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Cite Article

HOW TECHNOLOGICAL OVERLAP BETWEEN SPINOUTS AND PARENT FIRMS AFFECTS CORPORATE VENTURE CAPITAL INVESTMENTS IN SPINOUTS: THE ROLE OF COMPETITIVE TENSION

JOONHYUNG BAE
Sungkyunkwan University

JOON MAHN LEE
Korea University

Drawing on the literature on entrepreneurship and competitive dynamics, we investigate how technological overlap between spinouts and parent firms influences corporate investors' decisions regarding investments in spinouts. We suggest that a high level of technological overlap between a spinout and its parent firm deters potential corporate investors from making an investment in the spinout because of competitive tension arising from anticipated hostile actions by the parent firm. We further suggest that these negative effects are contingent on the tradeoffs between competitive risks and benefits. Our findings show that the negative effects are amplified when parent firms have a strong litigiousness in claiming their intellectual property rights. However, we find that the negative effects are mitigated when corporate investors can expect benefits from gaining indirect access to parent firms' technological knowledge. Using a sample of corporate venture capital investments in the U.S. medical device industry, we find evidence that supports our hypotheses.

Entrepreneurs often discover new entrepreneurial opportunities from their experience with previous employers, and initiate their own ventures (Klepper, 2001; Shane, 2000). Arguably, the most distinctive feature of this class of new startups, which are often called spinouts, is that they possess various types of resources that the founder(s) acquired during their time with former employers (i.e., parent firms).[1] Building on this notion, prior work on this parental relationship has found that the initial resource endowment of spinouts inherited from their parent firms can provide favorable conditions for their survival, suggesting spinout activities as an advantageous entrepreneurial choice (Agarwal, Echambadi, Franco, & Sarkar, 2004; Basu, Sahaym, Howard, & Boeker, 2015; Burton, Sørensen, & Beckman, 2002; Chatterji, 2009; Klepper & Sleeper, 2005).

However, recent studies focusing on the relationship between spinouts and their parent firms have hinted at the potential drawback of spinouts (Campbell, Ganco, Franco, & Agarwal, 2012; Walter, Heinrichs, & Walter, 2014; Wezel, Cattani, & Pennings, 2006). Specifically, from the parent firms' perspective, former employees'

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[1] Following previous studies, we define spinouts as entrepreneurial ventures founded by former employee(s) of established firms (i.e., parent firms) within the same industry (e.g., Agarwal et al., 2004). These ventures have no ownership affiliations with their parent firms at the time of their inception (Agarwal, Ganco, & Ziedonis, 2009; Kim & Steensma, 2017).

entrepreneurial activities can be harmful to parent firms' performance because the establishment of a spinout represents not only the loss of human capital but also a serious competitive threat. In particular, in industries where privately held technological knowledge is a critical source of competitive advantage (Grant, 1996; Teece, Pisano, & Shuen, 1997), spinouts may economize on the technological knowledge inherited from parent firms (Basu et al., 2015) and position themselves in a market similar to that of parent firms. In this case, there can arise significant competitive tension between parent firms and spinouts (Agarwal et al., 2004; Klepper & Sleeper, 2005), and parent firms may adopt a hostile attitude toward their spinouts.[2]

Grounding our study in this literature, we aim to provide a more balanced view to the research on employee entrepreneurship, which has predominantly suggested that spinouts benefit from the resources or knowledge transferred from parent firms. That is, by focusing on the potential hostile attitude of parent firms in high-technology contexts, we explore the possibility that the technological knowledge inherited from their parent firms might be a liability, causing spinouts to suffer more compared to other types of ventures. This study extends (but departs from) the extant research on spinouts by investigating when spinouts may suffer from their parent firms' potential hostile attitude, and under what conditions such negative aspects are magnified or alleviated. In doing so, we pay attention to the perspective of potential corporate investors within the same industry, which play an important role in the development process of new ventures (Alvarez-Garrido & Dushnitsky, 2016; Kim & Park, 2017; Park & Steensma, 2012).[3]

Specifically, we examine how corporate investors consider the competitive tension that arises because of technological overlap between spinouts and parent firms (hereafter TOSP) when they invest in spinouts. Our main premise is that, when making investment decisions, corporate investors may be concerned about the competitive risks stemming from the anticipated hostile attitude of the parent firm toward its spinout, or even toward the spinout's transaction partners.[4] Therefore, corporate investors are likely to be more worried about the parent firm's aggressive retaliations (e.g., legal or market-based competitive actions) when there is a high level of TOSP. As a baseline hypothesis, we argue that spinouts that have a high level of technological overlap with their parent firms are less likely than other ventures (nonspinouts and spinouts that have a low level of TOSP) to receive funding from corporate investors.

To delve into the mechanism underlying our baseline expectation, we examine the effects of TOSP within the sample of spinouts in our subsequent hypotheses.[5] In line with the baseline hypothesis, we first argue that the level of TOSP is negatively associated with the likelihood that a corporate investor will invest in a spinout. Building on this direct effect of TOSP, on the one hand, we theorize that the predicted relationship can be amplified when corporate investors consider that the potential risks of the investment are high (i.e., when parent firms are more likely to take aggressive actions with respect to the corporate investor's investment). On the other hand, we theorize that the predicted relationship can be mitigated when corporate investors expect greater benefits from the investments (i.e., when corporate investors can learn spinouts' knowledge inherited from the parent firm).

To examine our predictions, we used corporate venture capital (CVC) investments in the U.S. medical device industry, a setting characterized by a large number of spinouts (Chatterji, 2009; Gompers, Lerner, & Scharfstein, 2005) and a strong intellectual property protection regime (Cohen, Nelson, & Walsh, 2000; Dushnitsky & Shaver, 2009; Katila, Rosenberger, & Eisenhardt, 2008). Moreover, to validate our arguments

[2] The literature on competitive dynamics has defined competitive tension as "the strain between a focal firm and a given rival that is likely to result in the firm taking action against the rival" (Chen, Su, & Tsai, 2007: 102).

[3] For simplicity, we use the term "corporate investors" in a broad sense, which indicates established firms that operate a venture investment program within the same industry.

[4] Although parent firms and corporate investors operate in the same industry, they are not necessarily direct competitors with one another. As an example from our empirical context (the U.S. medical device industry), Medtronic competes directly against corporate investors such as Abbott Laboratories, Boston Scientific, and Johnson & Johnson in several market segments (e.g., cardiac and vascular, minimally invasive therapies, restorative therapies) (Medtronic, 2017). However, Medtronic rarely competes against other corporate investors such as GE Healthcare and 3M Healthcare.

[5] We develop the baseline hypothesis by comparing spinouts and nonspinouts, and in subsequent hypotheses we exploit the heterogeneity in the level of TOSP among spinouts. This is further articulated in the following paragraphs.

we interviewed several corporate venture capitalists, independent venture capitalists, and founders of spinouts to understand the nature of interactions between spinouts and corporate investors and to gain clarity regarding the potential challenges and benefits that corporate investors may face when investing in spinouts.

We make several noteworthy contributions to the management and entrepreneurship literature. This study primarily extends the literature on employee entrepreneurship by considering the potential drawbacks of spinout activities. Prior work in this area has predominantly focused on understanding the advantages of spinouts compared with other types of ventures (e.g., Agarwal et al., 2004; Burton et al., 2002; Chatterji, 2009; De Figueiredo, Meyer-Doyle, & Rawley, 2013). Although these studies enhance our understanding of why many entrepreneurs start their firms after obtaining some experience in established firms, researchers have paid little attention to questions such as why not all entrepreneurs start their firms as spinouts and why some spinouts do not rely on the knowledge of parent firms. By highlighting the potential drawbacks of spinouts, this study provides one answer to these questions and offers a more balanced view to the literature on employee entrepreneurship. Relatedly, we suggest a novel mechanism that "technological inheritance (or overlap)" may have negative performance implications for spinouts. Previous studies have considered technological inheritance of spinouts as a virtuous gift that increases the spinout performance as it acts as an initial resource endowment (Agarwal et al., 2004; Klepper & Sleeper, 2005) or reliable reputation transferred from the parent firm (Burton et al., 2002); however, we argue that technological inheritance may cause competitive tension, thereby deteriorating spinouts' business activities.

Moreover, this study contributes to the literature on competitive dynamics (Chen, 1996; Chen et al., 2007; Gimeno & Woo, 1996). While prior studies have provided us with a good understanding of how firms may behave in the midst of competitive dynamics, such studies have primarily focused on understanding competitive tension at a dyad level between firms (Chen & Miller, 2015; Sirmon, Gove, & Hitt, 2008). Our study is one of the first to extend this literature by suggesting how competitive tension between two firms can be transferred to a third party, emphasizing the transitivity of competition through an interfirm network. Building on this novel concept, we show that due to the competitive tension between two rivals, third parties will be hesitant to build a relationship with a firm that has a rival that is highly likely to take aggressive actions against the third party. In addition, our consideration of moderating factors that may increase competitive risks or benefits provides new insights into how competitive dynamics among firms influence the formation of interorganizational relationships. Our findings suggest that the decision regarding the formation of interorganizational relationships (i.e., in our context, investments in spinouts) may be based on the balance between the potential competitive risks and benefits

Finally, this study enriches the prior literature on the strategic motives of CVC investments (e.g., Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2005a; Maula, Keil, & Zahra, 2013; Paik & Woo, 2017; Park & Steensma, 2012). In contrast to prior studies that have looked at the antecedents of CVC investments, this study is one of first to theorize on the mechanism that may impede CVC investments—that is, the underlying competitive tension among organizations. Furthermore, we expand the literature by suggesting an underexplored motive of CVC investments: to explore and acquire the knowledge of competitors, which in turn may affect the overall competitive dynamics in an industry.

THEORETICAL BACKGROUND

Spinouts are generally considered to possess resources or knowledge transferred from their parent firms, which can form the basis upon which spinouts build their capabilities (Agarwal et al., 2004; Basu et al., 2015; Klepper & Sleeper, 2005). In particular, in high-technology contexts, because critical knowledge is often embedded in individual employees (Coff, 1997), employee founders bring not only the codified knowledge but also the tacit knowledge that they gained at parent firms to their new ventures (i.e., spinouts) (Agarwal et al., 2004; Campbell et al., 2012). Moreover, while working at parent firms, particularly entrepreneurial ones, prospective entrepreneurs can learn valuable industry-specific knowledge and entrepreneurial processes, and gain social and financial networks (Agarwal & Shah, 2014; Gompers et al., 2005).

Because these various types of resources and knowledge serve as the initial endowment of spinouts that can shape their technological capabilities, organizational routines, and strategic directions, it has been found that spinouts outperform other types of ventures in various industries, including laser disks (Agarwal et al., 2004), medical devices (Chatterji, 2009), and hedge funds (De Figueiredo et al., 2013). In a similar vein, external investors, in general, perceive the value of spinouts' inheritance in a positive manner when they search investment targets. When making investments, these investors often face information asymmetry problems since entrepreneurial ventures typically lack track records or ready-to-go products (Stuart, Hoang, & Hybels, 1999). Therefore, spinouts spawned by "entrepreneurially prominent" parent firms can be a reliable investment target because investors perceive that the knowledge of highly reputable parent firms is transferred to their spinouts, thus reducing uncertainty regarding the spinouts' prospects (Burton et al., 2002).

This largely positive view of the spinouts' inheritance relies on the implicit assumption that parent firms hold favorable, or at least neutral, feelings toward their spinouts. This assumption may be plausible when spinouts and parent firms maintain cooperative or complementary relationships with one another (Agarwal, Audretsch, & Sarkar, 2007). However, several studies have suggested that competitive tension between spinouts and parent firms may arise, particularly when spinouts economize on the technological knowledge of parent firms (Klepper & Sleeper, 2005; Walter et al., 2014). That is, because parent firms' critical knowledge can be used by spinouts to develop their own technological capabilities (Basu et al., 2015; Kim & Steensma, 2017), spinouts can become threats to the parent firms and ultimately have adverse effects on the parent firms' innovation and financial performance (Campbell et al., 2012; Wezel et al., 2006). Highlighting these negative effects of spinouts on parent firms' innovativeness and performance, Walter et al. (2014) suggested that parent firms often adopt a hostile attitude toward their spinouts, which has detrimental effects on the survival of spinouts.[6]

Competitive Tension Between Spinouts and Parent Firms

Firms face competitive pressures not only to gain more share in the product market but also to obtain resources in the factor market (Barney, 1986; Dierickx & Cool, 1989). Because critical resources are scarce and thus difficult to obtain, managers often perceive firms with similar resource profiles as "imposing the greatest competitive tension" (Chen et al., 2007: 106; see also Porac & Thomas, 1990). Therefore, competition in the product market is often traceable to upstream activities such as technological development (Markman, Gianiodis, & Buchholtz, 2009). In line with this reasoning, Oxley and Sampson (2004) viewed the degree of technological overlap between alliance partners as an important dimension of competitive tension that affects the scope and governance of alliances.

This notion indicates that the competitive tension between spinouts and parent firms can be significantly increased when the spinouts' knowledge bases are highly similar to the parent firms' own knowledge bases. When spinouts economize on the knowledge created by their parent firms or knowledge cocreated by their founders and parent firms, they may be able to commercialize new products that compete with those of parent firms (Agarwal et al., 2007; Anton & Yao, 1995; Klepper & Sleeper, 2005). Because this can create a serious competitive challenge, parent firms are more likely to be concerned about knowledge appropriation by spinouts that pursue similar technology domains. Moreover, spinouts represent a loss of critical human capital that can deteriorate parent firms' ongoing innovation and associated routines, and this may impair parent firms' competitive position relative to spinouts as well as other competitors. Hence, in these circumstances parent firms may choose to degrade the technological resources of spinouts (Capron & Chatain, 2008). For example, parent firms often take aggressive actions by disseminating negative information about the spinout (Walter et al., 2014) or even filing a lawsuit to protect their knowledge and maintain their position in the market (Klepper & Sleeper, 2005; Klepper & Thompson, 2010).

A lawsuit filed by Physio-Control against Heartstream, which was founded by former employees of Physio-Control, is illustrative of parent firms' aggressive actions. In this lawsuit, Physio-Control claimed the ownership of Heartstream's patented technologies in automatic external defibrillators by asserting that the technologies were initially conceived and developed while the founders of Heartstream were working at Physio-Control. As a result of this lawsuit, Heartstream had to pay $1.6 million to Physio-Control (Cardiac Science, Inc. v. Koninklijke

[6] In high-technology industries, many parent firms reveal hostile reactions toward spinouts when spinouts pursue similar knowledge domains by giving them a dishonorable label. For example, IBM labeled the 12 employees who left IBM to establish Information Storage Systems as the "dirty dozen" (McKendrick, Wade, & Jaffee, 2009), and Shockley Semiconductor called the eight founders of Fairchild Semiconductor the "traitorous eight" (Gompers et al., 2005).

Philips Electronics N.V., 2005).[7] This kind of conflict between spinouts and parent firms is also reflected by the statement of a lawyer who has extensive experience with the protection of intellectual property rights (DLA Piper, 2018):

> A major risk for a startup is the use by founders of materials from their prior employer. Such materials can range from trade secrets such as customer lists or semiconductor design methodology to computer software. This mistake can cripple a startup, because companies are becoming more aggressive in defending their intellectual property rights: a lawsuit, even if the startup wins, can prove to be fatal either due to delays in product introduction or distraction of the startup's management.

