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SEARCH AND INTEGRATION IN EXTERNAL VENTURING: AN INDUCTIVE EXAMINATION OF CORPORATE VENTURE CAPITAL UNITS

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Research summary: How do external venturing units effectively achieve external knowledge search and integration of their initiatives with mainstream organizational units? We investigate this largely unexplored question through an inductive study of 17 corporate venture capital units. We document a set of five novel practices that influence the efficacy of a unit's external search and internal integration and identify how these practices complement a broader set of practices used by all units. We highlight the entrepreneurial nature of managing an external venturing unit, often to overcome unfavorable corporate contexts, a perspective that prior research has largely overlooked. Our findings provide unique insights into why some corporate investors are better at learning from external start-ups than others.

Managerial summary: External venturing involves strategic partnerships by established firms with entrepreneurial ventures. Top management usually tasks autonomous units with searching for willing and potentially valuable partners. These units must integrate their activities with the operations of parent firms to elicit cooperation from important business units. To understand how external venturing units implement search and integration in combination, we study corporate venture capital (CVC) units, which form external partnerships through minority investments in start-ups. While all units adopted fundamental processes that are well established in the venture capital community, certain processes that are idiosyncratic to corporate investing helped units demonstrate superior performance in their strategic missions. These processes often required CVC unit managers to be entrepreneurial and politically savvy in building connections with relevant personnel in parent firms. Copyright © 2015 Strategic Management Society.

INTRODUCTION

Although established firms need to adapt to changing competitive environments to survive and prosper

Keywords: external venturing; corporate venture capital; search; integration; qualitative

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over time, they are often constrained in doing so by their own processes, cultures, and capabilities (Leonard-Barton, 1992). An important way incumbents can remain nimble while continuing to compete in core businesses is through corporate venturing—programmatic efforts to create new entrepreneurial ventures within the firm (Block and MacMillan, 1993). Venturing can be internal or external, depending on whether the venture idea and required resources originate inside or outside firm boundaries (Sharma and Chrisman, 1999).

In internal corporate venturing, new business ideas are generated and nurtured within the firm, often through autonomous efforts by lower-level employees rather than explicit top-down direction (Burgelman, 1985).¹ In contrast, external venturing involves a deliberate search for new ideas and knowledge outside firm boundaries (Keil, 2004; Keil *et al.*, 2008). Established firms typically pursue external venturing by partnering with and learning from young entrepreneurial ventures (Wadhwa and Kotha, 2006), through dedicated units distinct from the mainstream organization (Dushnitsky, 2012). These external venturing units are tasked with the responsibility of searching for new ventures that are willing and potentially valuable partners (Keil, 2004). Thus, the effectiveness of an external venturing unit depends considerably on the efficacy of its external search processes (Dushnitsky and Lenox, 2005).

Research also suggests the extent to which external venturing units are effectively integrated with mainstream units complements their external search efforts (Hill and Birkinshaw, 2014). External venturing units act as boundary spanners between external partners and units within their parent firms (Keil, Autio, and George, 2008) and thereby face unique challenges in fostering knowledge sharing between these parties (Puranam and Srikanth, 2007). To perform their assigned role effectively, external venturing units must overcome the apathy or outright resistance of mainstream units toward sharing resources with, or learning from, external venture partners (Chesbrough and Rosenbloom, 2002).² Effective integration of external venturing units secures cooperation for themselves and external partners from the mainstream organization, enhancing these units' performance (Gaba and Bhattacharya, 2012).

In sum, research demonstrates that external venturing can contribute to the renewal and resilience of incumbent firms and is distinct from internal venturing in important ways. Scholars have pointed out that while it is important for external venturing units to engage in both search and integration, achieving

both simultaneously can be challenging. Focusing on external search can result in relative isolation from the mainstream organization (Chesbrough and Rosenbloom, 2002; Sykes, 1990), while efforts at enhancing integration can detract from the unit's primary search mission (Hill and Birkinshaw, 2014).

