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Corporate venture capital and interfirm rivalry: A competitive dynamics perspective

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Abstract

Research Summary: This study views corporate venture capital (CVC) investment as a form of inter-firm rivalry. Adopting a competitive dynamics perspective, we argue that when a focal corporate investor invests in an entrepreneurial venture, that investment sends important competitive signals to its rivals, thereby increasing their likelihood of initiating a matching response. We theorize how three factors characterizing such investment—the amount of funding, industry relatedness between the corporate investor and the entrepreneurial venture, and the reputation of the corporate investor—can influence rivals' awareness of competitive threat, their motivation to respond, and therefore their likelihood of launching a matching counterattack. Our results demonstrate substantial support for our theoretical model.

Managerial Summary: This study views CVC investment as a form of competitive interaction, arguing that when a corporate investor participates in an investment round, it sends a competitive signal to its rival, motivating the latter to respond by also investing in CVC. Because of this counteraction, the competitive advantages of firms' CVC strategies may be temporary as rivals catch up and nullify the benefits

of a CVC initiative. Thus, when planning strategy, CVC managers need to take potential rival counteractions into account and carefully assess the competitive implications of their CVC strategy, perhaps by avoiding harmful counteractions through initiatives more subtle in execution and orientation, and thus "under the radar" of rivals.

1 | INTRODUCTION

Corporate venture capital (CVC) investments—minority-stake equity investments in entrepreneurial ventures—have emerged as a prominent means for incumbent firms to acquire external knowledge and new technologies, boost innovation, and enhance competitiveness (e.g., Alvarez-Garrido & Dushnitsky, 2015; Basu & Wadhwa, 2013; Chemmanur, Loutskina, & Tian, 2014; Gaba & Bhattacharya, 2012; Maula, 2007; Pahnke, Katila, & Eisenhardt, 2015; Wadhwa, Phelps, & Kotha, 2016). According to VentureXpert, PricewaterhouseCoopers, and the National Venture Capital Association (NVCA), many Fortune 500 companies, including Intel, Google, and Microsoft, have established CVC initiatives. From 1995 to 2012, CVC investments by established firms totaled more than $52.4 billion (Yang, Narayanan, & De Carolis, 2014).

This increase in CVC investments by established firms has inspired management researchers to explore the phenomenon through different theoretical lenses. Drawing on organizational learning theory, one stream of literature argues that CVC investments enable firms to learn about emerging technologies and nascent markets. By working with technology startups as well as co-investors, corporate investors cultivate new technologies and explore emerging business opportunities outside their traditional boundaries (Benson & Ziedonis, 2009; Dushnitsky & Shaver, 2009; Maula, Keil, & Zahra, 2013; Wadhwa & Kotha, 2006). Another stream of studies employs resource-dependence theory to argue that CVC investments act as an exchange mechanism allowing established firms to exchange financial capital for the novel technologies and ideas of new ventures (Hallen, Katila, & Rosenberger, 2014; Katila, Rosenberger, & Eisenhardt, 2008). Still, other research leverages institutional theory to show how CVC programs are shaped by the institutional forces in a parent firm's environment as well as in the venture capital market (Souitaris & Zerbinati, 2014; Souitaris, Zerbinati, & Liu, 2012). Furthermore, scholars have introduced real options theory, arguing that CVC investing represents an option that enables corporate investors to reduce the threats imposed by market and technological uncertainties (Basu & Wadhwa, 2013; Tong & Li, 2011; Yang et al., 2014). Recently, Gaba and Bhattacharya (2012) have linked the behavioral theory of the firm to the study of CVC, arguing that a focal firm's involvement in CVC investing is a function of its position vis-à-vis industry peers.

Notwithstanding these fruitful theoretical lenses, few studies have considered the critical role of *rivalry* in shaping firms' CVC strategy and outcomes. Indeed, although some scholars have highlighted the role of industrial peers in shaping a focal firm's CVC strategy (Gaba & Bhattacharya, 2012), no study has employed competitive dynamics theory to examine the potential competitive interdependence of rival firms' CVC strategies. Indeed, competitive dynamics scholars maintain that firms are in constant competition such that "firms act and rivals respond" (Chen & Miller, 2012, p. 13). Thus, when a focal firm undertakes a competitive action, whether strategic (e.g., offering a new product, forming strategic alliances) or tactical (e.g., cutting prices, improving service), its rivals—firms that compete in the same industry, typically having significant market commonality and resource similarity with the focal firm (Chen, 1996)—will evaluate that action to determine what they should do next. The more likely it is that the action

will enhance a focal firm's competitive strength, the greater the likelihood of a retaliatory response by rivals (Chen, 1996; Chen, Su, & Tsai, 2007; Derfus, Maggitti, Grimm, & Smith, 2008; Rindova, Becerra, & Contardo, 2004). Therefore, to maximize the efficacy of its actions, a focal firm must constantly assess their competitive implications and predict the potential responses of its rivals (Chen, Smith, & Grimm, 1992; Yu & Cannella, 2007).

We shall argue that competitive dynamics theory is particularly useful in the study of firms' CVC investments as these represent highly visible competitive actions with the potential to significantly enhance a focal corporate investor's innovative and competitive strengths (Dushnitsky & Lenox, 2005a). Such actions can challenge the competitive terrain, thereby prompting defensive reactions from rivals. Thus, CVC investments constitute a particular form of rivalry between firms: a focal corporate investor's CVC investments in innovative startups may make rivals feel threatened. The latter may lag the focal firm in acquiring the latest technologies or business ideas, and thus feel at a competitive disadvantage for future competition. This might induce them to defend their turf. Indeed, competitive dynamics researchers have highlighted this common practice of *matching response*, which occurs when a rival takes the exact same type of competitive action following a focal firm's initial action (Chen et al., 1992; Gimeno, Hoskisson, Beal, & Wan, 2005). Because CVC investments are risky and outcomes are difficult to predict, one way for a rival to keep up with the competitive advances of a focal corporate investor is to also invest in new ventures that operate in the same industry. In this article, we consider this practice as a *matching response in CVC-based rivalry*. If a rival initiates a matching response, the relative advantage of a focal corporate investor, obtained through the initial CVC investment, may be reduced. Thus, to maximize the competitive advantage associated with a CVC investment, the focal corporate investor must assess not only the strategic benefits of the investment per se, but also *the competitive signals that an investment may carry*, thereby anticipating and planning for the potential responses of its rivals.

For example, in 2014 Qualcomm recognized the technological and business potential of drone technology, a new technology primarily developed by startups. To participate in this technological development, in May 2014, Qualcomm, together with others, invested $13.2 million in Skycatch, a drone data startup specializing in industrial applications and data imaging. This investment allowed Qualcomm to access frontier drone technology and its associated commercial promise, which represented an important potential advantage in that highly competitive market. Six months later, in November 2014, Intel Capital invested, again together with others, $10 million in PrecisionHawk, which provided aerial mapping and tracking software for drones. This investment allowed Intel to catch up with Qualcomm in this frontier technology, thereby eroding the competitive advantage that Qualcomm could have developed through its initial investment in Skycatch. Such competitive interdependence in the CVC market was reflected in a statement by an Intel Capital executive concerning the firm's CVC investments: "If we don't start relationships with them (startups) now, we will get behind."[1] A CVC manager at an established firm expressed a similar concern in an interview conducted for this study: "We always need to observe the investment trend of the competitor, and in what kind of industries or technology the competitor is investing." Such comments argue for a focus on competition in studying CVC strategy. More specifically, the competitive nature of CVC demands that firms fully anticipate the potential consequences of their CVC strategy to lessen the possibilities of nullifying counteraction by rivals, and to maximize the effectiveness of their investments.

In this article, we build on competitive dynamics theory to explore rivalry in the form of CVC investments. Our premise is that a CVC investment by a focal corporate investor contains multiple competitive signals, which may influence rivals' *awareness* and *motivation*, two key behavioral drivers of competitive responses, and may thereby drive rivals toward or away from making CVC investments. Building on signaling theory and the CVC literature, we examine three CVC-related factors that are likely to serve as competitive signals: (a) the amount of funding invested in a new venture in a particular round, (b) the industry relatedness between a new venture and a focal corporate investor, and (c) the reputation of a focal corporate investor. Viewing these factors through the lens of competitive dynamics, we found them to have distinct competitive implications, and thus to significantly shape or deter rival responses. We tested our predictions on longitudinal data on 11,925 action-response dyads in 81 industries (based on four-digit SIC codes) from 2000 to 2014.

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Our study makes two primary contributions. First, we contribute to the CVC literature by leveraging insights from the domain of competitive dynamics. We argue that a focal corporate investor's investment in a new venture may contain competitive signals that evoke changes in rivals' CVC strategies. Second, our study enriches the research on competitive dynamics by highlighting hitherto neglected rivalry in the CVC market. Corporate investors tend to operate in competitive markets in which a focal firm's strategic behavior, such as a CVC investment, may threaten rivals. However, few competitive dynamics studies have examined this type of rivalry. By conceptualizing CVC investments as a particular form of rivalry, our study reveals a set of competitive signals pertaining to CVC investments and their competitive impacts.

