Founder Social Capital and Value Appropriation in R&D Alliance Agreements

Abstract

This paper investigates the micro-foundations of value appropriation involving startups and examines the relationship between founder social capital and value obtained by startups in R&D alliance agreements. We build on the bargaining framework for surplus division and propose that founder social capital facilitates a more expansive pool of partnering opportunities and thereby bestows bargaining advantages to a startup, leading it to obtain more value in an R&D alliance deal. More importantly, we develop a novel hypothesis about the complementarity between founder social capital and a startup's technological capabilities to suggest that the bargaining impact of founders' social capital becomes more pronounced when a startup is also endowed with superior technological capabilities. Further, we suggest that founder social capital can be particularly valuable for startups to secure outside opportunities when there is weak institutional financial support available. Empirical analyses of R&D alliance agreements in the biotechnology industry furnish evidence for our theory.

Keywords: Founder social capital; Value Appropriation; R&D Alliances; Technological capabilities; NIH funding.

1. INTRODUCTION

Startups in biotechnology and other industries rely on R&D alliances for the codevelopment of technology and sharing of knowledge with partner firms (e.g., Pisano, 1989; Mowery, Oxley, and Silverman, 1996) in order to develop and commercialize their technologies and nascent projects (e.g., Teece, 1988; Powell et al., 1996; Arora, Fosfuri, and Gambardella, 2001; Robinson & Stuart, 2007; Gans and Stern, 2003). However, while collaborative partnerships allow opportunities for value creation (e.g., Teece, 1986; Pisano, 1991; Anand and Khanna, 2000), startups' weak bargaining position limits their prospects for capturing a favorable share of the value created in an R&D alliance (e.g., Lerner and Merges, 1998; Lavie, 2007). Startups' poor bargaining situation stems from their lack of resources required for developing their ideas and technologies (e.g., Ahuja, 2000b) and the absence of stable relationships that can help them secure access to external resources (e.g., Baum, Calabrese, and Silverman, 2000; Shane and Stuart, 2002). As a consequence, startups do not naturally enjoy bargaining advantages in negotiations with their partners over the distribution of value in their alliances. Thus, a central question for startups is how they can advance their bargaining position and obtain a more favorable share of the value within R&D alliance agreements.

In this paper, we suggest that founders can play an influential role in enabling startups' favorable bargaining positions. Specifically, we draw upon the bargaining framework for surplus division (e.g., Tirole, 1988; Lippman and Rumelt, 2003) and propose that founders' social ties from prior venturing experience enable a focal venture to access outside partnering opportunities with other firms in the industry and to capture more value in R&D partnerships. Founders are key members of a new venture at founding and play an instrumental role in influencing a new venture's performance and development (e.g., Eisenhardt and Schoonhoven, 1990; Cooper et al., 1994; Gimeno et al., 1997; Colombo and

Grilli, 2005; Marvel and Lumpkin, 2007). Founders' accumulated social ties from prior experience would naturally carry forward to their subsequent ventures (e.g., Hite and Hesterly, 2001) and signify the extent of alternative partnering options beyond a focal alliance partner (e.g., Greve et al., 2012). The availability of such outside partnering opportunities may help startups pose a credible threat to their focal partners about opting for other partners (e.g., Sutton, 1986; Binmore et al., 1989; Lippman and Rumelt, 2003), so they bestow bargaining advantages for startups in their alliance negotiations. Our study therefore contributes to emergent research about the micro-foundations of firm strategy and performance (e.g., Felin, Foss, and Ployhart, 2015; Foss and Pedersen, 2016;) by emphasizing the role of founders in enabling a startup to capture superior value in their R&D partnerships. It also emphasizes the significance of social capital as a source of bargaining power (e.g., Bourdieu, 1986; Sobel, 2002).

More importantly, we also unpack the conditions when the role of founders' social capital for better bargaining becomes more or less meaningful for startups. First, we suggest that the positive influence of founders' social capital becomes more salient when startups also have demonstrable technological capabilities. While a startup with better founder social capital may be able to convey its alternative partnering opportunities, such threats are more credible when the startup itself possesses superior technological capabilities (e.g., Ahuja, 2000b). Startups are generally vulnerable to receiving a lower share of the expected output due to their weak bargaining positions, yet those startups with better capabilities will expect a higher share of the value in order to preserve incentives for value creation (e.g., Grossman and Hart, 1986) and generate good-quality innovative output in the R&D alliance (e.g., Stuart, 2000). Founders' social capital facilitates a pool of readily available outside options and strengthens the bargaining position of startups with superior technological capabilities. The complementarity between founder social capital and a startup's technological capabilities

therefore joins the bargaining perspective based on the availability of outside opportunities for financing R&D (e.g., Aghion and Tirole, 1994; Lerner and Merges, 1998) with the property rights framework (e.g., Grossman and Hart, 1986; Hart and Moore, 1990).

We also emphasize institutional support as an important contingency that can make the bargaining role of founder social capital less pronounced. Specifically, the availability of active institutional support, such as NIH funding programs for biotechnology startups, can help them ameliorate their poor prospects for gathering financial resources and technology infrastructure for R&D and technology development activities (e.g., Ferguson, 2012; Narayanan et al., 2018). The availability of such funding opportunities fortifies startups' asset bases and compensates for startups' lack of outside options for obtaining much-needed R&D resources. From a public policy standpoint, the substitutive role of NIH funding support for startups also suggest that while policy support for promoting financing opportunities for biotechnology startups is critical in this sector (e.g., Lerner, 2000; Audretsch, 2003; Toole and Czarnitzki, 2007), such institutional support can also be a shield for biotech startups lacking social capital against weak bargaining positions in R&D alliances. Furthermore, our findings suggest also suggest that even as institutional mechanisms such as patents foster incentives to innovate (e.g., Mowery et al., 2001; Shane, 2004), the availability of institutional support for securing financial and technical resources promotes bargaining opportunities for startups to capture higher value from their inventive effort in collaborative R&D projects (e.g., Lerner and Merges, 1998).

2. THEORY AND HYPOTHESES

Social capital theory suggests that an actor's relationships accruing from prior experience can be very useful for accessing information and mobilizing resources from other actors (e.g., Bourdieu, 1986; Coleman, 1990; Portes, 1998). Along these lines, prior research in management suggests that social capital can be beneficial for firms to acquire new

knowledge (e.g., Nahapiet and Ghoshal, 1998; Leana Van Buren, 1999; Yli-Renko et al., 2001) and widen their scope to connect with other firms in the industry (e.g., Granovetter, 1983; Walker et al., 1997). Specifically, the social ties of firms' top management team members can play a meaningful role in helping their firms establish linkages with other partners (e.g., Eisenhardt and Schoonhoven, 1996; Gulati and Westphal, 1999) and achieve superior performance (e.g., Collins and Clark, 2003; Florin et al., 2003). As social ties of individuals translate to a firm's potential to secure outside resources, they also are vital for better bargaining in interorganizational relationships (e.g., Dyer and Singh, 1998).

Research in economics and management emphasizes the important role of outside opportunities for enhanced bargaining in interorganizational negotiations (e.g., Sutton, 1986; Tirole, 1988; Binmore et al., 1989; Lippman and Rumelt, 2003). Partnering opportunities beyond a focal partner put a firm in a better position to bargain for a higher share of the gains from the collaboration. In this regard, a firm's social capital can be a channel for outside partnering opportunities. The firm can credibly threaten to quit a negotiation and contract with another firm, thus negotiating favorable contractual terms (e.g., Ostrom, 1995; Sobel, 2002) and appropriating more value from interfirm relations (e.g., Coff, 1999; Blyler and Coff, 2003).

By contrast, in the absence of outside opportunities, a party may have to forgo the value it expects to capture in a bilateral trade. This is also a familiar problem for startups in their R&D alliance negotiations with incumbent firms. While R&D alliances are essential for startups to develop and commercialize their technologies, startups are also likely to experience imperfect value appropriation in their alliance deals. A core problem for startups can be their lack of social capital with other firms owing to their newness (e.g., Stinchcombe, 1965; Singh et al., 1986; Shane and Stuart, 2002), barring them from enjoying outside partnering opportunities or alternate channels to access resources for developing their

technologies. In the hypotheses below, we combine these ideas and focus on the role of founders' social capital as an enabler of outside opportunities for startups and argue that it positively determines the share of the value a startup can negotiate in its R&D alliance agreements. Furthermore, we also argue that the effect of founder social capital will be greater for startups that also possess superior technological capabilities. In addition, we suggest that institutional financial support can be important for startups lacking in bargaining opportunities owing to their less developed social capital.