However, when spinouts pursue knowledge bases that are distant from those of parent firms, parent firms are less likely to be hostile because it is unlikely that these spinouts would jeopardize parent firms' performance (Walter et al., 2014). Indeed, spinouts can enhance parent firms' capabilities when the spinouts' complementary knowledge can spill back into parent firms (Agarwal et al., 2007; Kim & Steensma, 2017) or when the spinouts can provide complementary products or services (Somaya, Williamson, & Lorinkova, 2008). In these cases, parent firms may choose to behave favorably toward spinouts.[8]

Building on these studies that have indicated the heterogeneity in competitive tension between spinouts and parent firms, in this study we attempt to enhance our understanding of how competitive tension stemming from TOSP affects the likelihood that corporate investors will invest in spinouts. Considering the role of other industry incumbents as corporate investors is particularly important for our study for a couple of reasons. First, our main mechanism, competitive tension, should be accentuated when corporate investors invest in spinouts because the primary purpose of CVC investments is to gain external knowledge from new startups (Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2005a; Wadhwa & Kotha, 2006). Second, CVC investments are prevalent in technology-intensive industries (Basu, Phelps, & Kotha, 2011; Dushnitsky & Lenox, 2005a) and represent one of the largest sources for venture capital funding (Dushnitsky & Lavie, 2010; Pahnke, Katila, & Eisenhardt, 2015a), accounting for approximately 25% of the global venture capital dollars (CB Insights, 2017). In the next section, we develop hypotheses about how corporate investors evaluate the competitive risks and benefits associated with parent firms' anticipated attitudes toward spinouts in their investments.

HYPOTHESES DEVELOPMENT

TOSP and Competitive Risks of Investments in Spinouts

The foregoing discussion on competitive tension between spinouts and parent firms provides important insights for corporate investors when they invest in spinouts. Given that parent firms are highly concerned about future competitive threats by spinouts, we suggest that corporate investors are particularly worried about investing in spinouts whose knowledge bases are similar to those of parent firms, compared with investing in other startups. In the presence of a high level of TOSP, spinouts may suffer from parent firms' aggressive actions, which can impede corporate investors from achieving their strategic purpose of CVC investments. For example, if a parent firm takes aggressive actions against the spinout to disrupt or prevent the development of technologies based on the parent firm's knowledge, the corporate investor will not be able to benefit from gaining access to the spinout's knowledge.

Furthermore, corporate investors should consider how investments in spinouts would affect their existing relationships with parent firms. Because corporate investors and parent firms operate within the same industry, they are likely to be embedded in a set of direct or indirect interfirm relationships that may negatively influence the decision to invest in spinouts. This reasoning is consistent with the core idea in the literature on competitive dynamics that

[7] In addition to this example, the litigation filed by parent firms against their spinouts due to the conflict over intellectual property rights is often observed in our empirical setting of the medical device industry. For example, Boston Scientific filed a patent infringement lawsuit against its spinout, ev3 Inc (Boston Scientific Scimed, Inc. v. Ev3 Inc., 2007). Moreover, Smith & Nephew initiated a lawsuit when it recognized the conspiracy of its former employees to found a venture using Smith & Nephew's confidential technologies (Daily News, 2011).

[8] While knowledge (or technology) similarity and complementarity between firms are often used interchangeably, Makri, Hitt, and Lane (2010: 606) provided a good distinction between them. They suggested that the former is "the degree to which two firms' technological problem solving focuses on the same narrowly defined areas of knowledge," whereas the latter is "the degree to which two firms' technological problem solving focuses on different narrowly defined areas of knowledge within a broadly defined area of knowledge that they share."

firms often hesitate to initiate competitive actions against rivals because of the concern about aggressive responses (Chen, 1996; Gimeno & Woo, 1996). Building on this notion, we expect that when exposed to competitive tension between spinouts and parent firms, corporate investors are likely to forgo opportunities to invest in spinouts to maintain their relationships with parent firms, if any, because parent firms' business activities are likely to impact corporate investors in various ways (Walter et al., 2014).

For example, when corporate investors invest in spinouts that have a high level of TOSP, they can be prone to the direct risk of parent firms' aggressive actions. Once parent firms recognize the hazard of undesirable leakage of knowledge and human capital from spinouts to other firms, they may choose to penalize spinouts as well as corporate investors to prevent their knowledge from being appropriated by other organizations. In this case, corporate investors not only fail to utilize the innovative knowledge of spinouts but also experience conflict in their relationship with parent firms. Moreover, when a spinout's technological knowledge requires other relevant knowledge components, corporate investors are likely to hesitate to invest in the spinout with high TOSP. This is because corporate investors may not be able to gain the rights to utilize the bundle of technological knowledge whose ownership is dispersed across the spinout and parent firm. In particular, corporate investors' concern about the anticipated hostile attitude of parent firms can be amplified in industries with a strong intellectual property protection regime (e.g., medical devices, pharmaceuticals) because parent firms can effectively exert their influence using formal institutional arrangements (Agarwal et al., 2009; Cohen et al., 2000).

During our interviews with corporate venture capitalists, many of them confirmed that the potential hostile attitudes of parent firms are the main reason they might be hesitant to invest in a spinout with a high level of TOSP. For example, a corporate venture capitalist working for a large life science company stated the following:

> I would be very careful about investing in spinouts that are working on the technologies similar to those of parent firms. I would say come back and see me when you get the IP. Parent firms may just wait for the right moment to take action. Especially, some firms like Lion [fictitious name] are notorious for being very aggressive against spinouts.

Another corporate venture capitalist commented:

> It is important to consider the potential retaliation of a spinout's parent firm when making investments. So, before making investments in spinouts, we need to clearly identify whether their technologies are immune to potential legal actions by the parent firms. [. . .] We are especially careful about making investments when spinouts are going to compete with the parent firms in the same technological space.

As these interviewees illustrated, the risks of investing in spinouts are shaped by the competitive tension stemming from the TOSP such that when TOSP is high, corporate investors will become hesitant to invest in spinouts. However, when TOSP is low, corporate investors may face few competitive risks and thus will not necessarily exclude spinouts with low TOSP from potential investment targets. In sum, when a high level of TOSP exists, corporate investors may perceive serious risks associated with the anticipated aggressive actions of parent firms, thus deterring corporate investors from investing in those spinouts compared with other ventures, as well as spinouts with a low level of TOSP. Therefore, as a baseline hypothesis, we predict the following:

Baseline Hypothesis. Spinouts that have a high level of technological overlap with their parent firms are less likely than other ventures (i.e., nonspinouts and spinouts that have a low level of technological overlap with their parent firms) to receive an investment from corporate investors.

Moreover, our arguments leading to the Baseline Hypothesis indicate that although corporate investors are likely to hesitate to invest in spinouts with high TOSP, they may not do so when investing in spinouts with low TOSP. Hence, we further develop the Baseline Hypothesis by considering the heterogeneity in the level of TOSP among spinouts (rather than the heterogeneity between spinouts and nonspinouts). That is, we develop Hypothesis 1 by focusing only on spinouts, because we cannot examine the effects of TOSP for nonspinouts since they do not have parent firms by definition. Building on the logic above, we suggest the following:

Hypothesis 1. The level of technological overlap between a spinout and its parent firm is negatively associated with the likelihood that a corporate investor will invest in the spinout.

Contingent Effects of TOSP on Investments in Spinouts

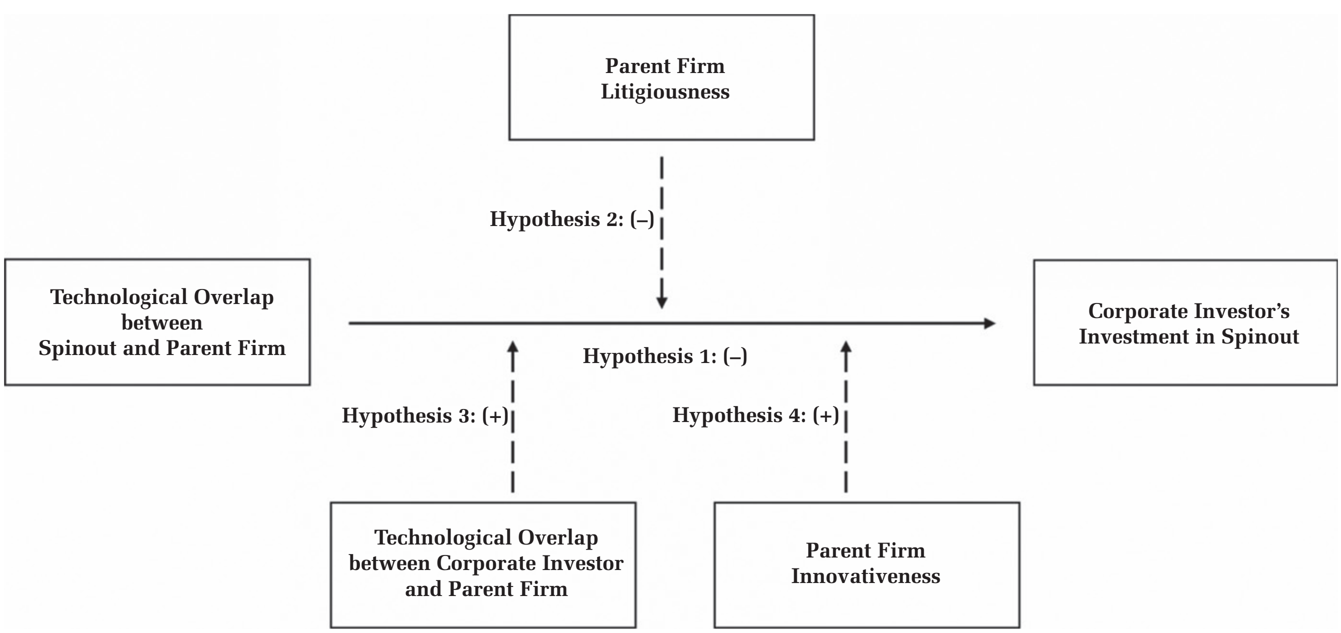
To make a more profound theoretical contribution to the spinout literature, it is imperative to examine whether our suggested mechanism, competitive tension stemming from TOSP, drives the relationship proposed in the baseline expectation. To do so, we develop hypotheses about boundary conditions that may differentially influence the negative effect of TOSP on the investments. In doing so, we rely on the insights of prior work on knowledge diffusion across interfirm relationships. This research has extensively examined not only how firms (knowledge recipients) seek to access competitors' technological knowledge (e.g., employee mobility, alliances) (Kale, Singh, & Perlmutter, 2000; Khanna, Gulati, & Nohria, 1998; Song, Almeida, & Wu, 2003) but also how firms (knowledge sources) protect their own technologies from undesired leakage to competitors (e.g., intellectual property protection regimes, transaction governance choice) (Agarwal et al., 2009; Katila et al., 2008; Oxley, 1997).

When applied to the investments in spinouts, the core ideas of these two research streams indicate that while corporate investors are concerned about parent firms' protective behavior, they may also expect competitive benefits from accessing the knowledge of spinouts inherited from the parent firms. Therefore, we propose that corporate investors' decision regarding investments may be influenced by the tradeoff between the competitive risks and benefits. Building on this notion, we develop boundary conditions under which corporate investors may perceive greater risks or benefits, which in turn would influence the relationship between the level of TOSP and the likelihood of investment proposed in Hypothesis 1. Figure 1 summarizes the theoretical model of our boundary conditions.

Factor increasing competitive risks. We suggest that the negative effects of TOSP on the likelihood of investments can be amplified by the parent firms' aggressiveness to claim their intellectual property rights. While firms seek to protect their knowledge and prevent its misappropriation by others, they may vary in the aggressiveness of their protective behavior.

Previous literature has identified litigation as one of the most aggressive and costly ways of resolving conflicts over intellectual property rights (particularly patents) among organizations. This is because, for the involved firms, the litigation process incurs huge legal costs, including the cost of lawyers, and incurs time costs due to trial proceedings, which may disrupt firms' ongoing innovation activities (Landes & Posner, 2003; Lumineau & Oxley, 2012; Somaya, 2003). Despite these costs, firms initiate patent litigations for various strategic reasons (Paik & Zhu, 2016; Somaya, 2012), including "desire to take out a competitor in a key market, to build a tough reputation, to protect its crown jewels" (Somaya, 2003: 18). In addition, firms may use litigation to signal potential challenges of technological development to other firms competing in a similar area (Howard, Withers, & Tihanyi, 2017). Hence, litigation with regard to claiming the intellectual property rights of patents is often viewed as an effective way to protect and

FIGURE 1
Theoretical Framework



appropriate rents from innovation efforts (Lanjouw & Schankerman, 2001). This notion is consistent with the findings of Agarwal et al. (2009), which showed that a strong reputation for patent litigation reduces knowledge leakage through employee mobility. Thus, on the one hand, when parent firms have a strong litigiousness, corporate investors may perceive the risks to be considerable, such that they are more likely to avoid investing in spinouts with a high level of TOSP. On the other hand, when parent firms have a weak litigiousness, corporate investors may perceive the risks to be less real, such that the negative effects of TOSP on the likelihood of investment in spinouts can be reduced. We therefore suggest the following:

> *Hypothesis 2. The negative effect of technological overlap between a spinout and its parent firm on the likelihood of a corporate investor's investment in the spinout is amplified by the level of the parent firm's litigiousness for intellectual property rights.*

Factors increasing competitive benefits. Although the concern about parent firms' potential hostile attitudes may curb corporate investors' investments in spinouts with a high level of TOSP, the presence of competitive benefits may outweigh these concerns and lead corporate investors to attend to the benefits of investing in spinouts with a high level of TOSP. Hence, we consider that the negative relationship between TOSP and the likelihood of investments in spinouts can be mitigated when the competitive benefits from the investments are expected to be large enough to offset corporate investors' concerns about competitive risks.

Because we focus on the competitive benefits from investing in spinouts, it is important to highlight that CVC investments serve the strategic goals to gain access to external technologies of small ventures. Corporate investors can do so through several mechanisms. First, when making investment decisions, corporate investors can learn ventures' technologies through due diligence with regard to various aspects, including the background of founders and management teams, business plans, technological capabilities, and market prospects (Dushnitsky & Lenox, 2005b; Wadhwa & Kotha, 2006). Second, corporate investors can obtain a board seat (or at least board observation rights) or a liaison program, through which they can intensively monitor ventures' development activities (Bottazzi, Da Rin, & Hellmann, 2004; Dushnitsky & Lenox, 2005b). More importantly, because corporate investors can provide complementary assets that are required to commercialize ventures' technologies (Alvarez-Garrido & Dushnitsky, 2016; Park & Steensma, 2012), corporate investors can have many opportunities to collaborate on research and development (R&D) activities with ventures, which enables extensive knowledge transfer from the venture to the corporate investor (Ceccagnoli, Higgins, & Kang, 2018).

