RELATIONAL PLURALISM IN DE NOVO ORGANIZATIONS: BOARDS OF DIRECTORS AS BRIDGES OR BARRIERS TO DIVERSE ALLIANCE PORTFOLIOS?

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Relational Pluralism in de novo Organizations:
Boards of Directors as Bridges or Barriers to Diverse Alliance Portfolios?

ABSTRACT

This paper develops relational pluralism as a collective construct whose dimensions are heterogeneity, multiplexity, and asymmetry. Relational pluralism is instantiated in the board of directors, whose network of relationships influence a new venture's ability to establish external links beyond the networks of the founding team. We argue that relational pluralism speeds the establishment of a diverse alliance portfolio, which in turn speeds the attainment of major revenue milestones in a new firm. We examine these ideas in a population of de novo semiconductor firms and find that diverse alliance portfolios emerge faster when a board includes members with heterogeneous, multiplex relationships, as well as central network positions. However, the asymmetric influence of outside board members can have both positive and negative effects: the alliance formation process is aided by outsiders in central network positions but impeded when central investors dominate the board. We discuss implications for our understanding of relational pluralism as a collective construct.

In this paper, we address the origins of diverse alliance portfolios in de novo organizations and their impact on organizational performance. It is well established that network relationships emerge from other relationships in organizations (Baker & Faulkner, 2002; Beckman, Haunschild, & Phillips, 2004; Gulati & Westphal, 1999; Lomi & Pattison, 2006; Mahmood, Zhu, & Zajac, 2011), yet our understanding of network origins is not complete. Contemporary theory offers a limited explanation of network structure emergence and the interdependencies that drive interorganizational relationships.

In particular, we examine how the structure and content of an initial set of organizational ties predicts important interorganizational relationships, specifically the creation of a diverse alliance portfolio. To understand a portfolio's origins, we draw on the idea of relational pluralism, defined as the extent to which an organization derives its meaning and possibility of action from other entities (Gulati, Kilduff, Li, Shipilov, & Tsai, 2010). We conceptualize relational pluralism as a *collection* of nested ties instantiated in the board of directors,[1] and we examine how multiple types of board ties influence the initial formation of alliance portfolios.

Relational pluralism highlights the power dynamics and interdependencies between different types of relationships within a network (Ranganathan & Rosenkopf, this issue; Rogan, this issue; Sytch & Tatarynowicz. this issue). For example, a network tie may bring multiple types of information (e.g., potential customers, marketing opportunities, or alliance partners). The distribution of information in the network—whether positioned centrally, in the periphery, or embedded in multiple nodes—can have positive or negative effects for the firm. Depending on where it resides in the network, information may facilitate a range of heterogeneous opportunities (e.g., new customers, financings, and alliance partners) or may direct a firm to

[1] We thank the editor, Andrew Shipilov, and an anonymous reviewer for this suggestion.

focus narrowly on a single opportunity (e.g., a particular customer focus). Specifically, we examine the heterogeneity, multiplexity and asymmetry in the network as key dimensions of relational pluralism. We show how these three dimensions describe a collective property of the board of directors' network, which helps shape the content of the firm's initial alliance portfolio.

In theorizing about the consequences of relational pluralism, we focus our attention on new ventures because we know the formation of social relationships is critical in this context. Without early external ties, new firms have an increased risk of failure (Singh, Tucker, & House, 1986; Stinchcombe, 1965). Furthermore, a firm's relational pluralism originates with the affiliations that people bring with them to the firm. Founders bring contacts, prestige, and expertise from prior experiences, and the founders' network is a key antecedent to subsequent relationships, such as venture capital financing (Burton, Sørensen, & Beckman, 2002; Eisenhardt & Schoonhoven, 1990; Hallen, 2008; Shane & Stuart, 2002). Building beyond founders' effects, we argue that a particularly influential source of network connections in new ventures is the founding board of directors. Board members are conduits to additional resources and contacts, such as attracting additional investments (Deutsch & Ross, 2003; Wasserman & Boeker, 2006). And unlike founders, board members can be simultaneously embedded in multiple networks due to their outside employment. This can result in multiple points of connection from any single board member, as well as divergent and competing views across board members. We theorize about the dimensions of relational pluralism and how the expertise, interests, and influence of the board shape the emergence of a diverse portfolio of alliances.

Furthermore, despite extensive research on boards of directors, we know little about boards in de novo organizations. Among established firms, boards of directors have a well-documented influence (for reviews, see: Beckman, 2010; Mizruchi, 1996) and are important

sources of information and social capital (Davis, 1991; Useem, 1979). However, research on founding boards is very sparse (Garg, 2013; Wasserman & Boeker, 2006) despite the fact that a new venture board is part of the foundation of the new firm and an important source of influence (Garg, 2013).

In sum, we ask: *How does the board of directors, as a collective instantiation of relational pluralism, shape diverse alliance portfolio emergence among de novo technology organizations?* We develop the dimensions of relational pluralism and explore their impact on alliance portfolio formation. We find a potential trade-off between the breadth of knowledge and social connections that board members bring, and the potential for a board member to channel firm activity in a specific direction given his or her relative power on the board. We find that heterogeneous and multiplex board ties have a significant positive impact on diverse alliance portfolio emergence. The analysis also reveals a dual effect of asymmetric board ties—portfolios emerge more quickly when there are multiple central board members and when a dominant outsider is on the board (without an investor tie), but portfolios emerge more slowly when an investor board member is dominant. In addition, we show that alliance portfolios have important consequences for the speed with which de novo organizations reach important revenue milestones. These results emerge from an empirical event history analysis of U.S. semiconductor firms founded between 1978 and 1985 and followed until 2002. Our study enhances knowledge about the dimensions of relational pluralism as a collective and its impact on the important outcomes of diverse alliance portfolios and attainment of firm revenue milestones.

RELATIONAL PLURALISM IN A COLLECTIVE

Prior research has shown that social relationships emerge from other relationships and thus should not be studied in isolation (e.g., Lomi & Pattison, 2006; Sytch & Tatarynowicz. this

issue). Instead, scholars must examine multiple types of ties and the structure of multiplex networks. For example, Shipilov and Li (2012) explore the dynamics of triads between two producers and a consumer and find that vertical relationships with customers drive the formation of horizontal relationships between producers. They show that it is both the type of ties (e.g., with customers and producers) and the structure of the network (e.g., triads) that brings opportunities and constraints to the firm (see also Ranganathan & Rosenkopf, this issue). This focus on tie content and structure provides a useful starting place to understand how relational pluralism provides theoretical purchase.

We argue that relational pluralism is best described as a *collection* of multi-faceted ties that shape organizational action through the depth and distribution of expertise and influence. Our definition bridges what Borgatti and Foster (2003) term connectionist and structuralist perspectives of networks. Connectionists attend to the content and type of information flowing through ties. Structuralists focus on the position and equivalence of actors as well as the structure of the network. As a collective construct, relational pluralism captures both the structure and content of a network by focusing attention on the content and distribution of different types of ties, as well as the interdependencies among them.

The board of directors can be usefully examined as an instantiation of relational pluralism. Consider the board of a startup—as soon as the first outside member joins the board of directors, the firm is connected to a larger community of organizations and draws status and resources from the outside board members. The board acts as a repository of multiple relationships with particular expertise and opinions, and relational pluralism develops through the structure of these board relationships. The board creates the heterogeneous, multiplex, and asymmetric relationships of the collective that shape the actions the focal organization can take.

As a collectivity, the board embodies a set of relationships that can simultaneously exhibit complementary, competing and conflicting goals.

Consequences of Relational Pluralism

Relational pluralism shapes how new ventures establish interorganizational ties and obtain important firm outcomes. We focus specifically on diverse alliance portfolio emergence, which is a key organizational outcome and central to current research on interorganizational relationships (Gulati, 2007; see Wassmer, 2010, for a review). An *alliance* is a voluntary arrangement among independent firms to exchange or share resources and to engage in the co-development or provision of products, services, or technologies (Gulati, 1998). An *alliance portfolio* is defined as a firm's collection of direct alliances with partners (Lavie, 2007). Recent work has found that *diversity of the alliance portfolio* predicts firm performance (Jiang, Tao, & Santoro, 2010; Koka & Prescott, 2008). A diverse alliance portfolio may improve performance by providing a range of resources that the firm has not yet had the ability to develop. When resources are redundant, the firm bears the cost of maintaining ties without the benefits of additional resources or knowledge. To this point, Baum, Calabrese and Silverman (2000) find that the diversity of types of alliances predicts growth in revenues, R&D spending, and patenting in biotechnology startups. Among entrepreneurial companies in particular, having diverse types of alliances (not merely a large number of alliances) drives firm performance (Bruyaka & Durand, 2012; Mouri, Sarkar, & Frye, 2012; Ozcan & Eisenhardt, 2009; Watson, 2007). This suggests that diverse alliance portfolios have positive firm-level consequences and are an important outcome to examine.

