IS IPO THE DEATH OF INNOVATION?

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ABSTRACT

This study examines whether changes made in the composition of the board of directors at the time of a firm’s initial public offering are related to changes in the firm’s innovation activity. The dependent variable is the change in R&D intensity from the pre-IPO period to the post-IPO period. Using a sample of 93 biotechnology or semiconductor firms with an IPO during the years 1996 – 2005, we find that changes in R&D intensity are negatively related to changes in (a) board size, (b) the percentage of members who are venture capitalists, and (c) the percentage of members with a science education and positively related to the change in age diversity.

INTRODUCTION

Innovation has been called the “life blood of corporate survival and growth” (Zahra & Covin, 1994). As a key component of corporate entrepreneurship, it can promote firm growth (Zahra, 1993) and has been associated with improved profitability (Covin & Slevin, 1991). Additionally, innovation allows firms to acquire new capabilities which can help the organization adapt better to a changing environment (Stopford & Baden-Fuller, 1994). As a result, there has been a large amount of research focused on organizational processes and structures that facilitate successful innovation (e.g., Barringer & Bluedorn, 1999; Covin & Slevin, 1991; Guth & Ginsberg, 1990; Miller, 1983; Sathe, 2003) which has given us considerable insight into factors that enable firms to innovate.

One area that has received less attention in innovation research is the influence that corporate governance may have on the degree to which firms pursue innovation. Agency and managerial theorists have produced an extensive amount of research regarding the effects of board characteristics on firm performance and strategic decision making (e.g., Hitt, Hoskisson, Johnson, & Moesel, 1996), but these have largely focused on established firms and have produced mixed results. Due to the fact that firms typically undergo significant structural changes in their governance prior to an initial public offering, the time surrounding this event provides a unique opportunity to examine the effects of varying board composition and structure (Baker & Gompers, 2003). An important focus of decision-making for firms undergoing IPO is innovation activity since the growth potential of these firms is often assessed based on their pre-IPO years. Existing research has found that the increased emphasis on financial controls following the governance changes during an acquisition often results in decreased innovative activity for the acquired firm (Hitt et al., 1996). Firms undergoing an IPO could be subject to similar pressures to emphasize financial controls as their performance becomes subject to scrutiny by the market. However, the effect of governance changes at IPO on the firm’s innovative activity remains an open question.
Firms undergoing an IPO suffer from a liability of market newness (Certo, 2003) due to the fact that investors have limited information and knowledge of the firm and its operations while it was a private entity. Firms preparing to undergo an IPO will often use their board of directors as a signal of quality to potential investors. However, the characteristics of the board and its individual members which increase the legitimacy of the firm to outside investors may be quite different from those which were responsible for guiding decision processes in the firm prior to the IPO.

While governance researches have relied heavily on agency theory in examining the effects of board composition and structure, a theoretical lens that has been used in the TMT literature is that of upper echelons theory (Hambrick & Mason, 1984), which suggests that the backgrounds and experience of managers will affect managerial perception of their environment and influence subsequent organizational strategies. In line with this reasoning, a study by Daellenbach and McCarthy (1999) suggested that CEO and TMT predisposition strongly affect a firm’s commitment to innovation. Extending upper echelons theory to the board of directors as suggested by Finkelstein and Hambrick (1996), would suggest that board members’ backgrounds and characteristics would affect their perceptions and evaluation of innovation activities in the firm, which in turn may influence the subsequent investment decisions the firm makes. As a result, the changes made in the board of directors at the time of IPO in order to address the liability of market newness may have unexpected consequences for the strategic direction of the firm.

The purpose of this study is to examine how board changes made in the year prior to IPO affect innovation activity within the firm.

Innovation Decisions and the Board of Directors

Tushman and Nadler (1986) define innovation as the creation of a product, service or process which is new to the business unit. As noted by O’Sullivan (2000), innovation is a cumulative and uncertain process. While many studies of innovation use innovation outcomes such as the number of new products or services introduced or adopted (Bantel & Jackson, 1989), these outcomes can be influenced by a number of external factors. Investment in internal innovation is inherently risky (Baysinger, Kosnik, & Turk, 1991) and there is a high likelihood of failure (Finkelstein & Boyd, 1998). So, while a firm may pursue an aggressive strategy of developing innovative new products, services or processes, there is no guarantee that they will be successful.