2.1 Research Hypotheses

2.1.1 Founder Social Capital

Founders are important organizational members of startups, and their social ties translate into their startups' networks (e.g., Hite and Hesterly, 2001). Specifically, founders' social ties from prior venturing experience can be a reservoir of partnering opportunities for startups (e.g., Birley, 1985; Ostgaard and Birley, 1996; Shane and Cable, 2002; Batjargal, 2003; Hallen, 2008) and can play an important role in attracting partnering opportunities beyond a focal partner (e.g., Aldrich and Fiol, 1994; Pennings et al., 1998; Packalen, 2007). Founders' serial venture activity thereby facilitates a stockpile of business relationships with a wide range of resource providers and potential collaboration partners (e.g., Shane and Stuart, 2002; Gompers et al., 2010). As founders assemble various kinds of organizational and financial resources for their prior ventures in this manner, they also broaden their network in the industry (Hsu, 2007). Through the contacts and networks that founders acquire through activities of their previous ventures, they can access information about other potentially available collaborators for their current venture (e.g., Granovetter, 1983; Gulati, 1999; Rangan, 2000).

In particular, interorganizational activities of founders' prior ventures, such as alliance partnerships and acquisition deals, generate an array of valuable business relations (e.g.,

Shane and Stuart, 2002; Hallen, 2008) and cement their social ties with incumbent partners. Founders with a significant amount of interorganizational activity in their earlier ventures are likely to be endowed with business connections with partners as well as investors who act as information intermediaries (e.g., Gulati, 1999; Podolny, 2001; Shane and Stuart, 2002). The amount of such ties that founders accumulate with other firms in the industry from their prior venture experience translates to available social capital and a pool of readily accessible partners for their focal venture. Therefore, superior founder social capital helps the venture credibly demonstrate its ability to access partnering opportunities outside the focal partner, and bargain for a greater share of the value in R&D alliance agreements. We therefore posit:

Hypothesis 1: The value obtained by a biotech venture in an R&D alliance agreement will be positively related to founder social capital.

2.1.2 Complementarity of Startup's Technological Capabilities

While founder social capital reflects a startup's prospects for accessing outside options, the usefulness of having these bargaining opportunities for value capture will be more salient for a startup in the presence of superior technological capabilities. Specifically, a startup with better quality technological resources can credibly indicate to its focal partner about its ability to opt for another partner within the pool of outside opportunities from its founder social ties, given that other firms are likely to seek linkages with it to tap into its knowledge base (e.g., Ahuja, 2000b; Gans and Stern, 2003). A focal partner is likely to take the threat seriously as it would be wary of losing out to potential competitors in the founder's network. The quality of the startup's technological resources therefore helps a startup derive greater leverage from the outside opportunities it can access from its founder social capital and reinforces a biotech venture's bargaining position in R&D alliance negotiations.

Furthermore, a startup with superior technological capabilities can gain more value from having better networked founders. As startup's technological contributions shape the overall quality and value of the collaborative innovative output (e.g., Stuart, 2000; Pisano,

1989), it is efficient for a startup with superior capabilities to obtain a higher share of the final output (e.g., Grossman and Hart, 1986; Hart and Moore, 1990). Yet, in reality startups' generally-poor networks undercut their prospects to gain as much as they might deserve (e.g., Aghion and Tirole, 1994; Lerner and Merges, 1998). As a consequence, founders' social ties play an important role for a technically superior startup to demonstrate the availability of partnering opportunities outside the focal partner, and thus augments the startup's potential to bargain for a greater share at the contracting stage.

The foregoing arguments suggest a complementary relationship between founder social ties and startup's technological capabilities. Specifically, insofar as founder social ties facilitate outside partnering opportunities and positively impacts a startup's value appropriation, the startup's technological capabilities helps pose a credible threat to its focal partner and further enhances its share of the value. By contrast, a venture with superior technological capabilities can experience a boost in its bargaining power through the outside partnering opportunities available from the social ties of its founder. We therefore suggest that a biotech startup's technological capability complements the positive effect of founder social ties and amplifies a startup's share of the value within alliance agreements. Thus, we posit:

Hypothesis 2: The positive effect of founder social capital on the value obtained in an R&D alliance agreement will be more pronounced for a biotech startup with superior technological capabilities.

2.1.3 Contingent Effects of Institutional Financial Support

Inasmuch as founder social capital supports a biotech startup's bargaining position in alliance negotiations, its usefulness is expected to vary with external conditions that determine a startup's prospects for securing outside financing opportunities and resources (e.g., Lerner et al. 2003). One important external factor for startups is the institutional support provided by government to foster innovation and promote financing opportunities for

garnering resources for technology development. Specifically, institutional programs such as NIH's small business innovation research and technology transfer programs represent dedicated institutional agencies through which the government can enable startup access to much needed financial resources along with technical infrastructure for R&D and commercialization (e.g., Link and Scott, 2010; Ferguson, 2012; Narayanan et al., 2018). The availability of such institutional funding opportunities therefore serves as an important outside option for gathering R&D resources and props startups' bargaining positions in R&D alliance negotiations. The bargaining role of founder social ties is therefore likely to become less useful for a biotech startup in the presence of generous institutional support through NIH programs. By contrast, a startup would find it especially difficult to secure funding opportunities for its projects when there is limited institutional support. In particular, new ventures' bargaining power weakens when there is limited availability of institutional funding. Thus, to the extent founder social capital can facilitate outside opportunities for the startup to secure R&D resources, it can be particularly valuable when there are fewer institutional funding opportunities. We therefore hypothesize:

Hypothesis 3: The positive effect of founder social ties on the value obtained by a biotech startup in an R&D alliance agreement will be more pronounced when there is less institutional financial support.

3. METHODS

3.1 Data and Sample

To test our hypotheses, we built a dataset of R&D alliances involving startups in the biotechnology industry. This industry context is ideal for our analysis for several reasons. First, biotechnology startups extensively rely upon alliances to develop and commercialize their technological ideas and innovations (e.g., Pisano, 1990; Powell, Koput, and Doerr-Smith, 1996; Roijakkers and Hagedoorn, 2006; Anand, Oriani, and Vassolo, 2010). Second, collaborative activity in the biotechnology industry is surrounded by considerable

uncertainty, and often alliance partners face information asymmetries about the prospects of biotech startups (e.g., Pisano, 1990; Powell, Koput, and Doerr-Smith, 1996; Lerner and Merges, 1998; Jones and Clifford, 2005). Third, biotech startups often have short track records and technological resources and capabilities that are difficult to judge, making it difficult for them to secure access to external resources and partners (e.g., Stuart et al., 1999; Nicholson, Danzon, and Mccullough, 2002; Levitas and McFayden, 2009). Finally, biotech startups and their alliance activities are well documented in this industry, providing rich information for empirical study.

In our analyses, we investigate the determinants of the value that startups attain in R&D alliance agreements. To accomplish this, we assembled contract data for R&D agreements in the biotechnology industry from Thomson Reuters' Recap database (now known as Cortellis Deals Intelligence) which is considered to be extensive in its reporting of alliance activity in this industry (Schilling, 2009) and also widely used in the literature (e.g., Robinson and Stuart, 2007). We obtained detailed data on the contract provisions for alliances of biotech firms formed between 1995 and 2010 and identified by Recap as collaboration, development, co-development, and research type agreements.

Most biotech startups in the biotechnology industry are VC-backed, because venture capitalists largely focus their investments in information technology and biotechnology industries (e.g., Lerner, 1994; Hsu, 2006) and play an active role in providing private financing to startups in these sectors (e.g., Sahlman, 1990; Zucker, Darby, and Brewer, 1998). We identified VC-backed biotech startups that obtained their first round of funding between 1995 and 2010 from Thomson VentureXpert database. This period witnessed active entry of biotech firms and remarkable growth in alliance activity in the biotechnology industry (e.g., Schilling, 2009). To collect information about founders for all the VC backed biotech startups, we relied on various sources such as BioScan, Bloomberg Businessweek,

and company websites. In addition, we also used sources such as SEC filings, LexisNexis, and other web searches to obtain the names of all possible unique founders for each firm in our sample. In our data of firm founders, we were able to gather information about founders for 98 distinct biotech firms using LinkedIn, company websites. In supplemental analyses presented below, we examined whether unobservable characteristics lead firms to enter into R&D alliances which might shape the relationships we study between founder social capital and the structure of alliance agreements and distribution of value between partners.

Further, we merged these data with patent information from the United States Patent and Trademark Office (USPTO) after tracking company histories and name changes. In order to reduce unobserved heterogeneity from cross-border transactions and to maintain consistency with the patent information from USPTO, we limited our analyses to firms founded in the United States. After implementing these sampling screens and excluding observations with missing values for the variables described below, our final dataset has details on the contract provisions for 183 R&D alliance agreements.