The Dimensions of Relational Pluralism as a Collectivity

To foster further research, Gulati et al. (2010) outlined three dimensions of relational pluralism: *heterogeneity* is defined as the extent to which actors form connections with others from quite different backgrounds, *multiplexity* is the extent to which actors are connected by more than one type of relationship, and *overlap* is the extent to which the focal actor's relationships are clustered in one group or span different groups. We examine all three dimensions; however, we use the term *asymmetry* rather than overlap because our theoretical attention is on the distribution and differences across ties rather than the density or overlap among the ties. To explore these dimensions, we examine the types of ties and the structure of the board network.

Heterogeneity. First, we argue that board heterogeneity provides the firm access to a broad range of alliance opportunities. We focus on diversity as a source of variety (Harrison & Klein, 2007), which brings unique information and opportunities that provide firm-level advantages (Baum et al., 2000; Beckman & Haunschild, 2002; Shipilov & Li, 2008). In particular, research shows that outside board members influence alliance formation (Beckman et al., 2004; Gulati & Westphal, 1999), and we extend this to suggest that board member hetereogeneity should increase the breadth and diversity of a firm's alliance portfolio. The central idea is that a heterogeneous board will provide a firm with a range of opportunities and ideas about collaborating with other firms. Indeed, research finds that boards with heterogeneous industry experience contribute more to board discussions and provide more advice in unstable competitive environments (Carpenter & Westphal, 2001). We extend these findings to suggest that board contributions and advice giving in entrepreneurial contexts (i.e., unstable environments) will translate into the focal firm forming different types of alliances.

We address three dimensions of board heterogeneity. First, outside board members often come from different industries (Garg, 2013), and each industry may rely on different alliance types and strategies. For example, board members from biotechnology may have experience with R&D alliances (Powell et al., 1996), whereas board members from software industries may have expertise and information about marketing alliances (Swaminathan & Moorman, 2009). Second, board members from different types of organizations (e.g., government agencies, financial firms, non-profits) provide different types of advice and counsel (Hillman & Dalziel, 2003). This should provide differential information about alliances: for example, universities are a likely source of in-licensing agreements, while large, established organizations are a likely source of commercialization alliances (Stuart, Ozdemir, & Ding, 2007). Thus board members from heterogeneous organizational types should facilitate diverse alliance portfolios. Third, board members may come from different geographic regions, with different regulations and local histories of interorganizational relationships (Marquis, 2003). For example, differences between Silicon Valley and Route 128 in Boston have been detailed by Saxenian (1994) and the different histories indicate different network structures and preferences. This, in turn, may suggest particular alliance strategies that are regionally specific.

In sum, the firm has access to a broader array of perspectives and information when outside board members span a range of industries, organizations, and regions. Heterogeneous ties provide firms with the information, opportunities and expertise to establish a range of types of alliances (e.g., partners for manufacturing, licensing, and joint product development). As a consequence we hypothesize:

> *H_1: The greater the heterogeneity of the board, as indicated by the diversity of board experiences, the greater the rate of diverse alliance portfolio emergence in de novo organizations.*

Multiplexity. We next argue that board multiplexity will facilitate the formation of diverse alliance portfolios. Multiplexity is defined as two or more different relationships between the same actors (Wasserman & Faust, 1994). For example, a board member who is also an investor or a customer creates a multiplex tie and brings additional information to the firm through this additional point of connection. Between two firms, multiplex ties indicate stronger relationships due to deeper, shared information and more trust between partners. In turn, trust facilitates the creation of subsequent ties (Gulati & Westphal, 1999). In particular, the knowledge and trust provided by multiplex ties may facilitate the formation of new higher risk interorganizational ties such as alliances (Kenis & Knoke, 2002).

However, just as there are different attributes of board members, board members bring different types of relationship multiplexity. Customer and supplier networks have been linked to the development of technological knowledge and research and development expertise (Mahmood et al., 2011). Thus, a customer-board member may provide connections to suppliers, insights about the market, and information about joint product alliances. Firms with venture capital investors, in contrast, are more likely to have research and development and licensing alliances (Hsu, 2006; Ozmel, Reuer, & Gulati, 2012). If a firm's board has customers *and* investors as members, there is a greater likelihood that the firm will have deep knowledge about multiple types of alliances. As a result, when a board is comprised of different types of multiplex ties, where multiple viewpoints are embedded in ties, board members will bring information about different types of alliances. This in turn will facilitate diverse alliance portfolio formation. Therefore, we hypothesize:

> *H_2: The greater the multiplexity of the board, as indicated by board members' multiple types of ties, the higher the rate of diverse alliance portfolio emergence in de novo organizations.*

Asymmetry. Our final dimension of relational pluralism is asymmetry. Here we move away from a strictly connectionist view of networks and also examine the content and types of board ties, thereby accommodating structuralist views (Borgatti & Foster, 2003). Rather than focus on the information advantages of a firm's breadth of ties, we focus on how the distribution of ties may enable or constrain firms by distributing influence across the network. When ties are concentrated or clustered together, the network will be balanced and all board members will have influence. However, when the structure of the network provides certain board members with more influence than others, there will be asymmetry in the network. Asymmetry in the structural position of board members is likely to translate into asymmetry of power and influence among board members. Ahuja, Polidoro and Mitchell (2009) find that the greater the centrality asymmetry, or the difference between the centrality of two partners, the more one partner is able to secure more favorable terms over another. More generally, interdependence is often asymmetric, and the actor with the greater advantage will exert more influence (Emerson, 1962; Gulati & Sytch, 2007; Pfeffer & Salancik, 1977). Furthermore, power imbalances can have negative consequences for the firm (Casciaro & Piskorski, 2005; Katila, Rosenberger, & Eisenhardt, 2008).

We extend the concept of power asymmetry to consider the distribution of centrality among a new venture's board of directors. There are critical power and information asymmetries between board members that can be captured by differences in network centrality (Khaire, 2010; Stuart, 1998). Furthermore, as Garg (2013: 93) notes, new venture board members "have other goals, such as enhancement of their own status, participation in more boards, and a particular interest in venture innovation, [and] they often represent their institutions and may have conflicts with other portfolio ventures." Although board members are likely to prefer that the new venture

succeed, the path and preferred pace of success is likely to differ widely among board members. As a result, the board members of a new venture may offer divergent advice that the new venture's managers must reconcile. These differences across board members create uncertainty as to the appropriate course of action for a venture. In essence, we may see principal-principal problems (rather than traditional principal-agent problems) because conflicts are likely between the various principal board members (Garg, 2013).

When the distribution of network centrality among board members is uneven, we hypothesize that those board members with greater centrality will be attended to, while the perspectives of other board members will receive less attention. While the distribution of power within the board or between shareholders is an understudied phenomenon in corporate governance (Jara-Bertin, López-Iturriaga, & López-de-Foronda, 2008), our hypothesis is consistent with the group literature. Here scholars find that high-status group members tend to dominate when status is heterogeneous across group members (Wittenbaum & Bowman, 2005). Although central board members are particularly important for entrepreneurial firms because they signal status and quality, a broad range of perspectives and information is necessary to develop an alliance portfolio. Thus, when the network is asymmetric, and the centrality of board members is unevenly distributed across the board network such that a few board members dominate, the firm will be less able to draw on the expertise of the full board. More formally:

> *H_3: The greater the asymmetry of the board, as indicated by the distribution of board member centrality, the lower the rate of diverse alliance portfolio emergence in de novo organizations.*

In addition to the structure of the board network, we also attend to the content of relationships that are asymmetric. This allows us to combine the structuralist and connectionist accounts and examine both the type of tie and the structure in which the tie is embedded (Ahuja,

2000; Mahmood et al., 2011). We examine whether certain *types* of ties are in central structural positions (see also Wang, Rodan, Fruin, & Zu, this issue), and we theorize about whether these types of board ties will restrict or encourage information flow and diverse alliance formation. Certain *types* of ties may have interests that converge or diverge from other ties, and the structure of these ties will impact their influence (Rogan, this issue). In particular, we examine whether a board member has multiplex ties, and we examine the structural position of such ties. Rather than looking at the aggregate multiplexity or heterogeneity in the network, here we look at the content and structural position of individual board ties.

A multiplex tie in a central structural position should have particular influence. As argued above, central structural positions are particularly influential and can lead the firm to focus more intently on the central actor's perspective and information. However, board members with multiplex ties are also influential because of the depth of their connections to the focal firm (Beckman & Haunschild, 2002). Thus, a structurally central and multiplex tie should be particularly influential. This tie may be the dominant voice on the board and restrict the amount of information shared by all board members (e.g., Wittenbaum & Bowman, 2005). This will limit the ability of the firm to develop a diverse alliance portfolio as information will be drawn from fewer sources.

In the context of de novo firms, we focus on investor-board members as the most influential multiplex tie. Although all outsider-board ties bring outside influence and expertise to the firm, the investor-board member is a multiplex tie that also brings a source of financing. Investor relationships are particularly important to new firms—founders with ties to venture capitalists are more likely to obtain venture capital (Shane & Stuart, 2002), and venture capital backing increases the likelihood of filing for an initial public offering (Beckman, Burton, &

O'Reilly, 2007). Yet these powerful relationships are also ripe for excessive influence and dependence because investors often have significant financial interests (commonly 20%) as well as control rights that can force the firm to shut down or sell (Gompers & Lerner, 1999; Lerner, 1995; Sahlman, 1990). This gives investors a relatively large voice in strategic decisions, like identifying alliance partners (Gorman & Sahlman, 1989).