While it can be argued that executives and corporate elites may influence the success of innovative pursuits within the firm through their selection of projects they choose to pursue, the existence of external factors which can influence the outcome of these decisions make it more difficult to determine the extent to which these actors are responsible for innovation in their firms. However, the degree to which the firm pursues innovation is a strategic decision that can be captured by examining the extent to which a firm allocates its resources toward this goal. Because, according to the American Law Institute, the role of the board of public companies is to hire and fire senior executives, set compensation, review, approve, and evaluate firm strategy, and to generally act as overseers of company business, the board of directors is legally liable for ensuring that shareholder’s interests are protected and are therefore obligated to be involved in strategic decision making (Mizruchi, 1983). Given the importance of innovation to firm performance and strategy, it is likely that the board will review and provide input on the major decisions in this area. In addition, research has shown that the board’s involvement in strategic decision making is particularly high for firms undergoing an initial public offering.

In spite of the multiple roles that boards play, studies of corporate governance have been predominantly guided by agency theory (Dalton, Daily, Ellstrand, & Johnson, 1998) and its focus
on the monitoring role of the board. In this view, the inability of the manager to diversify their employment risk causes them to be more risk averse than shareholders would like (Jensen & Meckling, 1976). In addition, managers are assumed to be self-interested and outside directors serve the primary role of monitoring managerial behavior and decisions to ensure that they are in the interests of the owners (Fama & Jensen, 1983). This result of this line of reasoning is that board composition, in terms of director affiliation and board size, has become one of the most studied dimensions in board research (Finkelstein & Hambrick, 1996; Zahra & Pearce, 1989).

Unfortunately, the results of agency studies linking board composition to market performance and other strategic outcomes has failed to yield consistent results (Dalton et al., 1998; Tosi, Werner, Katz, & Gomez-Mejia, 2000). There are several possible explanations for this lack of support. First, researchers may be placing too much emphasis on the monitoring role of outside directors, to the exclusion of their other roles (Daily, Dalton, & Cannella, 2003). Second, studies have typically neglected characteristics of individual board members beyond their affiliation. By classifying directors only in terms of insiders and outsiders, both sub-groups are treated as being relatively homogeneous in terms of their abilities, experiences and preferences that may influence their choices on strategic matters (Carpenter, Pollock, & Leary, 2003). However, some researchers have contended that complex decisions are influenced by behavioral factors (Cyert & March, 1963) which must be considered. Hambrick and Mason (1984) argued more specifically in developing their upper echelons theory that individuals will differ in their values and cognitive biases which will act as a series of filters, ultimately affecting their strategic choices.

Within the upper echelons perspective, scholars have typically looked at two distinct lines of reasoning (Camelo-Ordaz, Hernandez-Lara, & Valle-Cabrera, 2005). The first of these focuses on how demographic variables such as age, education and tenure of top management teams (TMT) serve as surrogates for cognitive biases and values which affect their preferences and, ultimately, their choices (e.g., Bantel & Jackson, 1989; Finkelstein & Hambrick, 1996; Forbes & Milliken, 1999; Smith & Smith, 1994; Tihanyi, Ellstrand, Daily, & Dalton, 2000; Wiersema & Bantel, 1992). The second line of research has looked at the effects of TMT diversity in terms of demographic characteristics and its effects on organizational results (e.g., Bantel & Jackson, 1989; Knight et al., 1999; Wiersema & Bantel, 1992). This research typically focuses on how diversity within the decision making group affects the decision process.

As noted by Carpenter, Pollock and Leary (2003), agency theory studies have tended to neglect the characteristics of board members, which may influence their evaluation of the risk involved in various strategy choices as well as the impact it may have on the group’s decision dynamics. Therefore, following the suggestion Jensen and Zajac (2004), we take a multi-theoretic approach in developing hypotheses for examining the influence of board structure and characteristics on innovation activity within the firm.

