

OUTSIDE BOARD COMPOSITION IN HIGH TECH START-UPS

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ABSTRACT

Boards of directors in large organizations have been subject to much empirical research, however, boards in start-ups have been a largely neglected research topic. The lack of research is surprising given that high tech start-ups have increasingly become multiple equity stakeholder firms. The rise in the number of equity stakeholders is driven by the increased availability of venture capital finance and the increased interest by public research organizations (including universities) in academic spin-outs. In this paper we address this research gap by examining board presence and composition in high tech start-ups. Drawing on agency theory, resource dependence theory and social network theory we examine the tensions that exist between the founding team and other equity stakeholders in determining outside board composition. Our results provide evidence that teams that have external equity stakeholders (e.g. VC firms and public research organizations) are more likely to develop outside boards that have complementary skills to the founding team. Conversely, in start-ups where the founding team has had autonomy in composing their own board the team tends to look for outside board members with similar or substitute human capital to the founding team.

INTRODUCTION

The literature on board composition has almost exclusively focused on large publicly held companies (Daily et al., 1998; Lynall et al., 2003). Only recently, research has explored the role and contribution of outside directors in small and medium sized enterprises (SMEs) (Huse, 2005; 2000). The study of board composition in SMEs is different from the study of board composition in large firms as SMEs are characterized by a lack of internal resources (Huse, 2000; Daily et al., 2002). Therefore, it is argued that boards in SMEs engage less in monitoring activities but rather act more as advisors to the managers (Ward, 1989). To date, one subgroup of SMEs that has remained largely understudied with respect to board activity is high tech start-ups. Only recently has research on the presence and evolution of boards in entrepreneurial ventures begun to emerge (Wasserman and Boeker, 2005). We find this dearth of research surprising given that entrepreneurial ventures, and in particular high tech ventures, are typically resource-poor and frequently have important external equity stakeholders such as providers of risk capital (e.g. venture capital firms) or providers of external technology (e.g. universities or public research organizations).

Agency theory suggests that board members may play an important monitoring function at the moment external stakeholders, such as venture capital (VC) firms and PROs (public research organizations – which include universities), get involved in the start-up. The external stakeholders will require the board to monitor financial disclosures and insider transactions with a sufficient level of external scrutiny and according to a prescribed set of expectations (Lynall et al., 2003).

In addition to a monitoring function outside board members are considered to have an important value-adding role to play in the development of high tech start-ups. High tech start-ups face the liability of smallness and the liability of newness (Henderson, 1999). The liability of smallness arises because small firms are unable to buffer themselves from market contractions due to the lack of financial resources and managerial weaknesses (Aldrich and Auster, 1986; Kale and Ardit, 1998). The liability of newness arises as the new firm needs to establish stable exchange relationships with

clients, creditors, suppliers and other organizations. New (and small) firms thus face problems associated with legitimacy (Aldrich, 1999). The human capital and networks (or relational capital) of board members may therefore be important resources in helping firms overcome the liability of newness and smallness (Hillman and Dalziel, 2003; Rosenstein, 1988; Deutsch and Ross, 2003) and may enhance the credibility and performance of the firm they serve (Certo, 2001). We define human capital, following Becker (1975), as a function of experience, education, expertise and reputation.

The presence of outside board members, however, is a necessary but not sufficient condition for the board to add value to the start-up. Outside members to the board can either bring human capital that is a substitute for, or a complement to, the founding team. In this paper we are interested in the conditions under which firms develop outside boards, and when the outside board members bring human capital that is complementary to, or a substitute for, the founding teams' human capital. Drawing on agency theory, resource dependence theory and social network theory we build a model to examine the tensions that exist between the different equity stakeholders in determining outside board composition. We test our model on a sample of high tech start-ups located in the Flanders region of Belgium.

The remainder of the paper is structured as follows. First, we provide an overview of the literature on board creation and composition. Second, we develop a model, with an accompanying set of hypotheses. Third, we present the sample frame, the sample itself and the data collection techniques employed in the study. Fourth, we present the results. Finally, we conclude and outline recommendations for future research and implications for practice.