Despite these contributions to our understanding of external venturing, this literature is limited in two important respects. First, while prior research has highlighted the importance and challenges of search and integration during external venturing, there is little examination of the specific practices³ that allow venturing units to overcome these challenges. Prior research has typically highlighted effective search processes without elaborating on how they may affect integration or vice versa. Therefore, research has yet to identify how search and integration processes can work in tandem without impeding each other. For example, Keil *et al.* (2008) identify particular problems external venturing units face in searching for external ventures and in integrating with mainstream units, but do not explore how particular venturing practices address these problems. Souitaris, Zerbinati, and Liu (2012) demonstrate trade-offs between structures that increase venturing units' legitimacy with external venturing audiences (facilitating search) and those that increase legitimacy with internal mainstream unit audiences (facilitating integration). However, this study does not examine how these inconsistencies can be resolved so that units can be efficacious in search *and* integration. Similarly, Souitaris and Zerbinati (2014) identify and describe eight practices that differentiate corporate venture capitalists (a particular form of external corporate venturing) from independent venture capitalists (VCs) but do not investigate which of these practices aid search or integration and how.

Second, research has primarily focused on top management initiatives that foster search and integration (Dushnitsky and Shapira, 2010; O'Reilly and Tushman, 2008). Scholars have highlighted how senior managers who create specialized units also try and find ways to integrate these units with the mainstream organization (Tushman and O'Reilly, 1996)⁴

¹ For example, firms often create autonomous units such as incubators or skunk works to nurture internal ventures with strategic potential but poor strategic fit with mainstream businesses (Burgelman, 1985; Sykes, 1990).

² Mainstream units often lack incentives to work with new ideas or knowledge generated by external venturing units, view such units as a threat to their internal activities, and resist ideas that are inconsistent with the organization's dominant cognitive frameworks and business logic.

³ Throughout this article, we use the terms *practices* and *processes* as synonyms.

⁴ For example, an organization's top management is responsible for 'strategic integration,' which consists of 'a common strategic intent, an overarching set of values, and targeted structural linking mechanisms to leverage shared assets . . . orchestrated by a senior team with a common fate incentive system and team processes capable of managing these inconsistent alignments in a consistent fashion' (O'Reilly and Tushman, 2008: 22–23).

and establish performance metrics and incentives to influence the search for external partners (Dushnitsky and Shapira, 2010). By emphasizing top management's role in integration and search, researchers have overlooked the potential for entrepreneurial agency by unit-level managers, particularly in the context of external venturing, to overcome the constraints and challenges of their corporate environment. While some recent studies acknowledge the importance of integration initiatives external venturing units undertake to build relationships with the mainstream organization (e.g., Hill and Birkinshaw, 2014), research is yet to highlight specific practices that unit-level managers can adopt in this regard.

We address these limitations by studying *how external venturing units effectively achieve external knowledge search and integration of their initiatives with mainstream organizational units*. We seek to identify processes that help overcome the challenges of implementing search and integration in combination. We examine an important type of external venturing unit, responsible for corporate venture capital (CVC) investments, to address our research question. CVC units are dedicated, specialized units of established firms that make minority equity investments in privately held entrepreneurial ventures (Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). CVC investments allow corporate investors to access and learn about potentially valuable or disruptive knowledge their portfolio companies are developing (Basu, Phelps, and Kotha, 2011; Dushnitsky and Lenox, 2005). The rapid global growth in the pursuit of CVC by incumbent firms over the past decade has been accompanied by increasing academic research on the topic (see Dushnitsky, 2012).

Given the lack of research into how and why external venturing units achieve effective search and integration, we conducted a qualitative, inductive study of 17 corporate venture capital units. This study extends substantive theory of CVC unit performance by explaining how unit-level processes differentially influence the efficacy of its search and integration. In particular, we document a set of five practices that prior research has not adequately examined, but which were found to have important influences on either CVC unit search or integration. Our results suggest that CVC units that minimize the complexity of deal negotiations with ventures and protect ventures' strategic interests improve their reputation among start-ups and VCs as attractive

investors. Units that evaluate and select ventures based on an early stage of development increase the search benefits they offer their parent firms by helping them probe potentially useful but uncertain technologies, markets, or business models before rivals. Moreover, CVC units that help develop explicit collaborative blueprints between venture partners and mainstream businesses create social contracts between the parties, thereby increasing venture integration. Finally, CVC units that avoid competing with mainstream units and frame their role as complementary reduce internal political resistance to their activities, resulting in more effective unit integration.