Our article is structured as follows: We draw on the CVC and signaling literature to identify the characteristics of a CVC investment that are likely to have the most significant strategic impact by posing the greatest competitive threat to a rival. Then we develop our hypotheses by using the competitive dynamics lens to argue how those CVC characteristics may influence a rival's awareness of a competitive threat and its motivation to respond. We proceed to present our method and findings before discussing our results.

2 | THEORY DEVELOPMENT

The success of a CVC investment very much depends on the market it attracts, the stage of product and technological development, and the ability to find partners (Benson & Ziedonis, 2009; Dushnitsky & Lavie, 2010). The extent to which rivals can respond with ventures of their own that interfere with these processes or outcomes must be an important concern for focal corporate investors. Unfortunately, competitive dynamics scholars have thus far neglected this key type of competitive initiative, an important avenue of competition and advantage in many industries. In our analysis, we shall demonstrate both the competitive reactions wrought by particular types of CVC investments, as well as their relevance for studying competition.

2.1 | Competitive dynamics and signaling theory

Research on competitive dynamics conceptualizes competition as a dynamic process of focal firm actions and rival responses. A competitive action is defined as an "externally directed, specific, and observable competitive move initiated by a firm to enhance its relative competitive position" (Smith, Ferrier, & Ndofor, 2001, p. 12). Similarly, a response is a specific countermove, undertaken by a rival following the focal firm's action, to defend its position in the competition (Chen, 1996; Ferrier, 2001). Based on this action-response framework, researchers have highlighted firms' quest for competitive advantage as an interactive process in which firms gain market advantages over rivals by proactively attacking them (action) and by engaging in retaliatory counteractions to rivals' attacks (response) (Chen et al., 1992; Chen & Miller, 2012). This action-response logic highlights the interdependency between rival firms' competitive behaviors, in which the competitive advantage gained by a focal firm through a specific action is eroded by a retaliatory counteraction by a rival. To remain competitive, a firm must anticipate and prepare for any potential responses of its rivals (Andrevski & Miller, 2022).

Signaling theory is particularly useful for studying the link between competitive actions and responses (Bianchi, Murtinu, & Scalera, 2019; Heil & Robertson, 1991). Signaling theorists suggest that the impact of a signal depends on the characteristics of a signal itself, as well as those of the signaler. A signal may have multiple characteristics. In particular, researchers have highlighted signal observability—"the extent to which outsiders are able to notice the signal" (Connelly, Certo, Ireland, & Reutzel, 2011, p. 45)—as a key determinant of its impact. In addition to the signal itself, the nature of signalers provides meaningful information as signalers generally have a privileged perspective on issues of interest, and thus their qualifications and acumen may influence how a signal is interpreted (Connelly et al., 2011).

In competition, firms do not have complete information on each other's intentions, and thus, signals suggesting such intentions are useful information. Thus, when a firm undertakes a competitive action, rivals interpret the signals the action carries before deciding how to react (Bianchi et al., 2019; Heil & Robertson, 1991). We shall argue that competitive signals evoke rivals' responses by influencing their awareness and motivation (Chen et al., 2007). *Awareness* refers to a firm's knowledge about its rivals and the competitive implications of their actions (Chen, 1996). *Motivation* captures a firm's reasons and intentions to take action. Typically, "a competitor will not be able to respond to an action unless it is aware of the action" and is "motivated to react" (Chen & Miller, 2012, p. 2). Thus, from a signaling perspective, when a focal firm undertakes a competitive action, the awareness and motivations driving rival responses may be a function of signals from the action per se and the firm that undertakes the action.

2.2 | Competitive dynamics and CVC investments

CVC investments represent a particular form of equity investment by corporate investors in the venture capital market. Theorists viewing CVC through the lens of the behavioral theory of the firm argue that corporations will invest in CVC when their innovation and R&D efforts fall short of aspirations (Gaba & Bhattacharya, 2012). As industry incumbents, corporate investors invest in new ventures not only for financial returns but also for strategic objectives such as filling gaps in their knowledge base, broaching emerging technologies or markets, and enhancing business ecosystems (Basu, Phelps, & Kotha, 2011; Pahnke et al., 2015). Because of these objectives, corporate investors often invest in new ventures that encompass different forms of technologies and distinct industry affiliations (Yang et al., 2014).

As noted, although researchers have used multiple theoretical lenses to study CVC, unfortunately no study has addressed CVC from the perspective of competitive dynamics. CVC investments by a corporate investor typically aim to acquire knowledge about new technologies and markets and to take advantage of opportunities beyond current boundaries (Benson & Ziedonis, 2009; Wadhwa & Kotha, 2006). By its very nature, a CVC investment is a strategic move undertaken by a corporate investor to enhance its competitive profile (Dushnitsky & Lenox, 2005b; Wadhwa & Kotha, 2006). By means of VC investing, a corporate investor may obtain early access to a new disruptive technology that can take market share from rivals, or it may cultivate a new market segment, leading customers to switch to that new segment. These outcomes often disrupt the market and cause disequilibrium among competitors. Therefore, such an investment is likely to evoke rivals' responses in the CVC market, which makes the competitive dynamics perspective an appropriate theoretical lens for studying CVC. Firms investing in the CVC market tend to operate in highly competitive markets and a corporate investor's investment in a new venture may impose competitive pressure on rivals, thereby provoking responses that may eventually counter or reverse the focal corporate investor's competitive advantage. Thus, the action-response logic may well apply to corporate investors' CVC investments.

Based on these arguments, we propose that when a focal corporate investor invests in a new venture, the action *contains competitive signals that serve as a basis for rivals to shape their own CVC strategy*. As mentioned above, signaling theory highlights that the impact of a signal depends on the signal per se and the qualifications of the signaler (Connelly et al., 2011). Thus, the competitive signals associated with a CVC investment are embedded in both the investment itself and in the corporate investor making that investment. We have argued that these signals will influence rivals' *awareness* and *motivation*, thereby influencing their CVC strategy. We focus on competitive signals reflected in the: (a) *amount of funding*, (b) *industry relatedness between the corporate investor and the new venture*, and (c) *reputation of the corporate investor*. Amount of funding and industry relatedness are two characteristics of the investment per se, whereas reputation is a characteristic of the signaler. As we shall argue, these factors have implications for rivals' later investments.

In our research framework, we use a CVC investment round as the unit of analysis and examine how competitive signals associated with a focal corporate investor's CVC investment may provoke or deter rivals' matching response—that is, their own CVC investment. A *matching response* results from interdependent, mutually referential decision

making, in which a focal firm's competitive actions increase the likelihood of its rivals' taking the same actions (Gimeno et al., 2005). Such responses are common because they defend the status quo without escalating the intensity of rivalry by extending its scope into different types of action (Chen et al., 1992; Lieberman & Asaba, 2006). Matching responses also allow competitors to maintain their relative competitive profiles and to minimize risk (Lieberman & Asaba, 2006). Evidence shows that matching responses are common in the airline industry (Chen & MacMillan, 1992), as are matching capacity expansion moves in the chemical industry (Gilbert & Lieberman, 1987), and matching international expansion moves in the telecommunications industry (Gimeno et al., 2005).

3 | HYPOTHESES

3.1 | Amount of funding

CVC researchers have utilized resource dependence theory to consider CVC as a mechanism by which corporate investors exchange resources with new ventures (Katila et al., 2008; Maula, 2007; Maula, Autio, & Murray, 2009). Particularly important in this context are the financial resources new ventures obtain from corporate investors. If a new venture represents an important opportunity, the amount of funding invested in the venture typically will be greater. Notably, when a corporate investor invests in a new venture, it often forms syndicates with other investors, and the total amount of the investment becomes critical in facilitating the development of the new venture (Lerner, 1994; Matusik & Fitza, 2012). Research has shown that increased funding may speed the growth of startups, enhance their technology development, and thereby achieve strategic objectives (Chang, 2004; Shane & Stuart, 2002). As Katila et al. (2008, p. 301) noted: "A key task for entrepreneurs in charge of mobilizing financial resources is then to form relationships so that the venture can prosper." These authors also provided empirical evidence that stronger resource needs drive ventures to form investment ties with corporate investors (Katila et al., 2008). Thus, the amount of funding represents a key factor in the study of CVC.

In a competitive market, when a corporate investor is involved in an investment event, the amount of funding invested in the new venture may function as a competitive signal for rivals. Specifically, we expect that the amount of funding will positively influence rivals' awareness and motivation, thereby increasing the likelihood of their matching response. In essence, the funding represents the confidence of experts in a venture as well as fuel and resources that enable a venture to succeed – that in turn may threaten rivals' markets or signal an opportunity for them to follow suit in reaction. First, Davila, Foster, and Gupta (2003) suggest that venture capital funding events emit important signals to external actors, and the amount of funding is positively associated with the intensity of those signals. According to this logic, if an investment is large, that attracts attention from rivals, thereby increasing their awareness of the focal corporate investor's action. Competitive dynamics research finds that greater awareness leads to a higher likelihood of reaction (Andrevski, Miller, Le Breton-Miller, & Ferrier, 2021; Chen et al., 2007). Thus, the amount of funding may positively influence rivals' likelihood of response.