THEORETICAL BACKGROUND

Agency theory suggests that boards of directors are formed to monitor managers on behalf of their shareholders (Eisenhardt, 1989; Jensen and Meckling, 1976). Powerful external stakeholders, therefore, may influence outside board composition (Jensen & Meckling, 1976; Fama and Jensen, 1983). In high tech start-ups, external stakeholders commonly are linked to the firm by either the provision of finance or technology. Equity providers may be a venture capitalist that invested alongside management due to the firm's potential for significant economic returns (Gabrielsson and Huse, 2005). Alternatively, a technology provider may be an academic institution or research institute that provided the technological resources for starting up the new venture (Clarysse and Moray, 2004). The fact that external equity stakeholders will demand the presence of outside board members to monitor their interests is a well established finding in the literature (see for example Rosenstein, 1988; Huse, 1998; Westhead, 1999; Fiegenger et al., 2000a, 2000b; Gabrielsson and Huse, 2002).

If external stakeholders are in power to change the board composition, a question emerges as to which people these stakeholders will attract in such a board. There are two conflicting perspectives which might explain the nature of board members that can be attracted. First, the resource dependency perspective explains that new board members will be attracted using rational criteria to increase the diversity in the board (Hillman and Dalziel, 2003). The main argument is that in order for the board to effectively monitor a venture the board should be comprised of individuals with a range of different human and social capital. Second, the social network perspective suggests that board members will be attracted in the social network of the stakeholders in power, be it the founding team or the external stakeholder such as the VC or the TTO (Technology Transfer Officer). This mechanism does not result in a rational selection of members to optimize board diversity but it results in the attraction of new members that belong to the same network, regardless the diversity they might introduce in the board. In the next paragraphs, we will discuss the two theoretical perspectives and their implication on board composition.

First, resource dependency theory views the firm as an open system, which is dependent on external organizations for the supply of key resources (Pfeffer and Salancik, 1978). The survival and success of a firm is dependent on the managers' abilities to manage the dependency of the firm on external resource providers (Pfeffer and Salancik, 1978). Blau (1964) argues firm strategy under resource dependency is to gain independence from one's environment. In the case of high tech start-ups, and other entrepreneurial ventures, the mentoring role of the board may be more important than the monitoring role (Fiegener et al., 2000; Wasserman & Boeker, 2005). Existing research has focused on the roles played by board members which include: advice and counseling, provision of legitimacy, acting as a communication channel, and provision of access to resources (e.g. Rosenstein et al., 1993; Deakins et al., 2000). The provision of resources and access to resources highlights the dependence that new ventures have on their environment. Consequently the management of high tech start-ups will try to acquire, access or develop resources that are strategic or scarce. Given the limited resource-base of a start-up, an outside board has the potential to be an excellent vehicle to obtain access to such scarce and/or strategic resources (Lynall et al., 2003). Under a resource-dependency logic outside board members will be chosen to maximize the provision of strategic and/or scarce resources to the firm. Consequently, firms will attract outside board members in order to initiate and maintain control over relationships, assets and contacts in the external environment of the firm (Gabrielsson and Huse, 2005). Hence, resource-dependency logic leads to the selection of outside board members that bring complementary resources to the company.

Second, social network theory provides an alternative insight into outside board composition. Social network theory examines how existing relationships influence behavior. In particular, the social networks of individuals, and more specifically their embedded relationships, will both facilitate and constrain behavior (Granovetter, 1985). Employing social network theory we argue that rather than attracting board members based on the complementarity of human capital and social capital, board members may be recruited from their existing social network. These individuals are likely to have

embedded relationships with the firm stakeholder because of the need for a good working relationship when acting in the stakeholder's interests (see: Uzzi, 1997). Consequently, the composition of the board may reflect the social networks of the principal stakeholders, such as the CEO and external financiers (Lynall et al. 2003). Furthermore, Bird (1989) argues that the recruitment of similar individuals is due to the social psychological needs of existing board members. Sapienza, Herron and Menendez (1992) state this position more strongly and argue that, "Whom they want to hire, is in part driven by a desire to duplicate their own qualities..." (Sapienza et al., 1992: 265). The social network perspective thus leads us to conclude that founding teams or external capital or technology providers will recruit board members from their own social networks. Consequently, external stakeholders will attract individuals with similar human and social capital to themselves.

MODEL DEVELOPMENT

In this section we build on the theoretical perspectives outlined above to develop a model of the impact of external stakeholders on outside board composition. The range and nature of different organizational stakeholders has been subject to debate (see: Dimovski and Brooks, 2004). Our focus in this paper is on primary equity stakeholders, namely those stakeholders that are, following Clarkson (1995), shareholders, investors, employees, customers, suppliers, government or communities, and that have an equity stake in the company. Employing this definition, equity stakeholders can be internal to the company, meaning that they are part of the founding team, or external (outside), meaning that they own an equity stake in the company but are not part of the founding team. In constructing our arguments we focus on the extent to which board members have complementary or substitute human capital to the founding team. Board members are defined as complementary if their skills or experiences are not available within the founding team yet, and substitutes if they have similar skill sets and experiences compared to the founding team members.

