more of a particular type of human and social capital, an issue that has been unexamined in past research. Likewise, current public company board appointments of the CEO and the board have a negative interactive effect – another case where more of a negative attribute is more detrimental. We also uncovered positive synergies as in the case of the CEO's and the board's scientific educational background *and* past public company board experiences. These combinations constitute instances where more is more beneficial.

Given that the interactive effects of various experience sets vary, it would be worthwhile to assess if other key experiences of the board and the CEO (e.g., past experience as a CEO, start-up experience) have positive or negative synergistic effects. Arguably, directors with CEO-experience may be able to more effectively communicate their advice to the CEO, and the CEO may in fact engage in advice-seeking behavior and be more receptive to this advice given their shared experience. Such open communication may foster more effective governance (Westphal, 1999). On the other hand, similar to industry-specific experience, shared CEO-experiences may reduce the objectivity of outside directors, result in groupthink tendencies, and thereby compromise the board's governing capability. Understanding how such common experience bases of the CEO and directors shape the balance between control and collaborative tensions of boardroom decision-making will be a noteworthy future research venue (Sundaramurthy and

Lewis, 2003). Qualitative studies that probe directors of how their experiences shape particular governance decisions and general boardroom activities may provide additional insights.

The interaction effects also shed light on the role of *diversity of experience* on boardroom functioning. Diversity is viewed as a source of strength as it fosters the flow of new ideas vital for creativity, promotes debate stemming from varied viewpoints, and adds greater depth to corporate decision-making (Milliken and Martin, 1996). On the other hand, diversity may cause dysfunctional conflict, slow decision-making, and adversely affect board governance (Finkelstein *et al*., 2009). Both perspectives are reflected in our results. Diversity of industry experience at the upper echelons (CEO and board) is valued in the IPO context, because it enables the IPO firm to access fresh ideas and links from other industries. However, congruence of experience between the CEO and the board in terms of public company board service is beneficial. Teasing out such variances in crisis situations and diversified environments can further enrich our understanding of the value of diversity of experience between the executive and the monitoring arms of the board.

Finally, the concept of human and social capital conjures up a positive image leading to the assumption that more is beneficial. An implication of this study is that in addition to these benefits, the costs of such capital also need to be considered. Board members who serve on many public boards may be valued for their reputation capital, but we find that they can also hurt the board's ability to govern. It is necessary to acknowledge that accumulated service on public boards is an asset; however, current appointments can be a liability as it can drain members of their time and energies required to effectively govern a public company.

While our research unbundles the interactive effects of individual and group human and social capital, an important limitation of our study is that, our measures and analysis do not

isolate the effects of human and social capital. This is a significant limitation of most research examining the human or social capital of boards and top management teams because the two types of capital are intimately intertwined (Coleman, 1988; Nahapiet and Ghoshal, 1998); hence, devising measures to isolate the two pose significant challenges and yet theorizing and constructing separate measures for each of these constructs could potentially make major contributions to multiple streams of research. Second, the sample in this study consists only of biotechnology firms. While the results of this study should be relevant to other technology-intensive industries, they may not generalize to all industries. It has been noted that high-tech entrepreneurs fear expropriation of the firm's knowledge and thus are hesitant to disclose details of the firm's technology, which makes it harder for investors to value these firms (Deeds *et al*., 1997). Given this high information asymmetry, it is possible that the signaling effects of the CEO's and the board's human and social capital are even more important in the biotech context. Thus, it is crucial to validate the importance of these effects in other industries.

In summary, our study indicates that it is imperative to unbundle the human and social capital of the CEO and that of the board, and examine their individual and interactive effects simultaneously. Such an approach will enable us to discover the positive and negative synergies associated with various types of board capital, which in turn will provide a nuanced understanding of the appropriate balance of experience-sets within the board across contexts.