Second, a greater amount of funding increases the motivation for rivals to counteract. According to competitive dynamics theory, rivals are likely to respond or to defend their own positions in the face of strong competitive pressures that could erode their performance (Derfus et al., 2008; Hsieh, Tsai, & Chen, 2015). When a corporate investor invests equity in a new venture, it often pursues strategic goals such as obtaining access to new technologies and novel business ideas. If a venture receives a great amount of funding from various investors, this typically suggests that the venture possesses promising technologies or pursues innovative business models and because of this, investors are willing to pay significantly to obtain access to the new venture. Access to such a venture may help the corporate investor to grow innovation capabilities and thus become more competitive (Dushnitsky & Lenox, 2005b). That enhanced competitive strength may motivate rivals to react. In addition, augmented CVC investment may spur the growth of a new venture and thus combat liabilities of newness (Chang, 2004). Shane and Stuart (2002) found that the amount of funding positively influenced the rate of IPO growth. Indeed, as the new venture becomes more

successful, it can serve as a strong partner of the corporate investor, thereby increasing the corporate investor's competitive edge. Such potential may motivate rivals to react.[2]

> **Hypothesis 1.** (H1). *The greater the total amount of funding a new venture receives in an investment round in which a corporate investor is involved, the greater the likelihood that a rival will undertake a matching response.*

3.2 | Industry relatedness

The industry affiliations of corporate investors and new ventures have captured the attention of researchers who consider firms' choice of industry a key strategic factor (Dushnitsky & Shaver, 2009; Keil, Autio, & George, 2008). A corporate investor may invest both in startups that operate in the same or related industries, as well as those operating in different industries (Keil et al., 2008). Industry relatedness captures the degree to which the primary industry of a corporate investor and that of a startup are related (Keil et al., 2008). When an investment is related to the primary business, it may access new knowledge of current business territories, find new ways to address problems via existing competencies (Gawer & Cusumano, 2002), and thereby enhance performance in the current market. In contrast, if the corporate investor invests in a startup in a different industry, it seeks knowledge outside its core areas to access new competencies or opportunities beyond its current market. Such investments may also allow a firm to advance from its current routines and knowledge domains to explore opportunities in new markets (Narayanan, Yang, & Zahra, 2009). Although both types of investments can be strategically beneficial, they may convey distinct competitive signals to rivals. Our premise is that a focal corporate investor's attack on rivals in their *core* industry represents a costly threat – more costly than that on a peripheral industry, which likely would have less effect on competitive outcomes.

We expect that as the industry relatedness between a focal corporate investor and a new venture increases, the likelihood that a rival will undertake a matching response will be higher. First, higher industry relatedness may increase rivals' awareness of the focal corporate investor's investment. Competitive dynamics theory highlights industrial affiliation as a key dimension in identifying competitors (Chen, 1996). For example, Tsai, Su, and Chen (2011) considered firms' presence in the same industry as the most salient factor in a competitive relationship between them. If a corporate investor invests in a startup that operates in the same industry, the startup tends to operate in the core market of the rival firms as well; this proximity will serve as a competitive signal to increase the likelihood that rivals have a greater *awareness* of the investment (Gimeno et al., 2005; Withers, Ireland, Miller, Harrison, & Boss, 2018). In contrast, if the corporate investor's investment targets a new venture in a completely different industry, that commercial distance may weaken the competitive signal and reduce rivals' awareness. Accordingly, we expect industry relatedness to be positively related to a rival's matching response.

Industry relatedness may also increase rivals' *motivation* to respond in kind. Competitive dynamics scholars found that rivals' likelihood of response is a function of the *centrality* of a focal firm's attack—"if an action directly attacks the key market of competitors, they are likely to respond quickly to show their commitment to defending the market" (Chen et al., 1992, p. 444; Chen, 1996; Chen et al., 2007). When a corporate investor invests in a new venture in the same or a closely related industry, the parties tend to have overlapping knowledge domains, common skills, and similar languages. This enables a corporate investor to better communicate with the venture and absorb its competencies, thereby increasing its ability to attack rivals in their core markets (Dushnitsky & Shaver, 2009; Keil et al., 2008; Maula et al., 2009; Schildt, Maula, & Keil, 2005; Withers et al., 2018). Thus, close industry relatedness between a corporate investor and a new venture may serve as a competitive signal that increases a rival's motivation to defend its turf. A matching response by the rival may successfully negate the threat imposed by the corporate investor (Theeke & Lee, 2017), thus, effectively restoring competitive balance. Yang and Hyland (2006), for example, maintained that when a focal firm has initiated mergers and acquisitions to enter the core product market of a rival, the rival is likely to also engage in mergers and acquisitions.

Hypothesis 2. (H2). *Industry relatedness between the corporate investor and the new venture in an investment round will be positively related to the likelihood that a rival will undertake a matching response.*

3.3 | Reputation of the corporate investor

Researchers have shown that venture capitalists differ in their reputations and that the more reputable venture capitalists provide important benefits for new ventures (Lee, Pollock, & Jin, 2011). When a new venture is sponsored by a highly reputable venture capitalist, it more readily attracts potential investors and establishes connections with important actors in the venture capital community, such as influential bankers and auditors (Nahata, 2018). These relationships can help the venture make better strategic decisions and improve routine activities (Lee et al., 2011). In addition, high-reputation venture capitalists tend to invest in ventures that are more likely to perform well (Nahata, 2018); thus, such an association may signal the quality of a new venture (Lee et al., 2011).

Indeed, signaling theorists have suggested that the qualifications of signalers may influence receivers' interpretation of their signals (Connelly et al., 2011). Accordingly, when a corporate investor invests in a new venture, its reputation may represent a competitive signal influencing rivals' awareness and motivation, and in turn, their potential response. When a highly reputable corporate investor invests in a new venture, rivals tend to have more awareness of that investment. Rindova, Williamson, Petkova, and Sever (2005) have defined a firm's reputation based on prominence and quality of outputs. High-reputation corporate investors are typically prominent actors in the venture capital market and their investments tend to attract the attention of the community. In addition, such investors often have records of successful investments. Lee et al. (2011) have suggested that a high-reputation corporate investor typically has taken multiple ventures public and such successes indicate the firm's "capabilities and achievements and make the firm highly distinctive" (Rindova, Petkova, & Kotha, 2007, p. 58). Thus, when such a corporate investor invests in a new venture, rivals are likely to be aware of that action.

Although the reputation of a corporate investor increases rivals' awareness of its investment, that reputation may decrease their motivation to respond. Competitive dynamics researchers have suggested that when a competitive attack is undertaken by a focal firm, rivals whose resources are dissimilar are unlikely to respond (Chen, 1996). Perceived payoff plays a key role in determining whether a response is undertaken. If rivals do not have the capabilities to imitate a focal firm's action or achieve equal success, they will not be motivated to respond (Chen, 1996; Chen & Miller, 2012). As noted, a high-reputation corporate investor typically has advantageous resources that make it distinct. When it invests in a new venture, rivals may consider themselves unable to match that action and therefore be unmotivated to respond. Competitive dynamics scholars suggest that "motivation is a prerequisite of behavior and is a stronger and more direct predictor of competitive relationship than awareness" (Chen et al., 2007: 106). Thus, although rivals tend to be aware of the investment of a high-reputation corporate investor, they may have reduced motivation to follow suit.

Hypothesis 3. (H3). *The higher the reputation of the corporate investor that invests in a new venture, the lower the likelihood that a rival will undertake a matching response.*

4 | METHODS

4.1 | Data

The population of our study consisted of CVC investments made by U.S. public firms (corporate investors) between 2000 and 2014. We focused on public firms because their competitive activities are more readily observed and their competitive relationships can be clearly established, which are prerequisites for analyzing actions and responses (Derfus et al., 2008; Nadkarni, Chen, & Chen, 2016). We chose the years 2000–2014 for several reasons. First, the

turn of the 21st century witnessed a new wave of CVC investments (Dushnitsky, 2012). Second, corporate investors were more active after 2000, and many initiatives involved multiple rounds of investment (Dushnitsky, 2011), which offered an ideal setting for capturing rivalry in the form of CVC investments. Finally, the time period was long enough to capture different economic conditions, including economic recovery (2004–2007 and 2011–2013) and economic crisis (2008–2010), which increased the generalizability of our findings.

Our unit of analysis was a funding event—a round of investment in which corporate investors form syndicates with other venture capitalists to invest in a specific new venture. When corporate investors are involved in funding events, they tend to invest in a series of discrete rounds so as to monitor the advance of new companies. We collected data on each funding event between 2000 and 2014 using multiple data sources. Our key data source was the VentureXpert database, which provided comprehensive and detailed descriptions of U.S. venture financing, including information about ventures, corporate investors and funding rounds (Dushnitsky & Lenox, 2005a). Because of its richness and reliability, this database has been widely used in CVC research (Hallen et al., 2014; Yang et al., 2014). We then matched the data from VentureXpert with information from the Compustat database, which offered comprehensive data on U.S. public firms.

4.2 | Action-response dyads

To test our hypotheses, we needed to identify action-response dyads among the CVC investments of rival firms. To do so, we first downloaded the entire investment records from VentureXpert for the chosen time frame, on the basis of which, we created a list of corporate investors. We manually matched the names of the corporate investors reported by VentureXpert with firm names that appeared in Compustat. Some corporate investors were associated with multiple CVC arms. After careful examination of each firm and its corresponding CVC arm(s), we constructed an initial list of 283 U.S. public firms that had invested in at least one new venture in the chosen time frame, which constituted our initial pool of corporate investors. We identified a total number of 4,275 VC investments made by these corporate investors.