In the absence of external equity stakeholders founding teams may look to attract outside board members with complementary human capital in order to reduce their resource dependency. Conversely, due to the limited social networks of the founding team the attraction of complementary outside board members may not always be possible. We argue that although it may be in the best interests of the venture commercially to attract board members with complementary human capital the impact of the team's social networks will have the overriding effect. Therefore, in the absence of external equity stakeholders board composition will reflect the founding team's social networks and board capital will be a substitute for the human capital of the founding team. Hence:

H1: In high tech start-ups that have an outside board, with no external equity stakeholders, board capital will be a substitute for the founding team's human capital.

The power of the external equity stakeholders, e.g. VCs and PROs, to influence the board composition reflects the fact that they have provided resources that are important to the development of the venture such as the finance or technology respectively. Building on the arguments above we contend that where external equity stakeholders are present they will recruit outside board members that reflect their own social networks rather than necessarily recruiting board members with complementary human capital.

First, we examine the role of the PRO as a potential equity stakeholder in high tech start-up firms. The PRO is considered to be an external equity stakeholder if the high tech start-up originated from a PRO, and is dependent on the PRO for the intellectual property (IP).¹ The IP needs to be formally transferred from the PRO to the start-up. As the PRO controls a strategically important resource, the PRO has power over the founding team. Hence the PRO will be able to influence the composition of the outside board. As any outside board members that are added by the PROs will be drawn from their predominantly scientific networks, we anticipate that their backgrounds will be scientific in nature. Evidence of this practice is provided by Clarysse and Moray (2004) who describe how PRO management tends to install their own professors or members of the technology transfer office as outside advisors in the board of their academic spin-offs.

The argument above suggests that in the case of founding teams with mainly scientific R&D experience, and which rely on the PRO for critical technological resources, the outside board members will have human capital that is a substitute for the founding team. Conversely, in case of teams that mainly consists of people with commercial and/or financial skills, the outside board members will have human capital that is complementary to the founding team, given that this human capital is expected to be mainly built on R&D experience. This leads us to the following hypotheses:

H2a: In high tech start-ups with founding teams characterized by high levels of R&D human capital, where the PRO is an external equity stakeholder, board capital will be a substitute for the human capital of the founding team.

¹ Under the majority of national innovation systems in the western world (including Belgium) the PRO owns the rights on the technology and could then license the technology to the start-up. In return for transferring the IP to the start-up the PRO will commonly take an equity stake return.

H2b: In high tech start-ups with founding teams characterized by high levels of commercial or financial human capital, where the PRO is an external equity stakeholder, board capital will be a complement to the human capital of the founding team.

Second we examine the case where a VC firm is an external equity stakeholder in a venture. The presence of a VC firm shifts decision making power over outside board composition from the founding team, which is in need of financial capital, to the VC firm. Employing social network theory we argue that in the presence of a VC firm stakeholder the outside board capital will reflect the social networks of the VC firm rather than the need for complementary human capital.

In the venture capital literature there has been an extensive discussion about the potential value added role which venture capitalists may play through the introduction of outside board members (Sapienza, 1992). Research suggests that VC firms add little or no value added in terms of commercial support (Rosenstein et al., 1993). Rather, VC firms tend to support managerial strategy initiatives rather than developing strategies themselves (Fried et al., 1998). This finding is not surprising given that that the VC firm's human capital tends to be highly related to experience in financial management as opposed to actual business experience or experience of a high tech sector (Knockaert et al., 2005). Therefore, outside board capital where the VC firm is an external equity stakeholder will be in the area of financial management.

Building on the above arguments we argue that where the founding team has mainly R&D or commercial experience then outside board capital will be complementary to the founding team's human capital. Conversely, in cases where the founding teams mainly have financial experience, the VC firm-dominated boards will have substitute outside board capital for the founding team. Hence:

H3a: In high tech start-ups with founding teams characterized by high levels of R&D or commercial human capital, where the VC firm is an external equity stakeholder, outside board capital will be a complement to the human capital of the founding team.

H3b: In high tech start-ups with founding teams characterized by high levels of financial experience, where the VC firm is an external equity stakeholder, outside board capital will be a substitute for the human capital of the founding team.