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Table 1. Descriptive statistics and correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Dependent variable																					
1. IPO underpricing	0.13	0.10																			
Independent variables																					
2. Directors' cumulative public board experience	3.99	2.62	-0.01																		
3. CEO's cumulative public board experience	4.37	2.60	0.03	0.06																	
4. Directors' current public board experience	1.43	1.41	0.12	0.04	0.02																
5. CEO's current public board experience	2.08	1.73	-0.01	-0.08	0.05	0.01															
6. Directors' science education	0.18	0.38	0.02	0.10	0.16	0.13	-0.02														
7. CEO's science education	0.24	0.22	0.01	0.12	0.08	-0.05	0.03	0.00													
8. Directors' biotech experience	4.16	1.44	0.04	0.06	-0.02	-0.03	0.02	0.02	-0.02												
9. CEO's biotech experience	4.59	2.08	0.05	-0.01	0.01	0.01	0.07	0.03	0.02	0.01											
Control variables																					
10. Underwriter rank	6.55	2.23	0.02	-0.04	-0.07	-0.05	-0.05	-0.17	-0.20	0.01	-0.02										
11. Risk	0.20	0.06	0.02	-0.11	-0.01	-0.02	0.02	0.09	-0.01	-0.01	0.02	0.05									
12. ln (Proceeds)	57.29	24.16	-0.12	-0.01	-0.04	0.11	0.02	0.06	0.01	0.03	-0.07	0.01	0.06								
13. Inside directors ratio	0.40	0.04	-0.02	0.04	-0.04	-0.09	0.04	0.09	-0.05	0.06	-0.05	0.06	-0.16	-0.01							
14. Board size	10.25	2.38	0.19	-0.03	-0.02	-0.01	-0.07	-0.09	-0.08	-0.04	-0.03	0.04	0.02	-0.01	0.21						
15. Board tenure	8.64	3.37	-0.02	-0.01	-0.02	0.02	0.00	-0.02	0.04	-0.03	0.02	-0.01	0.08	0.05	0.04	0.02.					
16. Director's high degree education	0.27	0.38	0.02	0.01	0.04	-0.06	-0.10	0.00	0.16	-0.08	-0.01	-0.02	-0.08	0.00	-0.03	-0.01	-0.03				
17. Directors' equity ownership	0.27	0.06	-0.05	-0.06	-0.10	-0.04	-0.09	-0.01	-0.04	0.07	0.07	0.00	0.02	-0.16	0.01	0.00	0.08	-0.02			
18. CEO's equity ownership	0.19	0.06	-0.02	-0.08	-0.01	0.00	-0.11	0.03	-0.03	0.00	0.00	0.00	-0.09	0.04	-0.03	0.05	0.00	-0.07	0.08		
19. Firm age	11.77	4.53	0.05	0.13	-0.06	-0.06	0.01	0.06	-0.01	-0.05	0.08	0.02	0.02	-0.01	0.06	-0.06	0.01	0.04	0.07	0.08	
20. Earnings per share	-1.02	4.06	-0.02	-0.12	-0.11	0.05	0.00	-0.14	-0.11	0.05	0.04	-0.08	-0.14	-0.08	0.19	0.02	-0.06	0.01	0.02	-0.03	-0.04

n=360. Correlations between 0.08 and 0.11 are significant at $p<0.05$; correlations greater than 0.11 are significant at $p< 0.01$.