Given these extensive interactions, we suggest that corporate investors can use investment in spinouts as an effective way to acquire competitors' knowledge and human capital. From the standpoint of corporate investors, when parent firms possess technologies that can help corporate investors' competitive position, spinouts with a high level of TOSP can be an attractive investment target. Moreover, the best employees who are equipped with valuable knowledge are more likely to leave their employers to set up their own ventures (Ganco, Ziedonis, & Agarwal, 2015; Klepper & Thompson, 2010). Therefore, technological knowledge and know-how embedded in the human capital can be readily transferred to and redeployed by spinouts for their own capabilities (Campbell et al., 2012; Carnahan, Agarwal, & Campbell, 2012; Kim & Steensma, 2017). Hence, if corporate investors can gain access to parent firms' critical knowledge and key human capital by investing in spinouts, they should be inclined to make investments in the spinouts. Supporting our view, a corporate venture capitalist working for a large semiconductor firm commented:

> Before deciding whether to make investment in a spinout, we evaluate the potential benefits that may arise from the knowledge of the spinout by considering its parent firm. If the spinout is expected to possess scientists with cutting-edge technology or knowledge of the parent firm that we can immediately benefit from, we might (positively) reconsider the investment decision.

However, as proposed in the Baseline Hypothesis, because investing in spinouts entails significant risks, corporate investors should carefully evaluate whether their competitive benefits will outweigh the competitive risks associated with the parent firms' anticipated hostile attitude. In the following paragraphs, we suggest two such conditions under which corporate investors can expect potential competitive benefits from investing in spinouts.

As a first condition, we expect that the level of technological overlap between corporate investors and parent firms (TOCP) will moderate the negative effects of TOSP on investments in spinouts. When the level of TOCP is high, the corporate investor and the parent firm are likely to share a similar strategic focus (Rothaermel & Boeker, 2008; Stuart et al., 1999) and compete in similar product markets (Chen, 1996;

Markman et al., 2009; Polidoro, Ahuja, & Mitchell, 2011). In the presence of high TOCP, corporate investors can gain access to valuable information (e.g., technology search, tacit know-how) about direct competitors by investing in a spinout that has a high level of TOSP. The human capital in a spinout is also likely to possess knowledge that is relevant to the corporate investor because of high TOCP. Furthermore, in the presence of high TOCP, as corporate investors possess relevant technological knowledge that can be combined with spinouts' knowledge, they may be less concerned about potential conflict over intellectual property rights. Hence, CVC investments in spinouts with high TOSP can be readily followed by subsequent transactions (e.g., alliances, acquisitions) that can provide the opportunity for a corporate investor to plug the spinouts' human capital into the workforce with little adjustment and learning costs. Our argument is supported by a corporate venture capitalist with multiple experiences investing in spinouts:

> Although we acknowledge the risk generated from potential retaliation of the parent firm, if a spinout seems to have the key knowledge or employee of our direct competitor, we would definitely be interested in investing in them. While we have to be careful, for some cases, it is hard to let it just pass.

Hence, in these cases, corporate investors' concerns about the anticipated hostile reactions by parent firms (when investing in spinouts with a high level of TOSP) can be offset because the expected benefits from the investment can partially compensate for the risks they may face. On the other hand, when TOCP is low, the benefits of investing in spinouts will be limited (or negligible) since the spinouts' knowledge embedded in employees is of little value to corporate investors' technological capabilities. Therefore, we suggest the following:

> *Hypothesis 3. The negative effect of technological overlap between a spinout and its parent firm on the likelihood of a corporate investor's investment in the spinout is mitigated by the level of technological overlap between the corporate investor and the parent firm.*

As a second condition, we suggest that when parent firms are highly innovative, corporate investors may have increased incentive to invest in spinouts with a high level of TOSP. As discussed above, founders of spinouts can bring with them technological knowledge and organizational routines that they learned while at their previous employers (Agarwal et al., 2004; Basu et al., 2015; Klepper & Sleeper, 2005). Because a spinout with high TOSP can readily replicate and redeploy the knowledge inherited from its parent firm (Campbell et al., 2012), corporate investors can access accumulated expertise of the parent firm by investing in the spinout.

In particular, when parent firms have strong innovation capabilities, corporate investors may have increased interest in spinouts with high TOSP. By investing in these spinouts, corporate investors can acquire indirect access to the new technological knowledge of their parent firms and develop that knowledge into commercialized outcomes (Yadav, Prabhu, & Chandy, 2007). Moreover, because parent firms with high innovativeness offer a training ground for more skilled employees, by investing in spinouts from highly innovative parent firms, corporate investors can gain access to high-quality human capital resources, which can be viewed as embodiments of the skills and knowledge of the parent firms. This benefit is particularly important in industries where a firm's performance heavily relies on a few star scientists, such as the pharmaceutical (e.g., Hess & Rothaermel, 2011) and biotechnology (e.g., Zucker, Darby, & Armstrong, 2002) sectors.

Hence, when parent firms are highly innovative, corporate investors' concerns for anticipated hostile reactions by parent firms (when investing in spinouts with a high level of TOSP) can be partially offset by the expected benefits from investing in spinouts. However, when parent firms are not strong innovators, the expected benefits will be limited because the spinouts' knowledge is unlikely to contribute to the corporate investors' technological capabilities. Therefore, we suggest the following:

> *Hypothesis 4. The negative effect of technological overlap between a spinout and its parent firm on the likelihood of a corporate investor's investment in the spinout is mitigated by the level of the parent firm's innovativeness.*

METHODS

Empirical Setting and Data

To test our hypotheses, we focused on CVC investments in the U.S. medical device industry during the period of 1995–2015. This empirical setting is well-suited to explore the hypothesized arguments, for several reasons. First, the medical device industry is one of the most active industries in generating spinouts (Gompers et al., 2005). According to a sample obtained by Chatterji (2009), approximately 35% of new ventures in this industry are founded by former employees of established firms; this is consistent with the ratio of our sample, as described in detail below. Moreover, spinouts and parent firms often compete directly in the same market. For example, in its Securities and Exchange Commission filings, Penumbra (2015) explicitly identified its parent firm (Boston Scientific) as one of the most notable competitors in the neuro and peripheral vascular devices market. Second, the medical device industry is R&D intensive, and technological knowledge is a critical source of competitive advantage. Hence, many incumbents in this industry attempt to obtain external technological knowledge by making CVC investments in entrepreneurial ventures (Dushnitsky & Lenox, 2005a; Katila et al., 2008). Finally, the medical device industry is appropriate for using patent-related information to reflect its technological environment. In this industry, firms are active in patenting activities because patents are an important means for securing rents from innovation (Chatterji, 2009; Chatterji & Fabrizio, 2014). Moreover, the firms in this industry take patent litigation risks very seriously, as noted by Stryker Corp. (2012: 4) in its annual report: "The medical device industry is characterized by extensive intellectual property litigation [. . .] Regardless of outcome, such claims are expensive to defend and divert management and operating personnel from other business issues." Hence, the strong intellectual property protection regime of this industry allows us to investigate how parent firms' anticipated hostile attitude toward spinouts influences corporate investors' decisions to invest in spinouts (Cohen et al., 2000).

To examine the likelihood of CVC investment in a spinout, we constructed two dyad year–level datasets. First, to test the Baseline Hypothesis, which compares spinouts and nonspinouts, we created a data set by considering all possible dyads involving a corporate investor and a venture that is at risk of receiving CVC investment in a given year (spinout and nonspinout sample).[9] That is, for each realized CVC investment deal, we built a set of nonrealized CVC investment deals between all potential corporate investors and all ventures as potential investees in the year in which the focal CVC investment was realized. Similarly, to test Hypotheses 1–4, which examine the heterogeneity among spinouts, we created a data set that includes all possible dyads between corporate investors and spinouts (spinout sample). This sampling approach has been widely used in previous studies on the formation of interfirm relationships because when it is unclear which potential dyad is likely to be formed, the sampling approach can predict the likelihood in an unbiased way (e.g., Gulati & Gargiulo, 1999; Reuer & Devarakonda, 2017).

We obtained data on CVC investments at the fund level from Thomson ONE's VentureXpert database. We then manually identified the corporate parents of each CVC fund (i.e., corporate investors) using data sources such as Bloomberg Businessweek, Capital IQ, and LexisNexis. To classify CVC investments by firms in the medical device industry, we restricted corporate investors to public firms that have had at least one medical device product approved by the U.S. Food and Drug Administration (FDA), because these firms can be considered to be interested in accessing a venture's technological knowledge and to be the direct or potential competitors of parent firms. Thus, established companies in related industries (e.g., pharmaceuticals) that have approved medical devices (e.g., Abbott Laboratories, Pfizer) are included as potential corporate investors; however, firms that have no approved medical devices were excluded, even if they have invested in medical device ventures, because they are unlikely to have a serious interest in the medical device industry (e.g., Comcast, Oracle).[10] The final sample includes 45 industry incumbents as corporate investors.

Using the VentureXpert database, we identified 838 U.S.-based, investor-backed ventures that operate in subsectors of the medical device industry (Maarten de Vet & Scott, 1992) and were founded between 1995 and 2010. We used these investor-backed ventures because they are likely to have viable technologies that can attract the attention of corporate investors (Katila et al., 2008; Kim & Steensma, 2017). To identify the spinouts among these ventures, we collected data on the career history of their founders by performing a rigorous search using various data sources, such as Bloomberg Businessweek's executive profile, Capital IQ, Crunchbase, Factiva, Relationship Science, LinkedIn, and company websites. In the operationalization of spinouts, prior studies have shown high variation, particularly in the time windows

[9] A venture is assumed to be at risk of receiving CVC investment from the year of its inception through two years after the year of the last financing round. We added two additional years because it is unclear whether a venture stopped receiving funding from external investors at the year of the last financing round that appeared in VenturXpert, and the average time between funding rounds in VentureXpert is two years. As a robustness check, we also used the year of last investment and one year after the year of last investment as the last year that a spinout is at risk of receiving CVC investment and found that the results are consistent with those described below. Ventures that experienced an initial public offering or acquisition are assumed to be at risk of receiving CVC investment until the year of these exit events (Katila et al., 2008).

[10] The analysis using the sample that includes CVC investments by firms without an approved medical device reveals results that are consistent with those described below.

used to define spinouts. For example, several studies have defined spinouts as ventures founded by ex-employees who left the parent firm in the preceding year (i.e., one-year window) (e.g., Agarwal et al., 2004; Ioannou, 2014; Walter et al., 2014). Other studies have used different windows, such as a three-year window (e.g., Gambardella, Ganco, & Honoré, 2014). However, many studies have defined spinouts as ventures founded by entrepreneurs who have previously worked for an incumbent firm at any time during their career (e.g., Basu et al., 2015; Beckman, 2006; Chatterji, 2009; De Figueiredo et al., 2013; Kim & Steensma, 2017; Klepper & Sleeper, 2005). Although it is likely that the effect of inherited knowledge can diminish as the time since leaving the parent firm increases, at the same time it is difficult to determine when founders exactly had their business ideas and planned to establish their own ventures. We therefore decided to use several different time windows in our main analyses, namely one-, three-, five-, and 10-year windows.[11]

Consistent with the definition of corporate investors, we considered parent firms as public firms that have had at least one medical device product approved by the FDA. In cases with multiple founders, we checked all of the cofounders' career histories and considered the ventures as spinouts if one of the cofounders met these conditions (Chatterji, 2009; Kim & Steensma, 2017). This sampling procedure resulted in 254 spinouts in the medical device industry (based on the 10-year window).[12] Because we used patent information for key independent variables as well as several control variables, we restricted the sample ventures to those that had been granted at least one U.S. patent, which resulted in a final sample of 679 ventures (215 spinouts and 465 nonspinouts).

Next, we combined these data with patent information from the U.S. Patent and Trademarks Office. We also collected data on the patent litigation history of parent firms and corporate investors using legal databases, such as Lex Machina and MaxVal's Litigation Databank. Furthermore, we gathered information on medical device products from the FDA's medical device approval database. We also used Thomson ONE's Mergers & Acquisitions and Securities Data Company databases to collect information about acquisitions and alliances, respectively. Finally, we used Compustat to obtain accounting information. After combining all these data, we constructed two samples: (a) a sample of 190,315 potential dyad-years between corporate investors and all ventures, of which 259 are realized CVC investment deals (spinout and nonspinout sample); and (b) a sample of 69,815 potential dyad-years between corporate investors and spinouts, of which 91 are realized CVC investment deals (spinout sample). Although the ratio of realized CVC investments is small, it is important to note that the sample is constructed based upon the assumption that every corporate investor makes an investment in every venture in a given year (Dushnitsky & Shaver, 2009). Moreover, the ratio is comparable to previous studies that have used a similar econometric approach (e.g., Diestre & Rajagopalan, 2012; Reuer & Devarakonda, 2017). Additionally, in our "Alternative Explanations and Robustness Checks" section, we validate our results by using rare events logistic regression models (King & Zeng, 2001) and regressions based on a randomly matched sample.

MEASURES

Dependent Variable

The dependent variable, *CVC investment*$_{ijt}$, is a binary variable that takes a value of 1 for a realized CVC investment dyad by a corporate investor i in a venture (or spinout) j in the year of t, and 0 otherwise.

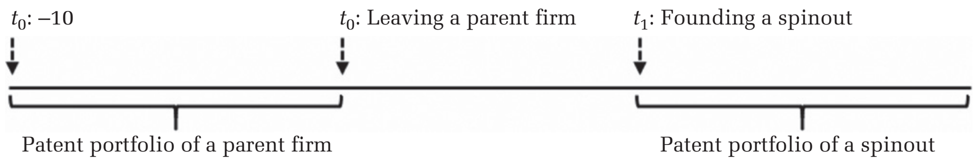
Independent Variables

We measured *TOSP* by considering the extent to which the patent portfolio of a spinout is similar to that of its parent firm (Chatterji, 2009). Specifically, we compared the patent portfolio of the spinout granted until the end of the sample period with the patent portfolio of its parent firm during the past 10 years before the founder left. Figure 2 shows the timeline of this variable. We

[11] Although we used several time windows in our main analyses, we used a 10-year window for supplementary analyses. This is because entrepreneurs in the medical device industry typically work for large corporations or research institutions in their early career and experience several startup companies before they found their own ventures (Chatterji, 2009). We conjecture that entrepreneurs in this industry seek to accumulate sufficient industry-specific knowledge because the development of a medical device requires considerable amount of experience, time, and investments (Fargen et al., 2013).

[12] Similar to the classification of ventures by the characteristics of founders in the medical device industry by Chatterji (2009), we find that out of 838 ventures founded between 1995 and 2010, 254 ventures are founded by former employees of large public firms (i.e., spinout), 278 by serial entrepreneurs, 188 by researchers (e.g., professor, physician, or scientist), 64 by professionals (e.g., venture capitalists and former executives in small ventures), and 54 by individuals without previous experience in the medical device industry.