The research model developed in this section is summarized in Figure 1. Hypothesis 1 considers board capital in case no external equity stakeholders are present. Hypotheses 2 and 3 suggest that the composition of the board, in terms of the degree to which the human capital of the outside board members is a complement or a substitute to the human capital of the founding team will be dependent on the social networks of the external equity stakeholder. In cases where there is no external equity stakeholder, the human capital of the outside board members will reflect the social networks of the founding team members.

---insert Figure 1 about here---

METHODS AND DATA

The sample

The high tech start-ups in this research are defined as new ventures, which have their own R&D activities and develop and commercialize new products or services based upon a proprietary technology or skill. Our sample of high tech start-ups is drawn from the Flanders region of Belgium. The advantage of using this region is that it provides us with a sample that is homogenous in terms of context. Flanders is a small, export-intensive economy, located in the northern part of Belgium. We selected Flanders because it is considered to be an emerging high tech region (Cantwell & Iammarino, 2001). To construct the sample frame, first we identified all the high tech start-ups among academic spin-outs, venture capital backed firms, and start-ups that received R&D subsidies. Second, we complemented our sample with a random selection drawn from the entire population of companies that are active in high-tech and medium high-tech industries. In total, our sample comprises 225 firms founded in Flanders (Belgium) since 1991.

For this study, data on the board of directors was collected for 140 companies. To judge whether the sample of 140 companies could be used to make inferences about the whole sample (225 companies), t tests and chi-square tests were performed on all relevant variables, including sector, company size and age, institutional origin, founding team characteristics and VC financing. Differences were significant for academic origin, the sector and the size of the founding team. The sub sample contained a higher proportion of academic spin-offs, a lower proportion of IT companies and had larger founding teams compared to the total sample. We account for these differences when commenting on our findings.

The 140 firms in our sample cover a wide range of technologies, including software (35%), micro-electronics (13%), medical-related technologies (16%), and others (36%). Thirty two per cent of the companies has an academic origin, and spun off either from university or a research organization. Twelve per cent of the companies had

received VC financing at time of start-up or within the first 18 years after founding, while another 38% have received external capital from other sources such as business angels, the university fund or informal investors. The companies in the sample had on average received 0.46 million Euro of external start-up financing.

The average size of the founding team is 2.36 people, with the smallest founding team having only 1 member and the largest 7 members. The background and experience of these founders is quite diverse, however, reflecting their technological origin. At founding 76% of the teams had R&D experience, 33% had commercial experience and 6% had financial experience. Finally, 35% had previous experience in another function, ranging from production to legal, consulting and engineering experience.

Data collection

The primary data source is a structured questionnaire, which enables the reconstruction of the firm's history and particularly focuses on the firm's resources, products, market characteristics, corporate governance and employees. The questionnaire was conducted during personal interviews with the founder or CEO. The founder or CEO was targeted because they typically possess the most comprehensive knowledge on the organization's history, the firm's strategy, its processes and performance (Carter et al., 1994).

Measurement of dependent variables

To test H1, H2a/b, H3a/b, we introduced two concepts in the research model, which we labeled board capital complementarity and board capital substitution. To measure board capital complementarity, we counted the number of board members that had complementary experience to the founding team. We distinguish between three categories of experience: R&D, commercial and financial experience. A board member is defined as being complementary to the founding team when he or she has experience in a category where none of the founding team members has experience. We measure board capital complementarity as the number of board members that have complementary

experience to the founding team. Conversely, board capital substitution is measured as the number of board members that had similar experience to at least one of the founding team members. As with board capital complementarity we use the three categories of experience as a starting basis. A board member is substitute to the founding team when he or she either has R&D experience, commercial or financial experience which is already available in the founding team.

The firms in our sample on average had 1.32 board members that were complementary to the founding team (standard deviation of 1.30), with a minimum of 0 and a maximum of 5. They had on average 0.89 board members that were substitute to the founding team (standard deviation of 1.13), with a minimum of 0 and a maximum of 5.

Measurement of independent variables

Academic origin. The academic or non academic origin of a spin-off was captured using a binary variable that took the value of 1 if the company had spun off from university or from a research organization and 0 otherwise.

Venture capital financing. In constructing this variable we constructed a binary variable that took the value of 1 if the company had received venture capital within the first 18 months after start-up finance and 0 otherwise. Please note that the venture capital situation in Flanders is quite specific, with only one VC managing substantial funds (GIMV) and a high number of funds managing relatively small amounts of financing.