In addition, investor-board members may focus narrowly on a particular subset of alliances or take a short-term view. Investor-backed firms are more likely to favor particular exit strategies like an initial public offering (Hsu, 2006) and attempt to go public faster, especially during economic booms (Gompers & Lerner, 2001). In addition, investor-board members may be more reliant on ties within their own network and be unwilling to create alliances beyond directly known firms. For example, investor-backed firms are narrower in their alliance choices and are more likely to ally with other firms who share the same investor (Lindsey, 2008). Furthermore, it is through existing ties to venture capitalists that firms most often obtain subsequent venture capital (Shane & Stuart, 2002). This suggests that investor-board members may narrow the breadth and type of alliances that are formed.

In contrast, non-investor outside directors are sources of more generic knowledge and strategic information (Mahmood et al., 2011). Outside directors focus broadly on providing advice to the firm (Garg, 2013). An outside board member who does not have an additional relationship with the focal firm (i.e., does not have a multiplex tie) thus provides more generic knowledge rather than particular expertise. Drawing from the literature on groups, we note that information processing is more likely to be biased when there are pre-discussion preferences among group members (Wittenbaum, Hollingshead, & Botero, 2004). In such situations of strong preferences, not all information is shared among the group. In our context, outside board

members, because of their generic knowledge, are less likely to have strong preferences or biases than a board member with a particular view (e.g., an investor-board member). When this outside board member holds a central structural position, it will not discourage a firm from attending to the alliance knowledge of other board members in less central positions.

Taken together, the asymmetries in board member centrality help alliance portfolio formation when the most central board member is one who has broad, generic knowledge rather than a particular perspective. Thus, not only does the distribution of influence matter, but it is particularly important to understand the types of ties in positions of power—a dominant outsider plays a very different role than a dominant investor. In sum, we argue that when the asymmetry between the outsider and investor-board member's centrality favors the investor-board members, the firm will be slower to develop a diverse alliance portfolio. When central outside-board members dominate the board, the generic expertise of the outside board member will facilitate the sharing of information and the formation of diverse alliance portfolios. Thus, we hypothesize two contrasting effects:

> *H_{4a}: The greater the asymmetry of the board, with outside directors having dominance, the greater the rate of diverse alliance portfolio emergence in de novo organizations.*
>
> *H_{4b}: The greater the asymmetry of the board, with investor-board members having dominance, the lower the rate of diverse alliance portfolio emergence in de novo organizations.*

In summary, the board of directors represents an instantiation of relational pluralism, and in conceptualizing the board as a collective, we consider the composition and dynamics of board experiences. Heterogeneity and multiplexity should provide more unique and deep information to the new venture. However, asymmetry among board ties may enable or constrain the new

venture's opportunities, depending on the type of asymmetry, by shaping attention and creating dependencies.

The Consequences of Initial Alliance Portfolio Formation

Once a de novo organization has formed its initial alliance portfolio, it holds a position in a larger network of interorganizational relationships (Hallen, 2008). Given membership in a larger organizational network, we can investigate whether the de novo organization is able to extract economic value from its portfolio. Although not central to our theoretical development, studies suggest diverse alliance portfolios should increase firm survival and performance (Bruyaka & Durand, 2012; Jiang et al., 2010; Watson, 2007). Thus we expect that creating such a portfolio early in the new firm's life will significantly shorten the time it takes to reach major revenue milestones. When an organization quickly secures multiple relationships with other organizational actors, the conventional risks of newness, illegitimacy, and organizational inexperience are mitigated (Hite & Hesterly, 2001; Khaire, 2010; Stinchcombe, 1965). Interorganizational alliances may accord advantages to startups that are typically associated with more mature organizations such as access to strategic and operational know-how (Teece, 2002), innovative capabilities (Powell, Koput, & Smith-Doerr 1996), or the perceived quality and reliability of its products and services (Stuart, Hoang, & Hybels, 1999). Therefore, we hypothesize:

> *H_5: Forming a diverse alliance portfolio will speed the attainment of important revenue milestones in a de novo organization.*

METHODS

Data and Population

We studied the emergence of diverse alliance portfolios in a population of de novo semiconductor firms. Proprietary data were collected directly from 105 semiconductor firms founded in the U.S. between January 1978 and December 1985, which include all new semiconductor merchant producers founded in the continental U.S. during this period. A de novo organization is defined as a private firm founded independently for the purpose of developing, manufacturing, and selling semiconductor components on the merchant market (called merchant producers). Excluded, by definition, are captive producers, firms that were in-house divisions and subsequently spun off, electronic distributors, and electronic design houses that design for others and neither produce nor market microelectronic devices. A master list of the population of all new merchant semiconductor producers was compiled from industry lists and directories. After eliminating duplicates across lists, we contacted the CEO of each firm and eliminated nine from further study because they did not meet the population definition above. One firm was subsequently dropped because the CEO was imprisoned for reporting illegal financial data to the SEC and we were not confident in the quality of the data. The final *n* for analysis is 104 cases or 99% of the identified population. We have company-level data from the firm's founding through 2002 or the venture's death.[2]

Capturing the full population of de novo semiconductor firms in the U.S. during this period reduces the survival bias common in entrepreneurial research. Typically, data on young

[2] Date of founding (month and year) was obtained from the founder or member of the founding top management team. We define organizational death as closing the organization's doors for business because the company ceases to be identifiable as a separate organizational form (Freeman, Carroll & Hannan, 1983: 694). We distinguish death from mergers and acquisitions, which indicate a change in the ownership status of the firm, but not necessarily its death as an operating entity. If an acquired or merged organization continued to operate as an independent subsidiary with accessible performance data it was coded as surviving, otherwise it was right censored at the time of acquisition.

firms are obtained from skewed samples, such as firms that have an initial public offering event (IPO) or receive venture capital (e.g., Thomson Venture Economics / VentureExpert databases), or are of a certain size (e.g., Dataquest sells data on semiconductor firms with $10 million and greater in revenues). For a study in our context, relying only on published sources would be problematic as just 39% of our population had an IPO event; only 46% received venture capital; and only 56% reached $10 million in revenues.

We selected 1978 as the first year of the study period, following Schoonhoven, Eisenhardt and Lyman (1990) and Katila, Rosenberger and Eisenhardt (2008). By this year, the Investment Tax Incentive Act (ITIA) had passed to reduce the capital gains tax, and the Employee Retirement Income Security Act (ERISA) was enacted and loosened restrictions on the investments of institutional investors. As a result, new firm births in the semiconductor industry dramatically surged between 1978 and 1985 (Dataquest, 1987: 3).

In the first wave of data collection between 1986 and 1988, we conducted structured interviews with founders, CEOs, and key executives, most on site and a few by telephone. Supplementary forms were used to gather financial history data (income, balance sheet, equity investments) and head counts over time by various job categories. For all data collected, we recorded the year and typically the month of key events and constructs (e.g., board member changes) from firm founding through their age in December 1987. Subsequently, five more waves of data were collected by telephone and through archival research, tracking interorganizational partnerships through 1990 (board and alliances) and outcomes through December 2002 (survival, acquisition, sales, and IPO). Thus we have board and alliance data from founding until 1990 (and use this to measure alliance portfolio emergence) and annual revenue data until 2002 (and use this to measure revenue milestones). Firms are right-censored at

time of death, or at the end of the observation period (December 2002). Over the observation period, 43% of the organizations survived ten or more years.

Dependent Variables

Diverse alliance portfolio emergence. Bruyaka and Durand (2012) define alliance portfolio diversity as having multiple types of alliance partners (see also Jiang et al., 2010; Mouri et al., 2012). However, in an entrepreneurial context the speed of making decisions and obtaining resources is also critical (Eisenhardt, 1989; Schoonhoven et al., 1990), therefore we present results on the speed with which a firm is able to establish three different types of alliances. Empirically, our measure of a diverse portfolio takes into account the timing and type of alliances. In addition, we examine another measure of diverse portfolio emergence: a Blau measure of diversity for types of alliances in the portfolio. We discuss differences between these measures in the results. Both measures acknowledge that managing a portfolio of alliances, and particularly several different types of alliances, is a complex management undertaking for a de novo organization with limited human resources. The correlations between the Blau measure and three types of alliances is $r = 0.40$. In our population, 63% of the firms obtained an alliance portfolio with three or more types and the average firm takes 2.4 years to obtain an alliance portfolio with three types. When we use diverse alliance portfolio as an independent variable for Hypothesis 5, we use the cumulative number of types of alliances (updated monthly) as our measure.