We then defined rivals of each corporate investor as public firms having the same four-digit Standard Industrial Classification (SIC) code as the focal corporate investor (Ferrier, Smith, & Grimm, 1999). Note that although an ad-hoc investment in a startup may be pursued by many firms, it is often the case that setting up a CVC capability is a prerogative of larger corporations. Accordingly, we assume that competitive tension is particularly higher among large firms (Chen et al., 2007) and thus, for each industry, we considered the top-20 public firms with the largest market shares in the focal corporate investor's industry as rivals, and monitored the occurrences of matching responses among these firms.[3]

Next, we identified CVC-related actions and responses for these competitive pairs. Prior competitive dynamics research has used temporal ordering of rival firms' competitive actions as the basis to identify action-response dyads (Derfus et al., 2008; Nadkarni, Pan, & Chen, 2019). Following this approach, we arrayed the initial sample of 4,275 CVC investments by industry and in temporal order. Theoretically, each investment could be considered an initial action. However, in some cases, the same action could also be a response to an earlier action; to avoid this confusion, we included only those actions that were unlikely to be responses. Competitive dynamics research has established that action-response links are likely to occur within a 1-year time frame (Chen & Hambrick, 1995; Miller & Chen, 1994, 1996). Thus, actions with no preceding actions in the prior year are unlikely to be responses. Building on this logic, for an investment to be considered an initial action, we required it to have no preceding investments by firms in the focal corporate investor's industry that targeted the same type of startups (those with the same four-digit SIC code) in a 1-year window. For instance, we considered Qualcomm's investment in Telcare Inc. an action because we did not find any investment from Qualcomm's industry that targeted startups with the same four-digit SIC code as Telcare. This yielded 804 "initial actions" by focal corporate investors.

Additionally, competitive dynamics research highlights "awareness" as a prerequisite of response (Andrevski et al., 2021; Chen, 1996). Thus, if a focal firm's investment was minor, it may not qualify as a strategic event. In general, smaller investments are less likely to be noticed, making them less likely to awaken rivals' awareness or to evoke a response. Thus, we limited our selection of initial actions to investment events of over 500,000 U.S. dollars. After dropping initial actions in which total investment was less than 500,000 U.S. dollars, we were left with 696 unique "actions" by which to create action-response dyads.

We then created action-response dyads for each initial CVC investment by a focal corporate investor. Specifically, a focal corporate investor's CVC investment marked the starting point of an observation window, which put all rivals at risk of making a response. We tracked each competitive pair to see if a rival made a response to the initial investment by a focal firm. Because our dependent variable was the likelihood of a matching response, we required that a rival's later investment would only be considered a response to a focal corporate investor's initial investment if the two ventures had the same four-digit SIC code. If a rival was found to have made a matching investment in a 1-year time frame, we recorded the occurrence of a response in the competitive dyad; otherwise, we recorded a censored case. We used a 1-year frame to observe a rival's response because a rival's action 1 year later than that of a focal firm was less likely to be a response.[4] (Chen & Hambrick, 1995). In some cases, a rival had multiple records of response within the observation window and we recorded the first as a response. The final data (in our main analyses) included 11,925 action-response dyads in 81 industries (based on four-digit SIC codes) from 2000 to 2014. This sample included a total of 3,568 competitor pairs, composed of 119 focal firms and 1,997 rivals.

4.3 | Measure

4.3.1 | Likelihood of matching response

We defined the likelihood of a matching response as the probability that a rival will use the same type of CVC investment as a response to a focal corporate investor's early CVC investment. Following previous studies using similar data (Allison, 1995; Park & Steensma, 2012), we used event history analysis to model the likelihood of a matching response. Specifically, an investment of a focal corporate investor marked the beginning of an observation window, which was closed by the occurrence of a rival's same type of investment or termination of the observation due to nonresponse within the year. As noted, we used 1-year observation windows to determine if an initial investment evoked a matching response in a competitive pair; that is, if no rival investment was observed 1 year after the focal corporate investor's initial investment, the observation was considered right-censored.

We operationalized the measure based on two variables: (a) *response*, a dichotomous variable indicating whether a matching response was observed, with 1 indicating a matching response and 0 indicating no matching response; and (b) *time delay*, a continuous variable capturing the number of days between the focal corporate investor's initial investment date and the date of a rival's matching response. If no matching response was observed, we treated the case as right-censored, with *time delay* measured as the number of days between the investment date and the date we closed our observation window. We also used right-censoring if the 1-year observation window was later than December 31, 2014. The instantaneous hazard of a rival response, $h(t)$, at time t, was defined as:

$$h(t) = \lim_{\Delta t \to 0} \left(\frac{\Pr\{t \le T < t + \Delta t | T \ge t\}}{\Delta t} \right)$$

where T represents the variable *time delay* and Pr indicates the likelihood of *response* = 1 during the time interval from t to $t + \Delta t$. Of the 11,925 action-response dyads, 57 responses were recorded.

4.3.2 | Amount of funding

This was the dollar amount that a new venture received in an investment event (Park & Steensma, 2012). We used the VentureXpert database to obtain this information. Following previous studies (Park & Steensma, 2012), we used the logarithm of the amounts in the calculation.

4.3.3 | Industry relatedness

Following established research (Keil et al., 2008), we operationalized *industry relatedness* based on the overlap between the SIC code of the new venture of the focal corporate investor and the SIC code of the competitor/focal firm.[5] If their SIC codes overlapped by four digits, we coded industry relatedness as 4; if they overlapped three digits, then we coded it 3. In the same way, we coded two-digit and one-digit overlaps. If their SIC codes are completely different, we coded industry relatedness as 0. We used the VentureXpert and the Compustat databases to obtain firms' SIC codes.

4.3.4 | Corporate investor reputation

The organizational literature has defined the reputation of a firm based on the prominence and quality of outputs. Based on this logic, Lee et al. (2011) have suggested using a composite measure to capture different facets of a corporate investor's reputation. The prominence of a corporate investor may be reflected by a large number of new ventures that receive its funding. In addition, the overall prominence of a corporate investor may change over time. Thus, we used the total number of portfolio companies that a corporate investor had invested in a 1-year window prior to the focal investment to capture the corporate investor's prominence (Lee et al., 2011). In addition, taking a venture public represents a highly visible and profitable way a corporate investor can capture value from its investment (Lee et al., 2011). Thus, the quality of outputs may manifest in the number of ventures that a corporate investor has taken public. We, therefore, used the total number of ventures that a corporate investor had taken public in the 1-year window prior to the focal investment to measure a corporate investor's quality of outputs (Lee et al., 2011). We then averaged the *z* scores of the two measures to arrive at a measure of corporate investor reputation.

Controls

We controlled for a number of factors that may serve as alternative explanations. In each competitive pair, we controlled the firm size of both a focal corporate investor and a rival because firm size may enhance the ability to pursue new opportunities (Smith et al., 2001), implying different levels of competitive threat. We measured firm size as the logarithm of total employees. We controlled for the performance of the focal corporate investor and the rival, measured as ROA (McDonald, Khanna, & Westphal, 2008) in the year of current investment. We controlled for the organizational slack of both the corporate investor and the rival because these resources may enhance the firm's ability to invest in CVC and undertake more competitive actions (Ferrier, 2001), thereby influencing the rival's response. Consistent with previous studies (e.g., Cheng & Kesner, 1997; Nadkarni et al., 2016), we measured slack based on the average of (a) the current ratio computed as current assets/current liabilities (available slack), (b) debt-equity ratio (potential slack), and (c) the ratio of general and administrative expenses to sales (recoverable slack). We controlled for technological intensity—the ratio of research and development expenditure to total sales—of the focal corporate investor and rival. For both, we controlled for investment history—how much a firm had invested CVC in startups in the same industry as the focal investor's initial investment. We used a 3-year rolling window to measure this as a count of such investments.

We controlled for the number of a corporate investor's other strategic actions (e.g., new products, strategic alliances, mergers and acquisitions, and technology innovation) because rivals' decisions may be influenced by these actions. Competitive dynamics scholars have differentiated strategic versus tactical actions conceptually and empirically (Andrevski & Miller, 2022; Chen & Miller, 1994; Connelly, Tihanyi, Certo, & Hitt, 2010; Ferrier et al., 1999). We followed Rindova, Ferrier, and Wiltbank (2010) and Connelly et al. (2010) in operationalizing this variable in several steps. We first identified news headlines containing the names of our sampled firms in our study period from the LexisNexis online database. Then, we content-analyzed each headline to determine the type of action with the help of a software program developed specifically for that purpose. This enabled us to classify each headline into one of the following action categories: merger and acquisition, new product introduction, strategic alliance, technological innovation, capacity change, marketing, change in organizational structure, improvement in distribution channel, and price action. Next, two management researchers ranked each type of action according to strategic significance, agreeing that the following types have the most strategic significance: new product introduction, strategic alliances, mergers and acquisitions, and technology innovation. We computed the frequency of these actions to operationalize a corporate investor's other strategic actions. For each competitive pair, we also controlled for the rival's firm size, performance, organizational slack, and technological intensity. We measured these variables in the same way as for the focal corporate investor.