3.2 Variables and Measurement

3.2.1 Dependent Variable

In our research hypotheses, we investigate the bargaining effects of founders on startups' returns from R&D alliances. Because outcomes of alliance activity are subject to uncertainty, determining the division of ex-post returns from collaborative activity between alliance partners ex-ante at the stage of negotiations is difficult (e.g., Pisano, 1990; Henderson and Cockburn, 1994; Lerner and Merges, 1998). In this regard, biotech startups and partner firms negotiate over the allocation of value-capturing rights which provide ownership and control over the intermediate activities and outputs that directly determine each party's share of the final value created from the alliance (e.g., Lerner, Shane, and Tsai, 2003; Adegbesan and Higgins, 2011). We constructed indicators of value-capturing rights as

identified by Lerner and Merges (1998), Adegbesan and Higgins (2011), and Ozmel et al. (2017) to operationalize our dependent variable. These rights include intellectual property rights, licensing rights, product development and manufacturing rights, and marketing rights. Consistent with our theory, we focus on the *Number of Value-Capturing Rights* attained by the startup. To operationalize our dependent variable, we counted the number of value-capturing rights obtained by a startup in a focal R&D alliance contract. In our sample, the average number of value-capturing rights is 4.4. There are eight instances where the rights captured by the startup is 0 (see Figure 1 for a histogram). As the number of value-capturing rights is a count variable, we employ negative binomial regression. We use negative binomial regressions as the estimation procedure since they relax the assumption of the equality in the mean response and variance, which is imposed by Poisson models, and they also account for potential omitted variable bias (Cameron and Trivedi, 1986; Hausman, Hall and Griliches, 1984). We also used Poisson regression and obtained similar results. We also used robust standard errors clustered by partner because some partners are involved in more than one alliance in our final sample. In supplemental analyses discussed below, we examine not only the count of value capturing rights but also their substance (e.g., upstream versus downstream rights) since they differ qualitatively, and we wish to determine whether or when startups are able to bargain for particular types of value capturing rights.

****Insert Figure 1 here****

3.2.2 Independent Variables

Hypothesis 1 suggests that founder social capital obtained from prior venture activity enhances the extent of outside partnering opportunities available to the startup, enabling it to bargain for more value in an alliance. We thus operationalized *Founder Social Capital* as the sum of the total number of alliances managed by a startup's founder among previous ventures

and the number of previous ventures that had been acquired prior to the founding of the focal startup.

In Hypothesis 2 we suggest that a biotech startup's technological capabilities complement founder social capital and augment a biotech venture's bargaining position. In the biotechnology industry, a firm's stock of patents indicates the nature of its R&D activities (e.g., Pakes and Griliches, 1980; Horstmann, MacDonald, and Slivinski, 1985) and reflects its R&D productivity (e.g., Schmookler and Brownlee, 1962) and the quality of its technological and R&D capabilities. We captured a start-up's technological capabilities in terms of the number of patents and measured *Biotech Patents* as the number of patent applications of the biotech venture that were eventually granted prior to the focal alliance (e.g., Ahuja, 2000b). In Hypothesis 3 we proposed the contingent effects of institutional support available for startups. We captured this by considering the annual budget allocated for NIH's (National Institutes of Health) small business innovation research and technology transfer programs, and measured *NIH Funding* as the natural logarithm of the total annual amount of allocated budget in a given year.

3.2.3 Control Variables

The biotechnology ventures in our sample are venture-backed, so we collected a vector of controls capturing the characteristics of the venture capitalist firms backing the startups and the venture funding they received at the time of the alliance agreements. Specifically, we control for VCs with superior industry specific investment experience who can open up outside opportunities for a startup in the form of collaborations beyond the current partners. Accordingly, we measured *VC Industry Experience* in the biotechnology industry to account for the industry-specific investment experience of a startup's VC backing (e.g., Sorenson and Stuart, 2001). Since our industry setting is biotechnology, we operationalized this variable as the natural logarithm of the average biotechnology investment

experience of the VCs who had been backing the startup prior to the date of the focal alliance. Prior research suggests that VC firms periodically evaluate the progress of their ventures and make decisions about investing in them (e.g., Gompers, 1995; Lerner, 1995). We calculated *Equity Funding* as the natural logarithm of the total dollar amount of VC funding received by the startup prior to the focal alliance.

In the biotechnology industry, firms' product development experience can also shape the rights assigned to each firm. So, we measured *Biotech R&D Experience* and *Partner R&D Experience* as the natural logarithm of the number of research and development alliances that were formed by the startup and partner firm, respectively prior to the focal alliance. We also measured *Partner Patents* as the natural logarithm of successful patents filed by the partner firm during the last five years prior to the focal alliance.

We also controlled for variables at the level of the dyad. We controlled for *Prior Ties* as the number of alliances between the firms prior to the focal alliance. We also measured *Technology Overlap* as the natural logarithm of the number of patent cross-citations between the R&D and partner firm prior to the date of the focal alliance (e.g., Mowery *et al.*, 1996; Rothaermel and Boeker, 2008).

We also controlled for aspects of the partnership that are likely to reflect on the terms that partners can negotiate in alliances. To begin with, we controlled for whether the alliance is in early stages of drug development and measured *Early Stage Deal* as a dichotomous variable that equals 1 if the alliance deal is signed in a discovery or pre-clinical stage, and 0 otherwise (e.g., Lerner and Merges, 1998; Robinson and Stuart, 2007). Next, we included several variables, such as whether there is exchange of equity, cross-licensing arrangement, or exclusivity to control for governance and incentive mechanisms that might drive value creation and affect the distribution of value. We included dummy variables *Equity* to indicate whether or not the alliance deal involves as equity component (Robinson and Stuart, 2007)

and *Crosslicense* to indicate whether the alliance deal involves exchange of intellectual property (e.g., Oxley, 1997). We also controlled for *Exclusivity* to indicate whether or not the alliance deal contains terms of exclusivity (Somaya, Kim, and Vonortas, 2011). Finally, we also controlled for a series of effects for the focal therapeutic domain for the alliance (*Therapeutic Effects*) (Macher and Boerner, 2006), its technological domain (*Technology Effects*), and the year in which the alliance deal was signed (*Year Effects*).

4. RESULTS

Table 1 reports a classification of the rights that comprise the set of value-capturing rights. Table 2 reports the definitions of variables in our analyses. Table 3 reports descriptive statistics and correlations of variables used in our analyses. The number of value-capturing rights retained by the startup averages 4.4. Correlations indicate that a startup with founders with superior social capital are likely to attain more value capturing rights ($p<0.05$). In a subsample in which *Founder Social Capital* is above the median, the new venture obtains 5.5 value-capturing rights, compared to 4.2 for others ($p<0.01$). Correlations also confirm that a startup's patent stock is also more likely to net them greater value capturing rights ($p<0.05$). The mean and maximum variance inflation factors are 1.42 and 1.95, respectively, and suggest no multicollinearity concerns.

****Insert Tables 1-3 here****

Table 4 reports the estimates of the negative binomial regression models for the number of value-capturing rights. Model 1 is a baseline estimation consisting of control variables. Models 2-5 augment this model to accommodate our hypothesized relationships. Consistent with Hypothesis 1 we find the estimated coefficient for *Founder Social Capital* to be positive in Model 2 ($p<0.01$), suggesting that founders' social capital positively impacts the startup's value-capturing rights in alliance agreements. Figure 2 graphically illustrates the positive relationship between founder social capital and the predicted values of value-

capturing rights obtained by the startup, holding all other covariates at their respective mean values. We also investigated the economic significance of this effect. With all variables at their means, we find a one unit increase of founder social capital from the mean increases the number of value capturing rights attained by the new venture by 10%. In Hypothesis 2, we suggest complementarity between founder social capital and startup's technological capabilities and predict that the positive relationship between founder social capital and startup's value-capturing rights is likely to be enhanced by the startup's technological capabilities. In Model 3 the coefficient estimate of the interaction effect between founder social capital and biotech patents is positive and significant (p<0.01), consistent with the expectation that they complement each other. Hypothesis 3 suggests that the positive relationship between founder social capital and value-capturing rights will vary with the prospects of NIH funding opportunities and, in particular, will be more pronounced when NIH support for biotech startups is lower. In Model 4 the coefficient estimate of the interaction between biotech market heat and founder social capital is negative and significant (p<0.01) as expected.

