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THE CONTINGENT EFFECTS OF TOP MANAGEMENT TEAMS ON VENTURE PERFORMANCE: ALIGNING FOUNDING TEAM COMPOSITION WITH INNOVATION STRATEGY AND COMMERCIALIZATION ENVIRONMENT

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How does the relationship between founding team composition and venture performance depend on the venture's strategy and business environment? Using data from a novel survey of 2,067 firms, we show that while diverse founding teams tend to exhibit higher performance, this is not universally true. We find that founding teams that are diverse are likely to achieve high performance in a competitive commercialization environment. On the other hand, technically focused founding teams are aligned with a cooperative commercialization environment and when the enterprise pursues an innovation strategy. These results are robust to corrections for endogenous team formation concerns. The findings suggest that ventures cannot ignore founding team composition and expect to later professionalize their top management teams to align with their strategy and environment.

INTRODUCTION

Founding teams of new ventures are typically composed of individuals with demographic characteristics much more alike than different as compared to a benchmark of randomly assembled teams (Ruef, Aldrich, and Carter, 2003). However, we have little knowledge of whether, or under what circumstances, founding team uniformity helps or hinders venture performance. Restated, we do not know when founders ought to include more diversity on their founding teams. Building on the upper echelon theory of organizations relating characteristics of the top management team (TMT) to organizational performance (Hambrick and Mason, 1984), existing studies of founding team composition generally suggest that diverse teams allow ventures to access a broader array of skills while more uniform teams tend to speed execution (Beckman, 2006; Eisenhardt and Schoonhoven, 1990). However, because the benefits to one type of founding team composition are likely to be more important under certain circumstances, we may suspect that one type of team composition is not unconditionally better than another.

We examine the impact of founding team composition on firm performance under two contingencies often important to new ventures: the

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business environment and strategy.[1] As founding teams are the first TMT of the enterprise, team composition impacts both current skills and, as a result of founder imprinting, has a variety of long-lived effects on organizational performance (Baron, Burton, and Hannan, 1999; Burton and Beckman, 2007; Boeker, 1989). We therefore believe that the business environment is an important yet understudied contingency to the relationship between founding team composition and performance. While the early literature discussed "fit" between different corporate strategies and varying organizational designs and investments (Maidique and Patch, 1982; Miles and Snow, 1978), only later did scholars examine how top management characteristics might align with strategies in shaping organizational performance (McGee, Dowling, and Megginson, 1995; Thomas, Litschert, and Ramaswamy, 1991). However, the critical role of founding team composition and the associated founder imprinting effects are not considered in this literature.

We examine features of firms' business environment that extend beyond the dimension of environmental stability versus turbulence and build on the early insight in the contingency literature that technical requirements are an important feature of the business environment that can impact organizational design (Woodward, 1965). In business environments in which new ventures enjoy strong appropriability for their innovations, such as through intellectual property protection, they will more readily engage in negotiations with partners for cooperative commercialization (as striking deal terms must involve innovation disclosure). Furthermore, should commercializing the innovation in a given industry also require assembling downstream complementary assets, such as a specialized sales force that the potential partner might possess, this reinforces the degree to which the environment favors a cooperative strategy (Gans and Stern, 2003; Teece, 1986). In contrast, a competitive environment is characterized by weak appropriability (so the entrepreneur is reluctant to bargain with and disclose innovation details to potential partners) and relatively low cost of assembling the requisite complementary assets (thus lowering the entrepreneur's costs of product market entry). We argue that the ideal founding team composition depends on whether the enterprise operates in a cooperative or competitive environment.

A second contingency we examine in the link between founding team composition and enterprise performance is the venture's innovation strategy. When considering the competitive strategies available to entrepreneurs, an important choice is whether or not to pursue an innovator strategy (Eisenhardt and Schoonhoven, 1990; Hellmann and Puri, 2000; Lieberman and Montgomery, 1988). Innovator strategies are marked by an opportunity-driven logic in which a certain degree of risk (often technological) is accepted in order to attain growth. Since firms have the choice of whether to pursue an innovator strategy, a natural question is whether this choice also has implications for the ideal founding team composition.

We therefore seek to address a missing perspective in the upper echelon literature as it applies to new ventures: The notion of aligning founding team composition with the business environment and strategy to enhance organizational performance. At a broad level, we believe this gap in the literature is an important one because the performance of entrepreneurial firms is a significant engine in driving economic growth and job creation (Haltiwanger, Jarmin, and Miranda, 2013; Roberts and Eesley, 2011). Furthermore, the founder imprinting literature suggests that the ability to add managerial expertise over the venture life cycle may be limited (Beckman, 2006; Beckman and Burton, 2008), implying that the stakes to founder composition decisions are magnified.

We use unique data on the founding management roles played at venture inception in 2,067 ventures started by alumni of the Massachusetts Institute of Technology (MIT) to shed light on founding team composition alignment with the organization's strategy and business environment. We examine three sets of variables: founding team composition (the diversity and technical focus of the founding team) and its alignment with two sets of contingent variables: (1) whether the industry commercialization environment is competitive or cooperative, and (2) the firm's degree of innovation strategy. We measure performance in a way consistent with the literature, i.e., whether the

[1] We use the terms business environment and strategy to refer to general concepts in the literature. When we discuss our hypothesis development and empirical operationalization, we use the terms commercialization environment and innovation strategy.

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enterprise and its equity holders achieve liquidity via an "exit" event such as an acquisition or IPO.

We find that founding teams that are diverse are likely to achieve high performance in a competitive commercialization environment. On the other hand, technically focused founding teams are aligned with a cooperative commercialization environment and when the enterprise pursues an innovation strategy. Our study therefore demonstrates the contingent relationship between founding team composition and organizational performance depending on business environment and strategy.

THEORY AND HYPOTHESES

In this section, we discuss our motivation for examining founding teams and review the literature on teams and organizational performance. We then turn our attention to theorizing about aligning founding team composition with two sets of factors that are likely to exhibit important contingencies—innovation strategies and commercialization environments. As we describe in greater detail below, these contingencies are likely to play particularly important and previously unexamined roles in shaping the necessary founding team characteristics for success.

Founding team composition

Upper echelon theory argues that TMT characteristics shape organizational performance (Beckman and Burton, 2008; Hambrick and Mason, 1984; Pfeffer, 1983), where a TMT is the group of top executives with overall responsibility for the organization (Finkelstein, Hambrick, and Cannella, 2009). While this literature has a long tradition regarding TMTs of established firms, far fewer studies have examined the link between founding teams and performance.

Founding teams are often the first TMT of an organization, and so we might initially expect the range of findings on TMTs to apply equally well to founding teams. We might more specifically expect this to hold under a pure "life cycle" view of entrepreneurial TMT succession, in which founders are replaced with new managers possessing skills appropriate for the given life stage of a venture (Greiner, 1972), with little or no organizational memory and adjustment costs of organizational procedures and culture. The argument is that organizations encounter different challenges at various stages in the life cycle of the organization, and, therefore, different top managers with new skills should be brought in (Boeker and Karichalil, 2002; Hellmann and Puri, 2002; Quinn and Cameron, 1983). Others have argued along similar lines that the departure of founders and hiring of "new blood" is necessary with certain transitions in the life of the entrepreneurial firm (Miller, 1993; Miller and Shamsie, 2001).

However, a long literature suggests that both environmental and founder imprinting can have long-lived effects on organizational processes, structure, and outcomes, even long after a founding team departs a venture (Baron *et al.*, 1999; Beckman and Burton, 2008; Eisenhardt and Schoonhoven, 1990; Stinchcombe, 1965). The imprinting view relies on a path dependency mechanism in which the early decisions about founding team composition shape future behavior, organizational structure, and, as a result, firm performance. These early choices are not easily undone, and so it becomes consequential whether the early team is well aligned with strategic decisions and with the industry environment. Such path dependency can result from many sources, including organizational routines that can guide behavior and that may transcend particular individuals. The high-level consequence for our purposes is that founding team composition and their decisions regarding business policy and organizational structure can be consequential even decades after founding the firm (Boeker, 1989; Miles and Snow, 1978).

Within the founding team literature, a main set of findings is that more homogenous founding teams may have advantages in faster decision making and execution (Brown and Eisenhardt, 1997; Eisenhardt and Schoonhoven, 1990), while diverse teams tend to have a broader set of skills and draw on a wider variety of information and experiences (Beckman, 2006; Beckman and Haunschild, 2002). Teams with a diversity of knowledge and skills who at the same time are able to execute quickly and efficiently are in an even more privileged position (Beckman, 2006; Eisenhardt and Schoonhoven, 1990). This team configuration might be possible because teams could have diversity in their functional backgrounds, but have uniformity by having a common employer, for example. Despite these findings on founding team configuration, Ruef *et al.* (2003)

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find that the composition of actual founding teams is much more uniform than would be expected relative to random pairings of founders.

At a broad level, these findings on founding teams largely echo the results from a large body of literature relating the demographic composition of TMTs to firm strategy and performance (for comprehensive reviews, see Finkelstein and Hambrick, 1996; Williams and O'Reilly, 1998). Many studies demonstrate a positive relationship between top management functional diversity and firm outcomes (Lant and Mezias, 1992). Diversity is thought to improve firm performance because it ensures that the TMT has a broader spectrum of experience and capabilities (Keck, 1997; Randel and Jaussi, 2003).