We controlled for each venture's stage and the number of co-investors in an investment round. When a corporate investor invests in a venture, the venture may be in its initial or later stage, which may have different implications for rivals. We used a dichotomous variable to indicate if a venture was in its initial stage. We followed Maula et al. (2013) to count the total number of investors involved in a particular CVC investment round. We obtained this information from VentureXpert.

We controlled for several characteristics of a corporate investor's industry, including the number of competitors, CVC intensity, munificence, concentration and dynamism. The number of competitors may affect a rival's perception of competition and thus may affect its decision to respond. We measured this variable as the count number of competitors. The total number of CVC investments by all firms in a focal corporate investor's industry may serve as alternative explanations for a rival's CVC decision; therefore, we controlled for this effect by adding the total number of CVC investments, regardless of their SIC codes, by public firms in a given year. Munificence was measured as the percentage change in total sales in an industry over two consecutive years (Bergh & Lawless, 1998). Concentration was measured as the Herfindahl index based on the established procedure suggested in previous studies (Ferrier, 2001). To measure dynamism, we first created 5-year rolling windows and used regression analyses in which a variable indicating each year was regressed on total industry sales ($y_t = b_0 + b_1 t + a_t$, where y is the total industrial sales, t represents the year, and a is the residual). Dynamism was calculated as the standardized error of the coefficient divided by the mean of total sales (Bergh & Lawless, 1998).

4.4 | Analytic methods

We used Cox proportional hazard models to analyze our data. The Cox proportional hazard method is particularly appropriate for our study for two reasons. First, it effectively models cases where no responses were observed by treating them as censored cases (Allison, 1995; Cox, 1972; Yu & Cannella, 2007). Second, assuming a fixed hazard ratio over time, the Cox proportional hazard model represents a robust technique for hazard rate analysis without requiring assumptions regarding the precise nature of the hazard's probability distribution (Allison, 1995; Cox, 1972). This technique is particularly efficient in the analysis of various forms of event history data (Allison, 1995; Gimeno et al., 2005). We also used accelerated failure time (AFT) regression models to analyze our data. While the Cox model assumes a fixed hazard ratio over time, the AFT method allows the hazard to accelerate or decelerate over time. As noted by Allison (1995), the results from Cox models and AFT models are often comparable; thus, we used both methods to enhance the robustness of our analysis. As we discuss below, we obtained consistent results using the two methods. We used Stata to analyze the data.

5 | RESULTS

Table 1 reports summary statistics for our variables. Table 2 reports corrections. We did not find critically collinear variables (e.g., *r* > .8) in our data (Yu & Cannella, 2007). Using ordinary least squares (OLS) regression with a *time delay* as the dependent variable, we computed the variance inflation factors (VIFs) for all the explanatory variables in our model and found that the VIFs fell in the acceptable range (<3).

Table 3 reports results from the Cox and AFT models. Hypothesis 1 postulated a positive association between *amount of funding* and the likelihood of rival response. In model 2, the coefficient for *amount of funding* was $\beta = 0.31$ with $p = .059$,[6] indicating that as *amount of funding* increased, the probability that a rival would respond also increased. Unlike a Cox regression, an AFT model reports the impact of covariates on "survival" rather than "failure"; thus, a positive coefficient in an AFT model indicates a negative association between the variable of interest and the likelihood that the event under investigation will happen. In model 4, the coefficient for *amount of funding* was $\beta = -0.31$ with $p = .064$, indicating that as *amount of funding* increased, the probability of rival nonresponse decreased. These findings supported H1.

Hypothesis 2 (H2) predicted a positive association between the *industry relatedness* and the likelihood of rival response. In model 2, the coefficient for *industry relatedness* was $\beta = 0.41$ with $p = .000$, indicating that as *industry*

TABLE 1 Summary statistics

	Mean	SD	Max	Min
Firm size[a]	9.51	2.31	12.02	3.4
Firm ROA	0.09	0.21	0.44	−0.39
Firm slack	0.84	0.35	1.5	0.04
Firm tech intensity	0.15	0.08	0.24	0
Firm strategic action[b]	3.29	1	4.74	1.1
Firm investment history	0.93	1.45	16	0
Rival size[a]	8.39	2.22	11.49	3.2
Rival ROA	0.01	0.34	0.51	−0.76
Rival slack	0.93	0.53	2.29	0.22
Rival tech intensity	0.18	0.13	0.34	0
Rival investment history	0.01	0.19	15	0
Venture stage	0.17	0.38	1	0
Number of investors	5.51	3.05	25	1
Number of competitors	18.69	2.2	20	12
Industry CVC intensity[a]	2.12	0.95	5.35	0.69
Industry dynamism	0.06	0.04	0.16	0.01
Industry concentration	0.13	0.1	0.41	0.03
Industry munificence	0.06	0.21	0.58	−0.35
Amount of funding[c]	9.22	1.06	13	6.22
Industry relatedness	0.67	1.18	4	0
CVC reputation	0.42	0.86	3.83	−1.07

Note: N = 11,925.
[a]Logarithm.
[b]Logarithm. For original firm strategic action, mean = 40.63, SD = 39.24.
[c]Logarithm. For original amount of funding, mean = 20,700.99($ in thousands), SD = 88,900.94.

TABLE 2 Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) Firm size	1.00																			
(2) Firm ROA	0.40	1.00																		
(3) Firm slack	−0.50	−0.10	1.00																	
(4) Firm tech intensity	−0.26	−0.07	0.54	1.00																
(5) Firm strategic action	−0.04	−0.00	0.26	0.20	1.00															
(6) Firm investment history	−0.03	−0.01	0.02	−0.03	0.11	1.00														
(7) Rival size	0.29	0.23	−0.08	−0.02	0.14	−0.04	1.00													
(8) Rival ROA	0.11	0.15	0.06	0.06	0.04	−0.05	0.37	1.00												
(9) Rival slack	−0.10	−0.03	0.21	0.11	0.04	0.01	−0.33	−0.01	1.00											
(10) Rival tech intensity	−0.00	−0.03	0.03	0.17	−0.08	−0.01	−0.21	−0.13	0.08	1.00										
(11) Rival investment history	−0.01	−0.01	−0.00	0.01	0.01	0.03	0.03	0.02	0.01	−0.01	1.00									
(12) Venture stage	−0.16	−0.03	0.09	0.06	0.01	−0.02	−0.02	−0.00	0.01	0.01	−0.00	1.00								
(13) Number of investors	0.19	0.06	−0.17	−0.16	−0.02	0.10	0.06	−0.03	−0.05	−0.05	−0.01	−0.18	1.00							
(14) Number of competitors	−0.23	−0.04	0.22	0.12	0.05	−0.05	0.17	0.07	0.01	−0.08	0.01	0.05	−0.07	1.00						
(15) Industry CVC intensity	0.15	0.15	0.15	0.03	0.27	0.02	0.27	0.05	0.02	−0.08	0.03	0.06	0.05	0.15	1.00					
(16) Industry dynamism	0.04	−0.06	−0.02	−0.01	−0.16	−0.02	−0.24	−0.10	0.10	0.12	0.01	−0.13	0.04	−0.16	−0.16	1.00				
(17) Industry concentration	−0.07	−0.21	0.01	−0.03	−0.19	0.02	−0.46	−0.24	0.14	0.10	−0.01	−0.04	0.01	−0.27	−0.21	0.39	1.00			
(18) Industry munificence	0.05	0.13	−0.12	−0.04	−0.18	−0.07	−0.03	0.03	−0.01	0.02	−0.02	−0.09	0.08	−0.04	−0.18	0.05	0.01	1.00		
(19) Amount of funding	0.06	0.03	0.04	−0.06	0.13	0.01	0.00	−0.02	−0.01	0.04	−0.00	−0.15	0.37	0.01	0.10	−0.03	0.12	−0.02	1.00	

(Continues)

TABLE 2 (Continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(10) Industry relatedness	0.02	−0.00	0.02	0.05	0.08	0.05	0.08	0.05	0.01	−0.13	0.04	0.02	0.01	0.10	0.01	−0.08	−0.10	−0.00	−0.05	1.00
(21) Corporate investor reputation	0.22	0.08	−0.17	−0.21	0.04	0.01	0.05	−0.06	−0.04	−0.04	−0.02	−0.13	0.59	−0.06	0.22	−0.04	0.02	−0.00	0.36	0.01

Note: $N = 11{,}925$. Correlations of absolute value greater than 0.02 are significant at $p < .05$.

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relatedness increased, the probability that a rival would respond also increased. In model 4, the coefficient for *industry relatedness* was $\beta = -0.41$ with $p = .000$, indicating that as *industry relatedness* increased, the probability of rival non-response decreased. Thus, H2 was supported.

Hypothesis 3 (H3) predicted a negative association between *corporate investor reputation* and the likelihood of rival response. In model 2, the coefficient for *corporate investor reputation* was $\beta = -0.52$ with $p = .022$, suggesting that the investment by a high reputation corporate investor was less likely to invite a rival's response. In model 4, the coefficient for *corporate investor reputation* was $\beta = 0.52$ with $p = .028$, suggesting that the investment by a high reputation corporate investor had a higher probability of delaying rival response. These findings supported H3.