****Insert Table 4 here****

We also examined the interaction effects graphically (Hoetker, 2007). Figures 3-4 graphically illustrate the average marginal effects, with 95% confidence intervals, of *Founder Social Capital* across various values of *Biotech Patents* and *NIH Funding*, respectively. Figure 3 suggests that the average marginal effects of founder social capital on the number of value-capturing rights obtained by the startup increases with biotech patents. This plot provides further evidence that founder social capital and technological capabilities of the biotech firm complement each other and augment a startup's ability to negotiate superior value in R&D alliance negotiations. We also investigated the economic significance of this effect. With all other covariates at their mean values, a one standard deviation increase of

biotech patents from the mean augments the positive marginal effect of founder social capital on the number of value capturing rights attained by the new venture by twofold. Figure 4 illustrates the interaction between founder social capital and NIH funding support and suggests that the average marginal effects of founder social capital on the number of value-capturing rights obtained by the startup diminishes with favorable NIH support. By contrast, it indicates that the effect of founder social capital is more pronounced when NIH support is poor. With all other variables at their mean values, we find a one standard deviation decrease of NIH support from the mean increases the positive marginal effect of founder social capital on the number of value capturing rights attained by the new venture by 61 percent. By contrast, a one standard deviation increase in NIH support from the mean decreases the positive marginal effect of founder social capital by almost 72 percent.

****Insert Figures 2-4 here****

Robustness Analyses

We performed a number of supplemental analyses in addition to the ones already described to investigate the robustness of our findings. In supplemental analyses we also examined the effects of founder social capital on specific types of value-capturing rights. Table 5 reports the relationship between founder social capital and specific intellectual property rights as well as downstream product development, manufacturing, and marketing rights. We considered intellectual property rights and examined the ownership of patents and know-how that potentially comes out of the R&D alliance. We defined a dummy variable that is equal to 1 if the R&D firm was allocated any share of the expected intellectual property (IP) output, and 0 otherwise, and performed a logistic regression. Our results suggest that a startup with superior technological capabilities is likely to get a higher share of IP output ($p<0.01$). This result supports the notion that a firm with superior technological resources is likely to gain a higher share of value-capturing rights as it would have greater incentives for

value creation (e.g., Grossman and Hart, 1986; Hart and Moore, 1990). Interestingly, we again find support for the impact of founder social capital ($p<0.01$), with results indicating that founder social capital can enable a biotech R&D venture to bargain successfully for a share of IP rights. We also find that the allocation of downstream marketing rights is positively related to founder social capital ($p<0.05$), while we do not find support for biotech firm technological capabilities affecting the distribution of this value capturing right ($p=0.306$). These results suggest that even though the R&D firm typically participates in upstream research activities and often lacks expertise and resources in downstream activities, the outside opportunities available through founder social capital enables the R&D firm to bargain successfully for a share of the value from downstream commercialization activities. Overall, these results offer support for the role of founder social capital as a bargaining chip for a startup in enabling a biotech venture to negotiate a share of IP and downstream rights.

****Insert Table 5 here****

We also performed treatment effect analysis to draw inferences about the relationship between founder social capital and the value startups can appropriate in their alliance negotiations. Specifically, we implemented the propensity-score matching (PSM) approach using *teffects psmatch* in Stata to estimate the average treatment effect of founder social capital. PSM is based on a matching estimators method and involves construction of a group of observations without the treatment that are comparable to a group of observations with the treatment on a vector of observed covariates that are likely to influence the treatment and the dependent variable (e.g., Rosenbaum and Rubin, 1983). In particular, this approach helps obtain a quasi-experimental setup and account for the potential non-randomness of a treatment variable (Morgan and Winship, 2007; Gangl, 2010). The treatment variable of interest in our analyses is whether a startup founder's social capital is above the median, though our interpretations are not sensitive to the cutoff value used in dichotomizing this

variable for this analysis. In the PSM approach, we obtained the propensity score for an observation to receive the treatment by specifying a probit regression and using all the other covariates employed in our analyses. We identified treated and control groups using nearest neighbor matching, and then estimated the average treatment effect of founder social capital on the value obtained by the startup. Further, we also implemented the inverse probability weighting approach (IPW) using *teffects ipw* in Stata where the inverse of propensity scores are used in the second stage estimation of the average treatment effect. The IPW approach is representative of a class of weighted regression estimators for causal effects and improves the efficiency of the estimates of the average treatment effects (e.g., Hirano et al., 2003; Morgan and Winship, 2007). Appendix A1 illustrates the treatment effect analyses, and the results across these models also suggest that the average treatment effect of founder social capital on the value captured by a startup is positive and significant. Furthermore, we also examined the conditional average treatment effects of founder social capital in subsamples of our two interaction variables in terms of superior *Biotech Patents* and *NIH Funding*, respectively. As anticipated by our hypotheses, the results suggest that the conditional average treatment effects of founder social capital are more pronounced in a subsample of firms with superior technological capabilities, while they are less pronounced in a subsample of firms with superior NIH funding (results in Appendix A2).

In addition to the steps we outlined above using matching estimator methods, we also investigated whether the above results were potentially subject to sample selection bias due to sampling on realized R&D alliance agreements (Heckman, 1979). Specifically, we assembled a set of counterfactual R&D alliance dyads for each realized R&D alliance dyad between a start-up and a partner firm in our sample. We propose multistate new viral disease outbreaks in the United States as an exclusion restriction in the first stage selection model for R&D alliance formation. The underlying intuition for this choice is that new viral disease outbreaks

reflect an exogenous shock and does not depend on other covariates, while it could potentially influence firms' propensity to attract alliance opportunities. As new viral outbreaks are sudden shocks and require deployment of drugs, biopharmaceutical firms perceive opportunities for new drug development or repositioning currently available drugs from their original indication as drugs for the new viral outbreak, in order to gain an advantage. Firms may be induced to go it alone and focus on deploying their in-house proprietary technologies to meet the drug needs during an outbreak than enter into R&D alliances. We therefore expect that the propensity for firms to form new alliances may diminish during the outbreak of a new viral disease. Specifically, we considered a three-year forward time window after a major multistate disease outbreak event occurred in the United States during 1990-2010 as an exclusion restriction for the first stage R&D alliance formation model. We obtained this data from the website of the Center for Disease Control (CDC) which is a national public health institute in the United States. Our exclusion restriction is negatively correlated with the likelihood of R&D alliance formation between a biotech firm and an incumbent partner (-0.014, $p<0.001$) and not related to our outcome variable of control rights allocation (0.037, $p=0.2045$). The F-statistic for this exclusion restriction is 20.62 and significant, suggesting that it is a valid exclusion restriction. The results (in Appendix A3) for first stage alliance formation suggest that the propensity for firms to enter into R&D alliances is likely to be lower during periods of new viral disease outbreaks. The inverse mills ratio in the second stage model (results appear in Appendix A4) is not statistically significant at conventional levels ($p=0.085$), and we continued to find that founder social capital enables startups to obtain value capturing rights in their R&D alliance agreements ($p<0.01$).

5. DISCUSSION

In this paper, we extend ideas from social capital theory about the significance of an actor's ties from prior experience for gathering resources from other actors (e.g., Bourdieu, 1986; Coleman, 1990; Burt, 1992; Portes, 1998), and we suggest that startups can mitigate their weak bargaining position by drawing on their founders' social capital. Specifically, we propose that founders' social capital from prior venturing experience facilitates immediate access to a pool of investors and partners (e.g., Florin et al., 2003; Hsu, 2007), and it can be an important source of outside partnering opportunities that can help startups gainfully contract in R&D alliances. Founders' social capital helps a startup credibly indicate to its focal partner that it can opt for another exchange partner in negotiations and thus obtain more value during alliance contracting. We therefore extend prior research on social capital which largely stressed the usefulness of social capital for firms to establish linkages with other partners (e.g., Eisenhardt and Schoonhoven, 1996; Walker et al., 1997; Gulati and Westphal, 1999) as well as to achieve new knowledge and superior performance (e.g., Nahapiet and Ghoshal, 1998; Leana Van Buren, 1999; Yli-Renko et al., 2001; Collins and Clark, 2003; Florin et al., 2003).

In our research we also find that the bargaining advantage that startups can enjoy from their founders' social capital becomes more salient for them when they also have demonstrable technological capabilities that reflect the quality of the contributions they can potentially make to the R&D alliance. Seminal ideas in the property rights literature (e.g., Grossman and Hart, 1986; Oliver and Hart, 1990) show that in bilateral contracting it is economically efficient to *ex ante* allocate greater control and property rights to a party whose contribution is central to the quality of the *ex post* output. In R&D contracting, incumbents are more likely to be concerned about information asymmetry about the potential value of startups' technological ideas. Unless startups can indicate the quality of their ideas and capabilities, incumbents may be wary about agreeing *ex ante* to giving more value and rights

to startups. In this regard, startups with outside opportunities can gain more value when they can also indicate the quality of their unobservable technological resources. By contrast, while startups with superior technological capabilities expect a greater share, the presence or absence of readily available outside options influences the value they can actually attain in alliance contracting. Our finding of the positive interaction between founder social capital and biotech technological capabilities unpacks a complementary relationship between social capital and technological capabilities on startups' value appropriation in R&D alliances. By revealing this complementarity between outside options and capabilities, we join the bargaining perspective based on the availability of outside opportunities for financing R&D (e.g., Aghion and Tirole, 1994; Lerner and Merges, 1998) with the property rights framework (e.g., Grossman and Hart, 1986; Hart and Moore, 1990).