Human capital of the founding team. We employ three different categories of human capital experience - R&D, commercial and financial experience. Commercial experience was defined as management or commercial experience within a company, ranging from sales management to business development. Financial experience is experience in audit, accounting, banking or other financial sectors. R&D experience is defined as experience in an R&D function within a corporate environment or in research in a research institution. The degree of experience in a particular category (e.g. R&D, commercial or financial) is defined as the cumulative number of years experience in a particular category divided by the total experience of all team members measured in

number of years. The degree of R&D, commercial and financial experience were all measured in the same way.

To measure board complementarity or substitution, we construct a new variable which is the interaction between the presence of a stakeholder such as a VC or a TTO (Technology Transfer Officer, which is the relevant stakeholder in the development of a new venture) and the degree of R&D, Commercial or Financial Experience. The interaction term between the external stakeholder dummy and the prevailing experience in the founding team shows to which extent the prevalence of this external stakeholder has an impact on the composition of the board. For instance, if the interaction term between the availability of a VC and the degree of financial experience in the founding team is positive and significant in the regression which explains the availability of substitute board members, this means that VCs will attract members with financial experience in the board, regardless the available competences in the founding team. The fact that it is significant also means that the VC is important in determining the composition of the board.

In the regression analysis, we use interaction terms of the degree of experience in a particular category and respectively VC finance and academic spin-off.

Control variables

Degree of team heterogeneity. Following Ucbasaran et al. (2003) we employ Teachman's (1980) scale to measure the heterogeneity of the team: $(H) = -\sum P_i (\ln P_i)$. This measure takes into account how team members are distributed among the different categories of a variable. The total number of categories of a variable equals 3, namely R&D experience, commercial experience and financial experience. P_i is defined as the number of years experience in function over the total team experience (measured as the number of years).

Statistical method and model specification

In order to model the effects of the influence of the external equity stakeholders and the nature of the founding team on board complementarity and board substitution we first had to address a potential selection bias problem. The selection bias problem may arise because ventures without outside board members will receive a figure of zero for board complementarity and substitution. It is well known that simply omitting such observations from the analysis can lead to biased estimates. One approach would be to estimate both decisions together using a Tobit model. This approach, however, involves the restrictive assumption that variables that explain the propensity decision are exactly the same as those that affect export intensity. In our view there is little *a priori* evidence that this should be the case, hence we employ the Heckman two-stage selection model (see, for example, Greene 2000: 926-937). The first stage involves estimating the existence of outside board members using a probit model. Stage two involves estimating board complementarity and substitution with the coefficients adjusted according to the results of the first stage.

In a first stage where we measured the existence of outside board members in a high tech start-up, we employed a binary logistic regression due to the binary nature of our independent model. The model took the form (equation 1):

$$\textit{Outside board members} = F(\textit{academic origin, VC finance, controls})$$

(1)

The control variables took the form of a vector of firm / industry variables including founding year, IT sector, sector experience of founding team and degree of team heterogeneity as outlined above. We used the founding year as control for the age of the company. All firms in the sample were founded between 1988 and 2002. Controlling for industry effects, we differentiate IT based companies and non-IT based companies. We define the dummy variable as 1 if the company is operating in the IT sector and 0 if the

company is operating in another sector such as biotech and microelectronics. We employed this variable to capture institutional characteristics which lead to mimetic isomorphism (Dimaggio and Powell, 1983). In order to control for sector experience of the founding team, we control for the number of founders that have experience in the sector the company operates in. The variable ranges between 1 and 3, and takes into account the cumulative sector experience of the founding team members in the same sector as the start-up. The variable takes value 1 if the founding team has cumulative sector experience of less than 3 years, 2 if the cumulative sector experience is between 3 and 6 years and 3 if the cumulative sector experience is higher than 6 years.

The final model took the form (equation 2):

*Board complementarity / substitution = F(degree of R&D experience, degree of commercial experience, R&D*VC funding, Commercial*VC funding, Financial*VC funding, R&D*academic, Commercial*academic, controls)*

(2)

The controls took the form of a vector which included the degree of heterogeneity of the team and the standardized residual of the auxiliary regression.

RESULTS

We are able to categorize our sample of high tech start-ups into three different types of firms according to the nature of external party involvement. First, high tech start-ups which originate from a PRO we term “academic spin-offs”. 70% of the academic spin-offs make use of a university pre-seed capital fund to start-up, 30% have no external capital at all. Second, high tech start-ups which have attracted VC firm investment within eighteen months after formal company formation we term “VC backed”. There are no examples of academic spin-offs which have substituted university seed capital for VC money. Finally, high tech start-ups that do not belong to the former two categories are categorized as “other”, these firms have no external equity stakeholder. The descriptive statistics for the three groups of firms that are included in our analysis are presented in Table 1. The three groups of companies differ significantly from each other on a number of variables, namely the degree of R&D experience, the external capital raised at founding, the size of the founding team, board size and number of outside board members.