Robustness checks

We employed several additional analyses to establish the robustness of our results. First, we used a 2-year time frame to model rival responses. In the main analyses, we used a 1-year window after a focal corporate investor's initial CVC investment to record a rival's response. However, some rivals may delay responding for more than 1 year. Table 4 reports results from Cox and AFT regression models using the 2-year response window. In the Cox

TABLE 3 Results from Cox and accelerated failure time (AFT) models

	Cox		AFT	
	(1)	(2)	(3)	(4)
Controls				
Firm size	0.28 (.049)	0.31 (.040)	−0.29 (.051)	−0.32 (.046)
Firm ROA	−0.75 (.430)	−1.00 (.329)	0.70 (.462)	0.95 (.356)
Firm slack	0.49 (.472)	0.57 (.420)	−0.52 (.447)	−0.58 (.409)
Firm tech intensity	8.72 (.002)	7.63 (.008)	−8.70 (.004)	−7.66 (.011)
Firm strategic action	−0.17 (.291)	−0.21 (.221)	0.17 (.306)	0.20 (.236)
Firm investment history	0.22 (.000)	0.09 (.076)	−0.22 (.000)	−0.09 (.074)
Rival size	0.66 (.000)	0.62 (.000)	−0.66 (.000)	−0.62 (.000)
Rival ROA	1.74 (.009)	1.90 (.005)	−1.74 (.012)	−1.91 (.008)
Rival slack	0.42 (.179)	0.38 (.238)	−0.42 (.182)	−0.38 (.239)
Rival tech intensity	0.21 (.870)	0.49 (.711)	−0.25 (.845)	−0.52 (.694)
Rival investment history	0.47 (.000)	0.39 (.000)	−0.48 (.000)	−0.39 (.000)
Venture stage	0.33 (.365)	0.23 (.550)	−0.33 (.368)	−0.23 (.551)
Number of investors	0.06 (.178)	0.11 (.047)	−0.06 (.181)	−0.11 (.056)
Number of competitors	0.24 (.096)	0.15 (.266)	−0.24 (.096)	−0.16 (.257)
Industry CVC intensity	0.53 (.002)	0.65 (.001)	−0.53 (.004)	−0.64 (.002)
Industry dynamism	4.22 (.306)	3.50 (.413)	−3.94 (.343)	−3.24 (.453)
Industry concentration	4.91 (.020)	5.10 (.023)	−5.05 (.020)	−5.24 (.024)
Industry munificence	0.66 (.380)	0.28 (.715)	−0.64 (.389)	−0.27 (.727)
Study variables				
Amount of funding		0.31 (.059)		−0.31 (.064)
Industry relatedness		0.41 (.000)		−0.41 (.000)
CVC reputation		−0.52 (.022)		0.52 (.028)
Log likelihood	−450.09	−437.75	−336.10	−323.78

Note: N = 11,925. Response = 57. *p*-values in parentheses.

regression (model 2), we found the coefficient for *amount of funding* was $\beta = 0.16$ with $p = .277$, the coefficient for *industry relatedness* was $\beta = 0.33$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = -0.38$ with $p = .047$. In the AFT regression (model 4), the coefficient for *amount of funding* was $\beta = -0.13$ with $p = .179$, the coefficient for *industry relatedness* was $\beta = -0.28$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = 0.24$ with $p = .068$. These results suggest that under 2-year response windows, whereas the explanatory power of *industry relatedness* and *corporate investor reputation* remained largely the same, the explanatory power of *amount of funding* seems to have declined.

Second, in the main analyses, we limited our selection of initial actions to investment events of over 500,000 U. S. dollars. In our robustness tests, we performed sensitivity analyses using 1 million U.S. dollars as the threshold. Table 5 reports results from Cox and AFT regression models using this threshold. In model 2, the coefficient for *amount of funding* was $\beta = 0.28$ with $p = .087$, the coefficient for *industry relatedness* was $\beta = 0.41$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = -0.52$ with $p = .022$. In model 4, the coefficient for *amount of funding* was $\beta = -0.29$ with $p = .091$, the coefficient for *industry relatedness* was $\beta = -0.41$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = 0.51$ with $p = .029$. These results were consistent with those from our main analyses.

TABLE 4 Results from Cox and AFT models using 2-year response window

	Cox		AFT	
	(1)	(2)	(3)	(4)
Controls				
Firm size	0.22 (.073)	0.27 (.043)	−0.13 (.098)	−0.14 (.086)
Firm ROA	−0.11 (.895)	−0.26 (.762)	0.37 (.490)	0.41 (.471)
Firm slack	−0.18 (.772)	−0.09 (.887)	−0.28 (.476)	−0.34 (.390)
Firm tech intensity	9.98 (.000)	8.74 (.002)	−4.36 (.006)	−3.70 (.020)
Firm strategic action	−0.13 (.367)	−0.14 (.380)	0.12 (.196)	0.15 (.115)
Firm investment history	0.24 (.000)	0.14 (.005)	−0.13 (.000)	−0.06 (.079)
Rival size	0.56 (.000)	0.55 (.000)	−0.49 (.000)	−0.48 (.000)
Rival ROA	1.62 (.006)	1.61 (.009)	−1.03 (.009)	−1.10 (.008)
Rival slack	0.45 (.134)	0.44 (.143)	−0.40 (.031)	−0.36 (.057)
Rival tech intensity	−0.13 (.916)	0.14 (.913)	−0.36 (.629)	−0.60 (.428)
Rival investment history	0.48 (.000)	0.42 (.000)	−0.30 (.000)	−0.24 (.000)
Venture stage	0.38 (.222)	0.40 (.228)	−0.23 (.275)	−0.16 (.474)
Number of investors	0.06 (.101)	0.10 (.040)	−0.04 (.136)	−0.06 (.048)
Number of competitors	0.26 (.060)	0.20 (.131)	−0.13 (.106)	−0.08 (.285)
Industry CVC intensity	0.42 (.007)	0.50 (.003)	−0.31 (.002)	−0.36 (.001)
Industry dynamism	3.89 (.314)	4.59 (.246)	−2.69 (.268)	−2.54 (.311)
Industry concentration	4.83 (.016)	5.02 (.016)	−2.42 (.062)	−2.53 (.066)
Industry munificence	1.08 (.112)	1.03 (.142)	−0.40 (.348)	−0.21 (.643)
Study variables				
Amount of funding		0.16 (.277)		−0.13 (.179)
Industry relatedness		0.33 (.000)		−0.28 (.000)
CVC reputation		−0.38 (.047)		0.24 (.068)
Log likelihood	−491.50	−482.16	−412.58	−398.19

Note: $N = 11,925$. Response $= 76$. p-values in parentheses.

Finally, we conducted an additional analysis using a broader definition of rivals. In our main analysis, we modeled responses by including the top 20 players in the industry as rivals in the competitive dyads. In Table 6, we included all public firms in the same industry and reran all the Cox and AFT models. In model 2, the coefficient for *amount of funding* was $\beta = 0.22$ with $p = .081$, the coefficient for *industry relatedness* was $\beta = 0.42$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = -0.31$ with $p = .077$. In model 4, the coefficient for *amount of funding* was $\beta = -0.21$ with $p = .056$, the coefficient for *industry relatedness* was $\beta = -0.41$ with $p = .000$, and the coefficient for *corporate investor reputation* was $\beta = 0.31$ with $p = .081$. These results are consistent with our main analysis, albeit weaker given the more peripheral nature of the rivals.

6 | DISCUSSION

We explored the competitive implications of firms' CVC investments based on the action-response framework from competitive dynamics (Chen, 1996; Tsai et al., 2011). Departing from prior CVC research in which corporate

TABLE 5 Results from Cox and AFT models using $1 M cut-off

	Cox		AFT	
	(1)	(2)	(3)	(4)
Controls				
Firm size	0.28 (.051)	0.31 (.040)	−0.28 (.053)	−0.32 (.045)
Firm ROA	−0.73 (.440)	−1.01 (.324)	0.68 (.471)	0.96 (.351)
Firm slack	0.50 (.465)	0.57 (.417)	−0.52 (.441)	−0.59 (.405)
Firm tech intensity	8.81 (.002)	7.71 (.007)	−8.79 (.004)	−7.74 (.010)
Firm strategic action	−0.19 (.244)	−0.21 (.219)	0.19 (.260)	0.21 (.234)
Firm investment history	0.22 (.000)	0.09 (.074)	−0.22 (.000)	−0.09 (.072)
Rival size	0.65 (.000)	0.62 (.000)	−0.65 (.000)	−0.62 (.000)
Rival ROA	1.74 (.008)	1.89 (.005)	−1.75 (.011)	−1.90 (.008)
Rival slack	0.42 (.178)	0.38 (.237)	−0.42 (.180)	−0.38 (.237)
Rival tech intensity	0.12 (.923)	0.42 (.743)	−0.16 (.897)	−0.45 (.726)
Rival investment history	0.47 (.000)	0.39 (.000)	−0.48 (.000)	−0.39 (.000)
Venture stage	0.31 (.389)	0.22 (.568)	−0.31 (.391)	−0.22 (.568)
Number of investors	0.06 (.188)	0.11 (.044)	−0.06 (.190)	−0.11 (.052)
Number of competitors	0.23 (.110)	0.15 (.268)	−0.23 (.108)	−0.16 (.258)
Industry CVC intensity	0.55 (.001)	0.65 (.001)	−0.54 (.003)	−0.65 (.002)
Industry dynamism	4.67 (.267)	3.59 (.404)	−4.39 (.302)	−3.33 (.444)
Industry concentration	4.70 (.027)	5.06 (.025)	−4.84 (.026)	−5.20 (.025)
Industry munificence	0.70 (.348)	0.31 (.691)	−0.69 (.357)	−0.30 (.703)
Study variables				
Amount of funding		0.28 (.087)		−0.29 (.091)
Industry relatedness		0.41 (.000)		−0.41 (.000)
CVC reputation		−0.52 (.022)		0.51 (.029)
Log likelihood	−449.26	−437.42	−335.26	−323.45