FIGURE 2
Timeline for Measuring Technological Overlap between Spinout and Parent Firm



consider the patent portfolio to be relevant to inherited knowledge during the period of ($t_0 - 10$) to t_0, in which the founder left the parent firm.[13] Some founders build their ventures at t_0 immediately after they quit (i.e., $t_0 = t_1$), whereas others build their ventures at t_1 after spending some time in other organizations, such as other small ventures or venture incubators associated with venture capital firms (i.e., $t_0 \neq t_1$). Therefore, the patent portfolio of a spinout is created using the patents of the spinout from t_1 up until the end of the sample period. Using this information, we calculated the technological overlap between a spinout j generated by its parent firm k as follows (Jaffe, 1986): $\frac{T_j T_k'}{\sqrt{T_j T_j'}\sqrt{T_k T_k'}}$ (1), where T_j and T_k represent vectors of the patent portfolio consisting of the number of patents in each patent class for spinout j and its parent firm k, respectively. It is worth noting that our measure of TOSP is not sensitive to the absolute number of patents in a class because it is the normalized product of patent distribution vectors (Oxley & Sampson, 2004). To test the baseline hypothesis, which compares the likelihood that a corporate investor will invest in spinouts with the likelihood that it will invest in nonspinouts, we created a binary variable (*spinout*) that takes the value of 1 for ventures founded by former employees of established firms, and 0 otherwise. Moreover, to consider the potential competitive tension between spinouts and parent firms, we created two nested binary variables by classifying spinouts into two groups based on the mean value of *TOSP: spinout with high TOSP* and *spinout with low TOSP*.

Moderating Variables

To test Hypothesis 2, we measured *parent firm litigiousness* by counting the number of unique patent infringement lawsuits filed by a parent firm during the five years prior to the year of a given CVC investment dyad. We view a firm's litigiousness as a general indicator of its reputation for "toughness" in enforcing the intellectual property rights associated with patents (e.g., Agarwal et al., 2009; Ganco et al., 2015).[14] To test Hypothesis 3, we measured *TOCP* using Jaffe's (1986) measure presented in Equation (1) during the five years prior to the year of a given CVC investment dyad.[15] To test Hypothesis 4, we measured a parent firm's innovativeness as the number of medical device products approved by the FDA during the 10 years prior to the year of a given CVC investment dyad (*parent firm new product*) (e.g., Pahnke, McDonald, Wang, & Hallen, 2015b; Wu, 2013).[16] While innovativeness is a multidimensional construct, a parent firm's ability to launch new products is an important signal that can attract corporate investors' attention to spinouts' inherited knowledge. For example, Hess and Rothaermel (2011: 900) viewed new product development as "a process of discovering new knowledge with the intent of transforming and embodying it in a final product." In constructing this variable, we counted

[13] In constructing the patent portfolio of a parent firm, we also used different time windows, such as five years, and the cumulative stock of patents, and found that our results are consistent with those described below.

[14] It is possible that parent firms' litigation against spinouts endogenously affects the level of TOSP or spinouts' innovation performance. Because this may confound the effect of TOSP on the likelihood of CVC investment, we measured parent firm litigiousness by excluding the number of patent litigations against spinouts from the total number of patent lawsuits filed by parent firms. The results of the analysis using this measure are consistent with those described below.

[15] Following previous studies, we used a five-year time window to generate the moderating and control variables based on patent information (e.g., Reuer & Devarakonda, 2017). The results of using different time windows (three-, four-, and 10-year windows) are consistent with those described below.

[16] We used a 10-year time window to generate the moderating and control variables based on the FDA's medical device data. This window was chosen to have a reasonable variation because it usually takes three to seven years from concept to market a new medical device (Fargen et al., 2013). To gain validity, we also used a five-year time window and found the results to be consistent with those described below.

the number of products approved through both 510(k) and premarket approval processes. We transformed this value using the natural logarithm function to reduce skewness. We mean centered all the explanatory variables described in this subsection before creating the interaction terms to avoid potential collinearity problems (Aiken & West, 1991).

Control Variables

We incorporated a host of control variables to capture the effects of other potential determinants of CVC investments. The first set of control variables is specific to ventures. We controlled for the number of patents applied (and eventually granted in later years) during the past five years (*spinout patent count*) (Hsu & Ziedonis, 2013). We also controlled for *spinout age* in years based on the spinout's year of foundation (Aggarwal & Hsu, 2009). We included a binary variable to control for whether a founder has a PhD degree in science or engineering areas (e.g., biochemistry, cardiovascular physiology) or an MD degree (*founder PhD or MD*).[17] In addition, we controlled for the number of years elapsed since a founder left the parent firm up until they founded a spinout (*time since left parent firm*). To control for the degree of human capital, we included the *number of founders*. We also controlled for the positive ongoing relationship between a spinout and its parent firm by controlling for the *collaborative relationship between spinout and parent firm*. This variable takes a value of 1 if the parent firm made a CVC investment in or formed an alliance with the spinout, and 0 otherwise. Lastly, following previous studies (Hallen, Katila, & Rosenberger, 2014; Katila et al., 2008), we controlled for ventures' needs for manufacturing resources as the average ratio of fixed assets to sales (*manufacturing resource need*) and needs for marketing resources as the average ratio of advertising expenses to sales (*marketing resource need*) in a given segment (4-digit Standard Industrial Classification (SIC) level).

Next, we included several variables that are specific to corporate investors. To control for corporate investors' technological capabilities (Dushnitsky & Lenox, 2005a), we included the number of patents applied by a corporate investor during the past five years (*corporate investor patent count*), as well as the number of medical device products approved by the FDA during the past 10 years (*corporate investor new products*). Moreover, we included *corporate investor R&D intensity*, measured as R&D expenses divided by sales. To account for ventures' concern regarding the misappropriation of their technological knowledge (Katila et al., 2008), we included the number of patent infringement lawsuits during the past five years in which the corporate investor was involved as a defendant (*corporate investor patent infringement*) (Kim & Steensma, 2017). We also controlled for *corporate investor size*, measured as the total assets. To control for the availability of investment capital (Dushnitsky & Lenox, 2005a), we included *corporate investor cash*, measured as the cash and cash equivalents. Finally, while corporate investors generally use their CVC programs to pursue strategic objectives, they may also pursue financial objectives (Gompers & Lerner, 1998). Therefore, following previous studies (Dokko & Gaba, 2012; Gaba & Meyer, 2008), for each corporate investor we created *corporate investor financial orientation,* measured as the ratio of portfolio companies that went public or were acquired by another company, and *corporate investor strategic orientation,* measured as the proportion of portfolio companies acquired by the focal corporate investor.

Next, we included three dyad-level (between a spinout and a corporate investor) control variables. First, we controlled for the extent to which a spinout's technological knowledge stock overlaps with that of a corporate investor using the measure presented in Equation (1) for the past five years (*technological overlap between spinout and corporate investor*). Second, we controlled for patent *cross-citations between spinout and corporate investor* for the past five years (Mowery, Oxley, & Silverman, 1996). Finally, we included *geographic distance between spinout and corporate investor*, measured as the great circle distance between them (Reuer & Lahiri, 2014).

Next, to account for the internal technological capabilities of parent firms, we controlled for the number of patents filed by a parent firm for the past five years (*parent firm patent count*). We also controlled for the existing relationship between a parent firm and a corporate investor by including a binary variable, *alliance between parent firm and corporate investor*. This variable was coded as 1 if they formed at least one alliance in the past and 0 otherwise. We included dummy

[17] Founders of spinouts who do not have a PhD or MD degree in relevant areas may have little experience in science or engineering. However, given that employees experience several different positions through their tenure, we implicitly assume that founders of spinouts possess a good enough understanding of relevant technological knowledge of parent firms. To validate this assumption, we conducted subsample analyses by dividing spinouts into two groups: a group of spinouts founded by former employees with a PhD or MD degree and another group of spinouts founded by former employees without such a degree. In both subsamples, we found results consistent with those described below.

variables for the industry subsectors in which spinouts operate in order to control for any other unobserved industry effects. Finally, we included the fixed effects of years of CVC investments to control for any temporal trends and unobserved differences in the CVC investment environment (Katila et al., 2008).[18]

ESTIMATION

Given that our dependent variable is binary, we used probit regression models to conduct the main analyses. We also used the same regression models with corporate investor fixed effects to account for any latent firm characteristics that may influence corporate investors' propensity to make CVC investments. However, this approach reduces the sample size significantly because the observations associated with corporate investor dummies are dropped from the sample when they have no variation in the value of the dependent variable (i.e., the value of the dependent variable for these observations is 0). We used robust standard errors clustered at the dyad level between a venture and a corporate investor to account for the nonindependence of dyadic observations (Ozmel, Reuer, & Gulati, 2013; Petersen, 2009).

RESULTS

Table 1 provides descriptive statistics and correlations for all variables used in the analyses to test the baseline hypothesis in the spinout and nonspinout sample. Table 2 presents the descriptive statistics and correlations for all variables used in the analyses to test Hypotheses 1–4 in the spinout sample.

Table 3 reports the estimation results of the probit regression models to test the baseline hypothesis. Models 1–5 show the results without corporate investor dummies, whereas Models 6–10 report the results with these dummies. Models 1 and 6 use *spinout* based on the 10-year window as a main independent variable to compare the likelihood that corporate investors invest in spinouts as opposed to nonspinouts. Models 2 and 7 include two binary variables (*spinout with high TOSP* and *spinout with low TOSP*) based on the 10-year window as the independent variables. We performed the same analyses by using different time windows, namely five-year (Models 3 and 8), three-year (Models 4 and 9), and one-year (Models 5 and 10) windows. In Model 1, the coefficient of *spinout* is negative but insignificant ($b = -0.02$, $p = 0.776$). In Model 2, the coefficient of *spinout with high TOSP* is negative and significant ($b = -0.43$, $p = 0.000$), whereas the coefficient of *spinout with low TOSP* is positive and significant ($b = 0.14$, $p = 0.057$), supporting the baseline hypothesis. Moreover, the coefficients of *spinout with high TOSP* and *spinout with low TOSP* are significantly different from each other ($p = 0.000$). As can be seen, the models using different time windows and those with corporate investor dummies also show consistent results. These findings indicate that while corporate investors are not necessarily less likely to invest in spinouts than in other types of ventures, they tend to avoid investing in spinouts that pursue technological domains similar to those of parent firms.[19]

Table 4 reports the estimation results of the probit regression models without corporate investor dummies for the likelihood of CVC investments in the spinout sample. Models 1–6 are based on the 10-year window to define spinouts, and Models 7–9 represent regression models based on five-, three-, and one-year windows, respectively. Model 1 contains only the control variables and Model 2 tests the direct effect of *TOSP*. Models 3–5 examine the effects of the moderating variables that are expected to amplify or diminish the main effect. Models 6–9 are the full models that include all interaction terms across different time windows. Consistent with Hypothesis 1, the coefficient of *TOSP* is negative and statistically significant ($b = -1.11$, $p = 0.000$ in

[18] Note that to reduce the skewness of our control variables, we transformed spinout patent count, corporate investor patent count, corporate investor new products, corporate investor size, corporate investor cash, geographic distance between spinout and corporate investor, and parent firm patent count using a natural logarithm function.

[19] The results in Table 3 suggest that while corporate investors avoid investing in spinouts with high TOSP, they may view spinouts with low TOSP as attractive investment targets because the coefficient of *spinout with low TOSP* is positive across all models (and significant in some models). This may indicate that there exists a turning point in the level of TOSP where corporate investors start to be concerned about investing in spinouts. We therefore divided our sample into the four groups of equal size based on the value of TOSP (i.e., quartiles) and created four binary variables for each group. The results of estimation using these four binary variables show that the two low TOSP groups (i.e., two low quartiles) show positive relationships with the likelihood of CVC investment; however, the two high TOSP groups (i.e., two high quartiles) turn to have negative relationships with the likelihood of CVC investment. These results may indicate that turning point in which corporate investors become concerned about TOSP exists between the two groups of the second and third quartiles.

TABLE 1
Descriptive Statistics and Correlation Matrix (Spinout and Nonspinout Sample)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. CVC investment	1.00																				
2. Spinout	0.00	1.00																			
3. Spinout with high TOSP	**−0.01**	**0.58**	1.00																		
4. Spinout with low TOSP	**0.01**	**0.66**	**−0.22**	1.00																	
5. Venture patent count (ln)	**0.02**	**−0.03**	**−0.01**	**−0.03**	1.00																
6. Venture age	**0.01**	**−0.09**	**−0.06**	**−0.06**	**0.13**	1.00															
7. Founder PhD or MD	0.00	**−0.33**	**−0.24**	**−0.17**	**0.03**	**0.06**	1.00														
8. Number of founders	0.00	**−0.03**	**0.07**	**−0.10**	**0.04**	0.00	**0.01**	1.00													
9. Manufacturing resource need	0.00	**0.09**	**0.14**	**−0.02**	**0.01**	**−0.07**	**−0.04**	**−0.06**	1.00												
10. Marketing resource need	**0.01**	**−0.08**	**−0.12**	**0.02**	0.00	**0.05**	**0.07**	**0.02**	**−0.64**	1.00											
11. Corporate investor patent count (ln)	**0.01**	**0.01**	0.00	0.00	**0.01**	**−0.05**	0.00	**−0.01**	**−0.02**	**0.01**	1.00										
12. Corporate investor new product (ln)	**0.03**	0.00	0.00	0.00	**−0.01**	**−0.03**	**0.01**	0.00	**0.03**	**−0.01**	**0.21**	1.00									
13. Corporate investor R&D intensity	**0.01**	0.00	0.00	0.00	0.00	**0.01**	0.00	0.00	**0.01**	0.00	**−0.03**	**0.14**	1.00								
14. Corporate investor patent infringement	**0.01**	**−0.03**	**−0.02**	**−0.02**	**−0.01**	**0.19**	0.00	**0.01**	**−0.05**	**0.01**	**0.37**	**0.24**	**−0.03**	1.00							
15. Corporate investor size (ln)	0.00	**−0.03**	**−0.02**	**−0.02**	**0.00**	**0.19**	**−0.01**	**0.01**	**−0.07**	**0.01**	**0.47**	**0.03**	**−0.12**	**0.47**	1.00						
16. Corporate investor cash (ln)	**0.01**	**−0.03**	**−0.02**	**−0.02**	0.00	**0.22**	**−0.01**	**0.01**	**−0.09**	**0.02**	**0.39**	**0.01**	**−0.03**	**0.43**	**0.83**	1.00					
17. Corporate investor financial orientation	**−0.01**	**0.02**	**0.01**	**0.01**	0.00	**−0.16**	**0.01**	**−0.01**	**0.05**	**−0.02**	**−0.15**	**−0.04**	**0.03**	**−0.23**	**−0.15**	**−0.13**	1.00				
18. Corporate investor strategic orientation	**0.03**	**−0.01**	**−0.01**	**0.00**	0.00	**0.03**	0.00	0.00	**−0.02**	**−0.01**	**0.04**	**0.27**	**0.20**	**−0.02**	**−0.14**	**−0.09**	**−0.07**	1.00			
19. Technological overlap between venture and corporate investor	**0.04**	**−0.01**	**0.03**	**−0.04**	**0.14**	**−0.01**	**0.01**	0.00	**0.05**	**−0.05**	**−0.01**	**0.38**	**0.07**	**0.02**	**−0.18**	**−0.16**	**−0.03**	**0.23**	1.00		
20. Cross-citations between venture and corporate investor	**0.03**	0.00	0.00	0.00	**0.05**	**0.02**	0.00	0.00	**0.01**	**−0.01**	**0.07**	**0.19**	**0.03**	**0.05**	**0.02**	**0.01**	**−0.02**	**0.17**	**0.27**	1.00	
21. Geographic distance between venture and corporate investor (ln)	0.00	**−0.10**	**−0.05**	**−0.07**	**0.07**	**−0.01**	**0.06**	**0.01**	0.00	**0.03**	**−0.07**	**0.04**	**0.00**	**−0.04**	**0.02**	**−0.01**	**0.03**	**−0.02**	**0.02**	0.00	1.00
Mean	0.00	0.37	0.16	0.20	1.64	5.26	0.42	1.40	0.46	0.01	6.52	2.77	0.09	10.25	10.22	7.57	0.45	0.01	0.09	0.00	7.48
Standard deviation	0.04	0.48	0.37	0.40	0.97	3.71	0.49	0.62	0.08	0.01	1.71	2.20	0.08	10.49	1.33	1.47	0.19	0.03	0.18	0.02	1.31
Min.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.11	0.00	0.00	0.00	0.00	0.00	5.34	0.00	0.00	0.00	0.00	0.00	0.00
Max.	1.00	1.00	1.00	1.00	4.96	20.00	1.00	5.00	0.59	0.06	9.20	6.30	0.84	93.00	13.59	11.41	1.00	0.20	1.00	0.60	9.76

Note: Bolded pairwise correlation are significant at the 0.05 level (two-tailed tests of significance); n = 190,315.