Furthermore, we also show that the leverage startups can enjoy from having superior founders' social capital is contingent on the availability of institutional support for garnering much-needed financial and technical infrastructure to conduct R&D activities. Specifically, we suggest that the opportunities for startups to secure the support of specialized programs, such as NIH funding and sponsorship programs geared towards helping biotechnology startups, can positively boost startups' prospects for securing value in R&D alliances. The availability of such funding opportunities from NIH serves as an outside option for gathering R&D resources and therefore serves as an important bargaining chip for biotechnology startups in R&D alliances. and indirectly promote the incentives for startups to create value in R&D alliances. As founders' social capital reflects partnering possibilities for startups, our finding therefore illustrates the substitutive role of NIH funding for startups without any founder social capital. When such outside options for financial support are lacking, the social capital of founders takes on particular importance in enabling startups to bargain for value capturing rights in alliances.

This study makes contributes to different streams of research on startups and R&D alliances. For the strategy and entrepreneurship literature, our study focuses on the performance of startups in alliance agreements. Prior research on the performance of startups has focused attention on liquidity events such as going public through an IPO or being acquired, and this research has emphasized how prominent VC affiliations and alliance networks can help startups secure value from them (e.g., Stuart *et al.*, 1999; Gulati and Higgins, 2003; Chang, 2004; Brau *et al.*, 2010). Though the timing of these liquidity events and the value obtained in them are significant for startups' success, it is also important for startups to gainfully contract with their R&D partners and capture value from their technological resources at earlier stages of development. Given that startups rely on alliances for co-developing their technologies (e.g., Baum et al., 2000) to create value from their resources (e.g., Teece, 1986; Anand and Khanna, 2000; Lavie, 2007), it is not clear how startups can capture their share of the total value in strategic alliances. In our study, we develop theory about the micro-foundations of value appropriation in strategic alliances by suggesting that founder social capital can be an important factor that helps innovative startups appropriate value from their resource in alliance partnerships. Our research therefore extends prior research which focused on firm-level factors (e.g., Adegbesan and Higgins, 2011) and emphasizes how founder social capital from prior entrepreneurial experience improves a startup's ability to bargain for superior value in bilateral contractual settings. While we have highlighted the effect of founders on the value startups can negotiate in alliance agreements, our findings also suggest that it would be interesting for future research to consider their role in shaping the value a startup can capture from the sale of its technology and services and when it is acquired or goes public. For example, future research could consider how founder social capital impacts a startup's negotiations in mergers and acquisition deals, as well as a startup's decision to go public and its IPO performance.

Our study also contributes to the stream of research on the value creation and performance of startups in strategic alliances (e.g., Dyer and Singh, 1998; Gulati, 1998). While prior research has examined how alliances facilitate opportunities for startups to learn and acquire new competences (e.g., Hagedoorn and Schakenraad, 1994; Mowery et al., 1996; Ahuja, 2000b; Stuart, 2000; Rothaermel and Deeds, 2004), another stream of work has investigated the role of various governance mechanisms to mitigate appropriation hazards in alliances (e.g., Gulati, 1995b, Oxley, 1997; Reuer and Arino, 2007; Somaya et al., 2011). This study builds upon and extends this stream of research by investigating the issue of control right allocation over value-creating activities and unpacking the bargaining role of startup founders' social capital (e.g., Kim and Mahoney, 2005; Adegbesan and Higgins, 2011). Given that division of control rights is a facet of alliance design and contracting, our findings also suggest that founders' track records might have implications for other dimensions of alliance contractual design. For instance, founders' superior credentials can signal the underlying quality of a new venture's assets and might also mitigate potential moral hazard concerns and contractual hazards for partners. So, it would be valuable to investigate if the signals and bargaining power a startup obtains from its founders can have implications for contractual complexity and choice of governance mechanisms (e.g., Poppo and Zenger, 2002; Hoetker and Mellewigt, 2009) and specification of particular contractual provisions in alliance contracts (e.g., Luo, 2002; Anderson and Dekker, 2005; Mesquita and Brush, 2008; Somaya et al., 2011; Elfenbein and Lerner, 2012).

Furthermore, while in this study we investigate how founders positively influence a new venture's share of the value within alliance agreements, it would be valuable to study other influences at multiple levels of analysis. For instance, future research might examine how partners' specific investments as well as dyadic elements such as resource contributions or competition outside the alliance shape partners' relative bargaining power (e.g., Kogut,

1988; Adegbesan and Higgins, 2011) and influence the allocation of value-capturing rights in alliance agreements. Finally, apart from the availability of NIH funding, other exogenous factors such as industry structure and competition among firms can also determine the nature of resources and outside opportunities available to firms (Lerner and Merges, 1998; Chatain and Zemsky, 2011; Adegbesan and Higgins, 2011), so it would be interesting to investigate how firm-level factors such as those we have studied might mitigate these effects and shape the distribution of value in inter-organizational arrangements.

5.1 Implications for Biotechnology Entrepreneurs

Our research also has several implications for biotech entrepreneurs. First, our study highlights the role of founders' social capital and connections with industry partner firms from prior venturing experience. The findings in our study indicate that biotech startup founders might work to cultivate and establish social ties with other firms in the industry and create a pool of accessible partners. Prospective biotech entrepreneurs must look forward and build connections with several firms, such as by participating in a variety of industry events and conclaves that may help entrepreneurs build informal ties with individuals across other firms (e.g., Prusak and Cohen, 2001; Glaeser et al., 2002; Chai and Freeman, 2019). Furthermore, having well-connected individuals in the top management team enhances startups' prospects for attracting partnering opportunities outside a focal partner (e.g., Gulati and Westphal, 1999), and thereby help startups realize greater value from their contributions in R&D partnerships. Our findings also show that these connections will be particularly useful for biotech ventures in their alliance negotiations when there is shortage of external opportunities to finance the ventures' technology development programs.

5.2 Policy Implications

Our findings also suggest that while policy support for promoting financing opportunities for biotechnology startups is critical in this sector (e.g., Lerner, 2000;

Audretsch, 2003; Toole and Czarnitzki, 2007), offering strong institutional support for biotechnology startups through government sponsored programs such as NIH's small business innovation research funds can also buffer biotech entrepreneurs from being subject to otherwise weak bargaining positions during their alliance negotiations. Likewise, the ability of entrepreneurs to prosper absent this support will differ across startups based upon founders' social capital. This suggests greater heterogeneity in startup success and their ability to make necessary strategic investments when financial support is lacking, while ventures will be more likely to obtain attractive terms in R&D alliance agreements when funding opportunities are available from institutions, such as the NIH. Often biotech entrepreneurs, including academic entrepreneurs, might be limited in their relationships (e.g., Baum et al., 2000), and their lack of ties with industry incumbents can have implications for their how much they can profit from their innovations (e.g., Teece, 1986). Having institutional support helps biotech entrepreneurs enjoy potential partnering opportunities and favorably bargain over the terms of their collaborative partnerships and thereby maintain incentives to create innovative value (e.g., Howells, 2006; Clarysse et al., 2011). From a public policy standpoint, our findings also suggest that while institutional mechanisms such as patents can help startup innovators enjoy the incentives to invent (e.g., Mowery et al., 2001; Shane, 2004), the availability of institutional support for securing R&D resources promotes opportunities for startups to capture higher value from their inventive effort in collaborative R&D projects (e.g., Lerner and Merges, 1998).

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Table 1. List of Value Capturing Rights

This table lists the value capturing rights which were included in the study. The Origin column lists studies that have used similar value capturing rights. We refer to Lerner and Merges (1998) as LM 1998, Adegbesan and Higgins (2011) as AH 2011, and Ozmel, Reuer, Yavuz, Zenger (2017) as ORYZ 2017.