A related yet distinct dimension of team composition is the degree to which founding teams adopt a technical focus (Baron *et al.*, 1999). For instance, a team composed solely of engineers or scientists with chief technology officer or vice president of engineering roles would be highly technically focused. We chose to examine technical focus rather than other dimensions (finance, operations, or marketing) because the prior literature has suggested that many firms, particularly those that are technology based, begin with a technical founding team and then subsequently "professionalize" by adding other functions to the top management team.

Unlike the founding team literature, the upper echelons literature on large, established firms has demonstrated certain contingencies shaping the optimal TMT composition. These studies largely show that the more complex the environment or strategy, the more that diversity among top executives is beneficial (Carpenter, 2002; Hambrick, Cho, and Chen, 1996; Priem, 1990). For instance, a firm's corporate diversification posture (Michel and Hambrick, 1992) and environmental turbulence (Haleblian and Finkelstein, 1993; Keck and Tushman, 1993) skew the ideal TMT composition towards diversity. Yet, within the literature on early TMTs, few papers discuss team demography contingencies or the importance of fit between the founding team and business strategy and the business environment.[2]

In summary, while scholars have noted that many founding teams are more focused and homogenous than diverse, we have little knowledge of *when* such founding team composition might be misaligned with innovation strategy or the business environment. We seek to begin gaining that understanding in this study by paying particular attention to the founding team, especially in light of the early team imprinting across a range of organizational processes. By doing so, we respond to Hambrick's (2007) call to examine the role of the founding team in greater depth. A recent meta-analysis on the relationship between TMT composition and firm financial performance suggests a middling direct relationship, but calls for work on moderating influences shaping the relationship between team composition and organizational performance more generally (Certo *et al.*, 2006).

Innovator strategy

A firm's strategy to be an innovator may impact the link between founding team composition and venture performance. When considering the competitive strategies available to entrepreneurs, an important choice is whether or not to pursue an innovator strategy (Eisenhardt and Schoonhoven, 1990; Hellmann and Puri, 2000; Lieberman and Montgomery, 1988). While it is not clear that an innovator strategy is always better than other alternatives (Katila and Chen, 2009; Lieberman and Montgomery, 1998), the choice has implications for the skills needed, which in turn directly relate to issues of founding team composition. A noninnovation-based firm tends to compete on dimensions other than technological innovation since it is not developing new-to-the-world products. Innovators introduce new products and services and primarily compete based on their technical edge. Since firms have the choice of whether to pursue an innovator strategy, a natural question is whether this choice also has implications for the ideal founding team composition.

As compared to firms pursuing an innovator strategy, which rely more on the single dimension of technical excellence for success, ventures *not* pursuing an innovation strategy will rely on a broader set of resources and skills for success. As a result, in most firms outside of that select group pursuing an innovator strategy, having a more functionally diverse founding team offers a performance advantage. Consistent with prior

[2] For example, Amason, Shrader, and Tompson (2006) use a sample of 174 firms experiencing an IPO to argue that highly diverse TMTs have lower performance when the venture had more novel products and services.

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literature, most such firms will have to be competent in a wide range of areas such as sales and marketing, product distribution, and cost leadership.

It is also important to consider the source of complexity in a venture and whether it comes from the technology or the business model aspects of the firm. In addition to Hambrick *et al.*'s (1996) conceptualization of environmental complexity, complexity may also affect the technical and/or business aspects of the venture. The specific source of complexity should be aligned with the team composition (technical focus or functional diversity). In ventures that are using an innovator strategy, the complexity is likely to reside in the technology aspect of the business (requiring depth in technical teams). In contrast, in ventures pursuing a noninnovator strategy, the technical aspects are likely to be less of an issue and the business is more likely to benefit from greater diversity in functional roles, such as marketing, sales, and distribution. Complexity in the technical aspects as a result of an innovator strategy can be better addressed via technically focused team members, and thus other more diverse functional roles will be likely to contribute less in this case.

In sum, consistent with prior literature, we expect diverse founding teams will be positively associated with venture performance. However, firms pursuing an innovator strategy will be an exception and will not experience the same positive impact from a diverse founding team. Outside of those firms pursuing an innovator strategy, multifaceted organizational skills, resources, and management are particularly important for value creation and capture, and diverse founding teams are more likely to possess such attributes. We therefore predict that, while diverse teams have a positive performance effect, this will not be the case in all situations:

> *Hypothesis 1a: Diverse founding teams are positively associated with venture performance, but are less beneficial when pursuing an innovator strategy*.

For firms pursuing an innovation strategy, on the other hand, a more technically focused founding team may improve venture performance.[3] This can stem from a variety of mechanisms including enhanced managerial focus on technical development, stronger links with the relevant labor market (which can facilitate identifying, recruiting, and retaining technical staff), and/or fewer frictions in executing a product development plan due to improved communication between management and technical staff.

In turn, venture capitalists (VCs) are disproportionately attracted to funding new enterprises pursuing an innovation strategy (Hellmann and Puri, 2000). VCs can help provide a range of services such as business development, strategic advice, corporate governance, and professionalization services, all of which can help entrepreneurs speed their products to market (e.g., Hellmann and Puri, 2000; Hsu, 2004, 2006).

Of course, not all new ventures will attract or wish to accept venture capital funding, and for these firms, pursuing an innovation strategy with technically focused teams can attract incumbent firm partners to perform complementary commercialization functions such as sales and marketing activities.

Technically focused teams are also likely to have an advantage when innovating. Such teams have better knowledge and expertise regarding what innovations have been tried previously and either failed or succeeded, and so have a better technical road map for product development. Franco *et al.* (2009) find that first mover advantage is stronger for ventures with strong technical capabilities. Prior work finds that when technical founders start a venture in their field of education, they have higher performance and exit rates, conditional on survival (Braguinsky, Klepper, and Ohyama, 2012). A technically focused founding team is more likely to achieve the technological milestones necessary to develop the invention (Boeker, 1989). They are also likely to have more connections to the external technical community, which can be helpful for providing information, building technical advisory boards, and overcoming technical challenges. Finally, technically focused teams are also likely to share heuristics and mental models allowing for faster decision making, better coordination, and a smoother working relationship among cofounders. We therefore expect:

[3] We thank an anonymous reviewer for pointing out that our thesis that founding team technical expertise can be important for an innovation strategy is not the same as the argument that team diversity can be problematic, as those attributes are not mutually exclusive within a team, as prior studies show.

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Hypothesis 1b: Technically focused founding teams, when they pursue an innovation strategy, are positively associated with venture performance.

Commercialization environment

Strategy and organization theorists have long been interested in the influence of the firm's environment (Porter, 1991; Selznick, 1949; Starbuck, 1983; Stinchcombe, 1965). Others have explored the strategic decision-making implications of high velocity environments (Eisenhardt, 1989) and social movement organizations (Eesley and Lenox, 2006). We focus on the line of work examining how certain technical dimensions of the industry environment can shape organizational design (Woodward, 1965).

Prior literature indicates that for several reasons, including technical requirements in some industries, firms typically undertake a strategic approach and partner with as opposed to compete against industry incumbents (Christensen and Bower, 1996; Fuller and Thursby, 2008; Lerner and Merges, 1998; Teece, 1986; Tripsas, 1997). This literature contains a theoretically based way to classify industry commercialization environments since it gives us a structured lens through which to predict how new ventures will likely make strategic choices and what types of teams they may need. For instance, in the biotechnology industry, ventures frequently develop a new technology and then partner with incumbents (pharmaceutical firms) who handle the subsequent steps of regulatory approval, marketing, sales, and distribution. In contrast, in some industries such as software it is more common for ventures to compete head-to-head in the product market with incumbent firms. These commercialization environments, which we label competitive versus cooperative with incumbents, tend to differ across industries (Gans, Hsu, and Stern, 2002, 2008). A key insight from this literature is that certain dimensions of industry environments, such as the importance of complementary assets and the effectiveness of intellectual property protection, especially relate to the technical requirements of the industry (Tripsas, 1997; Woodward, 1965). These shape the likelihood that a venture will pursue a competitive versus cooperative strategy with industry incumbents for commercializing their products or services (Gans and Stern, 2003; Lerner and Merges, 1998; Rothaermel, 2001).

In the *cooperative* environment, ventures tend to cooperate with incumbents and form partnerships with established firms in the industry to bring their products and services to market. Ventures in cooperative environments tend not to compete in the product market directly with incumbents; instead, they typically partner with industry incumbents. This type of cooperative commercialization environment characterizes industries like biotechnology (that often partner with incumbent pharmaceutical firms for regulatory approval, marketing, and distribution) and medical devices, telecommunications, or chemicals. In a *competitive* commercialization environment (for instance, software, consumer products, or web services), ventures seek to compete in the product market against incumbent firms rather than partner for commercialization (e.g., Katila, Rosenberger, and Eisenhardt, 2008; Tripsas, 1997).