Drawing from our data, we provide in-depth explanations for how these processes enhance aspects of search or integration and how they are complementary to each other as well as with other fundamental practices. Therefore, our study highlights how CVC units can overcome the trade-offs of effective search and integration and accomplish both effectively. It also suggests the benefits of an organizational configuration approach (Miller, 1996), in which variations in bundles of practices are responsible for favorable organizational outcomes rather than individual practices alone. Through our focus on micro-level practices adopted by unit managers, we highlight how these managers are required to be entrepreneurial and politically savvy to respond to corporate contexts that are sometimes unfavorable. These insights are often counter to conventional wisdom and have been largely overlooked by prior research.

THEORETICAL BACKGROUND

Prior research on CVC has been conducted at three levels of analysis (Narayanan, Yang, and Zahra, 2009). First, considerable research has focused on established firms' motivations to engage in CVC activity and the resultant outcomes to these firms from such efforts (Basu *et al.*, 2011; Dushnitsky and Lenox, 2005; Gaba and Meyer, 2008). Second, researchers have examined ventures' motivations for pursuing CVC relationships, how they manage the relationships with their investors, and how such ties affect venture performance (Dushnitsky and Shaver, 2009; Katila, Rosenberger, and Eisenhardt, 2008; Maula, Autio, and Murray, 2009). Finally, research has focused on CVC unit structures and practices that enable them to function more effec-

tively (Hill *et al.*, 2009; Souitaris *et al.*, 2012; Yang, Narayanan, and Zahra, 2009). We elaborate on the last research stream given its relevance to our research question.

Search and integration in CVC units

Recent studies have examined CVC units' search activities, that is, the formal role with which these units are tasked (Dushnitsky and Lenox, 2005). An important aspect of search is the generation of investment opportunities. Some studies highlight the benefits of 'syndication' or co-investing with other investors such as independent VCs (Hill *et al.*, 2009; Yang *et al.*, 2009). Syndication partnerships are beneficial in increasing the 'deal flow' of potential investment opportunities (Wright and Lockett, 2003) and, particularly for corporate investors, can help in learning good investment practices from experienced investors (Maula, Keil, and Zahra, 2013). While it is difficult for CVC units to form these relationships initially, they can gain legitimacy within the VC community by mimicking its decision-making and compensation practices (Souitaris *et al.*, 2012). CVC units can also access greater investment opportunities by enhancing their reputations as valuable partners that nurture portfolio companies with critical resources (Wadhwa and Basu, 2013).

CVC units' search activities also involve selection of ventures for investment from available opportunities. Some studies highlight the importance of selecting appropriate sectors in which to invest, proposing that relatedness to the investor's expertise (Keil *et al.*, 2008) and the technological opportunities that sectors offer (Dushnitsky and Lenox, 2005) should be considered. Moreover, research examines how learning from existing CVC relationships should also inform subsequent selection criteria. Keil *et al.* (2008) characterized CVC relationships as a form of 'disembodied experimentation,' wherein multiple trials with new technologies and business models take place outside the boundaries of the corporate investor, providing information about their potential economic value.

Other studies have focused on the integration approaches that enable CVC units to fulfill their role as knowledge brokers between parent firms and portfolio ventures. They suggest that effective CVC units should monitor their investments through board memberships or observation rights (Wadhwa and Kotha, 2006). Further, CVC units can facilitate integration with mainstream units by emphasizing

knowledge sharing at the organizational level and by building relationships with those units' managers based on trust and commitment (Weber and Weber, 2011). CVC units may also sacrifice the pursuit of legitimacy with VC firms to increase their legitimacy with internal mainstream units for more effective integration (Souitaris *et al.*, 2012).

In sum, research has typically examined how CVC units pursue either search or integration activities and has highlighted the challenges of pursuing both aspects simultaneously (Souitaris *et al.*, 2012; Weber and Weber, 2011). However, we know little about how CVC units effectively manage search and integration simultaneously, which is crucial to their own survival and their parent firms' renewal (Hill and Birkinshaw, 2014; Keil *et al.*, 2008).