We focus on all formal alliances formed early in the new ventures' lives (not only with other new ventures), but exclude ties to investors, a form of interorganizational relations that are not formal strategic alliances (e.g., Hallen, 2008). We collected monthly data on 626 unique alliances through 1990, with 1986 the peak formation year. Accordingly, we have the month-

year for the start and end of each alliance. Nearly 40% of these alliances endured for more than two years. Figure 1 contains descriptive information on the numbers, types, and timing of the different alliance types in our data as described to us during the interviews. Empirically, we observed twelve different alliance types, and the highest number of alliance types formed by a single firm was eight. The most common alliance types were manufacturing alliances, followed by technology licensing alliances, then joint product development alliances. These three types accounted for 82% of all alliances. This makes sense as firms founded after 1977 were often "fabless" semiconductor companies when first formed (i.e., they had no manufacturing facilities). Given the multi-million dollar cost of a new Class 1 semiconductor fabrication facility, forming alliances with existing manufacturers brought products to market faster than the time- and money-consuming path of building in-house fabrication facilities.

Insert Figure 1 about here.

Revenue Milestones. The second dependent variable is whether and when important revenue milestone events are reached. We code the year in which the firm obtains $10, $20, and $50 million in annual revenues. In interviews, venture capital and angel investors reported that attaining revenues between $10 and $20 million annually are a signal that a de novo venture is "doing well" (and may eventually be an IPO candidate or an acquisition target). Therefore, we use the $10 and $20 million milestones in the analysis. To examine a longer-term effect, we also predict to $50 million in revenues.

Independent Variables

Board Heterogeneity: 3-dimensional Blau index. To capture board heterogeneity, we created a Blau measure across three board attributes. The Blau index is useful when the underlying assumptions are about information breadth and variety and the variables are

categorical (Harrison & Klein, 2007). We consider three attributes of outside board members: (1) whether the board members are in different regions (U.S. states); (2) whether the board members' organizations are in different 2-digit SIC codes; and (3) whether the board members represent different organization types (e.g., a venture capital firm, a manufacturing firm, a research institute, a bank—including investment banks, a university, a corporate investor, or other organizations). We first calculate a separate Blau index for each attribute, then obtain their geometric mean to create a combined Blau index, as noted in Table 1. The separate Blau indices are correlated between $r = 0.75$ and 0.86, which suggests that combining the indices to a single measure has convergent validity and captures the same underlying construct: variety and breadth of information (Harrison & Klein, 2007).[3]

Insert Table 1 about here.

Board Multiplexity. A multiplex board tie is when an outside board member has another relationship with the focal firm. For example, an outside board member could be a customer, an investor or a "parent." Parent ties are with firms for whom two or more of the founders worked previously. Parent ties have been shown to be influential affiliations (Beckman, 2006; Burton et al., 2002). We counted the total number of types of board multiplexity (e.g., customer, investor, or parent) across all outside board members. This was calculated yearly through 1990 and ranges from no ties to all three types of multiplex ties (mean = 0.71; s.d. = 0.66). Depending on the year, roughly 10% of the firms have more than one type of multiplexity. Approximately 40–60% of the firms have one type of multiplexity on the board.

Board Asymmetry. For our first measure of asymmetry, we consider the asymmetry of board centrality within a focal firm. We measure centrality asymmetry in the board network by

[3] We find similar results with a Blau measure using an arithmetic mean, a Blau measure comparing each board member to the focal firm, as well as a Euclidean distance measure of differences between board members.

calculating the skewness of board centrality scores (Cowan & Jonard, 2009). When there is no skewness, centrality scores are evenly distributed around the mean. However, positive skewness indicates a longer tail on the right-hand side of the distribution with more centrality scores below the mean, whereas negative skewness indicates a long left-hand tail with more centrality scores clustered above the mean. Skewness in either direction suggests influence is unevenly distributed across the board (with either a majority of highly central board members, or a majority of low centrality board members).

We first measure the centrality of each board member in the industry. We identified all U.S. semiconductor firms in operation between 1977 and 1990 from Semiconductor Industry Association (SIA) directories and Dataquest, for a total of 246 firms. The founding and subsequent board members and their affiliations for the 104 new ventures were collected during interviews. For subsequent years, we referenced industry sources including Dataquest. For the public firms in the population, we used *Standard & Poor's Register: Directors and Executives* between 1977 and 1990 to collect board members' employers and board memberships. In total, we collected board data on 167 firms in the population (new ventures and public firms), accounting for 68% of the population. The missing firms are mostly private, mid-size companies for which board data are unavailable. Centrality is calculated using yearly board-member-level matrices. We first create a firm-affiliation matrix from which we create an affiliation-affiliation matrix and calculate a board member's standardized degree centrality score. The centrality measure captures the number of ties for each board member. Following the equation in Table 1, we then calculate skewness for each focal firm.

Our second measure of asymmetry captures the extent to which a board is dominated by one group (e.g., outside directors) rather than another (e.g., investor directors). This is measured

as the difference in centrality between the most central non-investor outside board member and the most central investor-board member in each year. To do this we create two different matrices and calculate degree centrality for each board member. Thus investor centrality is not a subset of board centrality. As large public companies are older and not often tied to venture capital firms, the investor-board network is comprised mostly of ties within the new ventures. The investors on the boards of the new ventures represent 54% of the investors for early and seed investments in the U.S. semiconductor industry between 1978 and 1990 (as listed by Thomson Reuters). It is clear that we are capturing a majority of the investments in the industry during the period studied. Given that we are interested in investors who occupy board seats, the fact that we are likely capturing the investors most central in the semiconductor network is important. However, only 36% of the investments mentioned by our firms are listed in Thomson. These latter results suggest we actually capture a much greater amount of the industry investment than indicated by Thomson, which is consistent with studies finding that the existing databases tend to underreport actual financing (Kaplan, Sensoy, & Strömberg, 2002).

Next we use a spline method to separate the differences into investor dominance and board dominance following the performance feedback literature (e.g., Greve, 1998, 2003). *Outside-Director Asymmetry* is the difference in centrality between the top outsider and top investor board member when the outsider has higher centrality and is zero otherwise. *Investor-Director Asymmetry* is the difference when the investor-board member has higher centrality and is zero otherwise (see Table 1 for the equations).

Controls. In all models, we controlled for founder and firm attributes that can be expected to influence both alliance and revenue outcomes. Research suggests the importance of the human and social capital of the founders, such as the strength of the founding team, prior

managerial and work experience, ties to investors, and founder's influence and power (Beckman, 2006; Boeker & Karichalil, 2002; Hallen, 2008). We follow Eisenhardt & Schoonhoven (1990) and measure the strength of the founding team as a composite of three variables shown to be important in other work: team size, joint experience, and heterogeneity of industry experience. Second, we controlled for the proportion of insiders on the board.

We also controlled for key firm and industry characteristics. First, we controlled for the innovativeness of the firm's first product as a measure of the underlying quality of the firm. We follow related work in this industry (Schoonhoven et al., 1990; Eisenhardt & Schoonhoven, 1990) and measure *firm innovativeness* as a scalar combination of the extent of new knowledge created and the extent of new knowledge synthesized as reported by the firm (Cronbach alpha = 0.75).[4] We also control for firm age and whether the firm has in-house fabrication capacity. Finally, we control for alliance formation trends in the industry including the cumulative number of alliances in the focal firm's cohort, as well as the rate of alliance emergence. This latter control is analogous to the rate dependence thesis in ecological studies (Delacroix & Carroll, 1983; Hannan & Freeman, 1987). The emergence of an alliance will be positively influenced by recently formed alliances. Specifically, we compute the rate of *prior alliance* formation as follows:

$$R_{t-1} = \frac{L_{t-1} - L_{t-2}}{\Delta t}, \qquad (1)$$

where R_{t-1} is rate at time t-1; L_{t-1} and L_{t-2} correspond to the cumulative number of alliances at time *t-1* and *t-2* respectively; and Δt is an interval of time during which an alliance is observed. See Table 1 for a detailed summary of all controls in the models of alliance portfolio emergence.

[4] As a robustness check, we also examined the product's micron line width as a measure of innovativeness (correlated at r = -0.32 with innovative knowledge). Micron line width is a technical specification for printing circuits on silicon, which reflects the degree of semiconductor miniaturization. Thus the smaller the line width, the more innovative the product. Results are robust to this alternative measure of innovativeness.

In the models of revenue milestone events, we also controlled for the level of demand for the firm and its products. We consider whether the firm made an initial public offering of stock, as this infusion of capital will enable future growth and speed attainment of significant revenue milestones—39% of our sample firms had an IPO event. We also controlled for the firm's market stage and industry competition. In our sample, there were 24 product categories, as articulated by several sources (interviews and industry reports from Dataquest and ICE). From these data, we calculate two controls consisting of a set of competitors and a market stage for each product category per year.[5] Within our population of firms, 86% of firms reached the market with at least one product.

Statistical Analyses: Time to Alliance Portfolio and Milestone Events

To examine time to a diverse alliance portfolio and the time to revenue milestone events, we used a semiparametric Cox event history model to obtain the rate at which firms achieve key events. The hazard ratio is associated with a one-unit difference in the dependent variable, holding all other predictors constant (Cleves, Gould, Gutierrez, & Marchenko, 2008). This is represented as:

$$r_k(t) = h_k(t) \exp \{A^{(k)}(t)\ \alpha^{(k)}\}, \quad (2)$$

where $r_k(t)$ is the transition rate at time t from the state at the origin (e.g., no revenue event) to the destination state k (e.g., alliance portfolio, \$10, \$20, or \$50 million), the baseline rate is $h_k(t)$, the vector of covariates is $A^{(k)}$, and the vector of coefficients is $\alpha^{(k)}$ (Blossfeld, Golsch, & Rohwer, 2007). The parameter estimate is on a log-hazard scale, that is e^{α}.