Table 2. Regression analysis of CEO and board capital on IPO underpricing

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-1.49	-1.18	0.22	0.80	-0.65	1.07 *
Directors' cumulative public company board experience		-0.76 ***	-0.17 *	-0.39 **	-0.56 **	-0.24 **
CEO's cumulative public company board experience		-0.78 ***	-0.31 **	-0.43 **	-0.70 **	-0.10 *
Directors' current public company board experience		0.48 **	0.15	0.21	0.15	0.37 **
CEO's current public company board experience		0.34 **	0.62 ***	0.22 **	0.61 ***	0.15 *
Directors' science education		-0.55 **	-0.51 ***	-0.18 *	-0.26 *	-0.39 **
CEO's science education		-0.14 *	-0.44 ***	-0.24 **	-0.15 *	-0.43 ***
Directors' years of bio-tech experience		-0.16 **	-0.18 ***	-0.18 **	-0.12 **	-0.10 *
CEO's years of bio-tech experience		-0.43 ***	-0.06	-0.32 **	-0.21 **	-0.04
CEO's *Directors' cumulative public company board experience			-0.16 **			-0.16 **
CEO's * Directors' current public company board experience				0.23 ***		0.23 **
CEO's * Directors' science education					-0.46 **	-0.31 *
Underwriter rank	0.40 **	0.26 *	0.19 **	0.26 **	0.39 *	0.24 **
Risk	0.34 **	0.30 **	0.28 *	0.39 **	0.24 *	0.31 **
ln (Proceeds)	-0.71 ***	-0.54 **	0.22 *	-0.23 **	-0.28 **	-0.26 **
Inside directors ratio	0.22	0.18	-0.20	0.16	0.20	0.12
Board size	-0.40 *	-0.22 *	0.19	-0.15	-0.33	-0.27
Board tenure	-0.17	-0.10	-0.17	-0.34 *	-0.33 *	-0.40 **
Directors' high degree education	0.04	0.04	-0.38 **	-0.15 *	-0.33 ***	-0.05
Directors' equity ownership	0.14	0.19	0.16	0.17	0.20	0.14
CEO's equity ownership	0.26 ***	0.25 ***	0.16 *	0.32 **	0.24 **	0.22 **
Firm age	0.13	0.09	-0.08	-0.04	-0.06	-0.12
Earnings per share	-0.43 **	-0.31 *	-0.39 **	-0.32 **	-0.33 **	-0.27 **
Year dummies	Included	Included	Included	Included	Included	Included
F-statistic	16.08 *	30.17 ***	24.53 **	26.68 **	29.93 ***	30.31 ***
R-square	0.31	0.33	0.40	0.36	0.40	0.45
Adjusted R-square	0.25	0.26	0.33	0.29	0.33	0.38

n=360; *p<0.10; **p<0.05; ***p<0.001

Table 3. Regression analysis of CEO and board capital on IPO underpricing contingent upon the age of the firm

	Young firms			Old firms		
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-0.75 *	-0.12	0.08	-0.54	-0.18	0.19
Directors' cumulative public board experiences		-0.63 **	-0.44 **		-0.57 **	-0.62 **
CEO's cumulative public board experiences		-0.33 **	-0.15		-0.13	-0.22 **
Directors' current public board experiences		0.28 *	0.44 **		0.29 **	0.37 **
CEO's current public board experiences		0.41 **	0.39 **		0.26 **	0.28 *
Directors' science education		-0.30 ***	-0.22 *		-0.19 ***	-0.34 **
CEO's science education		-0.60 **	-0.38 **		-0.26 *	-0.21 *
Directors' years of bio-tech experience		-0.15 **	-0.18 ***		-0.13 *	-0.13 ***
CEO's years of bio-tech experience		-0.35 **	-0.31 **		-0.12 **	-0.17 *
CEO's *Directors' years of bio-tech experience			0.12			0.49 ***
Underwriter rank	0.41 **	0.34 **	0.43 **	0.36 **	0.22 *	0.37 *
Risk	0.34 **	0.22 **	0.34 ***	0.40 ***	0.38 *	0.23 **
ln(Proceeds)	-0.55 **	-0.22 **	-0.23 ***	-0.31 ***	-0.18 **	-0.16 **
Inside directors' ratio	0.14	0.15	0.20	0.15	0.22	0.17
Board size	-0.37 *	-0.25 **	-0.34 **	-0.34	-0.18	-0.19
Board tenure	-0.34 *	-0.38 **	-0.32 **	-0.35 **	-0.19 *	-0.21 **
Directors' high degree education	-0.25 *	-0.27 *	-0.29 *	-0.06	-0.04 **	-0.15 **
Directors' equity ownership	0.24	0.11	0.27	0.13	0.10	0.09
CEO's equity ownership	0.22 **	0.20 **	0.33 ***	0.31 **	0.21 **	0.19 **
Earnings per share	-0.26 *	-0.43 **	-0.23	-0.34 **	-0.35 **	-0.15
Year dummies	Included	Included	Included	Included	Included	Included
F-statistic	17.98 *	22.98 **	25.22 ***	15.57 *	21.60 **	25.32 ***
R-square	0.32	0.37	0.41	0.26	0.30	0.36
Adjusted R-square	0.20	0.23	0.27	0.13	0.14	0.21