METHODS

We employed a qualitative, inductive research approach, which is appropriate for 'how' and 'why' questions (Eisenhardt and Graebner, 2007) such as those motivating our research. We sought to elaborate on 'substantive' theory—theory pertaining to a specific context and phenomenon (Burgelman, 2011)—of how and why CVC units achieve effective search and integration. Theory elaboration is implemented when preexisting conceptual ideas or a preliminary model drive a study's design, and results are contrasted with past findings through description, interpretation, and explanation (Lee, 1999).

Design and sample

Design

We used a multiple case design following 'replication' logic where cases are analogous to experiments. Each case serves to confirm or disconfirm the inferences drawn from others (Yin, 1994). This approach enables a broader exploration of the research question and a better grounding for theoretical insights using empirical evidence (Eisenhardt and Graebner, 2007). Although our research question primarily addresses the level of the CVC unit, we employed an embedded design involving multiple levels of analysis including the CVC unit and the parent corporation, which increases the likelihood of inducing richer and more reliable theoretical insights (Yin, 1994). Multiple-case, embedded

designs have been adopted in prior research on CVC to study related research questions (Keil *et al.*, 2008; Weber and Weber, 2011).

Sample

We sought to observe the CVC units of U.S.-based firms⁵ that exhibited maximum variation in certain observable characteristics (Miles and Huberman, 1994). Based on our reading of the CVC literature, we selected CVC units that varied by four observable characteristics: parent firm primary industry, parent firm size, CVC unit size, and age. This approach helped examine any variances in CVC unit practices in different contexts. To increase the likelihood of finding contrasting patterns and polar differences in performance (Yin, 1994), we sought cases that involved active CVC investors and recently disbanded units. We used Thomson Financial's VentureXpert database to identify active or recently inactive corporate investors that exhibited variation across these dimensions. Next, we contacted a senior manager at each CVC unit and invited him/her to be interviewed. If our initial contact declined, we contacted others in the same unit. If none of the managers responded positively, we expanded our list to other CVC units. Finally, we assembled a set of 17 cases (i.e., units)—13 active and four recently disbanded. To ensure the sample was consistent with our research question, we asked specific questions to corroborate media reports that all units had a primarily strategic mission involving access to external knowledge. Our CVC units pursued three types of strategic objectives: horizon scanning, gap filling, and ecosystem building, each of which have been identified and described in prior literature (Chesbrough, 2002; Kann, 2000).⁶

Descriptive information about our sample of CVC units, their parent firms, and interview subjects is provided in Table 1. We disguised unit names to protect their identities.

⁵ U.S.-based units carry out the vast majority of CVC investments (Dushnitsky, 2012). Sampling only these units also holds the influence of formal and informal national institutions constant.

⁶ Most units had more than one type of objective. Twelve units pursued horizon scanning, i.e., investing in ventures that were developing technologies and business models that could potentially disrupt their parents' products or technologies. Nine units pursued gap filling, i.e., investing in ventures with knowledge their parents did not possess but needed in order to develop new products and processes. Three units pursued ecosystem building, i.e., investing in ventures with complementary products that may enhance the demand for the parents' products.

Data collection and sources

Interviews

We conducted interviews in multiple waves from 2006 to 2012. As Table 1 shows, our primary respondents were senior managers of active CVC units and former senior managers of disbanded units. They represent 'key informants' who are highly knowledgeable about the phenomenon being studied (Kumar, Stern, and Anderson, 1993). To assess the perspectives of different internal stakeholders about a particular CVC program, we also interviewed senior managers from business units and corporate functions (e.g., R&D) at the parent organizations of many of the CVC units. These managers typically had long tenures and technological backgrounds at their respective firms. Therefore, our choice of respondents helped minimize recall problems that could potentially influence the results (Huber and Power, 1985).