These differences in the technical requirements of the industry environment have direct implications for the founding team composition. When in a competitive environment, entrepreneurial ventures typically have to make investments in their own complementary assets, such as marketing, sales, manufacturing, and distribution, to build the capabilities necessary to compete in the market. More functionally diverse founding teams have the human capital, skills, and diversity of experience to build the complementary assets necessary to commercialize a good. It is more challenging for a technically focused team of all engineers or scientists to build the sales, marketing, and distribution capabilities necessary for the firm to compete with industry incumbents. Consequently, we predict:

Hypothesis 2a: When in a competitive commercialization environment, diverse founding teams are positively associated with venture performance.

In contrast, a cooperative commercialization environment tends to favor ventures that partner with industry incumbents to bring their products and services to market. In these settings, a firm can exclude others from using its technology either by secrecy or because patent protection is more effective in these industries (Cohen, Nelson, and

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Walsh, 2000), thus mitigating the expropriation threat inherent in contracting with a partner. In addition, complementary assets owned by incumbents are important for commercialization and difficult for a new venture to replicate (Rothaermel, 2001; Tripsas, 1997), further enhancing the incentives for joint commercialization. As a result, a cooperative commercialization environment (such as in the biotechnology industry) may be aligned with a different type of founding team composition as compared with a competitive environment. In cooperative commercialization environments, ventures compete with one another to partner with industry incumbents.

In cooperative environments, competition exists among entrepreneurial firms in supplying innovations to larger firms, making a focus on technology and technical talent more important. Furthermore, start-up innovators have the option to license or sell their innovation to the incumbent rather than bear the full cost of developing complementary assets. When in a cooperative commercialization environment, a venture that is partnering can rely on an incumbent firm's capabilities in marketing, sales, and customer support, allowing it to have a more focused set of skills on the founding team. As a result, we expect that a technically focused founding team will be more beneficial for firms in a cooperative commercialization environment:

Hypothesis 2b: When in a cooperative commercialization environment, technology-focused founding teams are positively associated with venture performance.

DATA AND MEASURES

We test our hypotheses using a sample of 2,067 ventures founded between 1931 and 2003. We developed this sample from a novel survey administered in 2001 to all 105,928 alumni from MIT to generate a sample of firms where we have detailed information on founders as well as on firm performance. An alumni survey is particularly appropriate because it enables gathering data from a well-defined population of comparable individuals in multiple industries (Eesley, 2011). The alumni survey increases the response rate and trust in the survey for the respondents. By surveying all alumni, we have polled all who could have founded a firm within this population. Due to these advantages, the use of alumni surveys as a data collection methodology has been growing, especially in the domain of entrepreneurship research (Burt, 2001; Dobrev and Barnett, 2005; Hsu, Roberts, and Eesley, 2007; Lazear, 2004; Lerner and Malmendier, 2013).

The 2001 survey generated 43,668 responses from MIT alumni for a 41.2 percent response rate. Out of 7,798 alumni who had indicated that they had founded a company, 2,111 founders completed more detailed surveys in 2003, representing a response rate of 25.6 percent. Removing duplicates where more than one cofounder reported on the same firm brings us to a total sample of 2,067 companies. We are able to compare data on demographic and educational characteristics of the entire population of alumni with the survey respondents. Differences in means tests of observed characteristics of the responders and nonresponders of both the 2001 and 2003 surveys detect little difference between the groups.[4]

The data were matched with complementary data sources through 2006 via Compustat (for public companies), the United States Patent and Trademark Office (USPTO), and Dun & Bradstreet (for private companies). Industries covered in the sample include aerospace, architecture, biomedical, chemicals, consumer products, consulting, electronics, energy, finance, law, machine tools, publishing, software, telecommunications, other services, as well as other manufacturing. A key feature of this dataset is its scope of coverage: all living MIT alumni who graduated between 1930 and 2001 were surveyed.[5]

Dependent variables

Following many studies in the literature, we measure entrepreneurial success through observed IPO or acquisition liquidity events. We define a *favorable exit* as either an IPO or an acquisition if that acquisition met either of two criteria: it made money for the investors (the valuation was higher than the capital raised) or if the acquired firm was older than five years and had positive

[4] In only a few instances do the differences between the subsamples vary by three percentage points or more. For the 2001 survey, only the variables male, European citizen, and Middle Eastern citizen meet these criteria.

[5] Respondents also reported on firms that later failed as well (41 percent of the firms failed), so the data include failed founding attempts.

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(greater than 0) revenues. This measure eliminates acquisitions where the firm was acquired at a low valuation, was not generating positive cash flow, and would have otherwise gone out of business. Arora and Nandkumar (2011) recently used similar screening criteria to measure favorable exits. The acquisition and IPO events were self-reports in the MIT survey. We confirmed their accuracy with the Compustat and the SDC Platinum databases. We also tested the results for robustness by using alternative performance measure, *exits*, which equals 1 if the firm experienced any type of acquisition or IPO and 0 if not (as of 2003). The youngest firms would not have had sufficient time to have an IPO or acquisition so we restricted the analysis to firms founded in 1998 and earlier, giving the firms at least five years of operating time.

Independent variables

Team characteristics

We measure diverse teams by the different functional roles on the founding team with the variable *diverse team*. The survey asked respondents for the role at founding for himself or herself and for each cofounder. These roles were then coded according to whether they fell under technology roles (chief technology officer, chief scientist, etc.), finance, sales and marketing, or other. The number of roles thus ranges from 1 to 4. A *diverse team* is coded as a count of the number of functional roles on the founding team. Beckman and Burton (2008) similarly use the count of the number of functional roles on the founding team. We test for, and find, robustness to variants of this measure such as dichotomizing the variable split at the median of the underlying functional role count. As a measure of how technology-focused the founding team is, we created the variable *technically focused team* as a dichotomous variable equal to 1 if the founding team was entirely composed of individuals who indicated that their role at founding was focused on the development of the technology (as opposed to other roles including marketing, sales, finance, management, etc.).

Innovation

We measure firms' innovation strategy by creating a composite index of the extent to which a firm innovates as the basis of its strategy. The variable *innovator* ranges from 0 to 3 depending on how innovative the firm is. A firm receives a 3 if it indicated that innovation was critical for its success, if it held at least one patent at the time of the survey, and if the idea for the venture came from a research lab (corporate or university). The firm receives a 2 if two of these conditions hold, a 1 if only one of them holds, and a 0 if none of them holds. Compared with prior studies that use patent counts as a measure of innovation, this measure has the advantage of applying to both younger and older firms (younger firms often have fewer resources to file for patents). The measure also has the advantage of being able to be used across industries, including those industries where patenting may not be used as frequently since it is less effective (Cohen *et al.*, 2000). As a robustness check, we examine the results using the components of the innovator index and by using the average patent "originality" score for a firm's patents. The originality measure, a common one in the innovation literature, is a concentration index of the diversity of patent classes that a focal patent cites, with a patent citing a more diverse set of patent classes said to be more original (Hall, Jaffe, and Trajtenberg, 2001).

Commercialization environment

We follow Gans and Stern (2003) in contrasting two start-up commercialization environments, which depend on the extent to which existing complementary assets are made obsolete by innovation and the appropriability regime surrounding innovation. Teece (1986) defines complementary assets as the assets or capabilities of firms that assist in the commercialization of innovations.[6] These assets can be resources that firms own, such as brand reputation, distribution channels, or customer relationships. They can also be organizational competencies, such as manufacturing capabilities, sales and service expertise, or the ability to capture customer knowledge. When intellectual property rights (IPR) are strong, innovation is more valuable due to the reduction of potential opportunism or expropriation (Anton and Yao, 1995; Arora,

[6] Rosenbloom and Christensen (1994) describe a similar idea using the term "value network" to describe the system of producers and markets serving "the ultimate user of the products or services to which a given innovation contributes."

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Fosfuri, and Gambardella, 2001; Gans *et al.*, 2002). Start-ups have less fear of disclosing their IP when forming an alliance or partnership in this case (Katila *et al.*, 2008). Formal IPR are one of several channels innovators can use to capture the value of their innovations. IPR may be particularly important in some industries in reducing the risks of expropriation (since patent protection varies by industry (Cohen *et al.*, 2000)), thereby easing innovator contracting and knowledge disclosure.

We define an environment where competitive commercialization is more frequently used as one in which the patent channel of appropriability is relatively weak while, at the same time, incumbents' extant complementary assets for commercialization are largely disrupted (start-up innovators fear bargaining with industry incumbents for fear of expropriation at the same time as the cost of entry is relatively low). A cooperative commercialization environment is defined in the opposite way, where patent protection is effective and the importance of incumbents' existing complementary assets is sustained (and so start-up innovators feel more comfortable bargaining with incumbents, who have a comparative advantage in assembled complementary assets).