In a semiparametric Cox event history model, the estimated coefficients reflect shifts in the baseline hazard rate due to the specified covariates, and the estimated hazard ratios are

[5] Full details on construction of the market categories, and their validity checks, follows the Appendix of Eisenhardt and Schoonhoven (1990).

assumed to be proportional over time. To confirm this assumption, we use the Grambsch and Therneau test and find that the Schönfeld residuals are not significant, for either individual variables or the full model. This is consistent with the assumption that the effect parameters multiply the hazards (Cleves et al., 2008). As explained below, a formal two-stage model was conducted as a robustness check but is not preferred for theoretical and empirical reasons. We report the coefficients rather than the hazard ratio, but the hazard ratio can be calculated by exponentiating the coefficients.

RESULTS

We present two sets of analyses. For the first analyses, Table 2 presents the descriptive statistics and correlations for the analyses predicting the impact of relational pluralism on the rate of diverse alliance portfolio emergence. We have observations for 4,741 firm-months between firm founding and the date the firm obtains an alliance portfolio or exits the risk set.

Insert Table 2 about here.

Table 3 presents the Cox estimation of the emergence of a diverse alliance portfolio. The time to portfolio emergence is measured as the attainment of three types of alliances. Model 1 presents the control variables. Model 2 tests the effect of board heterogeneity on alliance portfolio emergence. Board heterogeneity increases the speed of obtaining an alliance portfolio, offering support for Hypothesis 1. Model 3 finds support for Hypothesis 2, that board multiplexity increases the speed a firm obtains a diverse alliance portfolio.

Insert Table 3 about here.

Models 4–6 test the asymmetry hypotheses on time to diverse alliance portfolio attainment. In Model 4, we see no significant influence of overall board skewness on alliance

portfolios. We then create a spline variable, examining positive and negative skewness separately with both spline variables taking on positive values (e.g., using the absolute value of negative skewness). Model 5 shows that negative skewness increases the rate of diverse alliance portfolio emergence. This offers partial support for our hypothesis (H_3), albeit not as we expected. When board members are clustered above mean centrality, and there is a long left tail of low centrality board members, firms obtain a diverse alliance portfolio more quickly (negative skewness). When the mass of the centrality scores is below the mean, with very few high centrality scores, we see no significant effect on alliance portfolios for positive skewness. This suggests that centrality is useful for gathering new opportunities, but the distribution of centrality also matters such that you need multiple highly central others to garner benefits.

Model 6 in Table 3 tests the effect of outsider-board and investor-board asymmetry on portfolio emergence (H_{4a} and H_{4b}). Model 6 shows that outsider-board asymmetry has a positive significant effect on the rate of alliance portfolio emergence as expected (H_{4a}). A firm has a higher rate of forming a diverse alliance portfolio when the most central outsider-board members prevail over the most central investor-board members. On the other hand, investor dominance has a negative effect, as expected (H_{4b}), but it is not significant in Model 6. In the full Model 7, however, the investor-board dominance has a marginally significant negative effect on diverse alliance portfolio formation, as expected.

In summary, we find that heterogeneous boards, multiplex boards, board asymmetry that favors outside directors, and multiple central board members have positive and significant effects on diverse alliance portfolio formation. The effects of multiplexity and outside-director dominance are marginally significant in the full Model 7. Investor-board asymmetry, where investors are dominant, has marginally significant negative effects. These results support the

view that the board of directors of de novo firms have significant effects on diverse alliance portfolio emergence, beyond the well understood (and controlled) effects of their founders, top management team quality, firm quality, and isomorphic institutional effects of alliance formation in birth cohorts and the industry. Theoretically, we demonstrate that the structure of the network and the structure of particular ties in the network have important effects. In terms of the control variables, we do see that the percent of insiders on the board has a positive effect on the rate of diverse alliance portfolio emergence. The firm-level controls are not consistently significant, except as firms age they are slower to obtain alliance portfolios.

To test the final hypothesis (H_6), we analyzed the impact of diverse alliance portfolios on organizational performance measured as time to attaining revenue milestones of $10, $20, and $50 million. For the second stage, Table 4 presents descriptive statistics and correlations for the revenue milestone analyses. On average, it took the de novo organizations 5.28 years to reach $10 million in revenues (s.d. = 2.49); 6.98 years to reach $20 million in revenues (s.d. = 3.93), and 9.47 years to reach $50 million in revenues (s.d. = 4.88). In our population, 56% of the firms reach $10 million, 47% reach $20 million, and 35% reach $50 million.

Insert Table 4 about here.

Table 5 presents the analysis for attainment of each revenue milestone. Across the top of Table 5 are a series of paired models, two each for the three revenue milestones: $10, $20, and $50 million. The first model in each set of two (Models 1, 3, and 5) are baseline models with no covariates, and they report coefficients for the controls. The second model in each pair (Models 2, 4, and 6) reports results for the test of Hypothesis 6, the effect of diverse portfolio emergence on each of the revenue milestones.

Insert Table 5 about here.

For the first two milestones ($10 and $20 million), there is a positive effect of alliance portfolio emergence on revenue milestone attainment; however, the results are not statistically significant for the $50 million milestones. Diversity of the alliance portfolio (the number of types of alliances obtained by the firm) increases the speed a firm attains significant revenue milestones. Coefficients for alliance portfolio emergence on revenue milestones attained are, respectively: $10 million ($\beta = 0.24^{*}$, s.e. = 0.10), and $20 million ($\beta = 0.23^{\dagger}$, s.e. = 0.12). When a de novo organization forms its initial alliance portfolio, it achieves two of these three important revenue milestones more quickly. Given that the average firm reached $50 million in revenues 9 years after founding, it is understandable that the utility of a diverse alliance portfolio, achieved on average 2.4 years after founding, is limited.

With respect to controls, having a strong top management team and a greater proportion of in-house fabrication helped speed attainment of all three revenue milestones, having an initial public offering helped speed attainment of $20 and $50 million revenue milestones, and addressing a growth stage market helped speed $50 million in revenues.

Robustness Checks and Alternative Explanations

We undertook additional tests to check the robustness of our results (results available upon request). We considered endogeneity, unobserved heterogeneity, and alternative specifications of our measures. Our results are robust for measuring alliance portfolio diversity as a Blau measure of alliance diversity, except for Hypothesis 4b. These results suggest that the benefits of heterogeneity and multiplexity, and the problems of board asymmetry, are largely similar using other measures of alliance portfolio diversity. However, the effects of investor-board members are negative and significant only in models that account for the speed with which a portfolio is obtained.

We also did further robustness checks on our asymmetry constructs. First, we calculated the differences in centrality within type of tie rather than across types of ties. We examined the difference in centrality between the top two outside-directors, and then we examined the difference in centrality between the top two investor-directors. These variables are not significant, suggesting that asymmetry across types of ties is what drives (or restricts) diverse alliance portfolio formation.

Unobserved heterogeneity might indicate that a third variable predicts both the independent and dependent variables. For Table 3, one such explanation is that diverse alliance portfolio formation is primarily due to the 'quality' of a new venture. In other words, a firm's quality attracts both diverse alliance partners and prominent board members. To account for this, we controlled for multiple measures of firm quality (e.g., innovativeness, team quality). However, we also need to point out that if such an indicator of quality existed in the highly uncertain world of new technology ventures, then venture capitalists, who are presumed to be experts, would have superior selection abilities (Amit, Brander, & Zott, 1998; Chan, 1983). We see from our results that this is not the case—highly central investors are hindering the speed of alliance portfolio formation (despite the significant economic benefits of portfolios). More generally, such superior selection abilities would be advantageous when making seed and early-stage investments, which lack obvious quality indicators such as sales or profits (Sahlman, 1990). However, any selection effect that may exist is limited, as two-thirds of seed investments fail, and half of early-stage investments fail as well (Ruhnka & Young, 1987; Wetzel, 1981). Indeed, scholars consistently find that in early-stage firms, selection effects are small (Amit et al., 1998; Baum & Silverman, 2004; Chemmaur, Krishnan, & Nandy, 2011; Sørensen, 2007) or insignificant (Ber & Yafeh, 2004; Bertoni, Colombo, & Grilli, 2011; Engel & Keilbach, 2007).

Thus, it is unlikely that VCs (or other board members) can identify a priori which de novo firms are of higher quality. These same studies find that VCs can have a strong and positive influence on firm growth through superior *mentoring* abilities (also see Hellmann & Puri, 2002; Kaplan & Strömberg, 2004). As lead investors typically sit on the boards of their portfolio companies, this suggests that board members help *develop* winners rather than selecting them a priori.