n=180; *p<0.10; **p<0.05; ***p<0.001

Table 4. Regression analysis of CEO and board capital on IPO underpricing contingent upon the performance of the firm

	Low EPS Firms			High EPS Firms		
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-0.69	-0.15	-0.57	-1.02	-0.48	0.80
Directors' cumulative public board experiences		-0.50 **	-0.44 **		-0.45 **	-0.48 **
CEO's cumulative public board experiences		-0.46 **	-0.58 ***		-0.27 *	-0.22 **
Directors' current public board experiences		0.55 ***	0.46 **		0.47 **	0.47 **
CEO's current public board experiences		0.48 ***	0.35 *		0.26 *	0.26 *
Directors' science education		-0.20 **	-0.19 *		-0.19 **	-0.12 *
CEO's science education		-0.27 **	-0.32 **		-0.15 *	-0.22 *
Directors' years of bio-tech experience		-0.19 **	-0.11 **		-0.09 *	-0.15 **
CEO's years of bio-tech experience		-0.31 **	-0.24 **		-0.10 **	-0.13
CEO's *Directors' years of bio-tech experience			-0.16 **			0.49 ***
Underwriter rank	0.52 **	0.35 **	0.38 **	0.41 **	0.21 *	0.29 *
Risk	0.37 **	0.24 *	0.33 **	0.35 **	0.45 *	0.24 **
ln(Proceeds)	-0.71 ***	-0.24 **	-0.19 *	-0.17 **	-0.24 **	-0.15 **
Inside directors ratio	0.20	0.12	0.18	0.15	0.20	0.18
Board size	-0.36	-0.21	-0.34	-0.27	-0.23	-0.24
Board tenure	-0.18	-0.43 **	-0.48 **	-0.14	-0.17 *	-0.21 **
Directors' high degree education	-0.04	-0.04 *	-0.11 **	-0.05	-0.15 **	-0.18 **
Directors' equity ownership	0.17	0.19	0.22	0.19	0.10	0.10
CEO's equity ownership	0.32 **	0.33 ***	0.35 **	0.34	0.23 *	0.22 **
Firm age	0.06	0.05	0.05	0.08	0.07	0.08
Year dummies	Included	Included	Included	Included	Included	Included
F-statistic	18.47 *	25.85 ***	24.56 **	12.51 *	21.28 **	22.64 **
R-square	0.32	0.39	0.40	0.29	0.32	0.37
Adjusted R-square	0.26	0.32	0.33	0.22	0.25	0.30

n=180; *p<0.10; **p<0.05; ***p<0.001

Figure 1. Interaction Between CEO's and Board's Cumulative Public Company Board Experience