TABLE 2
Descriptive Statistics and Correlation Matrix (Spinout Sample)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. CVC investment	1.00												
2. TOSP	**–0.02**	1.00											
3. Parent firm litigiousness	0.00	**–0.05**	1.00										
4. TOIP	**0.03**	**0.03**	**0.14**	1.00									
5. Parent firm new product (ln)	0.00	**0.22**	**0.11**	**0.14**	1.00								
6. Spinout patent count (ln)	**0.03**	**0.07**	**0.03**	0.00	**0.06**	1.00							
7. Spinout age	0.01	**0.01**	**0.09**	**–0.02**	**–0.15**	**0.20**	1.00						
8. Founder PhD or MD	0.01	**–0.02**	0.00	**–0.03**	0.01	**0.03**	**–0.02**	1.00					
9. Time since left parent firm	0.00	0.01	**0.02**	**0.04**	**0.09**	**–0.06**	**–0.08**	**0.02**	1.00				
10. Number of founders	0.00	**0.12**	**–0.03**	**0.03**	**0.15**	**0.05**	**–0.04**	**–0.08**	0.00	1.00			
11. Collaborative relationship between spinout and parent firm	0.00	**–0.03**	**0.06**	**0.03**	**0.09**	**0.02**	**0.06**	**–0.01**	**–0.08**	**–0.04**	1.00		
12. Manufacturing resource need	**–0.02**	**0.18**	**0.06**	**0.03**	**0.19**	**–0.09**	**–0.12**	**–0.09**	**0.03**	**–0.04**	**0.02**	1.00	
13. Marketing resource need	**0.02**	**–0.13**	**–0.08**	**–0.05**	**–0.18**	**0.10**	**0.05**	**0.14**	0.00	**0.01**	**–0.04**	**–0.63**	1.00
14. Corporate investor patent count (ln)	**0.01**	0.00	0.00	**–0.02**	0.00	**0.01**	**–0.04**	0.00	−0.01	0.00	0.00	**–0.02**	**0.01**
15. Corporate investor new product (ln)	**0.03**	0.00	**–0.01**	**0.40**	**–0.01**	**–0.01**	**–0.04**	0.00	**–0.01**	**–0.01**	−0.01	**0.02**	0.00
16. Corporate investor R&D intensity	**0.01**	0.00	−0.01	**0.14**	−0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
17. Corporate investor patent infringement	**0.01**	**–0.01**	**0.02**	**–0.01**	**–0.02**	**0.01**	**0.21**	**–0.02**	**0.03**	**0.02**	−0.01	**–0.03**	**–0.01**
18. Corporate investor size (ln)	0.01	**–0.01**	**0.03**	**–0.19**	**–0.01**	**0.02**	**0.20**	**–0.02**	**0.03**	**0.03**	0.00	**–0.05**	**–0.01**
19. Corporate investor cash (ln)	0.01	**–0.01**	**0.04**	**–0.17**	**–0.01**	**0.03**	**0.24**	**–0.02**	**0.04**	**0.03**	0.00	**–0.07**	0.00
20. Corporate investor financial orientation	−0.01	**0.01**	**–0.03**	0.01	**0.01**	**–0.02**	**–0.17**	**0.01**	**–0.03**	**–0.02**	**0.01**	**0.03**	0.00
21. Corporate investor strategic orientation	**0.03**	−0.01	**0.01**	**0.20**	**–0.02**	0.00	**0.03**	0.00	0.00	0.00	0.00	**–0.02**	**–0.01**
22. Technological overlap between spinout and corporate investor	**0.04**	**0.09**	**0.03**	**0.43**	**0.04**	**0.19**	**0.02**	0.00	0.00	**0.02**	**–0.01**	**0.02**	**–0.01**
23. Cross-citations between spinout and corporate investor	**0.03**	−0.01	0.01	**0.15**	0.00	**0.05**	**0.04**	**–0.01**	0.00	**0.02**	0.00	0.00	**–0.01**
24. Geographic distance between spinout and corporate investor (ln)	0.00	0.00	0.01	−0.01	**0.02**	**0.02**	0.01	**0.06**	**0.01**	**0.02**	**0.01**	**–0.03**	**0.05**
25. Parent firm patent count (ln)	0.01	**0.12**	**0.26**	**0.21**	**0.68**	**0.09**	**–0.07**	0.00	**0.07**	**0.14**	**0.12**	**0.09**	**–0.14**
26. Alliance between parent firm and corporate investor	−0.01	**–0.02**	**0.05**	**0.14**	**0.12**	0.01	**0.01**	**0.04**	**0.03**	**0.01**	**0.02**	0.00	**–0.01**
Mean	0.00	0.00	0.00	0.00	0.00	1.60	4.81	0.20	2.26	1.38	0.03	0.47	0.01
Standard deviation	0.04	0.23	12.05	0.24	1.85	1.05	3.58	0.40	3.13	0.59	0.17	0.08	0.01
Min.	0.00	−0.26	−6.14	−0.16	−4.05	0.00	0.00	0.00	0.00	1.00	0.00	0.11	0.00
Max.	1.00	0.73	72.86	0.84	2.62	4.80	17.00	1.00	10.00	4.00	1.00	0.59	0.06

Model 2), and the significance level remains the same across all specifications. The average marginal effect of *TOSP* based on the estimates of Model 2, which is calculated as the average of the individual marginal effect at the original value of each observation (Hoetker, 2007; Train, 1986), is −0.004 and statistically significant (z-stat = −3.40, p = 0.001), thus supporting Hypothesis 1.[20] The estimation also indicates that when the value of *TOSP* increases from its mean to one standard deviation above the mean, the likelihood of CVC investment decreases by 49.3%. As suggested in Hypothesis 2, the coefficient of the interaction between *TOSP* and *parent firm litigiousness* in Model 3 is negative and significant (b = −0.09, p = 0.066). Consistent with Hypothesis 3, the coefficient of the interaction between *TOSP* and *TOCP* in Model 4 is positive and statistically significant (b = 2.09, p = 0.008). In accordance with Hypothesis 4, the coefficient of the interaction between *TOSP* and *parent firm new product* in Model 5 is positive and significant (b = 0.39, p = 0.041).[21] These findings remain consistent in Models 7–9 using different time windows to define spinouts. It is worth noting that the marginal effect of TOSP increases as the time window to define spinouts decreases, which may indicate that corporate investors are more concerned about spinouts whose founders left their parent firms recently.

[20] Prior research has suggested that the level of TOSP may have a curvilinear relationship with spinouts' innovation performance because too much reliance on parent firms' knowledge may limit spinouts' innovation opportunities (Basu et al., 2015). To control for the possible effect of this reasoning on our main findings, as a robustness check we included the squared term of TOSP as a control variable. The results show that the squared term of TOSP has no significant effect on the likelihood of CVC investment.

[21] It is worth discussing the direct effect of *collaborative relationship between spinout and parent firm* on the likelihood of CVC investment because this variable represents the parent firm's perspective toward its spinouts. As can be seen in Table 4, this variable has a negative but insignificant coefficient. We conjecture that two competing forces drive this insignificance. On the one hand, corporate investors may perceive low competitive risks stemming from the parent firm's aggressive actions. On the other hand, corporate investors may not want to invest in a spinout that is already in a close relationship with its parent firm.

TABLE 2
(Continued)

	14	15	16	17	18	19	20	21	22	23	24	25	26
1. CVC investment													
2. TOSP													
3. Parent firm litigiousness													
4. TOIP													
5. Parent firm new product (ln)													
6. Spinout patent count (ln)													
7. Spinout age													
8. Founder PhD or MD													
9. Time since left parent firm													
10. Number of founders													
11. Collaborative relationship between spinout and parent firm													
12. Manufacturing resource need													
13. Marketing resource need													
14. Corporate investor patent count (ln)	1.00												
15. Corporate investor new product (ln)	**0.20**	1.00											
16. Corporate investor R&D intensity	**–0.03**	**0.14**	1.00										
17. Corporate investor patent infringement	**0.37**	**0.24**	**–0.02**	1.00									
18. Corporate investor size (ln)	**0.48**	**0.02**	**–0.13**	**0.47**	1.00								
19. Corporate investor cash (ln)	**0.40**	0.01	**–0.03**	**0.43**	**0.83**	1.00							
20. Corporate investor financial orientation	**–0.16**	**–0.04**	**0.02**	**–0.23**	**–0.15**	**–0.13**	1.00						
21. Corporate investor strategic orientation	**0.04**	**0.26**	**0.20**	**–0.02**	**–0.13**	**–0.07**	**–0.06**	1.00					
22. Technological overlap between spinout and corporate investor	**–0.02**	**0.38**	**0.06**	**0.02**	**–0.18**	**–0.17**	**–0.03**	**0.22**	1.00				
23. Cross-citations between spinout and corporate investor	**0.06**	**0.19**	**0.03**	**0.05**	**0.01**	0.00	**–0.02**	**0.18**	**0.27**	1.00			
24. Geographic distance between spinout and corporate investor (ln)	**–0.08**	**0.04**	0.00	**–0.05**	**0.02**	**–0.01**	**0.03**	**–0.03**	**0.01**	**–0.01**	1.00		
25. Parent firm patent count (ln)	**0.01**	**–0.01**	−0.01	**–0.05**	**–0.04**	**–0.04**	**0.03**	**–0.02**	**0.03**	**–0.01**	**0.01**	1.00	
26. Alliance between parent firm and corporate investor	**0.06**	**0.08**	**0.04**	**0.06**	**0.05**	**0.06**	0.00	0.01	**0.04**	**0.03**	0.00	**0.15**	1.00
Mean	6.53	2.75	0.09	9.85	10.18	7.51	0.45	0.01	0.09	0.00	7.31	5.16	0.04
Standard deviation	1.73	2.20	0.08	10.11	1.35	1.49	0.20	0.03	0.18	0.02	1.30	2.45	0.20
Min.	0.00	0.00	0.00	0.00	5.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max.	9.20	6.30	0.84	93.00	13.59	11.41	1.00	0.20	1.00	0.52	9.15	9.39	1.00

Note: Bolded pairwise correlation are significant at the 0.05 level (two-tailed tests of significance); $n = 69{,}815$.

Moreover, Table 5 shows that the probit regression models with corporate investor dummies based on different time windows provide generally consistent results, further supporting our arguments.

In interpreting the interaction effects in nonlinear models, such as probit regression, it is advised not to rely solely on the significance and sign of the coefficient of the interaction term because the interaction effects also depend on the coefficients of the interacted variables and the value of other variables (Hoetker, 2007). In Table 6, we therefore investigate the interaction effects by calculating the marginal effect of *TOSP* at varying levels of moderating variables (Wiersema & Bowen, 2009). Based on the distribution of observations (i.e., skewness), we used mean, mean + 1 *SD*, and mean + 2 *SD* to represent the low, medium, and high levels, respectively, of *parent firm litigiousness* and *TOCP*. We used mean − 1 *SD*, mean, and mean + 1 *SD* for the low, medium, and high levels, respectively, of *parent firm new product*. The first two columns show the marginal effect of *TOSP* based on the estimation without corporate investor fixed effects and the next two columns are based on the estimation with corporate investor fixed effects. Panel *A* indicates that the marginal effect of TOSP on the likelihood of CVC investment is smaller when *parent firm litigiousness* is at a low level compared with medium and high levels, thus providing further support for Hypothesis 2. In Panels *B* and *C*, we also find that the marginal effects of TOSP on the likelihood of CVC investment decrease with increasing levels of *TOCP* (Panel *B*) as well as *parent firm new product* (Panel *C*), suggesting the positive moderating effects of these two variables, as proposed in Hypotheses 3 and 4.

In Figures 3–5, we also examine the interaction effects graphically by plotting the predicted likelihood of CVC investment according to the level of *TOSP*, which is contingent on two different levels of moderating variables (i.e., low and high levels, as explained above). Specifically, we first computed the predicted likelihood for each observation over the range of *TOSP* at low and high levels of moderating variables and then calculated the average of the predicted values (Hoetker, 2007; Train, 1986). Figure 3 shows that increasing *TOSP* by one standard deviation from its mean value results in a decrease in the likelihood of CVC investment by 60.3% for the low level of *parent firm litigiousness*, but the figure

TABLE 3
Probit Regression for the Likelihood of CVC Investment (Spinout and Nonspinout Sample)