---insert Table 1 about here---

Table 1 indicates that academic spin-offs have a significantly higher degree of R&D experience within the founding team. In addition, they raised a significantly lower amount of external financing compared to the VC backed companies, but a higher amount compared to the other companies in the sample that were neither VC backed nor academic. The size of the founding teams of academic start-ups and VC backed companies is significantly larger than the size of the other founding teams in our sample.

VC backed companies have significantly larger boards compared to academic spin-offs, which in turn have significantly larger boards than the other companies in the sample. Also the number of outside board members is significantly larger for the VC backed start-ups compared to the academic spin-offs and the other firms. Academic spin-

offs have significantly more outside board members compared to the other firms in the sample.

The presence of outside board members

Table 2 presents univariate statistics to describe the sample differences between high tech start-ups which have an outside board and those that do not have one. We find that 60% of the high tech start-ups in our sample have boards with outside members, which highlights the prevalence in high tech start-up companies.

---insert Table 2 about here---

The composition of boards

To test the hypotheses relating to board complementarity and board substitution, we employed a Heckman selection procedure in order to control for the probability of having outside board members. Table 3 shows the regression models after controlling for the probability of having an outside board. Model 1 employs board complementarity as the dependent variable and model 2 employs board substitution as the dependent variable. All variance inflation factors were below 3.0 (maximum value 2.47) suggesting that multicollinearity was not an issue (Hair et al., 1998).

---insert Table 3 about here---

With regards to hypothesis H1 we find partial support for the fact that founding teams that do form an outside board, but do not have external equity stakeholders have board capital that is substitute to the human capital of the founding team. We find that a higher degree of commercial experience in autonomous teams leads to a higher number of substitute board members ($p < .10$). This means that the higher the commercial experience within the autonomous founding team, the more often the founding team will

add people with similar (commercial) experience to the board. We find no significant evidence that the proportion of R&D experience in autonomous founding teams leads to attracting either complementary or substitute outside board members, even though the signs of the coefficients are in the expected direction. Our evidence suggests, therefore, to partially support H1.

Hypothesis H2a states that board capital of academic spin-offs will be a substitute for the human capital of the founding team where the human capital of the founding team is characterized by high levels of experience in R&D activities. Hypothesis H3b states that board capital of academic spin-offs will be a complement for the human capital of the founding team where the human capital of the founding team is characterized by high levels of involvement in commercial and financial experience. Our findings, however, do not support our hypotheses. We find that academic spin-offs with a high degree of R&D experience on board tend to attract outside members that are complementary, and thus have commercial and/or financial experience. This finding suggests that the TTO officers which are usually involved in the team composition of academic spin-offs have developed social networks with non-technical persons that might be interested in a board position. In addition, academic founding teams with high degrees of commercial experience tend to attract board members that have complementary experience compared to the founding team members, i.e. have R&D experience. Our qualitative interview data shows that often the professors, who have developed the technology often remain at the board of the new start up, while leaving it to the founding team to commercialize the technology. Again, it shows that TTO officers have been successful in developing social networks with commercial persons that might be able to further commercialize the technology. In summary, H2a and H2b do not receive support.

Hypothesis H3a argues that high tech start-ups with founding teams characterized by high levels of R&D or commercial human capital, where the VC firm has some power, will have board capital that is a complement to the human capital of the founding team. Hypothesis H3b argues that high tech start-ups with founding teams characterized by high levels of financial experience, where the VC firm has some power, will have board capital that is a substitute to the human capital of the founding team. Our results reveal that boards of VC backed firms tend to have outside members with commercial

and financial experience that is complementary to founding teams whose human capital is characterized by high levels of experience in R&D and commercial experience. Conversely, in founding teams whose human capital is characterized by high levels of experience in finance VC firms tend to develop boards with human capital that substitutes that of the founding team. Our findings do not provide sufficient support for H3a, but do provide support for H3b. These results indicate that VCs often appoint outside board members with financial experience to the boards of their portfolio companies. Our qualitative data show that the representatives of the venture capital firm in the boards of small firms usually has only financial experience. However, the entrepreneurs do not expect more from the venture capitalist they have attracted. So, they look for additional board members themselves, which can bring the commercial and/or technical experience which is necessary.