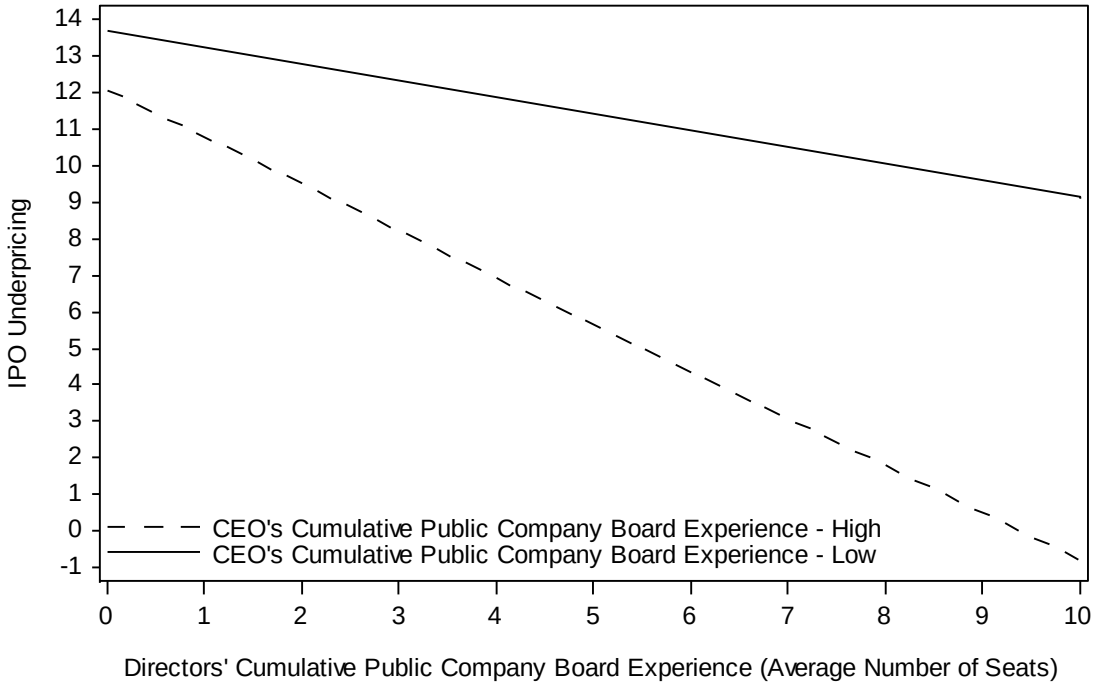

Figure 2. Interaction Between CEO's and Board's Current Public Company Board Experience