	Dependent Variable: CVC investment									
	10-year		5-year	3-year	1-year	10-year		5-year	3-year	1-year
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Main effect										
Spinout	−0.02					−0.02				
	(0.07)					(0.07)				
Spinout with high TOSP		−0.43***	−0.36***	−0.52***	−0.46***		−0.44***	−0.37***	−0.52***	−0.46***
		(0.12)	(0.13)	(0.14)	(0.15)		(0.13)	(0.14)	(0.15)	(0.15)
Spinout with low TOSP		0.14*	0.16**	0.10	0.08		0.14*	0.15*	0.10	0.07
		(0.07)	(0.08)	(0.08)	(0.10)		(0.07)	(0.08)	(0.08)	(0.10)
Control variables										
Venture patent count	0.18***	0.18***	0.18***	0.18***	0.18***	0.19***	0.19***	0.19***	0.20***	0.20***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Venture age	0.02*	0.02**	0.02*	0.02**	0.02**	0.02*	0.02**	0.02*	0.02**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Founder PhD or MD	−0.02	−0.03	−0.03	−0.03	−0.03	−0.01	−0.03	−0.02	−0.02	−0.02
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)
Number of founders	−0.02	−0.00	−0.01	−0.00	−0.01	−0.02	−0.00	−0.01	−0.00	−0.01
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Manufacturing resource need	0.09	0.32	0.19	0.13	0.11	0.26	0.49	0.34	0.29	0.27
	(0.88)	(0.90)	(0.89)	(0.89)	(0.89)	(0.93)	(0.94)	(0.94)	(0.94)	(0.94)
Marketing resource need	2.81	2.02	2.45	2.44	2.66	2.56	1.81	2.25	2.23	2.45
	(5.35)	(5.44)	(5.31)	(5.31)	(5.39)	(5.48)	(5.56)	(5.44)	(5.44)	(5.51)
Corporate investor patent count	−0.00	−0.00	−0.00	−0.00	−0.00	−0.03	−0.03	−0.04	−0.03	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Corporate investor new product	0.08***	0.08***	0.08***	0.08***	0.08***	0.11*	0.12*	0.12*	0.12*	0.12*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Corporate investor R&D intensity	0.58**	0.58**	0.57**	0.58**	0.57**	−0.11	−0.13	−0.12	−0.12	−0.12
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.41)	(0.41)	(0.41)	(0.41)	(0.41)
Corporate investor patent infringement	0.00	0.00	0.00	0.00	0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Corporate investor size	−0.03	−0.03	−0.03	−0.03	−0.03	−0.03	−0.03	−0.03	−0.03	−0.03
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Corporate investor cash	0.09**	0.10***	0.09**	0.09**	0.09**	0.02	0.03	0.03	0.02	0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Corporate investor financial orientation	−0.34**	−0.34**	−0.33**	−0.34**	−0.33**	−0.61**	−0.62**	−0.62**	−0.63**	−0.62**
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)
Corporate investor strategic orientation	3.02***	2.99***	2.99***	3.01***	3.02***	−1.25	−1.21	−1.25	−1.24	−1.23
	(0.69)	(0.70)	(0.70)	(0.69)	(0.69)	(1.46)	(1.47)	(1.47)	(1.47)	(1.46)
Technological overlap between venture and corporate investor	0.63***	0.68***	0.67***	0.66***	0.66***	0.25*	0.31**	0.30**	0.28**	0.28**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Cross-citation between venture and corporate investor	1.77***	1.66***	1.67***	1.70***	1.69***	1.68***	1.56**	1.54**	1.57**	1.57**
	(0.59)	(0.61)	(0.61)	(0.61)	(0.59)	(0.61)	(0.64)	(0.64)	(0.64)	(0.62)
Geographic distance between venture and corporate investor	−0.02	−0.01	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

TABLE 3
(Continued)

	Dependent Variable: CVC investment									
	10-year		5-year	3-year	1-year	10-year		5-year	3-year	1-year
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
Industry segment fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Corporate investor fixed effects	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Constant	−3.73***	−3.92***	−3.84***	−3.79***	−3.76***	−3.40***	−3.59***	−3.45***	−3.42***	−3.38***
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(1.19)	(1.21)	(1.20)	(1.20)	(1.20)
Log pseudolikelihood	−1721.11	−1698.39	−1706.00	−1704.67	−1710.19	−1599.10	−1578.54	−1586.09	−1584.45	−1589.53
Wald χ^2	306.17***	329.31***	323.37***	314.01***	316.95***	500.35***	527.27***	514.72***	490.09***	490.03***
Observations	190,315	190,315	190,315	190,315	190,315	130,259	130,259	130,259	130,259	130,259

Note: Robust standard errors clustered at the dyad level (venture-corporate investor) are in parentheses.
* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance)

TABLE 4
Probit Regression for the Likelihood of CVC Investment without Corporate Investor Dummies (Spinout Sample)

Variables	Dependent variable: CVC investment								
	10-year						5-year	3-year	1-year
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Main effect									
TOSP (Hypothesis 1)		−1.11***	−1.31***	−1.75***	−1.36***	−2.15***	−2.46***	−3.71***	−3.72***
		(0.27)	(0.34)	(0.34)	(0.34)	(0.41)	(0.50)	(0.69)	(0.79)
Interaction effects									
TOSP × Parent firm litigiousness			−0.09*			−0.12***	−0.19***	−0.38***	−0.43***
(Hypothesis 2)			(0.05)			(0.05)	(0.06)	(0.08)	(0.09)
TOSP × TOCP (Hypothesis 3)				2.09***		1.89**	2.45***	2.39**	2.58**
				(0.79)		(0.75)	(0.72)	(0.95)	(1.11)
TOSP × Parent firm new product					0.39**	0.37**	0.37**	0.38**	0.29
(Hypothesis 4)					(0.19)	(0.18)	(0.16)	(0.19)	(0.23)
Moderating variables									
Parent firm litigiousness		−0.00	−0.02**	−0.00	−0.00	−0.03***	−0.05***	−0.10***	−0.11***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
TOCP		0.55***	0.54***	0.78***	0.56***	0.76***	0.77***	0.83***	0.89***
		(0.16)	(0.16)	(0.18)	(0.16)	(0.18)	(0.20)	(0.23)	(0.27)
Parent firm new product		−0.01	0.00	0.00	0.05	0.07	0.05	0.04	0.07
		(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Control variables									
Spinout patent count	0.18***	0.19***	0.19***	0.19***	0.19***	0.19***	0.19***	0.12**	0.16***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Spinout age	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.05*	0.05*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Founder PhD or MD	0.03	0.07	0.07	0.06	0.08	0.08	0.07	−0.21	−0.18
	(0.12)	(0.13)	(0.12)	(0.13)	(0.13)	(0.13)	(0.16)	(0.20)	(0.20)
Time since left parent firm	0.01	0.01	0.01	0.00	0.01	0.01	0.07**	0.03	—
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.06)	
Number of founders	−0.06	−0.04	−0.05	−0.05	−0.04	−0.05	−0.00	0.03	−0.17
	(0.12)	(0.12)	(0.12)	(0.13)	(0.12)	(0.13)	(0.12)	(0.10)	(0.17)
Collaborative relationship	−0.06	−0.16	−0.14	−0.18	−0.16	−0.14	−0.07	−0.28	−0.28
between spinout and parent firm	(0.24)	(0.25)	(0.25)	(0.25)	(0.24)	(0.25)	(0.35)	(0.36)	(0.35)
Manufacturing resource need	−1.62	−1.25	−1.19	−1.22	−1.34	−1.27	−2.43	−2.76	−1.68
	(1.47)	(1.47)	(1.48)	(1.46)	(1.49)	(1.49)	(1.51)	(2.11)	(1.86)
Marketing resource need	28.26**	29.23**	29.32**	29.71**	29.82**	30.15**	46.19**	40.64**	27.51
	(12.78)	(13.03)	(13.11)	(13.04)	(13.12)	(13.20)	(18.68)	(20.12)	(27.69)
Corporate investor patent count	0.03	0.04	0.04	0.04	0.04	0.03	0.02	0.02	−0.00
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)

TABLE 4
(Continued)

Variables	Dependent variable: CVC investment								
	10-year						5-year	3-year	1-year
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Corporate investor new product	0.07**	0.05	0.05	0.05	0.05	0.05	0.04	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Corporate investor R&D intensity	0.48	0.27	0.27	0.29	0.27	0.29	0.37	0.10	0.07
	(0.38)	(0.42)	(0.41)	(0.41)	(0.42)	(0.41)	(0.45)	(0.51)	(0.53)
Corporate investor patent infringement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Corporate investor size	0.04	0.05	0.05	0.05	0.05	0.05	0.04	0.12*	0.16**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)
Corporate investor cash	0.02	0.03	0.03	0.03	0.03	0.03	0.04	−0.02	−0.05
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.09)
Corporate investor financial orientation	−0.25	−0.28	−0.27	−0.27	−0.27	−0.26	−0.28	−0.17	−0.19
	(0.27)	(0.26)	(0.25)	(0.26)	(0.26)	(0.26)	(0.28)	(0.33)	(0.38)
Corporate investor strategic orientation	3.44***	3.10***	3.09***	3.08***	3.12***	3.06***	3.03**	5.03***	3.14**
	(1.08)	(1.11)	(1.12)	(1.14)	(1.12)	(1.16)	(1.29)	(1.28)	(1.41)
Technological overlap between spinout and corporate investor	0.60***	0.62***	0.63***	0.51**	0.62***	0.52**	0.51**	0.59**	0.55**
	(0.20)	(0.21)	(0.21)	(0.23)	(0.21)	(0.24)	(0.25)	(0.24)	(0.28)
Cross-citations between spinout and corporate investor	1.80*	1.28	1.29	1.40	1.33	1.50	0.68	1.20	2.28
	(1.00)	(1.15)	(1.15)	(1.14)	(1.15)	(1.13)	(1.49)	(1.61)	(1.60)
Geographic distance between spinout and corporate investor	−0.04	−0.03	−0.03	−0.03	−0.03	−0.03	−0.04	−0.02	0.01
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)
Parent firm patent count	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.08	0.06
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)
Alliance between parent firm and corporate investor	−0.63*	−0.68*	−0.69*	−0.64*	−0.69**	−0.68**	—	—	—
	(0.34)	(0.35)	(0.35)	(0.35)	(0.34)	(0.34)			
Industry segment fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.84***	−3.26***	−3.35***	−3.41***	−3.25***	−3.45***	−2.73***	−3.52***	−3.97***
	(1.02)	(1.05)	(1.06)	(1.04)	(1.07)	(1.05)	(1.04)	(1.32)	(1.28)
Log pseudolikelihood	−594.80	−573.83	−571.38	−569.01	−570.47	−563.02	−458.68	−359.87	−291.47
Wald χ^2	622.59***	636.85***	829.75***	660.87***	631.04***	783.00***	1018.16***	983.52***	1168.97***
Observations	69,815	69,815	69,815	69,815	69,815	69,815	52,290	45,659	35,755

Note: Robust standard errors clustered at dyad-level (spinout-corporate investor) are in parentheses.
* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance)

TABLE 5
Probit Regression for the Likelihood of CVC Investment with Corporate Investor Dummies (Spinout Sample)

	Dependent variable: CVC investment			
	10-year	5-year	3-year	1-year
Variables	Model 1	Model 2	Model 3	Model 4
Main effect				
TOSP (Hypothesis 1)	−2.07***	−2.41***	−3.78***	−3.73***
	(0.44)	(0.54)	(0.72)	(0.79)
Interaction effects				
TOSP × Parent firm litigiousness (Hypothesis 2)	−0.14***	−0.22***	−0.42***	−0.50***
	(0.05)	(0.07)	(0.09)	(0.10)
TOSP × TOCP (Hypothesis 3)	1.46*	2.19***	2.06**	2.18*
	(0.81)	(0.80)	(1.04)	(1.16)
TOSP × Parent firm new product (Hypothesis 4)	0.42**	0.42**	0.44**	0.28
	(0.20)	(0.19)	(0.22)	(0.26)
Moderating variables				
Parent firm litigiousness	−0.03***	−0.05***	−0.11***	−0.13***
	(0.01)	(0.01)	(0.02)	(0.03)
TOCP	0.44**	0.38*	0.53**	0.49*
	(0.19)	(0.22)	(0.26)	(0.27)
Parent firm new product	0.08	0.07	0.05	0.09
	(0.06)	(0.07)	(0.08)	(0.07)
Control variables	Included	Included	Included	Included
Industry segment fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	−5.12***	−3.62*	−2.01	−0.88
	(1.90)	(2.14)	(2.21)	(3.50)
Log pseudolikelihood	−495.44	−395.48	−304.50	−242.79
Wald χ^2	772.00***	835.87***	736.87***	796.76***
Observations	30,492	22,597	16,977	12,341

Note: Robust standard errors clustered at the dyad-level (spinout-corporate investor) are in parentheses.
* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance)

for the high level of *parent firm litigiousness* is 94.2%. Figure 4 shows that when the *TOCP* is low, a one standard deviation increase in *TOSP* from its mean value reduces the likelihood of CVC investment by 73.9%. However, when the moderating variable is at the high level, a one standard deviation increase in *TOSP* from its mean value reduces the likelihood of CVC investment by 40.2%. Figure 5 shows that a one standard deviation increase in *TOSP* from its mean value reduces the likelihood of CVC investment by 78.4% for the low level of *parent firm new product* but by only 35.0% for the high level of *parent firm new product*.

Alternative Explanations and Robustness Checks

In Table 7, we examine the alternative explanations that may generate the apparently similar relationships observed in our main results. First, although we included the control variables that represent corporate investors' goal orientations regarding CVC investments (*corporate investor financial orientation* and *corporate investor strategic orientation*), it is challenging to completely distinguish between these two dimensions because CVC programs may serve various objectives (Dokko & Gaba, 2012). Hence, it is possible that corporate investors may avoid investing in spinouts with a high level of TOSP because they expect poor financial performance of investments in these spinouts. To address this concern, we investigated whether independent venture capital (IVC) investors, whose primary objective is to maximize financial returns (Gompers & Lerner, 2004), show a similar investment strategy to that of corporate investors. If our main results are driven by corporate investors' concern about financial returns

TABLE 6
Marginal Effect of TOSP at Different Levels of Moderating Variables

	Estimation without corporate investor fixed effects		Estimation with corporate investor fixed effects	
Value of Moderators	**Marginal effect**	***z*-statistic**	**Marginal effect**	***z*-statistic**
Panel A Moderating effect of parent firm litigiousness				
Low	−0.00471	−3.39***	−0.00977	−3.28***
Medium	−0.00679	−2.24**	−0.01493	−2.39**
High	−0.00882	−1.51	−0.01984	−1.66*
Panel B Moderating effect of TOCP				
Low	−0.00529	−3.73***	−0.01085	−3.64***
Medium	−0.00523	−3.35***	−0.00931	−3.16***
High	−0.00455	−1.89*	−0.00723	−1.73*
Panel C Moderating effect of parent firm new product				
Low	−0.00669	−3.14***	−0.01360	−3.06***
Medium	−0.00439	−3.35***	−0.00903	−3.19***
High	−0.00229	−1.49	−0.00444	−1.35

* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance)

(rather than competitive risks), IVC investors are also less likely to invest in spinouts with a high level of TOSP. In Models 1 and 2, we test this idea using Cox proportional hazard models to examine the likelihood of IVC investment (Model 1) and that of CVC investment (Model 2) in a given year. As can be seen, although the coefficient of *TOSP* is positive but insignificant in Model 1 ($b = 0.37$, $p = 0.366$), it is negative and significant in Model 2 ($b = -2.12$, $p = 0.029$), which is consistent with our theoretical arguments.