Board Composition and Innovation

When examining the effects of board size on organizational outcomes, researchers relied primarily on resource dependence theory (Dalton, Daily, Johnson, & Ellstrand, 1999), which suggests that directors provide important linkages to the external environment which facilitates the firm’s access to critical resources (Pfeffer & Salancik, 1978). In this line of reasoning, larger boards will theoretically have a positive relationship with firm performance as they provide the firm with access to more resources through larger and more diverse networks. This has led researchers to hypothesize a positive relationship between board size and firm performance (e.g.,
However, when considering the effects of board size on innovation intensity, we must consider the effects of group size on the decision making process. Unlike firm performance, the degree to which resources are allocated to a particular function in the organization reflects a strategic choice by the firm and we must consider not only the perspectives and resources that the directors bring to bear on the decision, but also the board’s involvement in the decision as well as the dynamics of the group on the decision making process.

Evidence from the group dynamics literature indicates that larger groups have more difficulty with coordination (Gladstein, 1984; Hackman & Morris, 1975), had lower motivation (Herold, 1979) and participation (Gladstein, 1984), and are less cohesive (Shaw, 1981 as noted by Goodstein, Gautam, and Boeker, 1994). In addition, Judge and Zeithaml (1992) found that board size was negatively associated with board involvement in strategy. Other studies have indicated that large boards are not able to conduct effective discussions (Herman, 1981) and are ineffective in making strategic decisions (Kovner, 1985). Furthermore, Olson (1982) argues that large groups are more likely to develop factions leading to group conflict which will limit the ability of the group to reach consensus on decisions involving complexity and ambiguity, such as those of investing in innovation.

As the board size increases, there will likely be less agreement as to whether or not investment in innovation activities is the best use of the firm’s financial resources, which may lead to delays in investment or a lack of investment on particular projects. These problems are expected to be worse based on the degree to which the board size changes. For this reason, we examine the percentage change in board size at IPO rather than the absolute change in size and hypothesize the following relationship:

**H1: The relative change in board size at IPO will be negatively related to R&D intensity.**

Agency theory arguments have been used to hypothesize that managers will forgo the long-term investments in research and development (R&D) that would be desired by shareholders in favor of short-term profitability that would benefit them personally. This is due to the fact that investments in R&D are generally a high risk, high returns strategy. Simply investing in R&D offers no guarantee that the firm will develop commercially successful products or processes that will enhance future profitability. However, that investment has an immediate negative impact on current profitability. Researchers have suggested that executives may resist investment in long-term R&D projects due to the high level of uncertainty involved and their inability to diversify their own personal risk (Baysinger et al., 1991). From this perspective, we would expect an increase in the percentage of outside directors to increase the investment in R&D as they pursued long-term strategies favored by the shareholders they represent.

In spite of the theoretical arguments, empirical evidence has failed to support this line of reasoning. In fact, some studies have found just the opposite -- that there is a significant, but negative, relationship between the percentage of outsiders and the firm's R&D investments (Baysinger et al., 1991; Hill & Snell, 1988). Similarly, the percentage of outside directors was found not to be significantly related to corporate entrepreneurship (Zahra, Neubaum, & Huse, 2000), despite agency predictions of a positive relationship. Meta-analyses examining the studies of the effects of board composition have also failed to yield significant support for agency theory
based arguments linking board composition to firm performance (Dalton et al., 1998) or critical strategic decisions where a conflict of interest may be expected (Deutsch, 2005).

Other researchers have argued that insiders are more inclined to invest in R&D due to information asymmetry. For example, Baysinger and Hoskisson (1990) suggested that insiders have a better understanding of the firm’s business and access to more detailed information regarding strategic decisions. It is suggested that outside directors are more likely to base their decisions on readily available financial information (Lorsch & MacIver, 1989). This is likely to be particularly true for new ventures undergoing an IPO. New ventures typically have higher organizational uncertainty (Arthurs, Hoskisson, Busenitz, & Johnson, 2008; Baysinger & Hoskisson, 1990; Zahra, 1996), so it may be difficult for new outside directors to fully appreciate the ability of the firm to successfully execute on higher risk R&D projects. As such, an increase in the percentage of outside directors making up the board at the time of IPO may result in increased resistance to supporting investment in innovation until they are more comfortable with the firm’s ability to generate successful innovations from that investment.