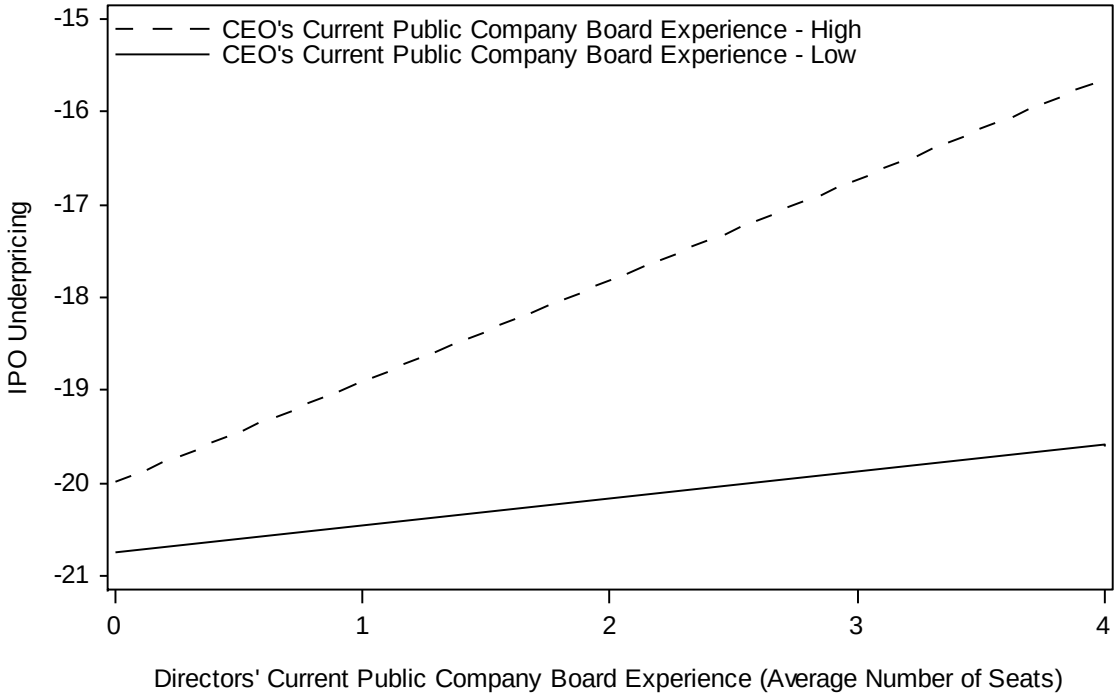

Figure 3. Interaction Between CEO's and Board's Science Education

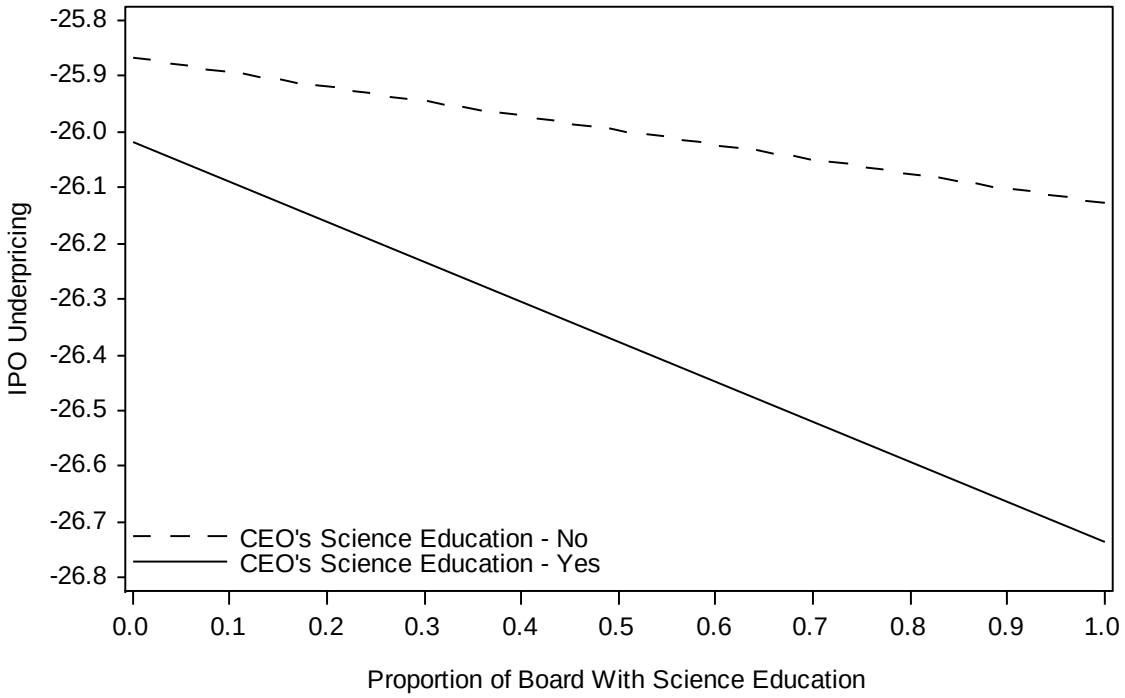

Figure 4. Interaction Between CEO's