For the revenue attainment models in Table 5, we also explored questions of causality and endogeneity. Empirically, faster firm growth may increase the formation of diverse alliance portfolios (rather than the reverse). As one check, we created one-year lagged variables of alliance portfolios and find the same results in predicting the rates of revenue milestones. In addition, to check the endogeneity issue more systematically, we applied a Hausman test where we first obtained residuals from the alliance portfolio models, and then included these as an independent variable in the revenue-milestone models. If the residuals from the alliance models are significantly related to the dependent variables of the revenue-milestone models, we can conclude that there are endogeneity issues (Wooldridge, 2010). The $10 million model showed weak endogeneity ($p < 0.10$). Therefore, we re-ran Table 5 with the estimated alliance portfolio as a predictor for the $10 million model. The coefficient of the estimated alliance portfolio is positive and significant, consistent with the results presented here.

Finally we tested for selection effects using a Heckman-like two-stage procedure (Wooldridge, 2010). Conceptually, we are predicting the speed of alliance portfolio emergence in the first stage, and the impact of having a diverse alliance portfolio on revenue milestones in the second stage. In order to use a Heckman-like procedure, we need to transform the rate of alliance portfolios into a dichotomous variable indicating that a firm has at least one alliance portfolio. In the first stage, we ran probit models with the dichotomized variable and computed

the inverse-Mills ratios (IMRs). Then we added the first-stage IMRs to the second-stage models, (i.e. the revenue-milestone models) as a control variable. Comparing the two-stage models with the primary models, the likelihood ratio statistics show the models are not different (at the p = 0.05 level). That is, the results of the adjusted models with IMRs show consistency with the previous models and there is no selection bias.

DISCUSSION

Importantly, relational pluralism is more than an aggregation of relational experiences. We conceptualize it as a collective concept—instantiated in the board of directors of new ventures—and identify three dimensions of relational pluralism: heterogeneity, multiplexity, and asymmetry. We find that board heterogeneity and board multiplexity have a significant positive impact on the speed with which a diverse alliance portfolio emergences in a population of de novo semiconductor firms. Board members bring a mixture of expertise in their attributes and in their relationships that support the creation of such a portfolio. Furthermore, new ventures benefit when multiple board members are more central in the larger network of their industry's firms, specifically when boards are comprised of multiple, highly central members and few of low centrality. This negative skewness of the centrality distribution suggests that influence is unevenly distributed across the board. Indeed, results also suggest that when board members who are investors have higher network centrality than other board members, the rate of diverse alliance portfolio emergence is depressed (although the dominance hypotheses are only marginally supported in the full model). In contrast, the rate increases when dominant board members are non-investors. These results speak to the precarious balance of power and expertise

on the boards of directors of de novo organizations and are of practical importance to new ventures.

We add asymmetry as an additional dimension to the theoretical account of relational pluralism. We argue that the distribution of ties may constrain firms by distributing influence unequally across the network. That is, asymmetry in the structural position of board members can translate into an imbalance of power and influence of the board members. The data support our theoretical intuition that power asymmetry among board members matters and is part of a more nuanced understanding of relational pluralism. Although multiple outside-yet-central board members aid the emergence of diverse alliance portfolios, a power imbalance on the board may have detrimental effects on portfolio formation. This impact is subtle, however, because venture capital and SBIR investments have been shown to have a positive effect on the formation of individual R&D, sales and marketing, and technology alliances (cooperative activities) (Hsu, 2006), but not portfolios. Rather it is only when investors' influence is asymmetric and unbalanced that problems like the one documented here are revealed. Asymmetries of power within the board can create dependencies and conflicts for the firm and create a number of principal-principal conflicts. These findings build on the recent focus on interdependencies across types of ties (Shipilov & Li, 2012; Ranganathan & Rosenkopf, this issue; Sytch & Tatarynowicz. this issue).

Our findings suggest that relational pluralism usefully combines a focus on tie content and tie structure. In addition to considerations of heterogeneity and multiplexity, which focus on tie composition along multiple dimensions, we consider asymmetry and the distribution of power across the entire network and across different types of ties. Our results are not a simple result of

'more is better'. If a firm is too reliant on a single board member (perhaps because of their deep pockets), it hinders the ability of the firm to develop external relationships.

We follow recent research focusing on diverse alliance portfolios as critical for high performing firms (Ozcan & Eisenhardt, 2009). We see how relational pluralism of the collective (e.g., heterogeneous, multiplex or asymmetric ties) shapes the development of these portfolios. Managing different types of alliances suggests a more complex capability is needed, and heterogeneity of expertise and a broad range of connections may be especially important for developing these types of portfolios. However, our findings also suggest power asymmetries may create a narrowness or dependence on a sub-set of board members that hinders the development of a broader range of alliances. This linkage between the types of relational pluralism at the board level and types of alliance portfolio warrants further exploration.

Our work also contributes to an understanding of entrepreneurship and founder effects (Beckman, 2006; Burton, 2001; Eisenhardt and Schoonhoven, 1990). We find that, in the context of U.S. semiconductor firms, alliance portfolio emergence is influenced by the board of directors more than by founders with substantial power and firm ownership. Board outsiders signal legitimacy to external partners, and they bring expertise and connections to the firm. In small de novo organizations, boards play a much more active role in the management of the firm and have a greater voice in strategic decisions than prior literature has recognized. In this paper we extend the categories of people that act as carriers of knowledge and contacts that benefit a new firm (Baty, Evan, & Rothermel, 1971).

Relatedly, this study makes a contribution to the sparse literature on boards of directors in de novo and entrepreneurial organizations. We find that not all outside board members are created equally. New ventures whose boards have more heterogeneous and multiplex

experiences are more likely to form a diverse alliance portfolio. While valuable in their own right, existing studies of entrepreneurial boards have focused exclusively on intraorganizational changes and dynamics (Boeker & Karichalil, 2002; Boeker & Wiltbank, 2005; Wasserman and Boeker, 2006). We show that a focus on relational pluralism can extend the literature on entrepreneurial boards by bringing attention to the board's role in linking the new venture to the greater environment. The present study demonstrates how a balance of power, prestige, and expertise on the board of de novo organizations contribute to developing the initial interorganizational relationships that are so critical to building a new organization's external legitimacy.

The results reported here also add to a growing literature that stresses the importance of speed in young firms and in organizations competing in high velocity environments. Building on Eisenhardt's (1989) theory about decision speed in high-velocity environments, Schoonhoven et al., (1990) found that team structure, competition, and modest innovation and expenditures speed first revenue attainment among new high technology organizations. Hallen and Eisenhardt (2012) examined nine young Internet securities firms to understand how venture capital investors accelerate the speed of fund raising (see also Judge & Miller, 1991). In de novo firms, speed is critical to obtain the sufficient monthly cash flow necessary for both survival and growth. While it may survive on marginal revenues per the literature on the "living dead" (Bourgeois & Eisenhardt, 1987; Meyer & Zucker, 1989), a firm cannot grow without increasing its revenues. Attaining investor-defined major revenue milestones, such as $10 million and $20 million, provides the de novo organization with the credibility to encourage existing investors to continue their support and to attract new investors for subsequent growth.

Limitations

The concept of relational pluralism as a collective reveals that we need to take a serious look at the composition, distribution and asymmetries in a firm's collection of relationships. Despite the advantages of relatively complete data on de novo firms from founding, there are some limitations to our data. Given that the average board size among our de novo firms was 4 board members (with a maximum of 10), we are limited in our empirical power. For example, almost half of our firms do not have multiplex board ties. Although we believe the advantages of examining the emergence of relational pluralism is worth these constraints, future research could profitably look at a larger collective for a more refined analysis of the dimensions of relational pluralism.

The benefit of a single industry study is that we can examine a comprehensive set of boards, alliances, and the ties across them knowing that a single set of technical conditions prevail across the industry. However, there are a number of open questions future research should consider. For example, how are the dimensions or effects of relational pluralism different (and perhaps accentuated) in other industries, such as biotechnology, where networks and alliances are even more prevalent (Powell et al., 1996)? In contrast, in emerging industries, like nanotechnology, the board networks are likely to be sparse and perhaps cut across more knowledge domains. In such industries, the level of heterogeneity and asymmetry in the network may be greater, causing conflicts. Here, multiplexity may have more benefits by creating common points of connection in an otherwise disconnected landscape. This speaks to the importance of understanding the underlying network structure of the focal industry, because the dimensions of relational pluralism that are important for a firm may be contingent on the structure of an industry and its stage of development.

Finally, what is the role of geographic agglomeration? As 75% of the semiconductor firms studied here were founded in Northern California, the relatively small geographical clustering of ventures also clusters related service populations, such as venture capitalists and law firms who specialize in the semiconductor industry. These conditions foster network connections. In contrast, new nanotechnology ventures are widely dispersed across the U.S. and a single industry 'center' like Silicon Valley does not exist. Thus it remains an open question whether an industrial geographical concentration may be necessary in order to observe boards of directors as collectives who represent an instance of relational pluralism. At the very least, the knowledge that networks have region-specific path dependencies (Marquis, 2003) should be examined in the context of relational pluralism.

In conclusion, the primary contributions of this study are threefold: (1) we develop and dimensionalize relational pluralism (adding the dimension of asymmetry) as a collective concept instantiated in the board of directors, (2) we add to the sparse literature on de novo organizations' boards of directors, and (3) we develop an understanding of the emergence and performance consequences of diverse alliance portfolios. The alliance portfolios studied are of significant consequence for these young firms, and relational pluralism acts as an important resource that helps a firm transition from a narrowly focused start-up firm to a strategically positioned and growing semiconductor firm.