Consistent with the theory-elaboration objective, we adopted a focused approach in which findings from prior research guided the data collection and analytical procedures (Eisenhardt, 1989). In particular, because our motivation is to extend theory concerning the role of search and integration in external corporate venturing, our data collection efforts were focused on, but not limited to, these specific aspects of units' activities. We developed a semi-structured protocol, with some variation among active and disbanded unit managers and parent organization managers. Open-ended questions in the protocol concerned the following areas of CVC unit operations: (1) motivation and structure of the CVC program; (2) determinants of investment volume and deal flow; (3) unit hiring and compensation practices; (4) evaluation and selection of portfolio companies; (5) monitoring of investment relationships; and (6) evaluation of individual investment and program success. Interviews followed the 'courtroom' procedure (Eisenhardt, 1989), focusing on facts, concrete examples, and quantitative data, which are less subject to cognitive biases and impression management than opinions or interpretations (Huber and Power, 1985).⁷ Each interview lasted one hour on average and was typically recorded and transcribed. We did a total of 28 interviews with a combined transcript length of 530 pages. Of these, 17 were with current and former

⁷ To encourage candor and accurate information, all subjects were assured confidentiality and the opportunity to review and revise the transcripts (Huber and Power, 1985).

Table 1. Sample of CVC units

CVC unit name (coded)	Parent firm's industry	Objectives+	Parent's revenues in 2006 (\$ million)	Year of unit establishment	Cumulative investment volume (\$ million)	Number of unit employees (approx.)	Informants	Unit status in 2006
Impressive Ventures	Semiconductors	1/2/3	35,382	1990	3,000	>100	Vice president of investment group, principal architect at parent, principal engineer at parent	Active
Qualified Ventures	Semiconductors	1/3	7,526	1999 (3 <i>ad hoc</i> investments earlier)	200 (Commitment of 500 million)	Initially 6 (size is larger now)	Head of investment group in North America, senior director of business development at parent, chief technology officer at parent	Active
Momentous Ventures	Telecommunications	1/2	42,879	1999 (earlier wave in the 1980s)	500	15	Corporate vice president and director of equity investing	Active
Masterful Ventures	Software	2/3	44,282	Mid-1980s (since parent's early days)	800	12 (in entire corporate development group)	Managing director of corporate development, Principal manager at parent	Active
Joyous Ventures	Pharmaceuticals	2	53,324	1973	500	28	Director of portfolio investments and analysis	Active
Glorious Ventures	Medical devices	1	Acquired (3,550 in 2005)	Just before IPO in 1994	200	5-7 (size has been as large as 30)	Vice president of business development, vice president of technology at competing firm	Active
Ultimate Ventures	Logistics	1/2	47,547	1997	36 (Approval required for every 25 million)	2 (have been 5 earlier)	Fund manager	Active
Auspicious Ventures	Instruments	1	4,973	2001 (<i>ad hoc</i> since 2000)	100	3 (30-40 in entire business creation group)	Investment manager	Active
Productive Ventures	Pharmaceuticals	2	48,371	2004 (earlier wave too)	100 (Commitment of 200 million in 5 years)	4	Senior manager in strategic investments group	Active
Knockout Ventures	Photographic equipment	1	13,274	2001 (indirect investments for 25 years)	100	9	Director and vice president of external alliances	Active
Dynamic Ventures	Chemicals	2	28,982	2003 (<i>ad hoc</i> since 1970s)	30	5	Venture development manager, vice president of R&D at competing firm	Active
Accomplished Ventures	Biotechnology	2	14,268	2004 (indirect investments earlier)	60 (Capitalization of 100 million)	3	Managing director of investment group	Active
Leading Ventures	Pharmaceuticals	1	15,691	2001 (limited partner 10 years ago)	86 (Capitalization of 175 million)	6	Executive director of new ventures, senior vice president of research at parent	Active
Booming Ventures	Aerospace	1	61,530	1999	Capitalization of 250 million	6-7	Managing director of investment group, director of corporate innovation at parent, vice president of technology of portfolio company.	Terminated in 2005
Advanced Ventures	Management services	1	18,228	1999 (<i>ad hoc</i> deals since 1995)	250	25	General partner of investment group, president of external collaborating organization	Terminated in 2002
Bountiful Ventures	Engineering and construction	1/2	20,500	1998	Capitalization of 200 million	20	CEO, chairman of investment group	Terminated in 2002
Innovative Ventures	Information technology	1	91,424	1999	200	6	Vice president of growth initiatives	Evolved into indirect investing

+1 = Horizon scanning; 2 = Gap filling; 3 = Ecosystem building

CVC unit managers and 11 were from other perspectives (mostly parent firm managers, but also a few portfolio company managers, co-investors, and competing firm managers).