We measure the importance of complementary assets and the effectiveness of patent protection in a firm's industry by matching the industry sectors with the Carnegie Mellon University (CMU) industry R&D survey (Cohen *et al.*, 2000). We create the measure of industry complementary asset importance by averaging the importance of complementary manufacturing and sales or services (then, we took the natural log to account for the skewed distribution). Sectors scoring high on this measure included electronics, telecommunication, machinery, chemicals and materials, biotechnology, medical devices, and consumer products (scoring low were software, finance, and services).[7] Similarly, we created an average of the importance of patents for protecting products and processes (and took the natural log to adjust for the skewed distribution) to create the measure of patent strength. Sectors high in patent strength included energy, electric utilities, aerospace, chemicals, materials, machinery, biotechnology, and medical devices (scoring low were finance, software, and services). We use the median values of these measures as the cutoff point. We use the median of the ratings on the importance of complementary assets in the sector, *complementary assets*, and the effectiveness of patent protection, *IPR strength*, to split the sample into firms that are in an environment where complementary assets are important and patent protection is strong (594 firms) and an environment where complementary assets are less important and patent protection is weak (885 firms).[8] The remaining firms in the sample were missing industry information, and our final regressions include 554 and 581 firms, respectively, due to missing values on other control variables.

Control variables

Another aspect of the environment that is likely to shape the characteristics of the founding team is the economic cycle, in particular, whether the firm was founded in a recession. General economic conditions at the time of founding were classified into expansion or contraction (recession) via the widely used National Bureau of Economic Research (NBER) Business Cycle Dating Committee's classifications (Stock and Watson, 2010). The variable *recession year* is equal to 1 if the firm was founded during a recession. We include this variable to proxy for founding conditions, as the prior literature suggests that founding in growth markets or high demand increases performance (Carroll and Delacroix, 1982; Eisenhardt and Schoonhoven, 1990; Romanelli, 1989).

The prior literature also shows that firm performance is partly related to industry factors, so we use a set of industry dummies as controls for the industry segment (such as biotech, software, and electronics). Survey respondents chose the industry category that best fit their firm.

[7] Not all MIT alumni firms fit into the industries in the CMU data (restaurants, dry cleaners, etc., are fairly rare). However, there are a number of services firms, such as consulting, law, accounting, and so on. These were grouped into an "other services" category. The results are robust to excluding these firms. Patents are very unlikely to be effective in the case of services firms; similarly, specialized complementary assets are likely unimportant. Thus, both of these measures are likely to be low. We therefore used the lowest values from the CMU survey for this category, which places them on similar footing as the printing and publishing industries, for example.

[8] Grouping industries based on their complementary assets and patent protection dimensions is a method grounded in the prior literature, and allows future researchers to classify new industries based on these characteristics.

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Since prior work finds that entrepreneurial performance is related to the founder's education level (Roberts, 1991), we control for the education level with *Master's degree* and *Doctorate degree* controls. While having a founder with a Doctorate degree might be an indication of a technology-focused team, not all doctorates in the sample are in technical fields, so we prefer the founding role measure and leave educational degrees as a control. Since more general experience may increase entrepreneurial performance, we control for founder age (Evans and Leighton, 1989). The variable *founder age* is the entrepreneur's age when the firm was founded. A number of studies show that the founder's prior industry experience increases firm performance (Ingram and Baum, 1997; Klepper, 2002; Klepper and Simons, 2000). Older, more experienced TMT members are found to aid firm performance. For example, CEOs in the microcomputer industry with an older experienced counselor make faster decisions, improving performance (Eisenhardt, 1989). We also measure experience in founding a firm with the variable *experienced entrepreneur* as a binary variable indicating whether the founder has prior entrepreneurial experience. Prior work has shown experienced entrepreneurial founders outperform their less experienced counterparts (Delmar and Shane, 2006; Eesley and Roberts, 2012).

Finally, we control for other team and firm-level effects that may influence firm performance. Since larger founding teams have been shown to outperform, we control for *founding team size* (in addition to the respondent) since having multiple members of a team leads to higher performance (Eisenhardt and Schoonhoven, 1990; Roberts, 1991). We control for *solo founder*, which is equal to 1 if there was only one founder. Older firms tend to be larger and have higher revenues, so we control for the age of the start-up, as measured by *firm age*. Since raising funding from external investors has been shown to be associated with higher firm performance and also may be easier for an experienced entrepreneur, we seek to control for these effects (Hellmann and Puri, 2002; Hsu, 2007). *External funding* is equal to 1 if the individual raised funds from venture capital firms or angel investors. It is possible that some ventures had more technical development prior to the founding of the company than others, allowing some to be ready for commercial sales, while others needed more technical development first. We therefore use a question from the survey about whether the founder had funding to develop a prototype prior to founding the company as another control variable (*prototype funded*).

ANALYSIS AND RESULTS

Table 1 provides descriptive statistics and a pairwise correlation table.[9] Table 2 reports the results of the logit regressions predicting *favorable exits*. Table 2, Model 2-1 shows results for the controls, and Model 2-2 shows just the main effects where *diverse team* is positive and significant ($p < 0.05$) and *technically focused team* is also positive and significant ($p < 0.10$). Models 2-3 and 2-4 test the effects of the interaction between team composition and the innovator strategy. Hypothesis 1a stated that diverse founding teams are positively associated with venture performance, but are less beneficial when pursuing an innovator strategy. Model 2-3 provides evidence supporting Hypothesis 1a. We find a positive (above 1) odds ratio on *diverse team*, indicating that these teams in general have a positive effect, and we find a negative (below 1) odds ratio on the interaction term between *innovator* and *diverse team*, indicating that diverse teams are significantly less beneficial when innovating. We find a positive odds ratio in Model 2-4 when interacting *innovator* and *technically focused team*, supporting Hypothesis 1b that when using an innovation strategy, technically focused teams are positively associated with performance.

Hypothesis 2a predicted that, when in a competitive commercialization environment, diverse founding teams would be positively associated with venture performance. In Table 3, Models 3-1 and 3-2 report results for only the controls in

[9] A majority (64 percent) of the firms have no founder in a technical role. Of the firms with no technical cofounders, 67 percent of them are solo founders. Of these, most are in service industries (law, consulting, management). We examined the types of degrees earned by those who indicated that they did not have a technical role on the founding team and found 61.5 percent had engineering degrees, 15.5 percent had science degrees, 13.9 percent had management degrees, 4.8 percent had humanities and social sciences degrees, and 4.3 percent had architecture degrees. Some of these individuals had been inventors and worked in technical roles in the past, but may have moved into management roles (29 percent indicated that, in their prior work experience, they had created patented inventions).

Table 1. Variables, descriptive statistics, and correlations

		Obs.	Mean	*SD*	Min	Max	1	2	3	4	5	6	7
1	Favorable exit	1809	0.226	0.419	0	1	1.000						
2	Diverse team	1809	1.261	0.521	1	4	0.164	1.000					
3	Technically focused team	1809	0.165	0.371	0	1	0.144	−0.195	1.000				
4	Recession year	1552	0.731	0.915	0	3	0.109	0.024	0.007	1.000			
5	Innovator	1809	0.224	0.417	0	1	0.278	0.262	0.198	0.028	1.000		
6	Master's degree	1520	0.263	0.440	0	1	0.042	0.063	0.009	−0.023	0.133	1.000	
7	Doctorate degree	1809	0.427	0.495	0	1	0.029	0.016	0.001	−0.027	0.073	−0.034	1.000
8	Experienced entrepreneur	1809	0.163	0.369	0	1	0.145	0.022	0.045	−0.001	0.088	−0.088	0.022
9	Founder age	1501	38.264	10.375	18	83	−0.097	−0.060	−0.032	0.008	−0.083	−0.049	0.021
10	Firm age	1127	13.268	9.852	1	71	0.252	0.074	−0.011	0.299	0.057	−0.039	−0.048
11	External funding	1771	0.427	0.495	0	1	0.283	0.201	0.152	−0.097	0.503	0.042	−0.009
12	Founding team size	1764	1.218	1.346	1	4	0.274	0.535	0.198	0.017	0.398	0.026	0.010
13	Solo founder	1764	0.391	0.488	0	1	−0.192	−0.375	−0.380	−0.008	−0.268	0.067	0.053
14	Prototype funded	1809	0.101	0.301	0	1	0.062	0.089	0.063	−0.068	0.304	0.086	0.016
							8	9	10	11	12	13	14
8	Experienced entrepreneur						1.000						
9	Founder age						0.259	1.000					
10	Firm age						−0.092	−0.088	1.000				
11	External funding						0.185	−0.102	−0.128	1.000			
12	Founding team size						0.135	−0.128	0.032	0.374	1.000		
13	Solo founder						−0.118	0.072	−0.055	−0.300	−0.783	1.000	
14	Prototype funded						0.006	−0.111	−0.080	0.210	0.165	−0.125	1.000

the competitive and cooperative strategy settings, respectively. We find support for the hypothesis in the significant, positive odds ratio on *diverse team* in the competitive strategy environment (Model 3-3). The odds ratio is significantly ($p < 0.05$) larger than in the cooperative strategy setting. Hypothesis 2b predicted that technically focused teams would be positively associated with venture performance when in a cooperative commercialization environment. This hypothesis was supported, as the odds ratio on *technically focused team* is positive and significantly larger ($p < 0.05$) than the same odds ratio in the cooperative environment setting (Model 3-6).[10]