Another factor of particular relevance in firms going through an IPO is that many of the inside directors are likely to have been involved with the founding and initial growth of the firm. Such intimate involvement with the firm may lead the inside directors to identify more personally with the firm and have more loyalty and commitment to it than would be expected for professional managers (Arthurs et al., 2008; Cardon, Zietsma, Saporito, Matherne, & Davis, 2005). The result of this attachment would be that inside directors may be more interested in the long-term success of the firm than is usually suggested by agency theory. The combination of inside director’s psychological commitment to the firm as well as their greater knowledge of the firm’s capabilities suggests the following hypothesis:

\[ H2: \text{An increase in the percentage of outside board members at IPO will decrease the R&D intensity of the firm.} \]

**Venture Capitalists and Innovation**

While the designation of outside versus inside director affiliation is an important one with regards to the monitoring function of the board, many studies have typically neglected characteristics of individual board members beyond this affiliation. As noted earlier, in classifying directors only in terms of insiders and outsiders, both subgroups are being treated as relatively homogenous in terms of their abilities, experiences and preferences that may influence their choices on strategic matters (Carpenter et al., 2003), which ignores individual behavioral factors that may influence complex decisions such as investments in R&D (Cyert & March, 1963).

While board members are legally responsible to the firm’s shareholders, venture capitalists may play a particularly unique role in the strategic decisions made by the firm following the IPO. Studies have consistently found that VC board members are actively involved with the formation and evaluation of the firm’s strategy (Fried, Bruton, & Hisrich, 1998; Rosenstein, Bruno, Bygrave, & Taylor, 1993). However, unlike most outside board members, VC’s typically represent single, large shareholders. This presents a conflict of interest in that their obligation to the limited partners of the venture fund gives them a strong incentive to maximize short-run profits in order to facilitate a profitable exit, while their role as a director of a public company suggests that they should try to maximize long-term profits for the broader group of shareholders they represent (Lorsch, Zelleke, & Pick, 2001).
For pre-IPO firms, this conflict does not exist as the firm is not yet publicly held. Furthermore, the IPO price will reflect future expectations of earnings for the firm rather than current or past earnings. The VC’s have an incentive to maximize the perceived future value of the firm in order to generate the largest price for the public offering and maximize their own profits. Once the firm goes public, the venture capitalists are likely to be more interested in short-term performance which will improve their chances of selling their stock at a premium on the open market. In fact, Lorsch, Zelleke, and Pick (2001) found that VC firms on average sold a third of their holdings within the first six months following the lockup period. This will be particularly true for VCs joining the board at the time of IPO. These are likely to be later round investors that have not participated in the gains achieved by the earlier investors and they will be interested in maximizing the gains for their venture fund. Therefore, we suggest that:

**H3:** An increase in the percentage of board members that are venture capitalists will be negatively related to changes in R&D intensity.

**Educational Background**

Another characteristic of board members that may influence their support of investment in innovation is their educational background. Upper echelons theory contends that, as a result of information overload and bounded rationality, decision-makers will only attend to certain portions of the task environment. The choice of the areas to which they direct their attention and the way in which they interpret that information will be affected by their individual cognitive bases and values (Hambrick & Mason, 1984). Previous research has shown that the selection of a particular area of study reflects an individual’s personality and cognitive style (Wiersema & Bantel, 1992). The idea that the educational background of top management teams will influence their strategic decision making has received empirical support as well. Hitt and Tyler (1991) found that the educational background of executives influenced their evaluation of acquisition candidates. Wiersema and Bantel (1992) found that top management teams that had a higher percentage of members with degrees in science and engineering were more likely to initiate strategic change.