FIGURE 3
Moderating Effect of Parent Firm Litigiousness (Hypothesis 2)

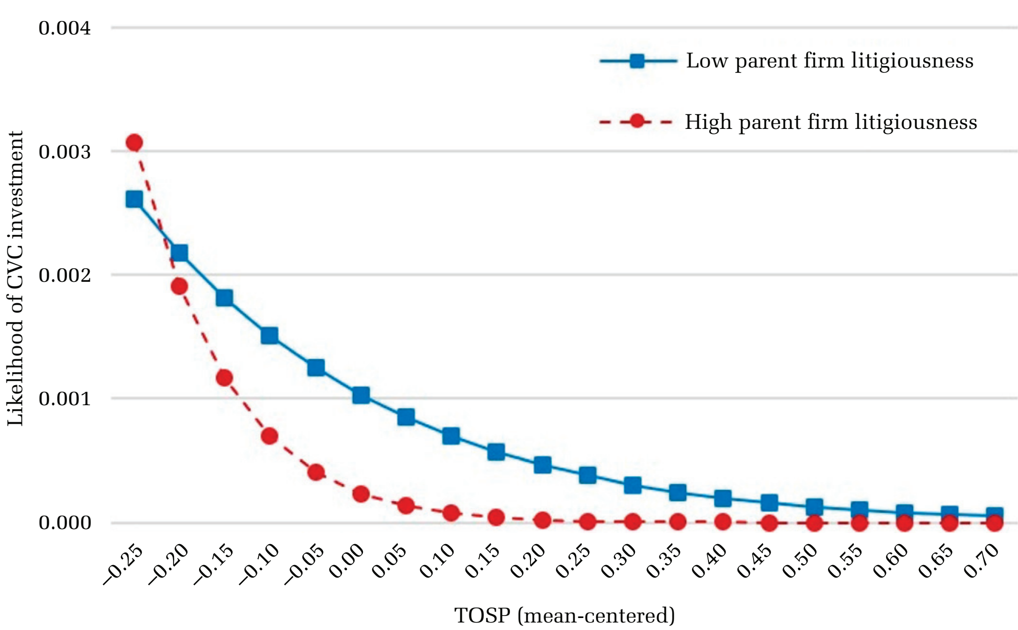
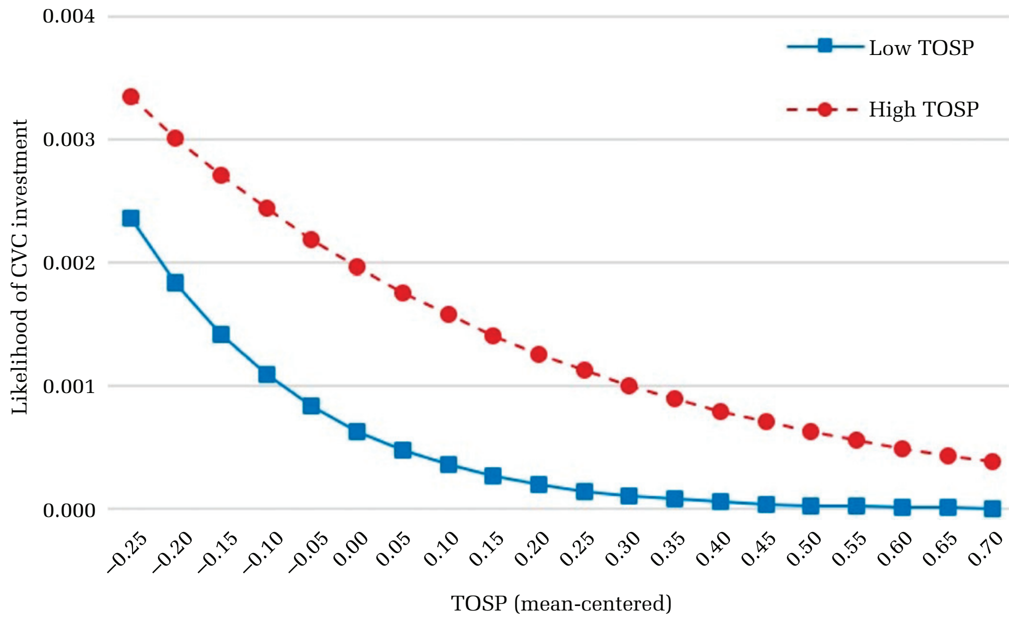


FIGURE 4
Moderating Effect of TOCP (Hypothesis 3)



Second, we address the concern that corporate investors are uninterested in spinouts with a high level of TOSP because these spinouts generate poor innovation performance compared to those with a low level of TOSP. To rule out the possibility of this alternative explanation, we estimated the effects of TOSP on spinouts' innovation performance (measured as the natural logarithm of 1 plus patent counts filed by a spinout in a given year) by using the spinout year–level data (Ahuja & Katila, 2001; Alvarez-Garrido & Dushnitsky, 2016). As shown in Model 3, which uses the panel regression with random effects for spinout sample, the coefficient of

FIGURE 5
Moderating Effect of Parent Firm New Product (Hypothesis 4)

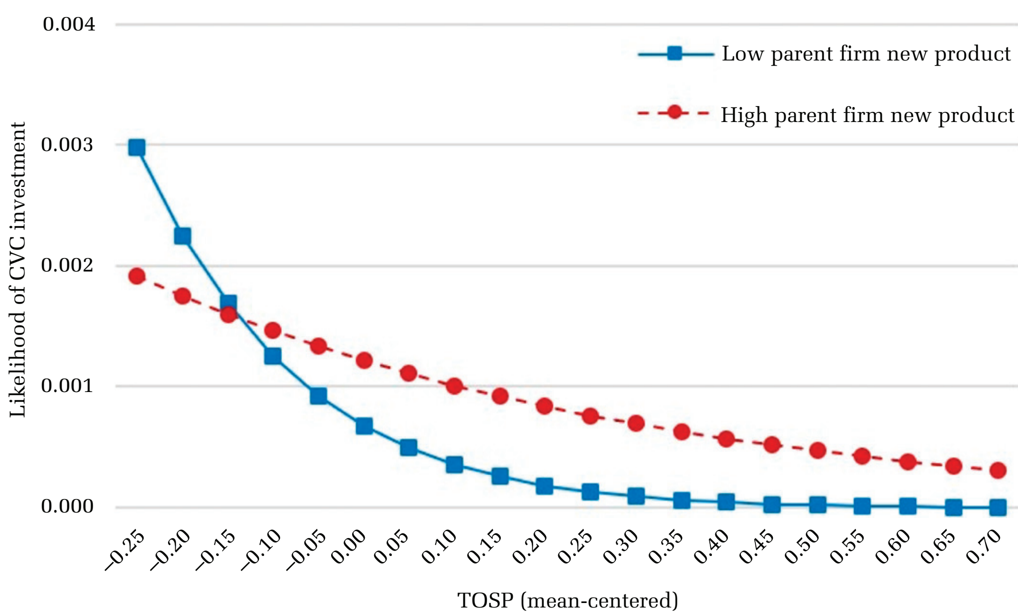


TABLE 7
Tests of Alternative Explanations

	Dependent variables		
	IVC investment	CVC investment	Innovation performance
Variables	Model 1	Model 2	Model 3
TOSP	0.37	−2.12**	0.05
	(0.37)	(0.97)	(0.06)
Spinout patent count	0.41***	0.84***	0.50***
	(0.10)	(0.17)	(0.02)
Spinout age	−0.07	0.08	−0.04***
	(0.04)	(0.06)	(0.01)
Founder PhD or MD	0.29	0.10	0.07**
	(0.19)	(0.48)	(0.03)
Time since left parent firm	−0.01	0.01	0.00
	(0.02)	(0.04)	(0.00)
Number of founders	0.05	−0.26	0.01
	(0.11)	(0.42)	(0.02)
Collaborative relationship between spinout and parent firm	−0.42	0.05	−0.01
	(2.03)	(0.78)	(0.06)
Manufacturing resource need	21.65***	7.73	−0.43
	(3.11)	(5.43)	(0.53)
Marketing resource need	−7.83	50.99	−5.47
	(21.45)	(38.75)	(5.26)
Parent firm litigiousness	−0.01	−0.03	−0.00
	(0.01)	(0.03)	(0.00)
Parent firm new product	0.06	−0.04	0.01
	(0.07)	(0.16)	(0.01)
Parent firm patent count	−0.07	0.11	−0.01*
	(0.06)	(0.13)	(0.01)
Industry segment fixed effects	Yes	Yes	Yes
Year fixed effects	—	—	—
Constant	—	—	0.41
			(0.21)
Log pseudolikelihood	−785.33	−169.78	—
R-squared	—	—	0.56
Wald χ^2	136.66***	92.06***	2210.37***
Observations	778	1,915	2,129

Robust standard errors clustered at the spinout-level are in parentheses.
* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance

TOSP is insignificant but positive ($b = 0.05$, $p = 0.411$), suggesting that the level of TOSP has no significantly negative effects on spinouts' innovation performance.

To ensure the reliability of the main results, we performed several additional analyses. First, we constructed alternative measures for TOSP. We used the measure of TOSP based on patent information in our main analyses because it is likely that competitive tension between spinouts and parent firms stems from the conflict in technology space. To check the sensitivity of this measure as a proxy for competitive tension, we used different measures that represent the overlap of product markets between spinouts and parent firms. To construct these measures, we used three approaches: (a) we searched news articles through Capital IQ, Google, and LexisNexis and created a binary variable coded as 1 if a spinout and its parent firm are described as major players in a specific market segment of the medical device industry and 0 otherwise; (b) we created another binary variable coded as 1 if a spinout and its parent firm have the same 4-digit SIC code and 0 otherwise (e.g., Krishnan, Martin, & Noorderhaven, 2006; Park & Russo, 1996); and (c) we calculated the overlap between the product portfolios of spinouts and parent firms across different product classes of the FDA. The results using these three measures are reported in Appendix A, and they generally support our arguments; however, while the results of models using the measure based on the FDA's product classes (Models 5 and 6) show directions that are consistent with Hypotheses 3 and 4, they are insignificant.[22]

Moreover, we considered the dynamic nature of TOSP. In operationalizing TOSP in our main analyses, we included the parent firm's patents only up until the year when a spinout's founder left the parent firm. However, given that a spinout and its parent firm may have ongoing relationships through existing social ties (Kim & Steensma, 2017), it is possible that a spinout may be influenced by its parent firm's technologies that are developed after the spinout's founding. In an unreported table, we therefore examined the effects of TOSP that are created using parent firms' patent portfolios 10, seven, and five years prior to a given dyad year. The results of models using these dynamic TOSP show qualitatively similar results to those described above. These results are available upon request.

Second, the use of a binary dependent variable (i.e., the likelihood of CVC investment) may not fully reflect the extent to which corporate investors perceive the risks associated with investing in spinouts. We therefore used the amount of investment as an alternative dependent variable because, when faced with competitive risks associated with TOSP, corporate investors are unlikely to make a large commitment (i.e., large investment) (Bernstein, Giroud, & Townsend, 2016; Hochberg, Ljungqvist, & Lu, 2007). In the analysis using an ordered categorical dependent variable based on the amount of investment, we still found strong support for our arguments.[23]

[22] We think there might be two reasons for the lack of support for Hypotheses 3 and 4. First, it may be because of the reduced statistical power because we had to remove 67 spinouts (approximately 31% of the sample spinouts) that have no approved medical devices. Second, it is also possible that corporate investors might not be interested in technologies that are already developed into products in the market because they can reverse-engineer (or imitate) the technologies of the device already released.

[23] We created a categorical dependent variable because our original dependent variable has a large number of zeros (i.e., unrealized deals) and thus have unequal frequency distribution in the value of investment amount (Long, 1997; Uzzi & Gillespie, 2002). We first coded 0 for unrealized deals and used additional quartile categories: 0–25 percentile, 26–50 percentile, 51–75 percentile, and 76–100 of the distribution of investment amount.

Third, we used alternative measures for parent firm's innovativeness to test Hypothesis 4. Following previous studies (e.g., Aghion, Van Reenen, & Zingales, 2013; Ahuja & Lampert, 2001; Lee, Kim, & Bae, 2020), we used the number of the parent firm's patents and the number of forward citations in the five years prior to a given year as a proxy for parent firm's innovativeness and found results supporting our arguments. The results of these analyses are available upon request.

Fourth, in the unreported table, to account for the rare events nature of CVC investments in spinouts, we performed the same analyses using the rare events logistic regression, which corrects for the potential bias from oversampling counterfactual observations (King & Zeng, 2001; Zhelyazkov & Gulati, 2016). In addition, to further address this concern we randomly matched each realized CVC investment dyad with 10 nonrealized dyads based on the industry subsector of a spinout and the year of CVC investment (e.g., Reuer & Devarakonda, 2017). The results of these analyses are consistent with the main results, and are available upon request.

Finally, we consider the potential endogeneity issue. If spinouts select the level of technological overlap between their knowledge bases and those of parent firms based on the prospect of obtaining funding from external investors, the likelihood of CVC investment may reflect the outcome of the endogenous process. To address this concern, we adopted an instrumental variable (IV) probit regression, in which we used noncompete agreement enforceability as an IV and found results that generally support our arguments. To reserve space, we provide detailed explanation about the IV probit regression in Appendix B.

DISCUSSION AND CONCLUSION

Contributions and Implications

Using a sample of CVC investments in the U.S. medical device industry, we find that corporate investors tend to avoid investing in a spinout that has a high level of TOSP. Moreover, the negative effects of TOSP on the CVC investments can be amplified when parent firms have a strong litigiousness in claiming their intellectual property rights. However, our findings also show that despite these risks, corporate investors are likely to make investments in spinouts with high TOSP if they expect to receive competitive benefits from accessing their competitors' knowledge, such as when their technological knowledge is closely linked to parent firms' knowledge bases and when parent firms have strong innovation capabilities.

This study offers several contributions and implications for the management and entrepreneurship fields. First, this study adds to the literature on CVC investments (e.g., Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2005a; Maula et al., 2013; Paik & Woo, 2017; Park & Steensma, 2012). While previous studies have provided important insights on the mechanisms that may attract corporate investors' attention (e.g., access to external technologies, identification of acquisition targets, etc.), our study suggests the mechanism that may impede CVC investments. Furthermore, although the literature has long argued that CVC investments are based on strategic objectives, previous studies have rarely considered that these investments may serve the purpose of exploring the knowledge of competitors. Our interaction analyses on competitive benefits extend the literature on the strategic motives of CVC investments by emphasizing the fact that corporate investors may attempt to indirectly acquire the knowledge of their competitors by investing in spinouts. Relatedly, given that CVC investments represent a collaborative relationship through which firms access external knowledge, these findings can also add to the research regarding competitive dynamics in interfirm relationships, such as licensing agreements and R&D alliances (e.g., Asgari, Tandon, Singh, & Mitchell, 2018; Cui, Yang, & Vertinsky, 2018).

Second, this study contributes to the literature on employee entrepreneurship by highlighting the downsides of spinout activities. Previous studies have predominantly suggested that various types of inherited resources of spinouts can enable them to outperform other new entrants (Agarwal et al., 2004; Burton et al., 2002; Chatterji, 2009; De Figueiredo et al., 2013). However, Walter et al. (2014: 2040) pointed out an important, yet often ignored, perspective of parent firms by stating that "whether a parent firm grants or denies these benefits may crucially depend on its attitude toward the spinout. Friendly parents are likely to support and cooperate with a spinout, whereas hostile parents might even combat and obstruct it." In extending this notion, we emphasize that the competitive tension stemming from a high level of TOSP can induce parent firms into having a hostile attitude toward spinouts, which, in turn, can adversely affect spinouts' relationships with external corporate investors.

Relatedly, our mechanism of the negative side of technological inheritance adds to the literature on interfirm relationships by analyzing how firms behave to prevent their own knowledge from leaking to competitors and to access competitors' technological knowledge. On the one hand, a set of studies from the perspective of knowledge source firms has focused on how firms protect their knowledge through various methods, such as hierarchical governance modes (Oxley, 1997), a narrow scope of collaboration (Oxley & Sampson, 2004), and intellectual property protection regimes (Agarwal et al., 2009; Katila et al., 2008). On the other hand, another research stream from the perspective of knowledge recipient firms has focused on the benefits of acquiring external knowledge through mobile employees (Rosenkopf & Almeida, 2003; Song et al., 2003) and collaboration with competitors (Kale et al., 2000; Khanna et al., 1998; Lavie, 2007). Our findings that corporate investors may consider the competitive risks as well as benefits in their decisions regarding investments suggest that the formation of interfirm relationships is a function of balance between the two.