In the logit regression tables, we present odds ratios, which give a sense of the size of the effects. However, while odds ratios are good at showing differences in the effects across groups, they do not adequately take into account the baseline main effects. Marginal effects take into account the baseline risk of a favorable exit and more accurately reflect the impact of a change in team composition. Based on Model 2-2 (Table 2), at the mean level of the other independent variables, we find the following marginal effects: for one additional functional role on the founding team, the main effect is an 8.9 percent higher likelihood of a favorable exit. Based on the specification in Model 2-4, when employing an innovation strategy, a *technically focused team* results in a 3.7 percent greater likelihood of a *favorable exit* (this estimate is the total effect, including the main and interaction effects). Hall and Woodward (2010) show that the mean return on a VC exit to the investors is $5M ($9M for the entrepreneurs), so this estimate would represent an increase in expected value of $185,000 for the VCs ($333,000 for the entrepreneurs). These results have significant real-world effects and a magnitude that would likely justify the costs of a headhunting firm or other efforts to recruit the right cofounder. With interaction effects in nonlinear models, graphing the interaction effect is necessary because the marginal effect is not equal to just changing the interaction term and depends on the levels of other variables (Norton, Wang, and Ai, 2004). When we graph the interaction effect (Figure 1), we find an inverse U-shaped relationship (for the innovation and *technically focused* founding team interaction) with the strongest positive effect at seven percent greater likelihood for

[10] Substituting an analysis with interaction terms instead of a split sample yields similar results. We present split sample analyses, as this allows the coefficients on the control variables to vary.

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Table 2. Logits of *favorable exit* for varied founding team structures under an innovator strategy (odds ratios using the entire sample are reported)

Variables	(2-1)	(2-2)	(2-3)	(2-4)
Diverse team		1.417**	1.816***	
		(0.309)	(0.419)	
Technically focused team		1.348*		0.899
		(0.300)		(0.178)
Innovator × diverse team			0.604***	
			(0.089)	
Innovator × technically focused team				1.337*
				(0.207)
Innovator	1.001	1.111	1.188*	0.953
	(0.078)	(0.102)	(0.112)	(0.081)
Recession year	1.782***	1.220	1.808***	1.766***
	(0.290)	(0.228)	(0.297)	(0.296)
Master's degree	0.838	1.021	0.869	0.990
	(0.112)	(0.158)	(0.117)	(0.137)
Doctorate degree	1.090	1.043	1.093	1.059
	(0.197)	(0.230)	(0.202)	(0.204)
Experienced entrepreneur	1.771***	1.548771**	1.700***	2.072***
	(0.258)	(0.275)	(0.255)	(0.315)
Founder age	1.000	1.006	1.000	0.999
	(0.007)	(0.008)	(0.007)	(0.007)
Firm age	1.040***	0.996	1.040***	1.038***
	(0.008)	(0.009)	(0.008)	(0.009)
External funding	1.646***	1.498**	1.723***	1.754***
	(0.271)	(0.275)	(0.277)	(0.299)
Founding team size	1.122	1.051	1.134	1.101
	(0.080)	(0.097)	(0.087)	(0.084)
Solo founder	0.639**	0.735	0.693*	0.603**
	(0.141)	(0.228)	(0.154)	(0.148)
Prototype funded	0.873	0.648*	0.862	0.858
	(0.177)	(0.167)	(0.170)	(0.185)
Constant	0.215**	0.109***	0.167***	0.238**
	(0.137)	(0.084)	(0.103)	(0.171)
Industry F.E.	Y	Y	Y	Y
Observations	1103	1103	1103	1103
Pseudo-R^2	0.117	0.094	0.124	0.126

Coefficients are odds ratios (numbers below one represent decreased odds). Robust, two-tailed standard errors appear in parentheses. F.E. = fixed effects.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

those at a moderate likelihood of a *favorable exit*. An additional function on the founding team when adopting an innovation strategy reduces the likelihood of a favorable exit by 8.4 percent (based on the specification in Model 2-3). This effectively cancels out the positive, beneficial effect of an additional function on the founding team in general. Graphing the interaction effect (Figure 2), we see that there is a U-shaped relationship, where the effect ranges from 2 to 4 percent lower likelihood at very low or very high probabilities of a favorable exit to 12 percent lower likelihood for those at a moderate likelihood of favorable exit. Finally, based on Table 3, Model 3-6, in the cooperative environment a technically focused founding team has a 12.8 percent greater likelihood of a favorable exit. In the competitive environment, based on Model 3-3, an additional function on the founding team results in a 7.9 percent increase in the likelihood of a favorable exit.

Additional analysis, robustness, and limitations

We ran additional analyses with variants of the dependent variable, independent variables,

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Table 3. Logits of *favorable exit* for varied founding team structures under different commercialization environment samples (odds ratios are reported)

Variables	Competitive (3-1)	Cooperative (3-2)	Competitive (3-3)	Cooperative (3-4)	Competitive (3-5)	Cooperative (3-6)
Diverse team			1.759**	0.959		
			(0.465)	(0.240)		
Technically focused team					1.175	1.760**
					(0.271)	(0.430)
Innovator	1.576***	0.897	1.523***	0.894	1.089	0.855
	(0.194)	(0.113)	(0.190)	(0.114)	(0.123)	(0.095)
Recession year	0.604*	1.850**	0.634	1.855**	1.191	1.038
	(0.181)	(0.466)	(0.193)	(0.468)	(0.276)	(0.233)
Master's degree	0.958	0.846	0.931	0.843	1.326	1.184
	(0.218)	(0.174)	(0.212)	(0.174)	(0.256)	(0.206)
Doctorate degree	0.553*	2.120***	0.568	2.119***	0.629*	1.423
	(0.197)	(0.580)	(0.203)	(0.579)	(0.174)	(0.330)
Experienced entrepreneur	1.872**	1.190	1.929***	1.181	3.327***	1.631**
	(0.459)	(0.267)	(0.476)	(0.272)	(0.683)	(0.318)
Founder age	1.002	0.995	1.001	0.995	0.981**	0.984
	(0.011)	(0.011)	(0.011)	(0.011)	(0.009)	(0.010)
Firm age	1.004	0.995	1.004	0.995	1.045***	1.102***
	(0.013)	(0.012)	(0.013)	(0.012)	(0.010)	(0.012)
External funding	1.101	2.597***	1.081	2.593***	1.672**	3.709***
	(0.280)	(0.701)	(0.273)	(0.700)	(0.361)	(0.810)
Founding team size	1.072	1.258**	0.991	1.269**	1.028	1.333***
	(0.130)	(0.133)	(0.136)	(0.147)	(0.101)	(0.136)
Solo founder	0.595	1.031	0.613	1.031	0.340***	1.029
	(0.234)	(0.367)	(0.245)	(0.367)	(0.110)	(0.320)
Prototype funded	1.406	0.389***	1.431	0.389***	1.060	0.814
	(0.509)	(0.129)	(0.526)	(0.130)	(0.330)	(0.231)
Constant	0.120***	0.206***	0.125***	0.208***	0.245***	0.0644***
	(0.064)	(0.122)	(0.066)	(0.123)	(0.124)	(0.035)
Observations	581	554	581	554	581	554
Pseudo-R^2	0.081	0.075	0.067	0.081	0.075	0.081

Coefficients are odds ratios (numbers below one represent decreased odds). Robust, two-tailed standard errors appear in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

industry environment, and other periods of time to investigate the robustness of the results.[11] The results are robust to using *exit* as a measure indicating whether the firm experienced any acquisition or IPO event instead of *favorable exit*. We also tested for and found that the results are not sensitive to alternative measures of our key independent variables. We narrowed the sample to those firms with patents so that we can test the impact of patent-based measures of the degree of innovation (*patent originality)* and found the results robust. The results (available from the authors) are also not sensitive to using patents and the percentage of revenues spent on R&D as alternative innovation measures. We find the results robust to using a binary variant of the variable *diverse team* equal to 1 if the team has greater than the median number of structural roles on the founding team as an alternative to the continuous *diverse team* variable.

Furthermore, defining the industry environments in alternative ways does not alter the results. While we decided to use the median values of *complementary assets* and *patent protection*, the results were robust to changing the exact division points across these environments and to simply

[11] In response to a reviewer request about how the combination of innovation strategy, commercialization environment, and team composition align, we ran three-way interactions. The prediction was that an innovation strategy in the cooperative environment with a technically focused founding team would be best. The three-way interactions suggest higher performance by technically focused, innovation strategy firms in the cooperative environment and by diverse, innovation strategy teams in the competitive environment.