Intellectual property rights	**Origin**
Exclusive ownership of some patents	ORYZ (2017)
Joint ownership of patents	LM 1998, AH 2011, ORYZ 2017
Exclusive ownership of all patents	LM 1998, AH 2011, ORYZ 2017
Right to use/transfer unpatented know how and/or other intellectual property	LM 1998, AH 2011, ORYZ 2017
Partial/Joint ownership of unpatented know-how and intellectual property	ORYZ (2017)
Exclusive ownership of unpatented know-how and intellectual property	LM 1998, AH 2011, ORYZ 2017
Entitled to future related inventions	ORYZ (2017)
Legal right to be informed if partner finds compounds using the research and know how attained during the alliance	ORYZ (2017)
Licensing Rights	
Right to grant sublicenses	LM 1998, AH 2011, ORYZ 2017
Perpetual license or option of continued licensing	LM 1998, AH 2011, ORYZ 2017
Exclusive license	ORYZ (2017)
Product Development and Manufacturing	
Right to manage clinical trials and process development	LM 1998, AH 2011, ORYZ 2017
Right to manufacture the final product	LM 1998, AH 2011, ORYZ 2017
Marketing Rights	
Basic marketing rights	AH (2010)
Universal marketing rights	LM 1998, AH 2011, ORYZ 2017
Exclusive marketing rights	LM 1998, AH 2011, ORYZ 2017

Table 2. Variable definitions and sources

Variable	Definition	Source
Number of Value-Capturing Rights	Total number of intellectual property rights, licensing rights, product development and manufacturing rights, and marketing rights, allocated to the startup	Recap
Founder Social Capital	Total number of alliances and acquisitions managed by a startup's founder in ventures prior to the focal venture	LinkedIn, BioScan, Bloomberg Businessweek, SEC filings, LexisNexis, and company websites, Recap
Biotech Patents	Number of granted patents to the biotech firm in the 5 years preceding the focal alliance	USPTO
NIH Funding	(log) total annual amount of NIH's allocated budget towards SBIR and tech. transfer programs	NIH website
VC Industry Experience	(log) Average biotech industry investment experience for the VC backing the focal venture	Thomson VentureXpert
Equity Funding	(log) Total amount of VC funding received by the biotech venture prior to the focal alliance	Thomson VentureXpert
Biotech R&D Experience	(log) Number of R&D alliances formed by the biotech venture prior to the focal alliance	Recap
Partner R&D Experience	(log) Number of R&D alliances formed by the partner firm prior to the focal alliance	Recap
Partner Patents	(log) Number of granted patents to the partner firm in the 5 years preceding the focal alliance	USPTO
Prior Ties	Number of alliances between the parties prior to the focal alliance	Recap
Technology Overlap	(log) number of patent cross-citations between the R&D and partner firm prior to focal alliance	USPTO and Recap
Early Stage Deal	1 if the alliance deal is signed at a discovery or pre-clinical stage	Recap
Equity	1 if the alliance deal involves an equity component	Recap
Crosslicense	1 if the alliance deal involves exchange of intellectual property	Recap
Exclusivity	1 if the alliance deal contain terms of exclusivity	Recap
Therapeutic Effects	Fixed effects for the therapeutic domain of the alliance deal	Recap
Technology Effects	Fixed effects for technological domain of the alliance deal	Recap
Year Effects	Fixed effects for the year in which alliance was signed	Recap

Table 3: Descriptive Statistics[a]

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Number of Value-Capturing Rights	1														
2	Founder Social Capital	**0.12**	1													
3	Biotech Patents	**0.13**	0.04	1												
4	NIH Funding	**0.15**	0.05	**0.26**	1											
5	VC Industry Experience	0.10	0.08	**0.17**	**0.21**	1										
6	Equity Funding	**0.11**	0.00	**0.12**	**0.31**	**0.56**	1									
7	Biotech R&D Experience	0.09	**0.12**	**0.54**	**0.41**	**0.26**	**0.14**	1								
8	Partner R&D Experience	0.04	0.09	**0.15**	**0.37**	0.11	**0.11**	**0.21**	1							
9	Partner Patents	0.10	**0.13**	**0.16**	**0.15**	0.08	**0.12**	**0.17**	**0.19**	1						
10	Prior Ties	0.01	**0.16**	0.11	-0.01	0.04	-0.01	**0.17**	0.05	**0.16**	1					
11	Technology Overlap	**0.11**	0.07	**0.47**	**0.25**	**0.12**	**0.14**	**0.32**	**0.14**	**0.36**	**0.23**	1				
12	Early Stage Deal	-0.07	0.08	-0.08	-0.01	**0.12**	0.04	0.04	-0.06	0.12	-0.01	-0.1	1			
13	Equity	0.08	0.02	0.01	-0.11	0.05	0.01	-0.07	-0.06	0.08	0.08	0.03	-0.08	1		
14	Crosslicense	**0.12**	0.06	-0.02	0.04	0.03	0.09	-0.02	-0.08	-0.05	-0.06	-0.05	-0.01	-0.02	1	
15	Exclusivity	0.01	-0.03	0.05	**0.23**	0.12	**0.20**	0.04	**0.18**	0.09	-0.04	0.05	**-0.22**	-0.1	**-0.14**	1
	Mean	4.25	1.51	47.89	2.41	5.69	8.60	2.45	0.31	5	0.17	0.41	0.28	0.01	0.03	0.64
	S.D.	2.23	2.80	102.44	0.45	2.27	3.27	3.69	0.70	2.77	0.52	0.88	0.45	0.12	0.17	0.48

[a]N=183. $p \leq 0.05$ in bold.

Table 4: Negative Binomial Regression Estimates for Value-Capturing Rights[a]

Variables	1	2	3	3	5
Intercept	-1.860*	-1.897*	-1.710*	1.514**	1.556**
	(0.839)	(0.830)	(0.836)	(0.543)	(0.516)
Year Effects[b]	101.33***	87.19***	84.34***	91.28***	80.31***
Technology Effects[b]	13.46*	14.91*	15.40*	14.10*	18.27**
Therapeutic Effects[b]	20.32**	21.67**	23.63**	24.74**	28.57***
Exclusivity	0.053	0.059	0.062	0.098	0.104
	(0.086)	(0.087)	(0.087)	(0.083)	(0.081)
Crosslicense	0.348*	0.309*	0.281†	0.404**	0.362*
	(0.162)	(0.153)	(0.151)	(0.151)	(0.158)
Equity	0.512***	0.477***	0.476***	0.452**	0.428**
	(0.134)	(0.129)	(0.132)	(0.157)	(0.159)
Early Stage Deal	-0.165	-0.187†	-0.185†	-0.169	-0.160
	(0.109)	(0.105)	(0.102)	(0.113)	(0.109)
Technology Overlap	-0.059	-0.070	-0.067	-0.061	-0.053
	(0.048)	(0.050)	(0.048)	(0.048)	(0.044)
Prior Ties	0.036	0.018	-0.003	0.025	-0.006
	(0.078)	(0.079)	(0.078)	(0.079)	(0.082)
Partner Patents	0.021	0.023	0.021	0.024	0.019
	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)
Partner R&D Experience	0.057	0.047	0.043	0.052	0.046
	(0.044)	(0.046)	(0.049)	(0.043)	(0.045)
Biotech R&D	-0.015	-0.015	-0.012	-0.013	-0.007
Experience	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)
Equity Funding	0.046**	0.041*	0.039*	0.038†	0.033
	(0.016)	(0.018)	(0.018)	(0.022)	(0.024)
VC Industry Experience	0.057**	0.055**	0.055**	0.050**	0.048*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
NIH Funding	1.749***	1.740***	1.649***	1.119***	1.128***
	(0.396)	(0.389)	(0.393)	(0.180)	(0.167)
Biotech Patents	0.054*	0.061*	0.075**	0.062*	0.064**
	(0.026)	(0.025)	(0.027)	(0.024)	(0.022)
Founder Social Capital		0.024**	0.026**	0.256**	0.283**
		(0.008)	(0.008)	(0.092)	(0.089)
Founder Social			0.063**		0.061**
Capital*Biotech Patents			(0.024)		(0.020)
Founder Social				-0.084**	-0.102**
Capital*NIH Funding				(0.032)	(0.032)
Log likelihood	-369.2	-368.4	-367.9	-367.7	-366.6
McFadden's R-squared	0.079	0.081	0.082	0.083	0.086
Wald χ^2	1020.46***	1028.95***	1035.49***	1045.29***	1058.01***

[a]N=183. Clustered robust standard errors in parentheses. [b]χ^2 values for joint significance of fixed effects. ***p<0.001, **p<0.01, *p<0.05, †p<0.1

Table 5: Logistic Regression Estimates for the Likelihood of Allocation of IP Rights and Downstream Rights