When examining how changes in the board of directors may influence the emphasis a firm places on innovation and investments in research and development, it seems logical to examine the impact of educational backgrounds in science or engineering fields. Research and development is a fundamental aspect of these academic disciplines. Individuals that pursue degrees in these areas are trained not only in conducting research, but also are likely to be more comfortable with the risk involved through familiarity with the process. Therefore, they would be expected to be more supportive of investments in this area and increasing the percentage of the board with an educational background in these fields would be expected to increase the emphasis placed on research and development. As such, we hypothesize the following relationship:

**H4:** An increase in the percentage of board members at IPO with educational backgrounds in science and engineering will be positively related to an increase in the R&D intensity of the firm following the IPO.

**Age Diversity and Innovation**

Researchers most often associate an executive’s age with a person's propensity for risk-taking (Herrmann & Datta, 2005). Younger managers have been found to be more risk oriented (Wiersema & Bantel, 1992) and more receptive to change (Carlsson & Karlsson, 1970). The effects of executive age have consistently been found to be significantly related to a variety of
organizational outcomes such as the degree of international diversification (Herrmann & Datta, 2005; Tihanyi et al., 2000), R&D spending (Barker III & Mueller, 2002), strategic change (Wiersema & Bantel, 1992), and firm growth rates (Child, 1974). In general, these studies consistently support the idea that older executives are more conservative and risk-averse.

These differences can be expected to lead to conflicts in the decision process. It has long been argued that certain types of conflict can be beneficial in that it forces people to consider different perspectives and confront issues (Coser, 1956; Deutsch, 1973). Such differing opinions expand the information available and provide a variety of information filters that lead to a wider view of the issue in question. This diversity of perspectives and the resulting debate may allow the firm to consider a wider range of innovation options and opportunities. Researchers have reasoned that exposure to opposing views provides additional information for the team members to process, allowing them to develop a more complete understanding of the problem and potential solutions (Pelled, Eisenhardt, & Xin, 1999). This line of reasoning has received some empirical support. For example, Olson, Parayitam, and Boa (2007) found that conflict positively influenced decision understanding, decision quality, and decision commitment in a study of 85 senior management teams in hospitals. Furthermore, a lack of conflict may result in “groupthink” (Janis, 1982), with managers overlooking important details and subsequently failing to recognize innovation opportunities. The result of these arguments is that we would expect an increase in the age diversity of the board to increase the R&D intensity of the firm following IPO.

H5: Changes in the age diversity of the board at IPO will be positively related to changes in R&D intensity.

METHODS

Data and Sample

The tests of hypotheses posed in this study require data about a firm’s board structure and R&D expenditures for the years immediately prior to and immediately following a firm’s initial public offering. Data were compiled using the VentureXpert database and the S-1 and 10-K filings available through the Edgar database of the Securities and Exchange Commission (SEC). The VentureXpert database was used to identify a sample of IPO’s that met the selection criteria defined for the study. First, the study focuses on firms in the semiconductor and electronics industry or the biotechnology industry because these firms typically have sizeable R&D expenditures. Innovation is a basis for competition in these industries and is the principal reason that most of the IPO firms were founded. R&D spending can serve as an indicator of that innovative activity for these firms.

The second criterion for selecting the sample was the year of IPO. The year in which the IPO occurred is designated as Year 0. The computation of the dependent variable requires three years of financial performance data both preceding and following IPO (years t-3, t-2, t-1, t+1, t+2, and t+3). Three years of financial results are available for firms whose IPO dates occurred during 2005 or earlier. The earliest dates for which S-1 prospectus filings are available in the on-line Edgar database are for IPO’s in 1996. Therefore, data availability defined the date range for this study as the ten-year period from 1996 to 2005. The third criterion required that the firms be involved in innovative activity as indicated by reported R&D spending on their income statements. A few of the IPO firms in the two target industries provide services to other firms in their industry but do no research of their own. These firms were not included in this study.
total of 162 IPO’s fitting these criteria were identified. Data on the variables of interest were available for 93 firms, and these comprise the sample used in this analysis.