CONCLUSIONS AND IMPLICATIONS

In this paper we have sought to shed light on a relatively understudied area of governance in high tech start-up firms, specifically, the composition of an outside board in high tech start-ups at the time of founding. The study of boards in high tech start-ups is important since high tech start-ups are commonly resource-poor. In order to overcome this resource poorness, high tech start-ups will depend on their environment for the attraction of additional resources. Board capital, consisting of human and relational capital may help to gain access to these resources.

This research complements previous research in the domain that has analysed board composition and the roles of boards and the impact of external equity stakeholders on board composition (Fiegener et al., 2000; Molz, 1985; Rosenstein et al., 1993; Lee et al., 1999). However, in order to understand whether board composition helps to gain access to resources that high tech start-ups are so often lacking, it is important to study board composition and the potential of the board to help start-ups to gain access to external resources. Researchers studying board composition have indeed emphasized that it is mainly board capital that will determine whether the start-up can gain access to external resources through the board (Hillman and Dalziel, 2003). Therefore, we examined the composition of the external board, and looked at how this composition related to the composition of the founding team. If the human capital of the external board members is similar to that of the founding team members, the access to additional external resources may be limited. Therefore, we examine whether or not the external board has human capital that complements or substitutes for that of the founding team. Besides, we looked at how the presence of external equity stakeholders affected board composition and board capital.

First, we found that founding teams without external equity shareholders do not tend to compose outside boards with complementary human capital, that is they tend to attract board members with a similar human capital. This may be due to the fact that they lack the social network to attract this complementary human capital.

Second, VC firms tend to recruit board members that have financial human capital and so add complementary human capital to boards where the founding team does not have such financial skills. However, in the cases where the founding team was characterized by high degrees of financial human capital then the VC-firm did not add complementary human capital in terms of the board, rather the human capital it added was a substitute for the founding team's human capital.

Third, contrary to our expectations academic spin-offs (start-ups with a PRO as external equity stakeholder) tend to attract outside members that are complementary, and thus have commercial and/or financial experience. Furthermore, in academic founding teams with high degrees of commercial experience tend to attract board members that have complementary experience compared to the founding team members, i.e. have R&D experience.

These findings have a number of implications for practice. First of all, these findings have a number of implications for high tech entrepreneurs who are typically resource-poor. First, it seems that, without the presence of external equity stakeholders, such as PROs, they do not tend to complement their human capital with that of board members. Further research should indicate what causes their reluctance for the attraction of external board members with complementary human capital. This may be caused by their own fear of losing autonomy due to the presence of external board members, but it may also be caused by the fact that they lack the appropriate network for finding these external board members. If this is the case, there is a role here for intermediation by government agencies and public policy. Second, these findings raises new questions on the value-adding role of the venture capitalist. Our findings suggest that most VC-appointed outside members of the board are people with financial experience. Researchers in the resource-based view of the firm have found the founding team's commercial experience to be a particularly important determinant for the company's future growth and survival (Heirman et al., 2006; Roberts, 1991; Cooper et al., 1994). The attraction of a venture capital firm to the company's capital does not lead to opening doors to this critical commercial human resource, at least not by means of the board of directors. It seems that, if high tech entrepreneurs aim at gaining access to external

resources by adding a VC in the board, it has little affect on the attracting on these external resources, at least in the context that we studied them. Third, we find however that attracting a PRO as external equity stakeholder does have an impact on board capital and that these boards often have external directors that have complementary human capital to the founding team.

These findings have academic implications and shed light on the factors that may lead external board members to bring access to resources to the board. This research provides new insights to agency theory, resource dependence theory and social network theory. This research shows that, even though from a resource dependence perspective it seems natural that high tech start-ups attract external board capital that is complementary to the founding team, this rarely happens in practice. This may be explained by the fact that both founding team members and external equity stakeholders, such as VCs, lack the social network to attract complementary human capital to the board. In some cases, they may consider the board as an agency instrument rather than a value-adding instrument.