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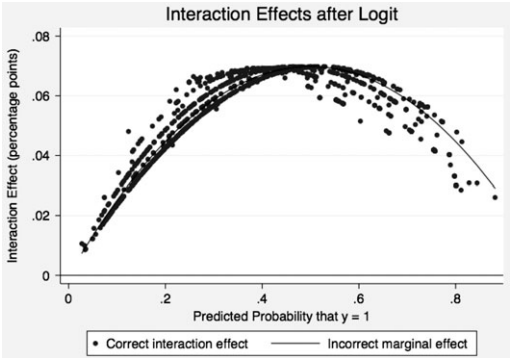

Figure 1. Interaction effect for innovation strategy and technically focused founding team plotted by the probability of a *good exit*. Corrected effect is plotted using the Norton *et al*. (2004) Stata command

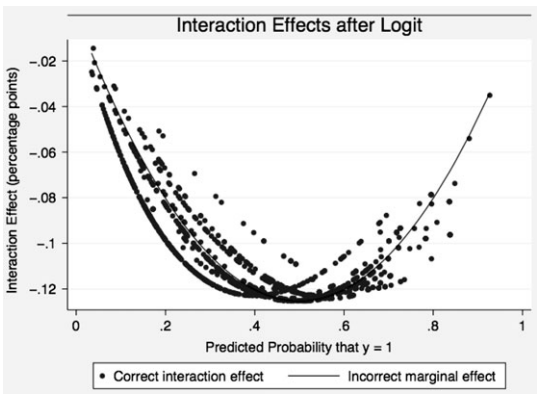

Figure 2. Interaction effect for innovation strategy and functionally diverse founding team plotted by the probability of a *good exit*. Corrected effect is plotted using the Norton *et al*. (2004) Stata command

defining them based on industries.[12] We also found that our results hold across a broad range of different time periods (either restricting the data to more recently founded firms or to just firms founded before a certain year to test whether right censoring was driving our results).

We next assessed whether our results are driven by the possible codetermination of founding team composition and business environment and strategy. Prior literature suggests that many studies in the management and organizations literature have concluded that team formation considerations precede strategy formulation. In this spirit, Beckman (2006) writes (p. 742): "Indeed, prior work on new ventures has shown that founders and founding teams shape a firm's initial strategies, structures, actions, and performance (e.g., Beckman, 2006; Boeker, 1989; Burton, Sørensen, and Beckman, 2002; Eisenhardt and Schoonhoven, 1990; Gompers, Lerner, and Scharfstein, 2005; Roure and Maidique, 1986)." Ruef and colleagues (2003: 754) interpret their findings as indicating that "founding teams are generally formed for reasons of social convenience, and not strategy."

Nonetheless, since team formation may be an endogenous process alongside the choice of innovation strategy and commercialization environment (particularly for more savvy entrepreneurs), we use subsample analyses and an instrumental variables approach as robustness checks. We use two different subsamples in Table 4, panels B and C (young founders and "naïve" teams) where the teams would plausibly be formed less for strategic reasons and are more likely formed based on social convenience. We use a subsample of first-time founders who are young (under the age of 28). For naïve teams, we use teams where the founders indicated they met via family, socially, in school, or in the research lab. In Table 4, panel A, we use an instrumental variables (IV) approach with an IV probit estimation procedure, as a Hausman test shows that the founding team variables may potentially be endogenous. Using these three analyses, we find results consistent with our main results.

To conduct our IV analysis, we ran the first stage as a probit regression on the potentially endogenous variables, *technically focused* and *diverse team*. We constructed the instrument *idea from research* (for *technically focused* teams) and *team from work* (used for *diverse* teams) where these variables indicate the primary source of the idea and founding team. These instruments are used separately in the regressions and are significantly correlated with the founding team composition, but should not be correlated with the error term through omitted variables. The instruments satisfy the exclusion restriction because the source of the idea or team (research or work) should not have a direct impact on the likelihood of a favorable exit (venture execution rather than strict venture genesis is more likely to determine ultimate enterprise outcomes). We then assessed the instrument's relevance. Using an F-test where

[12] Biotechnology, machine tools, chemicals, and telecommunications make up the majority of cooperative environment firms, and electronics and software firms make up the majority of the competitive environment firms.

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Table 4. Instrumental variables probits and subsample logits of *favorable exit* for varied founding team structures under different estimation strategies

	All (4-1)	All (4-2)	Competitive (4-3)	Cooperative (4-4)	Competitive (4-5)	Cooperative (4-6)
Panel A: Instrumental variables (IV probit)						
Diverse team		2.544***			2.357***	−1.975***
		(0.291)			(0.218)	(0.091)
Technically focused team	0.096		1.942***	2.333***		
	(0.124)		(0.443)	(0.308)		
Innovator × diverse team		−1.457***				
		(0.144)				
Innovator × technically focused team	0.101					
	(0.096)					
Observations	1274	718	531	350	349	414
Log-likelihood	−957.595	−1108.705	−561.769	−385.838	−462.609	−401.807
Panel B: Under 28 years old and first-time founder						
Diverse team		3.864***			0.569*	−3.727*
		(1.418)			(0.337)	(2.060)
Technically focused team	−1.621*		0.102	3.175***		
	(0.975)		(0.415)	(1.184)		
Innovator × diverse team		−0.742				
		(0.596)				
Innovator × technically focused team	0.970**					
	(0.437)					
Observations	135	131	73	191	81	234
Pseudo-R^2	0.116	0.108	0.199	0.145	0.269	0.094
Panel C: Naïve teams						
Diverse team		2.155***			1.571*	0.149
		(0.678)			(0.810)	(0.759)
Technically focused team	−0.736		0.768	3.019*		
	(0.792)		(0.801)	(1.769)		
Innovator × diverse team		−1.997***				
		(0.583)				
Innovator × technically focused team	1.467**					
	(0.722)					
Observations	123	123	74	69	74	69
Pseudo-R^2	0.275	0.346	0.352	0.193	0.287	0.247

Robust, two-tailed standard errors appear in parentheses.
Controls are the same as in Tables 3 and 4 but are not shown to save space. We use two different subsamples in panels B and C (young founders and naïve teams) where the teams would plausibly be formed less for strategic reasons and are more likely formed based on social convenience. In panel B, we use a subsample of first-time founders who are young (under the age of 28). For naïve teams in panel C, we use teams where the founders indicated they met via family, socially, in school, or in the research lab. In panel A, we report instrumental variables regressions. For the *technically focused team* variable, we use *idea from research lab* as an instrument, and all R^2 statistics are relatively high, indicating there is not a weak-instrument problem. The F-statistic is 8.66, which exceeds the critical value of 6.66 of a weak instrument. For the *diverse team* variable, we use *team from industry* as an instrument. All the R^2 statistics are relatively high, so they do not imply a weak-instrument problem. The F-statistic is 3.31. If we are willing to accept at most a rejection rate of 15 percent of a nominal 5 percent Wald test, we can reject the null hypothesis that the instruments are weak, since the test statistic of 3.31 exceeds its critical value of 2.84.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

the first stage model is compared to a model without the instrument, we find that the F-statistic is greater than the recommended values, suggesting that the instruments are not weak.[13] The results in Table 4 are consistent with our main Tables 2 and 3, providing greater confidence in our findings. In

[13] We also assess the instruments' exogeneity using the overidentification J-test. Including all of the team sources from the survey, including *team from social*, *team from school*, and *team met via family*, the test fails to reject the null that the instrument is valid. This test assesses whether the bundle of instruments is exogenous assuming that at least one of the instruments is exogenous. These additional instruments are not used in the IV regression since they are weak instruments; however, they allow us to perform the J-test for overidentification to test the exclusion restriction.

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Table 4, panel A, in our IV estimates, it is worth noting that *technically focused team* becomes significant in the competitive environment as well as the cooperative environment. This does not occur in panels B and C.

DISCUSSION AND CONCLUSION

Our main findings are that technically focused teams are aligned with a cooperative commercialization environment and when using an innovation strategy, while diverse teams are higher performing in a competitive commercialization environment. These results have implications for the related literatures on entrepreneurship, top management teams, and strategy.

Prior work has examined factors such as the career history of founders and top management team, strategy, and market growth (Eisenhardt and Schoonhoven, 1990). This literature has generally argued that a functionally diverse founding team is optimal (Beckman, Burton, and O'Reilly, 2007).[14] In addition, the prior literature shows that the general complexity surrounding the organization is an important factor in top management team composition (Priem, 1990). We provide theory and evidence that, in some cases, a diverse team is less beneficial and a more technically focused founding team does better. In these cases, when using an innovator strategy or in a cooperative industry environment, the complexity regarding technical issues is high while business model complexity is relatively lower. Our results show that the source of the complexity has implications for the type of top management team associated with higher performance. As a result, our work responds to Hambrick's (2007) call to examine the role of the founding team as well as calls for work on moderating influences (Certo *et al.*, 2006) by showing that the characteristics of highly performing founding teams may be contingent on their alignment with two factors—innovation strategy and industry commercialization environment.