**Dependent Variable**

The dependent variable is defined as changes in a firm’s level of innovation intensity between the pre-IPO period and the post-IPO period. An indicator of innovation intensity that is commonly accepted in innovation research is a firm’s R&D intensity, or the level of R&D spending as a proportion of some measure of available resources such as the firm’s total revenues, total spending, or total assets. For the purpose of this study, R&D intensity is computed as annual R&D expenditures divided by year-end total assets. The IPO firms that are the focus of this study are often quite young. Consequently, many have little to no revenue as well as limited expenditures for things other than R&D. Total Assets serves as a useful base for computing R&D intensity for IPO firms because it is typically a non-zero number.

The pre-IPO period was defined as the three years preceding the year of IPO (Year 0). Similarly, the post-IPO period was defined as the three years following the year of IPO. The R&D intensity for each period is computed as an average of the R&D intensity in each of the three years of the period. Then, the change in R&D intensity is the difference between the post-IPO value and the pre-IPO value.

**Independent and Control Variables**

*Percentage change in board size.* All variables that measure changes in characteristics of the board require distinguishing between members who were serving prior to the IPO and those who were added at the time of IPO. The prospectus identifies all board members serving at the time of the IPO and reports the date when each member joined the board. For the purpose of this study, members who joined the board during the twelve months prior to the IPO date are designated as new members and they are included only on the post-IPO board. Any member whose tenure is longer than twelve months prior to the IPO is included in both the pre-IPO and post-IPO boards. The twelve-month time frame was selected to define “new” members because board-level actions typically involve major strategic decisions with long-range implications. Therefore, for members who have served a year or less prior to the IPO date, it is primarily after the IPO that their influence will be seen in the strategic decisions and financial results of the firm. The percentage change in board size is computed as the percentage by which the number of board members increases from the pre-IPO period to the post-IPO period.

*Change in the percentage of outside members.* The prospectus identifies the current employer of each board member. Inside members of the board are those individuals who are also employees of the IPO firm. All other members are classified as outsiders. The percentage of the total number of members of the board who are classified as outsiders is computed for both the pre-IPO board and the post-IPO board. The change in the percentage of outside members is the difference between the pre-IPO percentage and the post-IPO percentage.

*Change in the percentage of members who are venture capitalists.* Individuals are designated as venture capitalists if (a) their employer is a venture capital firm or the private equity subsidiary of an investment bank or (b) they are individual, private investors. The percentage of the total number of members of the board who are classified as VC’s is computed for both the pre-IPO
board and the post-IPO board. The change in the percentage of VC members is the difference between the pre-IPO percentage and the post-IPO percentage.

*Change in the percentage of members with science or engineering educational backgrounds.* The coding for the educational background of a board member was based on that individual’s undergraduate major field of study. The percentage of the total number of members whose undergraduate major was a field in the physical sciences or engineering was computed for both the pre-IPO board and the post-IPO board. The change in the percentage is the difference between the pre-IPO percentage and the post-IPO percentage.

*Change in age diversity.* Age diversity is operationalized for both the pre-IPO board and the post-IPO board as the coefficient of variation of board member age at the time of IPO. The coefficient of variation is a normalized measure that accounts for not only the standard deviation of the age of the members but also the mean age for the board. The change in age diversity is the difference between the pre-IPO age diversity measure and the post-IPO measure.

Additional variables are included in the analysis to control for possible alternative explanations for the hypothesized relationships. These variables and their theoretical linkages to other variables in the study are explained in the following paragraphs.

*Firm age at IPO.* Many different factors drive a firm’s decision to undertake an IPO, and firms can make this decision at any of a number of points in time. Firms can vary widely in their ages at the time of IPO, and a firm’s age could influence its ability to sustain or its interest in sustaining a high level of R&D activity. Older firms, for example, may be more stable in their R&D spending, while younger firms may shift more dramatically in their resource allocations between R&D and selling activities once a marketable product is identified. Compared with older firms, very young firms may be more reliant on the operating capital obtained from VC’s, and consequently, the presence of and role of VC’s on the board may vary depending on firm age.