Variables	1	2	3	4	5	6
Intercept	-59.945***	-61.770***	-63.938***	-63.507***	-63.757***	-68.372***
	(4.963)	(4.917)	(5.252)	(5.270)	(6.655)	(5.363)
Year Effects[a]	175.70***	180.82***	179.32***	299.24***	264.36***	300.62***
Technology Effects[a]	16.38*	14.71*	18.70**	16.27*	13.26*	12.29*
Therapeutic Effects[a]	26.65**	27.40**	27.09**	23.77**	23.03**	21.27**
Exclusivity	0.735	0.623	0.755	-0.147	-0.152	-0.158
	(0.462)	(0.523)	(0.515)	(0.659)	(0.515)	(0.524)
Crosslicense	0.176	0.120	0.154	0.422	0.268	0.319
	(0.132)	(0.133)	(0.121)	(0.504)	(0.482)	(0.464)
Equity	0.276†	0.304†	0.240	0.279	0.284	0.181
	(0.165)	(0.157)	(0.168)	(0.484)	(0.463)	(0.478)
Early Stage	0.535	0.266	0.367	-1.947**	-1.852**	-1.860**
Deal	(0.673)	(0.721)	(0.674)	(0.688)	(0.631)	(0.629)
Technology	0.072	0.050	-0.005	-0.417†	-0.476†	-0.474†
Overlap	(0.264)	(0.280)	(0.288)	(0.237)	(0.276)	(0.263)
Prior Ties	-0.288	-0.468	-0.603	0.473	0.356	0.356
	(0.474)	(0.475)	(0.520)	(0.441)	(0.411)	(0.409)
Partner	0.043	0.070	0.064	0.305*	0.319*	0.319*
Patents	(0.087)	(0.099)	(0.099)	(0.148)	(0.152)	(0.158)
Partner R&D	-0.176	-0.260	-0.245	-0.406	-0.414	-0.413
Experience	(0.303)	(0.304)	(0.327)	(0.397)	(0.395)	(0.405)
Biotech R&D	0.009	0.551	0.047	0.236	0.198	0.204
Experience	(0.479)	(0.463)	(0.482)	(0.541)	(0.413)	(0.555)
Equity	0.378†	0.289	0.367†	-0.105	-0.107	-0.107
Funding	(0.194)	(0.208)	(0.209)	(0.147)	(0.143)	(0.148)
VC Industry	0.137	0.186	0.174	0.160	0.170	0.170
Experience	(0.115)	(0.119)	(0.122)	(0.151)	(0.159)	(0.157)
NIH Funding	7.970***	8.282***	8.492***	9.142***	9.174***	9.827***
	(0.635)	(0.666)	(0.655)	(0.689)	(0.742)	(0.701)
Biotech	0.016**		0.018**	-0.001		-0.000
Patents	(0.006)		(0.007)	(0.007)		(0.007)
Founder		0.336**	0.320***		0.101*	0.099*
Social Capital		(0.110)	(0.082)		(0.042)	(0.042)
Observations	160	160	160	169	169	169
Log likelihood	-80.91	-79.64	-76.59	-88.88	-88.43	-88.43
McFadden's R-squared	0.227	0.239	0.268	0.218	0.222	0.222
Wald χ^2	254.11***	255.39***	261.54***	260.90***	266.68***	266.75***

Clustered robust standard errors in parentheses. [a]χ^2 values for joint significance of fixed effects.
***p<0.001, **p<0.01, *p<0.05, †p<0.1.

Figure 1. Histogram of Number of Value-Capturing Rights

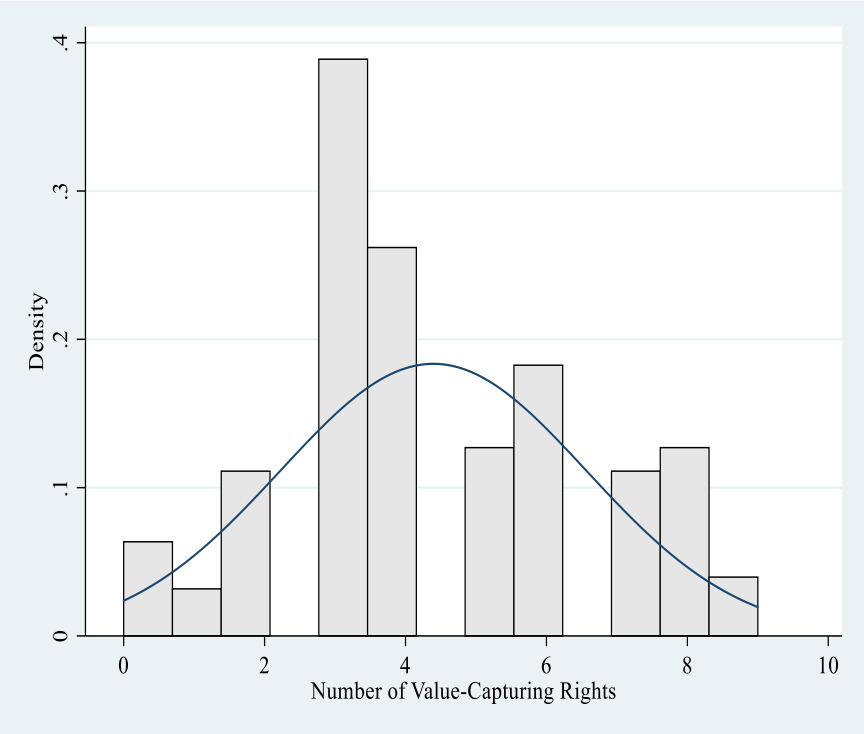


Figure 2. Predicted Values of Number of Value-Capturing Rights for Various Values of Founder Social Capital

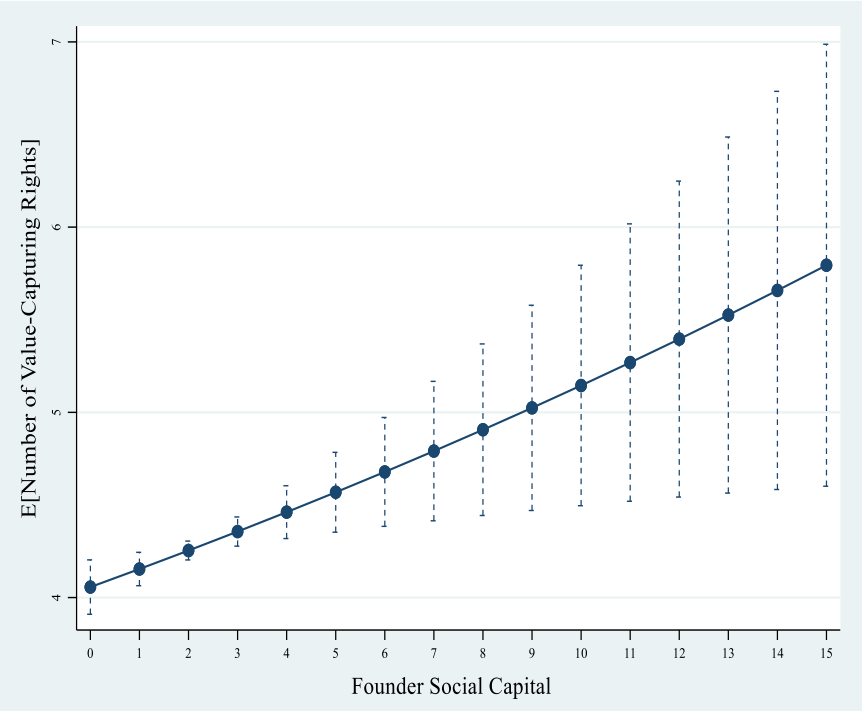


Figure 3: Average Marginal Effects of Founder Social Capital with 95% CIs across Values of Biotech Patents