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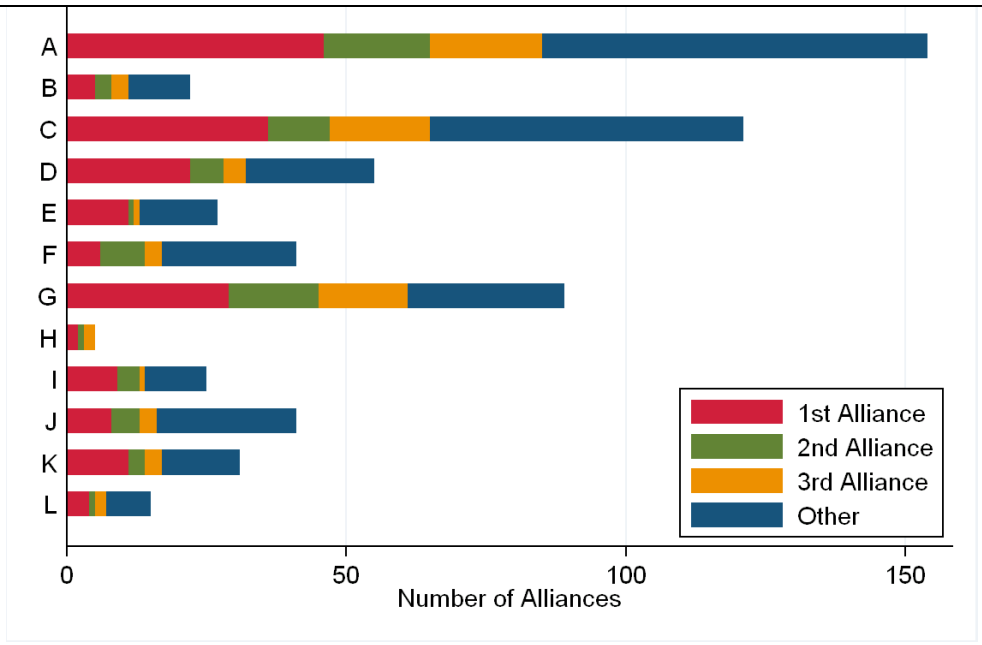
FIGURES & TABLES



A. Other firm provides manufacturing for startup (n = 154).
B. Startup provides manufacturing for other firm (n = 22).
C. Other firm licenses technology to startup (n = 121).
D. Startup licenses technology to other firm (n = 55).
E. Other firm licenses product to startup (n = 27).
F. Startup licenses product to other firm (n = 41).
G. Joint product development (n = 89).
H. Joint venture (n = 5).
I. Other firm provides second source for startup (n = 25).
J. Startup provides second source for other firm (n = 41).
K. Other firm provides marketing for startup (n = 31).
L. Startup provides marketing for other firm (n = 15).

Figure 1. Distribution of alliance types.

Table 1. Variables

Stage 1 (Diverse Alliance Portfolio Emergence)

Variable	Measure	Updated
CONTROLS		
Strong Team	Dummy coded 1 if a strong team (when TMT has >2 founders, >50% joint work experience, and >2 s.d. heterogeneous industry experience), 0 if otherwise.	At founding
Founders' Ownership %	Percentage of ownership.	Annual
In-House Fabrication	Percentage of total sales volume accounted for by in-house fabrication (manufacturing) for the focal firm.	Annual
Firm Innovation	Scalar combination of the extent of new knowledge created and the extent of new knowledge synthesized as embedded in the firm's first product (0 = no innovation, 10 = high innovation).	At founding (or first product)
Firm Age	Number of months since focal firm founding.	Monthly
Insiders on Board	Proportion of insiders on the board of directors.	At founding and 1987
Alliance Population	Sum of all alliances in the birth cohort of the focal firm minus the focal firm's number of alliances, by year.	Annual
Alliance Rate	Rate of alliance formation in the industry in the prior month.	Monthly
INDEPENDENT VARIABLES		
Heterogeneity: 3-dimensional Blau measure	Geometric mean of three Blau Indices. $mb_{ik} = \sqrt[N_d]{\prod_{d}^{N_d} b_{ikd}}, \quad D = \{d \mid 1,2,3\}; N_d = 3$ $s.t.\ b_{ikd} = 1 - \sum_l p_{ikd}^2$ b_{ikd}: Blau index based on d^{th} attribute (org type, industry, or state) in focal firm i at k^{th} year p_{ikd}: proportion of board members that are of the same attribute d in focal firm i at k^{th} year across l categories	Annual
Multiplexity	Sum of indicator functions of investor, customer, and parent board members. $m_{ik} = \mathrm{I}_{Investor,ik} + \mathrm{I}_{customer,ik} + \mathrm{I}_{parent,ik}$ m_{ik}: multiplexity of board members of focal firm i at k^{th} year $\boldsymbol{I}_{investor,\,ik}$: 1 if a focal firm i 's board includes at least one investor at k^{th} year; 0 else $\boldsymbol{I}_{customer,\,ik}$: 1 if a focal firm i 's board includes at least one customer at k^{th} year; 0 else $\boldsymbol{I}_{parent,\,ik}$: 1 if a focal firm i 's board includes at least one parent organization at k^{th} year; 0 else	Annual

Stage 1 (Diverse Alliance Portfolio Emergence) – continued

Variable	Measure	Updated
Asymmetry: Skewness	Skewness of board degree centrality values by year $w_{ik} = \frac{\sum_{j}^{n_{ik}} \left(c_{ijk} - \hat{c}_{ik}\right)^3}{(n_{ik}-1)\dot{c}_{ik}^3}$ W_{ik}: centrality skewness of board partners of focal firm *i* at kth year c_{ijk}: degree centrality of partner *j* of focal firm *i* at k^{th} year $\hat{c}_{ik}$: mean of focal firm *i*'s partners' degree centrality at kth year $\dot{c}_{ik}$: standard deviation of focal firm *i*'s partners' centrality at kth year n_{ik}: the number of board members in focal firm *i* at k_{th} year	Annual
Asymmetry: Outsider-Director	$max\ c^{outsider}_{ik} - max\ c^{investor}_{ik}$ if $max\ c^{outsider}_{ik} - max\ c^{investor}_{ik} > 0$ 0 if else $max\ c^{outsider}_{ik}$: the maximum in degree centrality among outsider-board members of firm *i* at kth year $max\ c^{investor}_{ik}$: the maximum in degree centrality among investor-board members of firm *i* at kth year	Annual
Asymmetry: Investor-Director	$\lvert max\ c^{investor}_{ik} - max\ c^{outsider}_{ik} \rvert$ if $max\ c^{outsider}_{ik} - max\ c^{investor}_{ik} < 0$ 0 if else	Annual

Stage 2 (Revenue Milestone)

Variable	Measure	Updated
Strong Team	Dummy coded 1 if a strong team (when TMT has >2 founders, >50% joint work experience, and > 2 s.d. heterogeneous industry experience), 0 if otherwise.	At founding
Founders' Ownership %	Percentage of ownership.	Annual
In-House Fabrication	Percentage of total sales volume accounted for by in-house fabrication (manufacturing) for the focal firm.	Annual
Firm Innovation	Scalar combination of the extent of new knowledge created and the extent of new knowledge synthesized as embedded in the firm's first product (0 = no innovation, 10 = high innovation).	At founding (or first product)
Firm Age	Number of months since focal firm founding.	Monthly
IPO	Dummy coded 1 starting in the month of IPO, 0 otherwise.	At event, monthly
Market Stage (Growth, Emergent, or Mature)	Category dummy (based on inflation-adjusted annual sales): Emergent market (<$100M); Growth market (>$100M, growth rate >20%); Mature market (>$100M, growth rate <20%).	At founding
Competition	Standardized annual count of competitors in one of 24 target markets, divided by mean of worldwide semiconductor sales.	Annual