*Firm size.* Just as firms can vary in age at IPO, they can vary in size. Size differences can affect R&D spending. For example, larger firms may be better positioned to assume the risks of uncertain payoffs that accompany innovative activity. Firm size is an important consideration in the context of IPO firms because size – especially when measured by total assets – is subject to change as a consequence of the IPO. Firm size is measured as total assets in the IPO year. Because skewness was detected in this measure, the log of total assets is used in the analysis.

*Year of IPO.* The market’s receptivity to IPO’s varies over time. This varying interest could influence the decisions that firms make when trying to align themselves to market expectations. Consequently, any significant relationships between board composition changes and R&D spending could occur not because of any influence of one on the other but because both decisions are dependent on the state of the public equity market when the firm enters. The IPO’s included in this study cover the ten-year span between 1996 and 2005, a period containing years of both strong and weak IPO markets. Further, the IPO’s in this study are not evenly distributed throughout the period. The distribution of the 93 IPO’s in the sample is as follows: 1996 – 11 firms; 1997 – 23; 1998 – 2; 1999 – 4; 2000 – 37; 2001 – 3; 2002 – 1; 2003 – 4; 2004 – 5; 2005 – 3. To account for any influence of IPO year on the relationships of interest in this study, the year of the firm’s IPO is included as a control variable. The IPO year is coded using a series of dummy variables with 1996 serving as the base year to which the other years are compared.
Industry. As noted earlier, the sample for this study was drawn from only two industries. These two industries – biotechnology and semiconductor – are similar in that both allocate considerable resources to R&D and rely heavily on innovation as a basis for competition. However, there may be fundamental differences between these industries in behaviors that are central to the hypothesized relationships in this study. Therefore, a variable that indicates the firm’s industry is included in the analysis. This variable is coded as 1 if the firm is in the biotech industry and 0 if the firm is in the semiconductor industry.

RESULTS

The data were analyzed using OLS regression, and the analyses were performed using SPSS Statistics 17.0. A review of the correlations among the variables indicates that some correlations are significant. However, the highest correlation among the variables of interest in the hypotheses is only around 0.40. Additionally, the variance inflation factors (VIFs) conformed to the accepted guideline (3 or less) indicating that multicollinearity is not a concern with these data.

Table 1 presents the results of the regression analyses. Model 1 is the base model which includes only the control variables. Model 2 tests the hypothesized relationships. The negative coefficient associated with the percentage change in board size has a moderately significant p-value (p < .10). This result offers support for the negative linear relationship specified in Hypothesis 1. The coefficient for the change in the percentage of outside board members is not significant. Therefore, these data do not provide support for Hypothesis 2.

Hypothesis 3 predicted a negative linear relationship between the change in the percentage of VC members on the board and the change in R&D intensity. The negative and significant (p < .05) coefficient for the change in VC membership indicates that H3 is supported by these data. Hypothesis 4 predicted a positive linear relationship between change in the percentage of members having a science or engineering education and the change in R&D intensity. The coefficient for this variable is significant (p < .05) but it is negative, indicating that this variable is related to change in R&D intensity but in the opposite direction to that hypothesized. Finally, the positive and significant (p < .05) coefficient for the change in age diversity supports Hypothesis 5.

DISCUSSION AND CONCLUSION

This study contributes to the research stream that investigates the influence that characteristics of boards and of the individual board members have on the strategic decisions made by those boards of directors. The unique contribution of this study is that it considers how changes in board composition are related to changes in strategic decisions. The strategic decision investigated here is the spending level in support of innovation. Consistent with Hypothesis 1, the negative coefficient for the percentage change in board size suggests that R&D spending tends to decrease as board size increases. Since larger boards have more difficulty with coordination (Gladstein, 1984; Hackman & Morris, 1975), motivation (Herold, 1979) and participation (Gladstein, 1984), it may be more difficult to get consensus on risky moves. R&D is considered to be a high-risk expenditure due to the uncertainty of the payoff.