Note: N = 11,701. Response = 57. *p*-values in parentheses.

investors (e.g., Benson & Ziedonis, 2009) or new ventures (e.g., Alvarez-Garrido & Dushnitsky, 2015) were the principal points of reference, we adopted a relational perspective to examine competitive interaction between firms in the form of CVC investments. Drawing on competitive dynamics theory (Chen, 1996), we used an investment round as the unit of analysis and examined how factors pertaining to a focal corporate investor's specific CVC investments may influence the likelihood that rivals will engage in matching responses. Consistent with competitive dynamics theory (e.g., Chen et al., 1992), our results suggest that a focal corporate investor's investment may influence the *awareness* and *motivation* of its rivals and thus the likelihood that those rivals will engage in the same type of strategic behavior.

6.1 | Theoretical contribution

Our research bridges the competitive dynamics and CVC literature in several important ways. Competitive dynamics researchers have shown that competitive signals indicating a focal firm's strategic posture—embedded in factors such

TABLE 6 Results from Cox and AFT models with all rivals included

	Cox		AFT	
	(1)	(2)	(3)	(4)
Controls				
Firm size	0.12 (.158)	0.08 (.380)	−0.12 (.164)	−0.08 (.387)
Firm ROA	−0.51 (.434)	−0.38 (.578)	0.47 (.469)	0.33 (.621)
Firm slack	−0.38 (.446)	−0.56 (.268)	0.38 (.444)	0.57 (.263)
Firm tech intensity	3.27 (.052)	2.03 (.242)	−3.28 (.054)	−2.07 (.233)
Firm strategic action	−0.24 (.044)	−0.27 (.028)	0.24 (.049)	0.27 (.033)
Firm investment history	0.21 (.000)	0.11 (.008)	−0.21 (.000)	−0.11 (.011)
Rival size	0.78 (.000)	0.78 (.000)	−0.77 (.000)	−0.77 (.000)
Rival ROA	−0.09 (.183)	−0.12 (.103)	0.09 (.190)	0.12 (.110)
Rival slack	0.16 (.001)	0.16 (.001)	−0.16 (.001)	−0.16 (.002)
Rival tech intensity	−0.04 (.194)	−0.03 (.277)	0.04 (.196)	0.03 (.274)
Rival investment history	0.43 (.000)	0.38 (.000)	−0.43 (.000)	−0.38 (.000)
Venture stage	0.29 (.314)	0.23 (.439)	−0.30 (.305)	−0.24 (.421)
Number of investors	0.00 (.966)	0.02 (.688)	−0.00 (.962)	−0.02 (.690)
Number of competitors	0.00 (.566)	−0.00 (.446)	−0.00 (.571)	0.00 (.439)
Industry CVC intensity	0.41 (.008)	0.57 (.001)	−0.40 (.011)	−0.57 (.001)
Industry dynamism	7.24 (.038)	5.22 (.146)	−7.01 (.048)	−4.99 (.166)
Industry concentration	2.37 (.277)	2.03 (.380)	−2.47 (.256)	−2.16 (.347)
Industry munificence	0.34 (.561)	0.05 (.930)	−0.33 (.571)	−0.04 (.945)
Study variables				
Amount of funding		0.22 (.081)		−0.21 (.085)
Industry relatedness		0.42 (.000)		−0.41 (.000)
CVC reputation		−0.31 (.077)		0.31 (.081)
Log likelihood	−867.48	−852.01	−637.54	−621.99

Note: N = 73,959. Response = 92. *p*-values in parentheses.

as resource endowments, innovation, growth potential, or competitive actions—may influence rivals' *awareness* of competitive pressure and *motivation* for defensive actions (Chen et al., 2007). Our study builds on this line of thinking and signaling theory to examine inter-firm rivalry in the context of the CVC market, and to empirically test how factors characterizing a focal corporate investor's CVC investment may influence rival responses. Previous research has shown that industry affliction and resource exchange between corporate investors and new ventures are important factors in determining the outcome of firms' CVC investing (Dushnitsky & Lenox, 2005b). Our study embraces arguments from competitive dynamics theory (Chen, 1996) to address the competitive signals associated with these factors. Our results demonstrate that the amount of funding and choice of industry in a focal corporate investor's CVC investment contain competitive signals to evoke rivals' awareness and motivation to match the focal corporate investor's action (Basu et al., 2011). In addition, signaling theory also suggests that the qualifications of signalers serve as competitive signals (Connelly et al., 2011). We found that if an investment is made by a "powerful" corporate investor (highly reputed in the CVC market), this very factor may discourage rivals from engaging in matching responses.

Our study contributes both to the CVC and competitive dynamics perspectives. Clearly, as technologies keep developing at a faster and more uncertain rate, and partnerships and strategic alliances become more common, CVC initiatives have grown in popularity (Yang et al., 2014). They have become increasingly important aspects of firms' competitive repertoires. Yet they have been neglected by scholars of competitive dynamics. This is a serious oversight as new ventures represent a core means of competing for a growing number of firms (Maula et al., 2013). As we have seen, they also may evoke competitive responses so that current models of competitive dynamics can be leveraged to better understand the competitive threats and opportunities represented by CVC initiatives.

CVC scholars to date have paid scant attention to the extent to which ventures invested by corporate investors may attract imitation or similar initiatives from rivals, reactions that may well cancel the advantages of their initiative. This is a significant challenge as, paradoxically, the same attributes that may induce some corporate investors to invest in a venture—for example, funding from partners or closeness to the core business—may also invite imitation that cancels the ultimate advantages or benefits of the competitive initiative. Practically, this may imply that corporate investors must, when deciding on their ventures, anticipate the potential responses of rivals and consider whether they have the resource, path dependence, or market advantages to sustain venture success in light of competitive replication. They may also wish to consider means of keeping their ventures below the radar until they develop the resources and capabilities to sustain success.

Although we view competitors' CVC investments as influencing a focal firm's CVC strategy, we recognize that the success of a firm relative to its competitors can also be a driver of managerial aspirations relating to innovation, and thus their CVC engagement (Gaba & Dokko, 2016). In fact, literature leveraging the behavioral theory of the firm argues that CVC investments can be influenced by the degree to which firms' efforts at innovation, renewal and R&D meet managerial expectations. A particularly important source of aspiration comes from a focal firm's position vis-à-vis its industry peers (Gaba & Bhattacharya, 2012). Where a focal firm's performance falls below expectations, managers may be more willing to engage in riskier approaches to business renewal, including corporate venture capital investment. By contrast, where firms are content with their innovation efforts – where these match or exceed aspiration levels, firms might be less willing to venture forth by adopting venture capital initiatives (Gaba & Bhattacharya, 2012). Notably, while both the behavioral theory and competitive dynamics highlight the motivation of managers to engage in CVC, they differ in terms of the source of this motivation. Whereas the behavioral theory emphasizes "social aspirations," competitive dynamics theory focuses on the specific competitive activity as a key driver in evoking responses.

Empirically, we followed Gaba and Bhattacharya (2012) to test how a rival's innovation performance vis-a-vis social aspiration may influence its likelihood of responding to a focal firm's CVC investment (see Table 7).[7] Consistent with their prediction, we found that when a rival's innovation performance falls below aspiration, it is more likely to launch a matching response. Notably, even after adding these variables to our analyses, our findings remained consistent.