Table 2. Descriptive Statistics for Diverse Alliance Portfolio Emergence

	Variables (N = 4741)	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Alliance Portfolio	0.69	1.23	0	8															
2	Strong Team	0.17	0.38	0	1	-0.02														
3	Founders' Ownership %	32.98	27.37	0	100	0.00	-0.15													
4	In-House Fabrication	24.64	42.06	0	100	0.03	0.09	-0.09												
5	Firm Innovation	5.38	2.40	0	9.67	0.02	0.12	-0.06	-0.05											
6	Firm Age (in months)	34.73	27.92	1	149	-0.12	0.04	-0.32	0.07	-0.15										
7	Insiders on Board	0.37	0.32	0	1	0.00	-0.07	0.40	0.04	-0.13	-0.22									
8	Alliance Population	17.68	16.45	0	52	0.28	-0.08	0.02	-0.21	0.09	-0.45	0.02								
9	Alliance Rate	0.65	1.18	0	8	0.12	-0.03	-0.01	0.03	0.01	-0.10	-0.02	0.26							
10	Heterogeneity: 3-dimensional Blau	0.14	0.23	0	0.70	0.11	-0.02	-0.12	0.02	0.20	-0.21	-0.06	0.31	0.10						
11	Multiplexity	0.71	0.66	0	3	0.16	0.01	-0.10	0.20	0.01	-0.34	0.03	0.36	0.15	0.36					
12	Asymmetry: Skewness	0.04	0.27	-1.36	1.48	0.03	0.05	-0.07	-0.05	0.06	-0.08	-0.02	0.11	0.04	0.25	0.09				
13	Asymmetry: Skewness, Positive	0.07	0.22	0	1.48	0.07	0.07	-0.11	-0.02	0.14	-0.14	-0.10	0.15	0.07	0.49	0.20	0.83			
14	Asymmetry: Skewness, Negative	0.03	0.15	0	1.36	0.04	0.00	-0.02	0.07	0.10	-0.05	-0.11	0.01	0.02	0.25	0.12	-0.61	-0.07		
15	Asymmetry: Outside-Director	0.00	0.00	0	0.04	0.08	-0.04	-0.09	-0.08	0.11	-0.07	-0.02	0.19	0.08	0.21	0.18	-0.05	0.03	0.14	
16	Asymmetry: Investor-Director	0.00	0.00	0	0.03	0.06	0.03	-0.04	-0.02	0.10	-0.10	0.01	0.13	0.06	0.20	0.09	0.09	0.14	0.04	-0.05

Table 3. Cox Analysis of the Hazard of Diverse Alliance Portfolio Emergence

	1	2	3	4	5	6	7
CONTROLS							
Strong Team	.297	282	.315	.290	.365	.487	.633
	(.469)	(.512)	(.480)	(.476)	(.491)	(.458)	(.472)
Founders' Ownership %	-.013†	-.012	-.010	-.014†	-.014†	-.010	-.008
	(.007)	(.008)	(.007)	(.007)	(.008)	(.007)	(.008)
In-House Fabrication	.006	.006†	.003	.006†	.004	.008*	.005
	(.003)	(.003)	(.004)	(.004)	(.004)	(.004)	(.004)
Firm Innovation	.000	-.030	.029	.007	-.034	-.031	-.024
	(.070)	(.074)	(.070)	(.069)	(.070)	(.077)	(.079)
Firm Age	-.126***	-.125***	-.119***	-.128***	-.126***	-.129***	-.128***
	(.017)	(.017)	(.018)	(.017)	(.018)	(.017)	(.019)
Insiders on Board	1.135†	1.192†	1.392*	1.087†	1.413*	1.025	1.792**
	(.596)	(.625)	(.597)	(.579)	(.600)	(.645)	(.688)
Alliance Population	.004	.000	-.002	.004	.006	.001	-.005
	(.012)	(.012)	(.014)	(.013)	(.013)	(.013)	(.013)
Alliance Rate	-.101	-.109	-.108	-.102	-.112	-.113	-.125†
	(.070)	(.071)	(.070)	(.070)	(.072)	(.071)	(.072)
HYPOTHESIZED EFFECTS							
Heterogeneity:		1.587*					1.500*
3-dim. Blau measure		(.649)					(.692)
Multiplexity			.560*				.517†
			(.262)				(.266)
Asymmetry:				-.572			
Skewness				(.763)			
Asymmetry:					.795		
Skewness, Positive					(.555)		
Asymmetry:					3.148***		2.702***
Skewness, Negative					(.658)		(.615)
Asymmetry:						62.060**	45.950†
Outside-Director						(23.060)	(24.740)
Asymmetry:						-28.680	-54.600†
Investor-Director						(29.970)	(29.330)
Log Likelihood	-501.97	-420.92	-421.86	-424.86	-415.21	-415.21	-404.13
AIC	867.25	867.25	861.72	867.72	850.41	860.10	834.26
ΔDeviance ($\chi 2$)	-	9.421**	7.535**	1.529	20.84***	11.16***	43.00***

Firm-months: 4741, # of firms: 104, # of Events: 65, Standard errors in parentheses

$^{\dagger}p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$; two-tailed tests

Table 4. Descriptive Statistics Predicting Revenue Milestone Events

Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9
10MM (N = 6849)													
1. Strong Team	0.14	0.35	0	1									
2. Founders' Ownership %	31.17	28.67	0	100	-.07								
3. In-House Fabrication	19.11	38.12	0	100	.08	-.03							
4. Firm Innovation	5.56	2.33	0	9.67	.08	-.09	-.01						
5. Firm Age (in months)	47.84	43.08	1	249	-.11	-.12	-.14	.01					
6. IPO	0.05	0.21	0	1	-.07	-.13	-.02	.08	.19				
7. Growth Market	0.33	0.47	0	1	-.08	.07	-.04	.08	-.18	.15			
8. Emergent Market	0.39	0.49	0	1	.05	-.13	.02	.18	.16	-.10	-.55		
9. Competition	0.01	0.01	0	0.10	.04	.07	.21	-.16	-.32	.03	.19	-.40	
10. Alliance Portfolio	0.96	1.36	0	8	.11	-.05	.09	.02	-.25	.02	.13	-.01	.09
20MM (N = 8459)													
1. Strong Team	0.15	0.36	0	1									
2. Founders' Ownership %	29.23	28.14	0	100	-.05								
3. In-House Fabrication	18.51	37.75	0	100	.09	-.03							
4. Firm Innovation	5.51	2.45	0	9.67	.10	-.13	.01						
5. Firm Age (in months)	58.69	50.34	1	262	-.11	-.14	-.17	-.04					
6. IPO	0.08	0.26	0	1	-.06	-.14	.00	.00	.25				
7. Growth Market	0.32	0.47	0	1	-.10	.03	-.03	.12	-.15	.02			
8. Emergent Market	0.36	0.48	0	1	.13	-.10	.04	.22	.03	-.06	-.51		
9. Competition	0.01	0.01	0	0.10	.05	.09	.25	-.12	-.36	-.04	.16	-.33	
10. Alliance Portfolio	0.92	1.40	0	8	.11	-.04	.14	.01	-.29	-.03	.14	.01	.14
50MM (N = 10759)													
1. Strong Team	0.18	0.38	0	1									
2. Founders' Ownership %	26.00	26.60	0	100	-.05								
3. In-House Fabrication	16.49	36.16	0	100	.07	.00							
4. Firm Innovation	5.80	2.42	0	9.67	.12	-.18	-.03						
5. Firm Age (in months)	72.40	56.77	1	262	-.03	-.21	-.23	.11					
6. IPO	0.17	0.37	0	1	-.02	-.23	-.05	.11	.43				
7. Growth Market	0.31	0.46	0	1	-.05	.04	.00	.09	-.17	-.09			
8. Emergent Market	0.37	0.48	0	1	.12	-.11	.01	.25	.07	.05	-.51		
9. Competition	0.01	0.01	0	0.10	.04	.13	.28	-.18	-.43	-.14	.15	-.31	
10. Alliance Portfolio	0.90	1.46	0	8	.04	-.04	.18	.01	-.27	-.03	.12	.01	.15

Table 5. Cox Analysis of the Hazard of Attaining Revenue Milestones

	Model 1 Baseline 10 MM	**Model 2** Portfolio 10 MM	**Model 3** Baseline 20 MM	**Model 4** Portfolio 20 MM	**Model 5** Baseline 50 MM	**Model 6** Portfolio 50 MM
CONTROLS						
Strong Team	.996**	.948**	1.116**	1.075**	1.123**	1.119**
	(.364)	(.365)	(.330)	(.322)	(.351)	(.356)
Founders' Ownership %	-.010*	-.011*	-.007	-.008	-.009	-.009
	(.005)	(.005)	(.007)	(.007)	(.010)	(.010)
In-House Fabrication	.011***	.009**	.010*	.008†	.010*	.010*
	(.003)	(.003)	(.005)	(.005)	(.005)	(.005)
Firm Innovation	.010	.011	.031	.047	-.034	-.033
	(.067)	(.069)	(.079)	(.083)	(.106)	(.107)
Firm Age	.037**	.039**	.021	.022†	.024	.025
	(.013)	(.014)	(.013)	(.013)	(.015)	(.015)
IPO	.616	.571	1.157**	1.146**	1.854***	1.852***
	(.675)	(.638)	(.432)	(.424)	(.407)	(.409)
Growth Market	.437	.368	.703	.598	1.028*	1.023*
	(.402)	(.411)	(.474)	(.492)	(.485)	(.492)
Emergent Market	-.477	-.544	-.258	-.358	-.716	-.720
	(.412)	(.429)	(.425)	(.453)	(.630)	(.633)
Competition	.011	.008	.013	.010	-.014	-.014
	(.013)	(.014)	(.023)	(.023)	(.035)	(.034)
HYPOTHESIZED EFFECTS						
Alliance Portfolio		.236*		.229†		.023
		(.095)		(.121)		(.124)
Log Likelihood	-206.647	-204.190	-168.020	-166.099	-106.516	-106.505
AIC	431.293	428.380	354.039	352.197	231.032	233.010
ΔDeviance (χ^2)	-	4.914*	-	3.842*	-	.022
N	6849	6849	8459	8459	10759	10759
#Firms	104	104	104	104	104	104
#Events	58	58	49	49	36	36

†$p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$; two-tailed tests

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