and Board's Biotech Experience for Old Firms

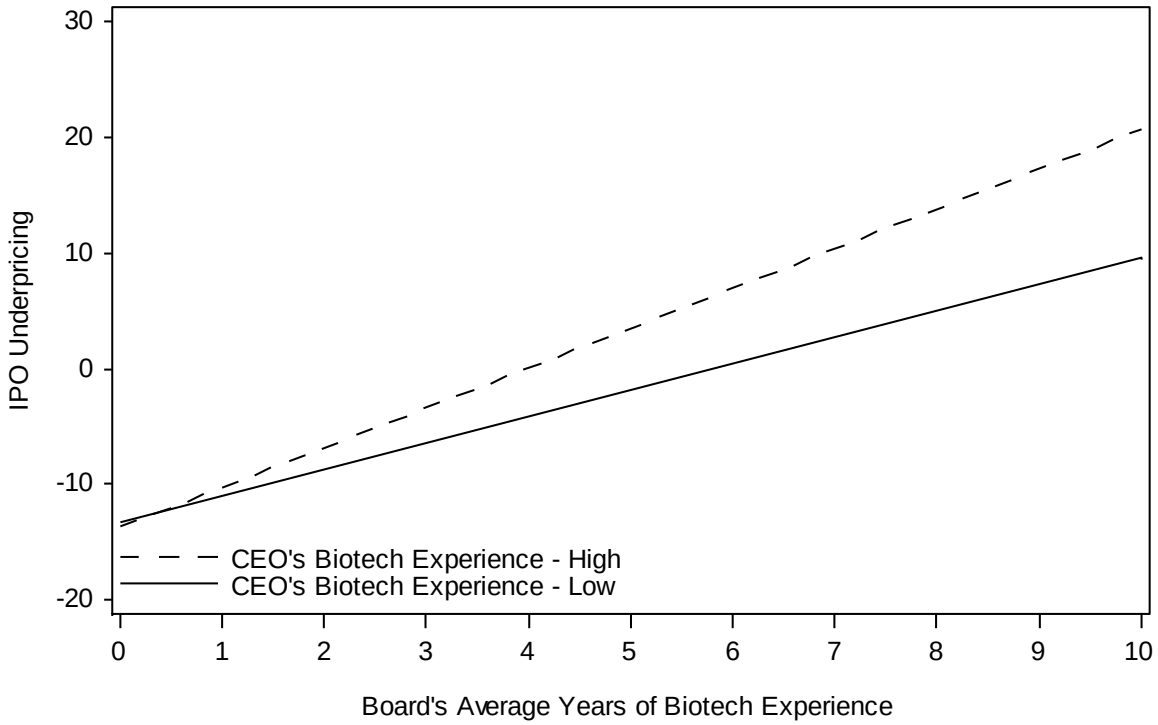

Figure 5a. Interaction Between CEO's and Board's Biotech Experience for Low Performing Firms