Figure 1: Research Model

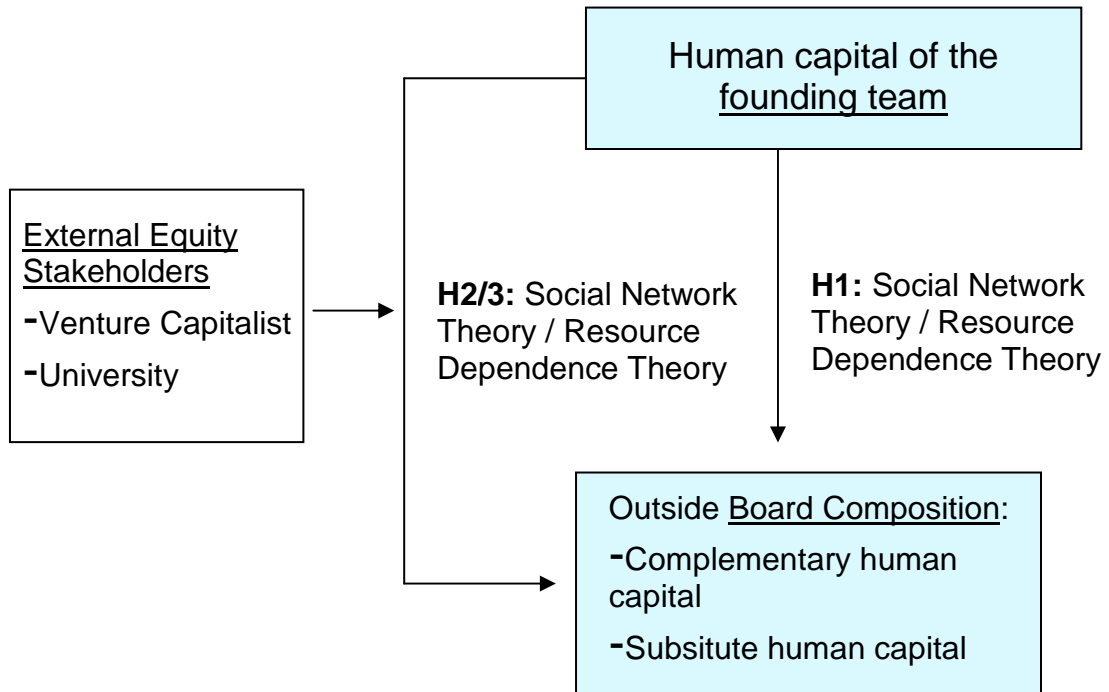


Table 1: Descriptives

	Academic Spin-off	VC-backed*	Other
Founding team heterogeneity	0.14 (0.25)	0.19 (0.34)	0.21 (0.29)
Degree of R&D experience founders****	0.87 (0.25)	0.53 (0.46)	0.48 (0.42)
Degree of Commercial experience founders	0.050 (0.10)	0.11 (0.23)	0.78 (0.13)
External capital at Founding****	404 290 (931 132)	2 086 032 (1 873 385)	75 355 (469 407)
IT sector	0.33 (0.47)	0.44 (0.51)	0.35 (0.48)
Size Founding Team***	2.84 (1.41)	2.50 (1.31)	2.05 (1.24)
Size Board****	4.75 (1.41)	5.63 (1.96)	3.07 (1.36)
Number of outside board members****	1.82 (1.45)	3.44 (1.46)	0.88 (1.18)

*high tech start-ups that are not academic spin-offs with venture capital within eighteen months after start-up

Kruskal Wallis Test; levels of significance: *=.10; **=.05; ***=.01; ****=.001

Table 2: Univariate statistics

	No outside board members	Outside board members	Overall
Sector			
IT	44.9%	55.1%	35%
Other	36.3%	63.7%	65%
External shareholders			
Academic origin**	26.7%	73.3%	32%
VC-backed****	12.5%	87.5%	12%
Overall	39.6%	60.4%	100%

Chi-Square Test. Levels of significance: *=.10; **=.05; ***=.01; ****=.001; n=140

Table 3: Regression (Hypotheses 1-3)

	Dependent variable= number of complementary board members	Dependent variable= number of substitute board members
	MODEL 1	MODEL 2
Independent variables		
Degree of R&D experience	-.833 (.521)	.730 (.452)
Degree of commercial experience	-1.456 (1.240)	1.963* (1.077)
Degree of financial experience	---	---
R&D * VC finance	1.834** (.706)	-.988 (.613)
Comm * VC finance	6.243**** (1.491)	-1.098 (1.294)
Fin * VC finance	-28.977 (24.23)	50.890** (21.034)
R&D * academic	2.491** (1.107)	-.042 (.961)
Comm * academic	.868 (4.776)	6.071 (4.147)
Fin * academic	---	---
Control variables		
Degree of team heterogeneity	.143 (.879)	.829 (.763)
Standardized residual of auxiliary regression	.262 (.326)	-.554 (.283)*
Constant Term	1.038** (.486)	.416 (.422)
F-value	4.040***	4.760***
R ²	.583	.622
Adjusted R ²	.439	.492

Levels of significance: *.10; **=.05; ***=.01; ****=.001; n=39

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