Prior research highlights the strategic benefits of CVC investment (Dushnitsky & Lenox, 2005a). Our study however suggests that CVC investments result from not only the pursuit of resources or competitive position, but also the CVC behavior of competitors. This echoes the view from competitive dynamics: "It perhaps becomes appropriate to define strategy as dynamic maneuvering—moves and counter moves—rather than static positioning, such as resources, routines, capabilities, generic strategy, industry structure" (D'Aveni, Dagnino, & Smith, 2010, p. 1372). Thus, it is important to consider CVC investments as a form of "dynamic maneuvering—moves and countermoves" (D'Aveni et al., 2010, p. 1372) and to examine CVC through the lens of dynamic competition. By considering firms' CVC investments as a particular form of rivalry, we incorporate concepts from corporate entrepreneurship to enrich our understanding of inter-firm rivalry. Prior competitive dynamic research has examined how characteristics associated with actions such as pricing, capacity enhancement, marketing or new product introduction may influence inter-firm rivalry (Ferrier, 2001; Yu & Cannella, 2007). Our study moves beyond these types of competitive actions to suggest that in the corporate entrepreneurship setting, incumbent firms may use CVC investments as a means of

TABLE 7 Results from Cox and AFT models with social aspiration (below and above) as controls

	Cox		AFT	
	(1)	(2)	(3)	(4)
Controls				
Firm size	0.33 (.017)	0.38 (.014)	−0.33 (.019)	−0.37 (.017)
Firm ROA	−0.48 (.612)	−0.70 (.493)	0.42 (.647)	0.65 (.518)
Firm slacks	0.70 (.301)	0.89 (.210)	−0.73 (.268)	−0.90 (.197)
Firm tech intensity	9.20 (.002)	8.18 (.005)	−8.93 (.003)	−8.02 (.008)
Firm strategic action	−0.13 (.422)	−0.18 (.293)	0.13 (.431)	0.17 (.306)
Firm investment history	0.22 (.000)	0.09 (.094)	−0.22 (.000)	−0.09 (.073)
Rival size	0.61 (.000)	0.57 (.000)	−0.59 (.000)	−0.56 (.000)
Rival ROA	1.36 (.038)	1.53 (.024)	−1.33 (.042)	−1.50 (.028)
Rival slacks	0.36 (.279)	0.29 (.396)	−0.34 (.285)	−0.28 (.395)
Rival tech intensity	−0.81 (.546)	−0.69 (.622)	0.72 (.581)	0.62 (.652)
Rival investment history	0.46 (.000)	0.36 (.000)	−0.46 (.000)	−0.36 (.000)
Above social aspirations	0.01 (.135)	0.00 (.322)	−0.01 (.108)	−0.00 (.266)
Below social aspirations	0.06 (.001)	0.06 (.000)	−0.05 (.002)	−0.06 (.001)
Venture stage	0.27 (.456)	0.06 (.887)	−0.26 (.465)	−0.05 (.903)
Number of investors	0.05 (.251)	0.11 (.041)	−0.05 (.238)	−0.11 (.047)
Number of competitors	0.26 (.069)	0.18 (.187)	−0.25 (.069)	−0.18 (.181)
Industry (firm) CVC intensity	0.51 (.001)	0.65 (.000)	−0.50 (.003)	−0.63 (.001)
Industry dynamism	2.91 (.474)	1.89 (.655)	−2.57 (.516)	−1.56 (.707)
Industry concentration	3.87 (.069)	4.33 (.055)	−3.93 (.061)	−4.39 (.051)
Industry munificence	0.51 (.474)	−0.01 (.994)	−0.47 (.495)	0.03 (.972)
Study variables				
Amount of funding		0.27 (.092)		−0.27 (.096)
Industry relatedness		0.45 (.000)		−0.44 (.000)
CVC reputation		−0.58 (.009)		0.56 (.013)
Log likelihood	−439.27	−425.23	−324.86	−310.88

Note: N = 11,925. Response = 57. *p*-values in parentheses.

improving their competitive profiles or defending their competitive positions. The ultimate outcome of this strategy may be improved or eroded by the characteristics of their CVC investments. For example, CVC investments that are more subtle in scale, execution, and direction may be less likely to invite nullifying counteraction by rivals.

6.2 | Empirical contribution

Modeling response represents a core challenge for competitive dynamics scholars. Competitive interaction is reciprocal such that a focal firm's response to a rival's action can itself trigger subsequent responses. This is a core tenet of competitive dynamics. Despite that, there is a limited time frame within which to define action–response relationships. This study uses a 1-year time frame (Miller & Chen, 1996). Specifically, if there was no response within a year of a focal firm's action, we concluded that the focal firm's action did not receive a response from the rival. Similarly, a focal firm's investment was considered as an "initial action" only if there were no similar investments by competitors 1-year prior.

In our study, we tried different options to model responses included in the analyses depending on (a) the response time frame (1- or 2-year windows); (b) the cutoff amount for funding of initial actions; (c) the inclusion of industry competitors (top 20 or all firms). In the Appendix A, we provide an overview of the multiple ways in which we modeled responses to ensure robustness. Notably, the same rival could have more than one response to an initial action undertaken by a focal firm. We also modeled multiple responses from the same rivals and obtained similar results.

6.3 | Future direction and limitations

There are several directions that future studies may consider to further this line of research. First, firms' CVC investments and CVC-based rivalry may be especially important in uncertain industries in which innovation is risky and expensive (e.g., drugs, semiconductors), but less important in more stable industries. Also, CVC investments in network industries may be associated with more distinct competitive dynamics versus those in non-network industries (Chahine, Athurs, Filatochev, & Hoskinsson, 2012). In other words, the nature of the industry may serve as a moderating condition for considering CVC-based inter-firm rivalry. The implications of complementary versus substitutable technologies of a CVC and its investments would also be useful to explore. Future studies may draw from competitive dynamics and the CVC literature to more fully theorize these ideas. Another important research direction is to explore the role of firm success in meeting its innovative aspirations in influencing CVC investment (Gaba & Bhattacharya, 2012; Gaba & Dokko, 2016). How much does the degree to which a firm meets the innovative aspirations of its top managers drive CVC investments? How does that compare, for example, with the impact of the signaling factors studied in this research?

Second, our study uses a particular investment round as the unit of analysis to research the competitive interdependence among firms' CVC investments. However, future studies may examine this form of rivalry at the portfolio or repertoire level. Indeed, CVC research has investigated the characteristics of firms' overall CVC portfolio (Yang et al., 2014). Building upon this research, future studies may explore how a focal corporate investor's overall CVC portfolio may influence that of its rivals. For example, if there is a strategic shift in a focal corporate investor's CVC investment trajectory, will this change evoke strategic responses by a rival in the CVC market as well (Yang et al., 2014)? In addition, besides matching responses, is it possible that a rival may respond to a focal firm's CVC investment by undertaking other forms of competitive actions (e.g., acquiring a small firm)? These important yet unaddressed questions await further investigation.

Third, future studies may explore other competitive signals associated with various technological relationships between new ventures and corporate investors. Hellmann (2002) noted that the technology of a new venture and

that of a corporate investor may be complementary or strongly substitutable, and such technological relationships may affect the corporate investor's strategic goals and its interactions with the new venture, which may represent different competitive signals for rivals.

We are aware of the limitations of our study. First, it examines publicly traded U.S. firms to capture inter-firm rivalry, and this focus may limit the generalizability of our findings. We encourage further studies to explore how small firms use CVC investments to compete and examine how their rivals respond. Second, we pursued our research question using a large archival sample. Future studies could use more fine-grained methodologies such as surveys or interviews to capture how CVC managers process competitive information in deciding their CVC investments (Andrevski et al., 2021). Finally, whereas we employed the lens of competitive dynamics to adopt *awareness* and *motivation* as central mechanisms to predict rival responses, we did not directly measure these concepts. Similarly, we were unable to measure directly the "competitive pressure" rivals face when firms initiate CVC strategies. Therefore, future research could use more exacting survey and field study approaches to examine these central mechanisms directly as well as to measure rivals' competitive perceptions.

7 | CONCLUSION

This study examines established firms' CVC investments as a particular form of competitive interaction. By bridging the CVC literature and competitive dynamics, we argue that when a corporate investor participates in an investment round, it sends a competitive signal to its rival, motivating the latter to join in CVC investing as well. Because of this interaction, the competitive advantages generated by firms' CVC strategies may be temporary as rivals catch up with and nullify some of the technological, specialization, and learning benefits of a CVC initiative. Thus, when planning strategy, CVC managers need to take rivals' potential counteractions into account in their decision making, and carefully assess the competitive implications of their CVC strategy, paying special attention perhaps to reducing harmful counteractions via initiatives that are more subtle in execution and orientation and will fall "under the radar" of rivals.

ENDNOTES

[1] http://www.christina-larson.com/intel-buys-its-way-deeper-into-china/

[2] CVCs sometimes may use investments in ventures as real options and strategically invest less capital in each venture. From a competitive point of view, such an investment strategy may not only keep the option value but also reduce potential responses from rivals. In addition, there is some uncertainty in venture growth paths and even if a venture receives more funding, there is no guarantee it will be successful. Nonetheless, rivals tend to plan for the worst and thus, the competitive signal associated with a large amount of total funding may still raise their willingness to respond.

[3] Note that the top 20 players in an industry may vary by year.

[4] We also used a 2-year time frame to record a rival's response and the results remained consistent albeit weaker given the more peripheral nature of the rivals. We report the results as additional analyses.

[5] By design, the rival has the same SIC code as the focal firm.

[6] All *p*-values are based on two-tailed tests.

[7] Based on the suggestion of Gaba and Bhattacharya (2012), we used new product introductions to assess firms' innovation performance. We collected new product introduction data for all competitors in each industry, computed social aspiration based on the yearly industrial average, and used a spline function to compare a focal firm's slopes above and below the social aspiration level.

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APPENDIX A

A.1 | An overview of alternative ways to model responses

Rivals included to observe response	Time window to observe response	Cut-off	Modeling first or multiple responses	Number of observations	Responses identified	Where to find results based on this approach
Top 20	1 year	$500 K	First only	11,925	57	Table 3
Top 20	2 year	$500 K	First only	11,925	76	Table 4
Top 20	1 year	$1 M	First only	11,701	57	Table 5
All	1 year	$500 K	First only	74,925	92	Table 6