Third, this study extends the prior literature on competitive dynamics (Capron & Chatain, 2008; Chen, 1996; Chen et al., 2007; Gimeno & Woo, 1996). This literature seeks to understand the actions and reactions of rivals and thus focus on competitive tension in dyadic relationships (e.g., specific rivals) (Chen & Miller, 2015). However, Madhavan, Gnyawali, and He (2004) emphasized that competition in triads plays an important role in interfirm networks. We extend this notion by suggesting the transitivity of competitive tension through interfirm network. That is, we argue that competitive rivalry can be transferred to a third party when the third party forms a relationship with one of the competitive rivals. We believe that this novel argument is not limited to the CVC investment settings and can be generalizable to various types of interfirm relationship (e.g., alliance and joint venture) that may threaten the competitive position of firms embedded in the triad. Building on this insight, we argue and show that the transitivity of competitive tension has important behavioral implications, particularly for the third party, since the third party may be hesitant to build a relationship with either of the two firms that experience serious competitive tension.

Finally, this study contributes to the literature on potential knowledge leakage that can take place across organizational boundaries. While previous studies have focused on undesirable knowledge leakage in direct ties (e.g., Diestre & Rajagopalan, 2012; Dushnitsky & Shaver, 2009; Hallen et al., 2014; Katila et al., 2008), recent studies have started to investigate this issue by considering indirect ties (e.g., Hernandez, Sanders, & Tuschke, 2015; Ryu, McCann, & Reuer, 2018). For example, Pahnke et al. (2015b) suggested that new ventures that are indirectly connected to their rivals through a shared venture capital investor are vulnerable to potential "competitive information leakage." Similarly, Ryu et al. (2018) showed that firms adopt hierarchical governance forms in their R&D alliances when their partners are colocated in an agglomerated region where competitors can gain indirect access to their knowledge. Building on the insight of this emerging literature, our study incorporates the perspective of third parties (i.e., corporate investors) and examines how they perceive the risks and benefits of forming a tie with small ventures.

Limitations and Future Research

This study has several limitations that can provide opportunities for future research. First, the conclusions drawn from the findings in our research setting may be limited in terms of generalizability to other industry settings where parent firms' retaliation options are limited. We suggest that corporate investors place greater emphasis on the risk side rather than the benefit side when they consider making investments in spinouts. However, this may, in part, reflect the fact that the medical device industry has strong intellectual property protection regimes (Cohen et al., 2000; Dushnitsky & Shaver, 2009) in which firms can effectively protect their knowledge through formal institutional arrangements. In industries that have a weak intellectual property protection regime, it is possible that our main prediction has a different relationship since corporate investors may place greater emphasis on the benefit side of acquiring technical knowledge of the spinouts. In a similar fashion, if the corporate investors are immune or less sensitive to litigation related to intellectual property rights, it is also possible that they prioritize competitive benefits over risks. Thus, future research may examine other industry settings or corporate investors' characteristics to examine whether corporate investors focus on the benefits of accessing spinouts' knowledge and human capital in industries where parent firms' aggressive actions may have weak deterrent effects. Moreover, although we propose several positive, as well as negative, aspects of knowledge transfer through employee entrepreneurship and investment ties, we cannot provide decisive performance implications. For example, given that there may exist both competitive risks and benefits of investing in spinouts, it is unclear whether corporate investors can create value by acquiring the knowledge and human capital of the spinouts. In future research, it would be worthwhile to investigate the conditions under which the expected value of investing in spinouts translates to better performance of corporate investors.

Second, in this paper we develop our theoretical arguments based on the concept of competitive tension that can be transferred through interfirm relationships. In doing so, we focus on conflicts over patented technological knowledge in the context of CVC investments. The CVC investments allow us to examine our theoretical mechanisms in that they have widely been viewed as a primary means to acquire knowledge residing in ventures and precede other external technology acquisition activities (Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2005a). However, competitive interactions can occur in various dimensions. For example, firms often experience conflict over implicit or tacit knowledge in cases of employee migration or knowledge-sharing collaborations. Additionally, firms have serious competitive tension in other corporate development activities (e.g., R&D alliances or acquisitions) in the product market (rather than in the technology market). Hence, it may be interesting to consider the effect of competitive tension in various types of external knowledge acquisition activities. For example, future research may exploit the heterogeneity among different governance modes (Keil, Maula, Schildt, & Zahra, 2008; Tong & Li, 2011) and examine how the competitive tension associated with technological knowledge or product markets influences governance choices and their effects on firm performance. Empirically, while we suggest the transitivity of competitive tension, our data are structured at the dyad level between spinouts and corporate investors; therefore, our approach cannot capture the entire range of competitive actions and reactions in triadic relationships. Although doing so is beyond the scope of our paper, it may be interesting to examine the network structural effects of competitive tension among indirectly connected firms.

Finally, our theory of potential technology spillover through employee entrepreneurs and interfirm relationships is based on the notion of knowledge inheritance between spinouts and parent firms. To be conservative, our empirical analyses therefore focus only on the TOSP before founders left the parent firm. However, even after founding spinouts, founders can embrace the technological knowledge from parent firms through existing social ties, such as previous colleagues at the parent firm (Corredoira & Rosenkopf, 2010; Kim & Steensma, 2017). We conjecture that it might be more advantageous for spinouts to tap into the parent firm's recent knowledge via social contacts. Our additional analysis that considers different time windows to define the parent firm's technological portfolio represents an initial effort to test the mechanism of the ongoing relationship between spinouts and parent firms; however, we also recognize that this evidence is not conclusive. We believe that future studies adopting other various methodologies (e.g., field studies) or more detailed data on social ties will be able to provide deeper understanding of mechanisms underlying our theoretical predictions.

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Joonhyung Bae (joonbae@skku.edu) is an assistant professor at SKK Business School, Sungkyunkwan University. He received his PhD in management from the Krannert School of Management, Purdue University. His research focuses on the areas of interorganizational relationships, entrepreneurship, and innovations.

Joon Mahn Lee (joonmahn@korea.ac.kr) is an associate professor at Korea University Business School, Korea University. He received his PhD in strategic management from the Wharton School, University of Pennsylvania. He is interested in understanding characteristics of founders, corporate governance, coordination among firms in business ecosystem, and technology innovations.

APPENDIX A

TABLE A1
Alternative Measures of Competitive Tension between Spinout and Parent Firm

	Dependent variable: CVC investment					
	Based on news articles		Based on SIC code		Based on product class	
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Main effect						
Competition between spinout and parent firm	−0.73***	−0.74***	−0.75***	−0.79**	−0.64**	−0.66**
	(0.14)	(0.15)	(0.29)	(0.32)	(0.28)	(0.30)
Interaction effects						
Competition between spinout and parent firm	−0.04**	−0.05**	−0.08***	−0.09***	−0.05*	−0.05*
× Parent firm litigiousness	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Competition between spinout and parent firm	0.97***	1.03***	−0.13	−0.24	0.33	0.24
× TOCP	(0.32)	(0.36)	(0.49)	(0.50)	(0.53)	(0.56)
Competition between spinout and parent firm	0.06	0.06	0.33**	0.38**	0.07	0.07
× Parent firm new product	(0.06)	(0.07)	(0.16)	(0.18)	(0.10)	(0.11)
Moderating variables						
Parent firm litigiousness	−0.00	−0.00	−0.00	−0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TOCP	0.19	−0.16	0.58***	0.36*	0.71***	0.50*
	(0.23)	(0.28)	(0.16)	(0.20)	(0.26)	(0.29)
Parent firm new product	−0.02	−0.01	−0.07*	−0.07	−0.06	−0.05
	(0.05)	(0.06)	(0.04)	(0.04)	(0.06)	(0.06)
Control variables	Included	Included	Included	Included	Included	Included
Industry segment fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Corporate investor fixed effects	No	Yes	No	Yes	No	Yes
Constant	−2.99***	−4.60**	−3.09***	−4.77**	−4.69***	−3.60
	(1.05)	(1.94)	(1.07)	(1.94)	(1.40)	(4.42)
Log pseudolikelihood	−563.65	−495.72	−569.55	−497.43	−283.86	−248.72
Wald χ^2	964.57***	956.25***	893.11***	773.00***	877.24***	653.63***
Observations	69,815	30,492	69,815	30,492	44,669	12,392

Note: Robust standard errors clustered at the dyad-level (spinout-corporate investor) are in parentheses.
* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$ (two-tailed tests of significance)

APPENDIX B

In instrumental variable (IV) probit regression, we used *noncompete agreement enforceability* as an instrument for *TOSP*.[1] By focusing on the variation in the enforceability of noncompete agreements in employment contracts across different states in the United States, prior work has suggested that the enforceability of noncompete agreements tends to limit employee mobility (Marx, Strumsky, & Fleming, 2009) and screen the formation of spinouts (Starr, Balasubramanian, & Sakakibara, 2018). Building on these studies, we considered that the enforceability of noncompete agreements has a plausibly negative association with the level of *TOSP* because noncompete agreements are likely to selectively prevent employees from relying on the knowledge of parent firms that are located in states with strong enforceability. However, it is unlikely that the

[1] The Wald exogeneity test of an instrumented variable indicates that the null hypothesis of no endogeneity can be rejected ($p = 0.09$), which suggests that *TOSP* may be subject to the endogeneity concern.

TABLE B1
IV Probit Regression for the Likelihood of CVC Investment

Variables	Main IV probit (Full sample)		Parent firm litigiousness (Hypothesis 2)		TOCP (Hypothesis 3)		Parent firm new product (Hypothesis 4)	
	First stage	Second stage	High	Low	High	Low	High	Low
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Main effect								
TOSP (Hypothesis 1)		−4.17***	−5.55***	−0.74	−3.44**	−5.08***	−2.70*	−3.59**
		(0.89)	(0.07)	(3.62)	(1.73)	(0.24)	(1.49)	(1.44)
Moderating variables								
Parent firm litigiousness	−0.00***	−0.01**	−0.01***	0.19**	−0.01	−0.01***	−0.04*	−0.01
	(0.00)	(0.00)	(0.00)	(0.08)	(0.01)	(0.00)	(0.02)	(0.01)
TOCP	−0.02	0.33	−0.02	0.62***	0.40	0.50	0.84**	0.19
	(0.01)	(0.20)	(0.08)	(0.22)	(0.30)	(3.03)	(0.35)	(0.21)
Parent firm new product	0.03***	0.09*	0.23***	−0.16**	0.02	0.16***	−0.03	0.05
	(0.00)	(0.05)	(0.01)	(0.06)	(0.07)	(0.02)	(0.14)	(0.09)
Noncompete agreement enforceability	−0.01***							
	(0.00)							
Control variables	Included	Included	Included	Included	Included	Included	Included	Included
Industry segment fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.19***	−2.81**	−3.79***	−5.05***	−4.06***	−2.10**	−5.84***	−3.29***
	(0.04)	(1.11)	(0.26)	(1.56)	(1.29)	(0.83)	(2.01)	(0.84)
Log pseudolikelihood	—	7569.27	6786.63	2043.84	5318.59	2415.40	9745.04	2078.32
Wald χ^2	—	1205.48***	21881.87***	657.18***	873.18***	4713.62***	632.05***	1420.63***
Observations	69,815	69,815	23,805	33,980	34,261	26,650	27,978	33,234

Note: Robust standard errors clustered at the dyad-level (spinout-corporate investor) are in parentheses.

* $p < 0.1$

** $p < 0.05$

*** $p < 0.01$ (two-tailed tests of significance)

enforceability of noncompete agreements has a direct impact on corporate investors' decisions to make an investment.[2] That is, the effect of the instrument on the likelihood of CVC investments can occur only through the variable that is instrumented (Angrist, Imbens, & Rubin, 1996).[3]

In the first stage, we estimated the regression of *TOSP* on the instrument (*noncompete agreement enforceability*), which is measured as the enforceability score of each state from Starr (2018) in addition to all the variables used in the main model (Model 2 in Table 4) (Semadeni, Withers, & Certo, 2014). In the second stage, we estimated the likelihood of CVC investment using the predicted value of *TOSP* derived from the first stage. Consistent with the main results, Model 2 shows that *TOSP* is negatively associated with the likelihood of CVC investments ($b = -4.17$, $p = 0.000$). Because we have an instrument only for the main independent variable of interest and because the interaction terms between the instrument and moderating variables perform poorly in practice (Rawley & Simcoe, 2010), we examined the moderating effects using the subsample analyses (e.g., Desender, Aguilera, Lópezpuertas-Lamy, & Crespi, 2016; Koh, Qian, & Wang, 2014). Specifically, we divided the full sample into high and low groups based on the median value of moderating variables and then performed IV probit regressions for each group.[4] Consistent with Hypothesis 2, while *TOSP* has statistically significant negative effects on the likelihood of CVC investments in the subsample of high *parent firm litigiousness* ($b = -5.55$, $p = 0.000$ in Model 3), the significance of negative effects disappears for the subsample of low *parent firm litigiousness* ($b = -0.74$, $p = 0.839$ in Model 4). The coefficients of *TOSP* are negative and statistically significant for both high and low *TOCP* ($b = -3.44$, $p = 0.047$ in Model 5 and $b = -5.08$, $p = 0.000$ in Model 6). Models 7 and 8 show that the coefficients of *TOSP* are negative and significant for both subsamples of high *parent firm new product* ($b = -2.70$, $p = 0.071$ in Model 7) and low *parent firm new product* ($b = -3.59$, $p = 0.012$ in Model 8). While the coefficients of *TOSP* in Models 5–8 are significant, the marginal effects of TOSP are greater when the levels of *TOCP* and *parent firm new product* are low, supporting Hypotheses 3 and 4.

[2] It is worth noting that ventures receive CVC investments a couple of years after its inception and are acquired several years later; however, a noncompete agreement usually lasts less than two years immediately after the termination of employment (Starr et al., 2018). We therefore conjecture that noncompete agreement would not be a serious concern at the time when corporate investors make CVC investments.

[3] Following the suggestions of previous studies, we tested the relevance and exogeneity of the instrumental variable. As shown in Model 1 of Appendix B, *noncompete agreement enforceability* is negatively associated with *TOSP* and is statistically significant, thus suggesting the strength of the instrument variable ($b = -0.01$, $p = 0.000$). Moreover, the weak identification test statistic (Cragg–Donald Wald *F*-statistic) from the first stage is 245.3, which is greater than the 10% maximal IV size Stock–Yogo critical value (16.38) (Stock & Yogo, 2005). The exogeneity of the instrument variable is also supported by its nonsignificance when included as a control variable in the model that estimates the likelihood of CVC investment ($p = 0.160$) (Murray, 2006).

[4] The first stage estimates of the subsample analyses are not reported in Appendix B because of a lack of space. The results of subsample analyses should be interpreted with a caveat because the relevance of *noncompete agreement enforceability* is not satisfied in the subsamples of high parent firm litigiousness (Model 3) and high parent firm new product (Model 7). However, in these groups, the Wald exogeneity test of instrumented variable suggests that the null hypothesis of no endogeneity cannot be rejected ($p = 0.468$ and $p = 0.273$, respectively).

APPENDIX B REFERENCES

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