We also contribute to the debate between life cycle and imprinting models of founding teams. Life cycle models have argued that ventures can add the appropriate skills and top managers as they are needed over time (Audia and Rider, 2005; Greiner, 1972). Those models assert that a venture becomes professionalized over time, and so a fit between the founding team and the eventual innovation strategy is unnecessary as the right skills can be added at a later stage (Hellmann and Puri, 2000; Keck, 1997; Randel and Jaussi, 2003). In contrast, imprinting models argue that the founding team composition has lasting influences on the firm (Beckman and Burton, 2008; Burton and Beckman, 2007). We contribute to this literature by showing that the initial founding team must be aligned with the strategy and environment to produce long-term organizational performance, which may limit the effectiveness of sequential TMT professionalization over the venture life cycle. For instance, having a technically focused founding team in place may provide numerous benefits. Technical milestones such as completion of design, proof-of-concept, prototype completion, and pilot production indicate a new firm's development stage (Sahlman, 1990), and a technically focused team can more quickly progress through technical stages of development (Katila *et al.*, 2008). Such development can help the start-up innovator more successfully gather financial resources (Hallen, 2008) and enable the firm to give up less equity when raising financial capital (Gompers, 1995). Finally, while the firm's business environment continues to interest strategy and organization theorists (Porter, 1991; Selznick, 1949; Starbuck, 1983; Stinchcombe, 1965), little or no prior work has related firms' commercialization environments to their founding team composition. The early contingency literature related organizational design decisions to features of the business environment such as stability versus turbulence (Burns and Stalker, 1961), yet such organizational design decisions did not include founding team composition. While the prior literature studies new ventures' entry strategies and

[14] We do not regard our results as at odds with the results of Beckman (2006), which finds that diverse teams are more likely to undertake exploratory innovation. That study examines diverse teams in terms of prior employer affiliations, whereas we examine diverse teams by functional roles. The Beckman study examines the extent to which firms pursue an exploratory versus exploitative innovation strategy rather than their success in innovating or the firm's likelihood of an exit. Beckman (2006) does examine firm growth as an outcome measure, but finds that exploratory innovation has a negative and insignificant effect on firm growth. While a diverse team (in terms of prior employer affiliations) may be more likely to pursue an exploratory innovation strategy, our results show that they will be more likely to have a favorable exit if they operate in a competitive environment and that they will have lower performance if they attempt to adopt an innovation strategy in a cooperative environment.

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finds that such strategies are contingent on the business environment (Gans *et al.*, 2002; Teece, 1986), we suggest that the commercialization environment is an important contingency in the relationship between founding team composition (and the associated information and skills of the start-up) and organizational performance. Consequently, our findings contribute to the literature by showing how technical aspects of the industry commercialization environment influence founding team composition.

Limitations and future research

One limitation of our research is that we cannot observe the precise ordering of who joined the founding team in relation to the timing of strategy and entry decisions. However, in keeping with the commercialization environment literature, we have conceptualized our analysis statically. A question for future research is: Under what circumstances would a more dynamic conceptualization of changes in strategy or environment result in different implications for team composition? Another limitation is that we have not explicitly examined the costs of searching for teammates. Finally, another area for future research is in conceptualizing the skills and information available beyond the founding team to the broader set of resource providers (i.e., investors, early employees, and advisors). An open question is whether these resource providers bring some of the same benefits to the venture.

While these and other future research directions would be interesting, our results here aid existing efforts to better understand when certain organizational structures, including founding team composition, might be aligned with firms' strategy and business environment. Our work is among the first to suggest that entrepreneurs may need to take into account likely future strategic commercialization choices and environments when forming their founding team.

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REFERENCES

Amason AC, Shrader RC, Tompson GH. 2006. Newness and novelty: relating top management team characteristics to new venture performance. *Journal of Business Venturing* **21**(1): 125–148.

Anton JJ, Yao DA. 1995. Start-ups, spin-offs, and internal projects. *Journal of Law, Economics, and Organization* **11**(2): 362–378.

Arora A, Fosfuri A, Gambardella A. 2001. *Markets for Technology: The Economics of Innovation and Corporate Strategy*. MIT Press: Cambridge, MA.

Arora A, Nandkumar A. 2011. Cash-out or flame-out! Opportunity cost and entrepreneurial strategy: theory, and evidence from the information security industry. *Management Science* **57**(10): 1844–1860.

Audia PG, Rider CI. 2005. A garage and an idea: what more does an entrepreneur need? *California Management Review* **48**: 6–28.

Baron J, Burton M, Hannan M. 1999. Engineering bureaucracy: the genesis of formal policies, positions, and structures in high-technology firms. *Journal of Law, Economics, and Organization* **15**(1): 1–41.

Beckman C. 2006. The influence of founding team prior company affiliations on firm behavior. *Academy of Management Journal* **49**: 741–758.

Beckman CM, Burton MD. 2008. Founding the future: path dependence in the evolution of top management teams from founding to IPO. *Organization Science* **19**(1): 3–24.

Beckman C, Burton MD, O'Reilly C. 2007. Early teams: the impact of entrepreneurial team demography on VC financing and going public. *Journal of Business Venturing* **22**: 147–173.

Beckman CM, Haunschild PR. 2002. Network learning: the effects of partners' heterogeneity of experience on corporate acquisitions. *Administrative Science Quarterly* **47**: 92–124.

Boeker W. 1989. Strategic change: the effects of founding and history. *Academy of Management Journal* **32**: 489–515.

Boeker W, Karichalil R. 2002. Entrepreneurial transitions: factors influencing founder departure. *Academy of Management Journal* **45**(4): 818–826.

Braguinsky S, Klepper S, Ohyama A. 2012. High-tech entrepreneurship. *Journal of Law and Economics* **55**(4): 869–900.

Brown SL, Eisenhardt KM. 1997. The art of continuous change: linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly* **42**: 1–34.

Burns T, Stalker GM. 1961. *The Management of Innovation*. Tavistock: London, UK.

Burt RS. 2001. Attachment, decay, and social network. *Journal of Organizational Behavior* **22**(6): 619–643.

Burton MD, Beckman CM. 2007. Leaving a legacy: position imprints and successor turnover in young firms. *American Sociological Review* **72**(2): 239–266.

Burton MD, Sørensen JB, Beckman C. 2002. Coming from good stock: career histories and new venture formation. *Research in the Sociology of Organizations* **19**: 229–262.

Carpenter MA. 2002. The implications of strategy and social context for the relationship between top management team heterogeneity and firm performance. *Strategic Management Journal* **23**(3): 275–284.

Carroll GR, Delacroix J. 1982. Organizational mortality in the newspaper industries of Argentina and Ireland: an ecological approach. *Administrative Science Quarterly* **27**(2): 169–198.

Certo ST, Lester RH, Dalton CM, Dalton DR. 2006. Top management teams, strategy and financial performance: a meta-analytic examination. *Journal of Management Studies* **43**(4): 813–839.

Christensen CM, Bower JL. 1996. Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal* **17**: 197–218.

Cohen W, Nelson R, Walsh J. 2000. Protecting their intellectual assets: appropriability conditions and why U.S. manufacturing firms patent (or not). Working paper W7552, National Bureau of Economic Research(NBER), Cambridge, MA.

Delmar F, Shane S. 2006. Does experience matter? The effect of founding team experience on the survival and sales of newly founded ventures. *Strategic Organization* **4**(3): 215–247.

Dobrev SD, Barnett WP. 2005. Organizational roles and transition to entrepreneurship. *Academy of Management Journal* **48**(3): 433–449.

Eesley C. 2011. Alumni surveys as a data collection methodology. Working paper, Stanford University, Stanford, CA. Available at: http://www.stanford.edu/~cee/Papers/Eesley_Alumni_surveys.pdf (accessed 1 January 2013).

Eesley C, Lenox M. 2006. Firm responses to secondary stakeholder action. *Strategic Management Journal* **27**(8): 765–781.

Eesley C, Roberts EB. 2012. Are you experienced or are you talented?: When does innate talent versus experience explain entrepreneurial performance? *Strategic Entrepreneurship Journal* **6**(3): 207–219.

Eisenhardt K. 1989. Making fast strategic decisions in high-velocity environments. *Academy of Management Journal* **82**(5): 929–964.

Eisenhardt KM, Schoonhoven CB. 1990. Organizational growth: linking founding team, strategy, environment, and growth among U.S. semiconductor ventures, 1978–1988. *Administrative Science Quarterly* **35**(3): 504–529.

Evans DS, Leighton LS. 1989. Some empirical aspects of entrepreneurship. *American Economic Review* **79**(3): 519–535.

Finkelstein S, Hambrick D. 1996. *Strategic Leadership: Top Executives and their Effects on Organizations*. West Publishing Company: Minneapolis/St. Paul, MN.

Finkelstein S, Hambrick D, Cannella A. 2009. *Strategic Leadership: Theory and Research on Executives, Top Management Teams and Boards*. West Publishing Company: Minneapolis, MN.

Franco A, Sarkar MB, Echambadi R, Agarwal R. 2009. Swift and smart? The moderating effects of technological capabilities on the market pioneering—firm survival relationship. *Management Science* **55**(11): 1842–1860.

Fuller AW, Thursby MC. 2008. Chapter 8 Technology commercialization: cooperative versus competitive strategies. In *Technological Innovation: Generating Economic Results, Advances in the Study of Entrepreneurship, Innovation & Economic Growth*, Vol. 18, Libecap GD, Thursby MC (eds). Emerald Group Publishing Limited: London, UK; 227–250.

Gans JS, Hsu DH, Stern S. 2002. When does start-up innovation spur the gale of creative destruction? *Rand Journal of Economics* **33**(4): 571–586.