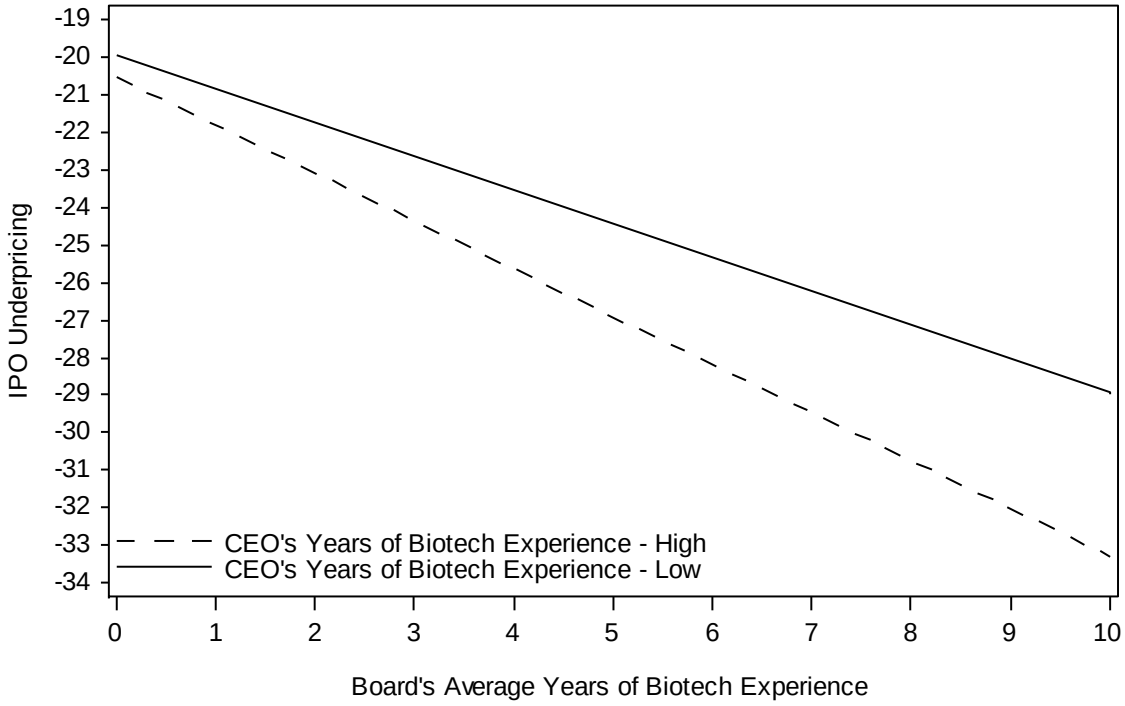

Figure 5b. Interaction Between CEO's and Board's Biotech Experience for High Performing Firms

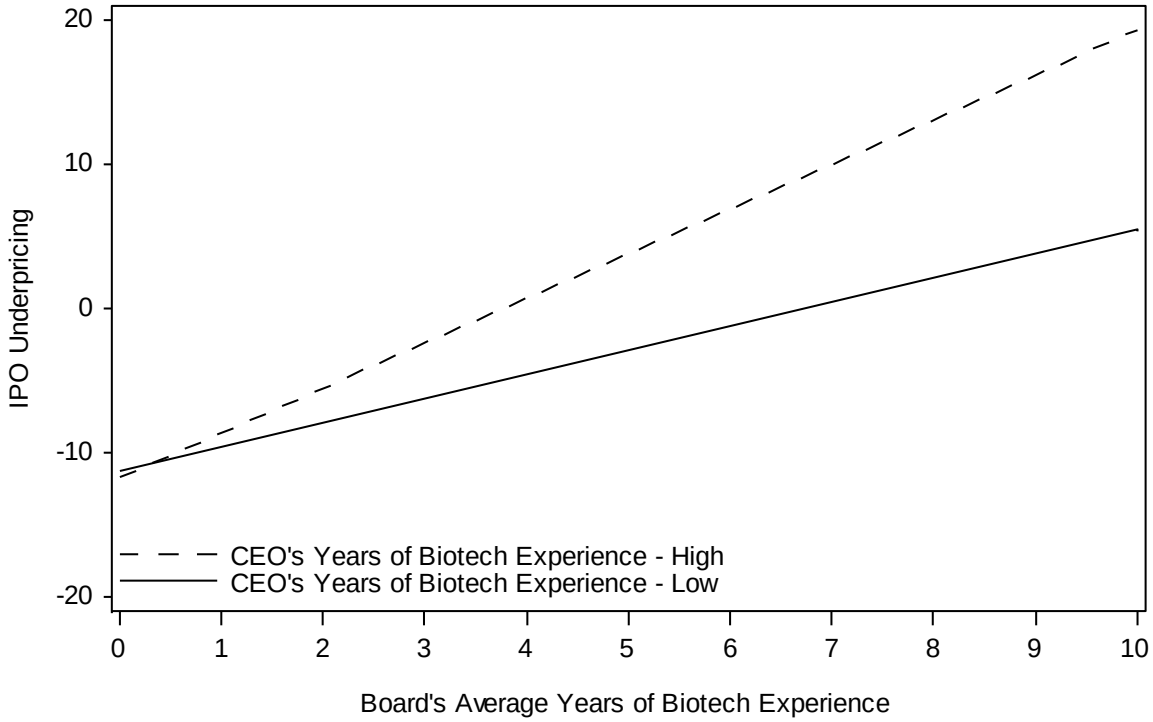

Figure 6. Theoretical overview of the results