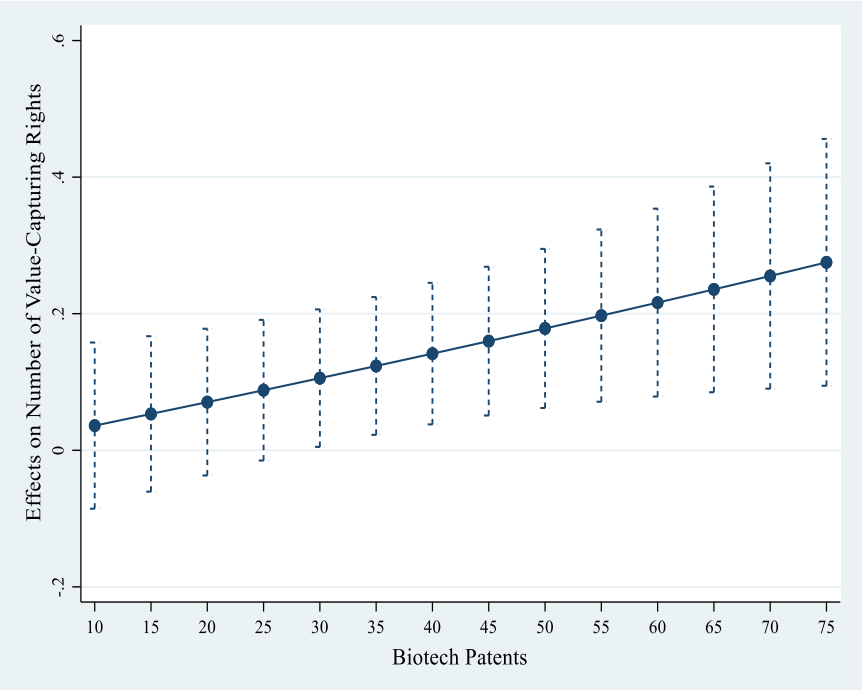
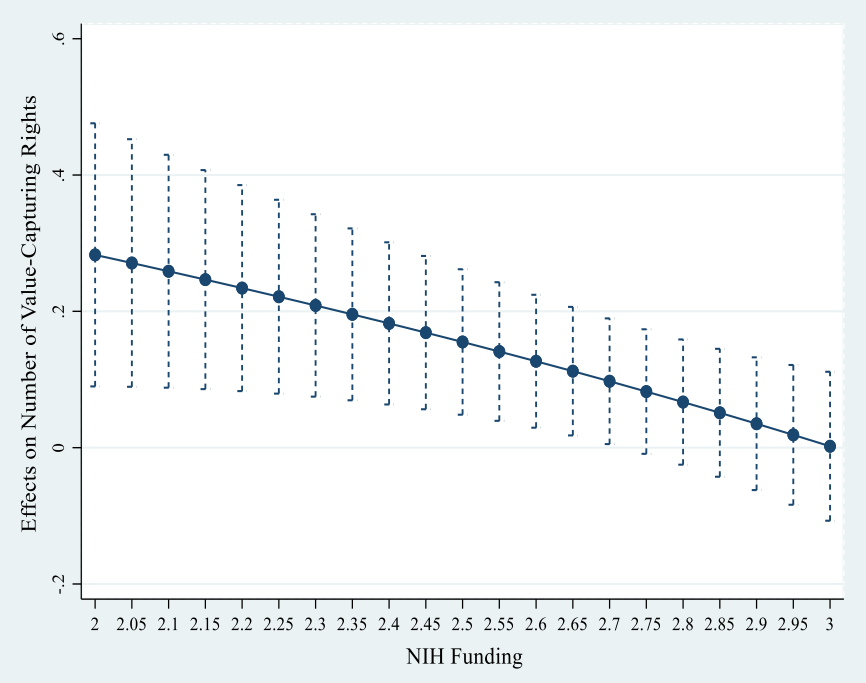


Figure 4: Average Marginal Effects of Founder Social Capital with 95% CIs across Values of NIH funding



Appendix A1. Average Treatment Effects Analyses of Founder Social Capital

Panel (a)	Model 1		Model 2	
	PSM	P > z	IPW	P > z
Founder Social Capital	1.211	(0.001)	1.256	(0.003)
SE	(0.353)		(0.417)	
95% CI	[0.518, 1.905]		[0.437, 2.075]	

Appendix A2. Conditional Average Treatment Effects Analyses of Founder Social Capital

Panel (a)				
	Model 1		Model 2	
	PSM	P > z	IPW	P > z
Biotech Patents (above median)	1.806	(0.010)	1.519	(0.006)
SE	(0.698)		(0.557)	
95% CI	[0.438, 3.175]		[0.426, 2.611]	
Biotech Patents (below median)	1.495	(0.061)	1.039	(0.055)
SE	(0.799)		(0.542)	
95% CI	[-0.070, 2.062]		[-0.023, 2.101]	

Panel (b)				
	Model 1		Model 2	
	PSM	P > z	IPW	P > z
NIH Funding (above median)	0.750	(0.196)	0.312	(0.449)
SE	(0.580)		(0.413)	
95% CI	[-0.38, 1.178]		[-0.497, 1.124]	
NIH Funding (below median)	1.455	(0.009)	1.502	(0.001)
SE	(0.557)		(0.435)	
95% CI	[0.363, 2.547]		[0.648, 2.355]	

Appendix A3: First Stage Alliance Formation Model[a]

Variables	1
Intercept	-15.252***
	(1.724)
Year Effects[b]	545.11***
Technology Effects[b]	71.16***
Therapeutic Effects[b]	50.85***
New Disease Outbreak	-0.402***
	(0.068)
Exclusivity	0.587**
	(0.222)
Crosslicense	0.560
	(0.399)
Equity	0.339†
	(0.177)
Early Stage Deal	-0.027
	(0.319)
Technology Overlap	7.919***
	(1.678)
Prior Ties	1.419***
	(0.205)
Partner Patents	0.027†
	(0.016)
Partner R&D Experience	0.011
	(0.008)
Biotech R&D Experience	-0.149
	(0.129)
Equity Funding	0.102***
	(0.026)
VC Industry Experience	0.157*
	(0.075)
NIH Funding	-1.576***
	(0.096)
Biotech Patents	0.394***
	(0.068)
Founder Social Capital	0.039***
	(0.011)
Log likelihood	-6039.7
McFadden's R-squared	0.159
Wald χ^2	1334.56***

[a]N=61,681. Robust standard errors in parentheses.

[b]χ^2 values for joint significance of fixed effects.

***p<0.001, **p<0.01, *p<0.05, †p<0.1

Appendix A4: Second Stage Negative Binomial Regression Estimates[a]

Variables	1	2	3	4	5
Intercept	-1.970*	-2.031*	-2.120**	-2.188**	-1.924*
	(0.866)	(0.859)	(0.737)	(0.836)	(0.841)
Year Effects[b]	100.82***	107.49***	97.67***	118.40***	116.50***
Technology Effects[b]	42.81***	46.41***	46.53***	45.18***	45.01***
Therapeutic Effects[b]	36.76***	37.81***	26.37***	38.76***	36.85***
Inverse Mills Ratio	0.151	0.176†	0.182†	0.212†	0.203†
	(0.097)	(0.102)	(0.107)	(0.110)	(0.113)
Exclusivity	0.065	0.074	0.085	0.095	0.102
	(0.083)	(0.085)	(0.085)	(0.081)	(0.081)
Crosslicense	0.366*	0.326*	0.320*	0.371*	0.337*
	(0.157)	(0.150)	(0.151)	(0.150)	(0.153)
Equity	0.554***	0.520***	0.529***	0.436**	0.415*
	(0.156)	(0.151)	(0.159)	(0.162)	(0.163)
Early Stage Deal	-0.158	-0.182†	-0.180†	-0.159	-0.151
	(0.111)	(0.106)	(0.104)	(0.115)	(0.111)
Technology Overlap	-0.056	-0.069	-0.069	-0.056	-0.048
	(0.049)	(0.051)	(0.049)	(0.050)	(0.046)
Prior Ties	0.064	0.048	0.033	0.058	0.029
	(0.081)	(0.083)	(0.085)	(0.085)	(0.089)
Partner Patents	0.020	0.022	0.021	0.020	0.017
	(0.015)	(0.016)	(0.016)	(0.015)	(0.015)
Partner R&D	0.057	0.046	0.041	0.051	0.045
Experience	(0.045)	(0.046)	(0.049)	(0.043)	(0.045)
Biotech R&D	-0.021	-0.022	-0.019	-0.020	-0.015
Experience	(0.013)	(0.013)	(0.015)	(0.013)	(0.014)
Equity Funding	0.048**	0.042*	0.041*	0.036	0.032
	(0.016)	(0.019)	(0.019)	(0.022)	(0.024)
VC Industry	0.059**	0.058**	0.058**	0.051**	0.049*
Experience	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
NIH Funding	1.585***	1.547***	0.428†	1.521***	1.396***
	(0.362)	(0.361)	(0.240)	(0.353)	(0.356)
Biotech Patents	0.053**	0.056**	0.056**	0.057**	0.056**
	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
Founder Social		0.025**	0.024**	0.285**	0.307***
Capital		(0.010)	(0.008)	(0.097)	(0.092)
Founder Social			0.076**		0.071**
Capital*Biotech			(0.026)		(0.024)
Patents					
Founder Social				-0.093**	-0.108**
Capital*NIH				(0.033)	(0.033)
Funding					
Log likelihood	-368.5	-367.4	-367.4	-365.3	-364.4
McFadden's	0.081	0.084	0.084	0.089	0.091
R-squared					
Wald χ^2	996.09***	1005.94***	1012.58***	1017.22***	1029.11***

[a]N=183. Clustered robust standard errors in parentheses. [b]χ^2 values for joint significance of fixed effects. ***p<0.001, **p<0.01, *p<0.05, †p<0.1