Gans JS, Hsu DH, Stern S. 2008. The impact of uncertain intellectual property rights on the market for ideas: evidence from patent grant delays. *Management Science* **54**(5): 982–997.

Gans JS, Stern S. 2003. The product market and the market for "ideas": commercialization strategies for technology entrepreneurs. *Research Policy* **32**(2): 333–350.

Gompers PA. 1995. Optimal investment, monitoring, and the staging of venture capital. *Journal of Finance* **50**: 1461–1490.

Gompers P, Lerner J, Scharfstein D. 2005. Entrepreneurial spawning: public corporations and the genesis of new ventures, 1986 to 1999. *Journal of Finance* **60**(2): 517–614.

Greiner LE. 1972. Evolution and revolution as organizations grow. *Harvard Business Review* **50**(4): 37–46.

Haleblian J, Finkelstein S. 1993. Top management team size, CEO dominance, and firm performance: the moderating roles of environmental turbulence and discretion. *Academy of Management Journal* **36**(4): 844–863.

Hall BH, Jaffe AB, Trajtenberg M. 2001. The NBER patent citation data file: lessons, insights and methodological tools. Working paper Series w8498, National Bureau of Economic Research(NBER), Cambridge, MA. Available at: http://ssrn.com/abstract=285618 (accessed 1 January 2013).

Hall RE, Woodward SE. 2010. The burden of the nondiversifiable risk of entrepreneurship. *American Economic Review* **100**(3): 1163–1194.

Hallen B. 2008. The causes and consequences of the initial network positions of new organizations: from whom do entrepreneurs receive investments? *Administrative Science Quarterly* **53**: 685–718.

Haltiwanger J, Jarmin R, Miranda J. 2013. Who creates jobs? Small vs. large vs. young. *Review of Economics and Statistics* (Forthcoming).

Hambrick DC. 2007. Upper echelons theory: an update. *Academy of Management Review* **32**(2): 334–343.

Hambrick DC, Cho TS, Chen MJ. 1996. The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly* **41**(4): 659–684.

Hambrick DC, Mason PA. 1984. Upper echelons: the organization as a reflection of its top managers. *Academy of Management Review* **9**(2): 193–206.

Hellmann T, Puri M. 2000. The interaction between product market and financing strategy: the role of venture capital. *Review of Financial Studies* **13**(4): 959–984.

Hellmann T, Puri M. 2002. Venture capital and the professionalization of start-up firms: empirical evidence. *Journal of Finance* **57**(1): 169–197.

Hsu DH. 2004. What do entrepreneurs pay for venture capital affiliation? *Journal of Finance* **59**: 1805–1844.

Hsu DH. 2006. Venture capitalists and cooperative start-up commercialization strategy. *Management Science* **52**: 204–219.

Hsu DH. 2007. Experienced entrepreneurial founders, organizational capital, and venture capital funding. *Research Policy* **36**: 722–741.

Hsu DH, Roberts EB, Eesley CE. 2007. Entrepreneurs from technology-based universities: evidence from MIT. *Research Policy* **36**: 768–788.

Ingram P, Baum J. 1997. Opportunity and constraint: organizations' learning from the operating and competitive experience of industries. *Strategic Management Journal* **18**(S1): 75–98.

Katila R, Chen E. 2009. Effects of search timing on product innovation: the value of not being in sync. *Administrative Science Quarterly* **53**: 593–625.

Katila R, Rosenberger J, Eisenhardt KM. 2008. Swimming with sharks: technology ventures, defense mechanisms, and corporate relationships. *Administrative Science Quarterly* **53**: 295–332.

Keck SL. 1997. Top management team structure: differential effects by environmental context. *Organization Science* **8**(2): 143–156.

Keck SL, Tushman ML. 1993. Environmental and organizational context and executive team structure. *Academy of Management Journal* **36**(6): 1314–1344.

Klepper S. 2002. The capabilities of new firms and the evolution of the U.S. automobile industry. *Industrial and Corporate Change* **11**(4): 645–666.

Klepper S, Simons KL. 2000. Dominance by birthright: entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. *Strategic Management Journal* **21**(10/11): 997–1016.

Lant TK, Mezias SJ. 1992. An organizational learning model of convergence and reorientation. *Organization Science* **3**(1): 47–71.

Lazear E. 2004. Balanced skills and entrepreneurship. *American Economic Review* **94**(2): 208–211.

Lerner J, Malmendier U. 2013. With a little help from my (random) friends: success and failure in post-business school entrepreneurship. *Review of Financial Studies* (Forthcoming).

Lerner J, Merges RP. 1998. The control of technology alliances: an empirical analysis of the biotechnology industry. *Journal of Industrial Economics* **46**(2): 125–156.

Lieberman MB, Montgomery DB. 1988. First-mover advantages. *Strategic Management Journal* **9**(5): 41–58.

Lieberman MB, Montgomery DB. 1998. First-mover (dis)advantages: retrospective and link with the resource-based view. *Strategic Management Journal* **19**: 1111–1125.

Maidique MA, Patch P. 1982. Corporate strategy and technological policy. In *Readings in the Management of Innovation*, Tushman ML, Moore WL (eds). Pitman: Marshfield, MA; 273–285.

McGee JE, Dowling MJ, Megginson WL. 1995. Cooperative strategy and new venture performance: the role of business strategy and management experience. *Strategic Management Journal* **16**(7): 565–580.

Michel JG, Hambrick DC. 1992. Diversification posture and top management team characteristics. *Academy of Management Journal* **35**(1): 9–37.

Miles RE, Snow CC. 1978. *Organizational Strategy, Structure, and Process*. McGraw-Hill: New York.

Miller D. 1993. Some organizational consequences of CEO succession. *Academy of Management Journal* **36**: 644–659.

Miller D, Shamsie J. 2001. Learning across the life cycle: experimentation and performance among the hollywood studio heads. *Strategic Management Journal* **22**(8): 725–745.

Norton EC, Wang H, Ai C. 2004. Computing interaction effects and standards errors in logit and probit models. *Stata Journal* **4**(2): 154–167.

Pfeffer J. 1983. Organizational demography. *Research in Organizational Behavior* **5**: 299–357.

Porter ME. 1991. Towards a dynamic theory of strategy. *Strategic Management Journal* **12**: 95–117.

Priem RL. 1990. Top management team group factors, consensus, and firm performance. *Strategic Management Journal* **11**(6): 469–478.

Quinn R, Cameron K. 1983. Organizational life cycles and shifting criteria of effectiveness: some preliminary evidence. *Management Science* **29**: 33–51.

Randel AE, Jaussi KS. 2003. Functional background identity, diversity, and individual performance in cross–functional teams. *Academy of Management Journal* **46**(6): 763–774.

Roberts EB. 1991. *Entrepreneurs in High Technology: Lessons from MIT and Beyond*. Oxford University Press: New York.

Roberts EB, Eesley CE. 2011. Entrepreneurial impact: the role of MIT—an updated report. *Foundations and Trends® in Entrepreneurship* **7**(1–2): 1–149.

Romanelli E. 1989. Environments and strategies of organization start-up: effects on early survival. *Administrative Science Quarterly* **34**(3): 369–387.

Rosenbloom RS, Christensen CM. 1994. Technological discontinuities, organizational capabilities, and strategic commitments. *Industrial and Corporate Change* **3**(3): 654–668.

Rothaermel FT. 2001. Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal* **22**: 687–699.

Roure JB, Maidique MA. 1986. Linking prefunding factors and high-technology venture success: an exploratory study. *Journal of Business Venturing* **1**(3): 295–306.

Ruef M, Aldrich H, Carter N. 2003. The structure of founding teams: homophily, strong ties, and isolation among U.S. entrepreneurs. *American Sociological Review* **68**(2): 195–222.

Sahlman WA. 1990. The structure and governance of venture-capital organizations. *Journal of Financial Economics* **27**(2): 473–521.

Selznick P. 1949. *TVA and the Grass Roots*. University of California Press: Berkley, CA.

Starbuck WH. 1983. Organizations as action generators. *American Sociological Review* **48**: 231–266.

Stinchcombe AL. 1965. Social structure and organizations. In *Handbook of Organizations*, March JG (ed). Rand McNally & Company: Chicago, IL; 142–193.

Stock JH, Watson MW. 2010. Indicators for dating business cycles: cross-history selection and comparisons. *American Economic Review* **100**(2): 16–19.

Teece DJ. 1986. Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy* **15**: 285–305.

Thomas AS, Litschert RJ, Ramaswamy K. 1991. The performance impact of strategy—manager coalignment: an empirical examination. *Strategic Management Journal* **12**(7): 509–522.

Tripsas M. 1997. Surviving radical technological change through dynamic capability: evidence from the typesetter industry. *Industrial and Corporate Change* **6**(2): 341–377.

Williams KY, O'Reilly CA. 1998. Demography and diversity in organizations: a review of 40 years of research, in Staw, BM and Cummings, LL, (eds.), *Research in Organizational Behavior* (Volume **20**). JAI Press: Greenwich, CT; 77–140.

Woodward J. 1965. *Industrial Organization: Theory and Practice*. Oxford University Press: Oxford, UK.

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