Hypothesis 2 proposed that the change in the percentage of outsiders on the board would be negatively related to the change R&D intensity. The logic underlying this hypothesis is that outsiders will bring an external, market orientation and consider short-term financial performance more than insiders who tend to be focused on the projects going on internally and their long-term potential. Hypothesis 2 is not supported by the data. One explanation for this result is that
outsiders serving on boards of IPO firms may have prior experience as managers or directors of IPO firms. This experience may increase their appreciation for the importance of the firm’s R&D spending to the long-term strategy of the firm. The fact that the change in board size is significant (hypothesis 1) but the change in outsiders is not suggests that getting agreement among an increased number of board members for maintaining the level of pre-IPO spending may be the issue more than any influence of outsiders.

Hypothesis 3, which proposed that a change in the percentage of board members who are VC’s will be negatively related to the change in R&D intensity, is supported by this analysis. This result indicates that, for example, an increase in the percentage of board members who are VC’s is associated with a decrease in the firm’s R&D intensity. This result is consistent with existing research demonstrating that, as firms become increasingly concerned with financial controls, innovation activity decreases (Hitt et al., 1996). IPO firms are facing market scrutiny for the first time, and VC’s are key representatives of the investment market perspective. Additionally, VC’s joining the board near the IPO date are likely to be late-stage financiers who tend to want a quick return on their investment and a quick exit. A firm that has obtained late-stage financing can perhaps show that the production of a marketable product and, correspondingly, sales and profits are imminent. Attention and the allocation of resources would naturally shift toward selling the new product, and the allocation to R&D could drop for these firms. Considered in conjunction with hypothesis 2, the results for hypothesis 3 suggest that it is not necessarily the addition of outsiders to the board that is associated with changes in R&D intensity but, instead, the perspective that those outsiders bring. Hypothesis 3 focuses on the perspective of VC’s.

Hypothesis 4 examines the effects of the board member’s educational background on R&D intensity. Although the coefficient for this variable is significant, the direction of the relationship is opposite to the hypothesized direction. This suggests that increasing the percentage of board members that have technical degrees actually decreases the firm’s R&D intensity. It is possible that a board with a higher percentage of members with such degrees place proposed projects under more scrutiny and analysis. Particularly in a case where the percentage increases as this indicates the addition of new board members with such a background and these new members may feel the need to establish their position and value to the board by exercising their expert power in this area. However, these results bear further investigation.

Age, the focus of hypothesis 5, can also serve as an indicator of the perspective of a board member. The results indicate that a change in age diversity among the board members is positively associated with a change in R&D intensity. This result is consistent with research indicating that heterogeneity and opposing viewpoints is positively associated with a group’s understanding of potential solutions to problems and to their commitment to decisions (Pelled, Eisenhardt, & Xin, 1999; Olson, Parayitam, and Boa, 2007). Age diversity is one dimension of heterogeneity among team members, and that heterogeneity can contribute to the group’s being supportive of change and new ideas. The perspectives of both young and old members of a board can facilitate the firm’s expenditures for R&D. Younger members have a longer-term perspective on the investment time horizon and, as a result, may support riskier expenditures. Older members may also be supportive of expenditures for research because they have the experience to appreciate how long research takes to pay off, particularly members who have worked with IPO firms or innovative, research-intensive firms in the past.

The implications of this study include, first, that changes in board structure at IPO do appear to affect strategic decision-making in the firm. The potential effect of board structure characteristics should be considered in forming the board prior to going public. Second, board members’
backgrounds and individual characteristics may influence key decisions such as investments in R&D. Because decisions such as R&D spending may have long-term implications, board members’ characteristics and the decision-making dynamics of board structure changes are important considerations as firms prepare to go public.

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REFERENCES


### Table 1: OLS Regression Estimates

<table>
<thead>
<tr>
<th>Dependent Variable: Change in Innovation Intensity (R&amp;D Expenditures/Total Assets for 3 years pre-IPO vs. 3 years post-IPO)</th>
<th>Model 1</th>
<th>Model 2</th>
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<tbody>
<tr>
<td><strong>Step 1: Controls</strong></td>
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<td>H2: Change in Percent Outside Members</td>
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<td>H3: Change in Percent VC Members</td>
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<td>H4: Change in Percent Members with Science or Engineering Educational Background</td>
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</table>

*a Standardized regression coefficients are reported.

* p < .05  ** p < .01  *** p < .001