Archival data

We supplemented interview data and follow-up e-mails with archival information about each CVC unit and corresponding parent firm. This information was collected from a variety of sources such as parent firm 10K statements, company Web sites, Factiva, Lexis-Nexis, and VentureXpert databases. It included data on unit investment volumes and patterns, choices of sectors, motivations, rounds of investments, and syndication activities. The supplementary data enriched informant statements, helped clarify ambiguous statements, and confirmed interview data where applicable. Such diverse sources helped triangulate our primary data (Jick, 1979) and examine them from multiple vantage points (Yin, 1994).

Data coding and analysis

Following prior research (Eisenhardt and Graebner, 2007; Miles and Huberman, 1994), we used a three-step analytical procedure, as described next:

Step 1: Within-case analysis to identify search and integration processes

We treated all data about a sample CVC unit as constituting a single case (Miles and Huberman, 1994). We followed the practice of ‘constant comparison’ (Strauss and Corbin, 1998) through cycles of comparing basic coding of raw data with induced higher level abstractions. First, we carefully read the interview transcripts and associated archival materials in order to ‘open code’ an informant’s responses using his/her own language (retaining words, phrases, terms, or labels offered by the informant). We tagged each passage that conveyed a particular point, thought, or idea with one or more codes that reflected what the informant was describing. Next, we reduced the dimensionality of these open codes by constructing first-order processes (Strauss and Corbin, 1998). Finally, first-order processes were grouped into broad activity themes that involved a critical aspect of search or integration. The mapping and clustering of codes and processes involved numerous iterations until we reached ‘theoretical

saturation’ (Miles and Huberman, 1994) where no new theoretical categories emerged from the last few cases studied.

Step 2: Evaluating performance outcomes for each case

Research suggests that high performing CVC units positively affect diverse stakeholders and maintain favorable relationships with these stakeholders (Bassen *et al.*, 2006; Hill and Birkinshaw, 2014). Thus, we sought to capture the nature of our units’ relationships with three important sets of stakeholders: the parent firm’s top management, business unit personnel, and investing partners, each of whom is vital to the units’ continuance (Hill and Birkinshaw, 2014). Observations by unit managers (and parent firm managers wherever applicable) on relationships with these critical stakeholders were used to evaluate each unit’s performance in fulfilling its strategic mission.

We identified four strong performers based on respondents’ observations of favorable relationships with all three stakeholders: Impressive, Qualified, Momentous, and Leading Ventures. We also identified three weak performers where respondents reported unfavorable relationships with each of these stakeholders: Booming, Advanced, and Knockout Ventures. The remaining units, which had mixed assessments, were treated as average performers.

In 2006 (when we conducted our initial interviews), the four strong performers had been active for five to 16 years, and their cumulative investments ranged from \$80 million to \$3 billion. In contrast, two of our weak performers, Booming and Advanced, had been disbanded recently. The third unit, Knockout, was still active and had accumulated investments of around \$100 million, but annual investment volumes were volatile and the unit was often on the verge of termination.⁸

The strong and weak performers are highlighted in Table 2, along with representative quotes regarding their relationships with the three types of important stakeholders.

We also attempted to confirm our categorizations of strong, average, and weak performers using archival data to evaluate the extent to which the CVC

⁸ The unit was terminated in 2012 as we were working on subsequent revisions, which increased our confidence in the predictive reliability of our evaluative approach. The respondents from the other two disbanded units reported mixed outcomes and suggested that closure might have occurred for reasons other than performance.

Table 2. Strong and weak performing units

Unit	Observed performance	Top management relationship	Business unit relationship	External partner relationship
Impressive	Strong	Positive ‘[Our management] was very clear about maintaining our investment pace and quite public in their view that the right time to invest is during down cycles. We were concerned about where innovation was going to come from, which is ultimately what drives our industry, and we were not going to let up.’	Positive ‘We’re viewed as kind of an honest information broker source for the company. People want to talk to us all of the time to get a sense of what’s going on out there in the marketplace which they might be missing.’	Positive ‘Our most important source of quality deals is our entrepreneurial network. This consists of proven entrepreneurs that we’ve worked and invested with in the past.’
Qualified	Strong	Positive ‘Now it’s a situation where not only is there a strategic need to sustain this activity, but people are actually very happy about the results of this. And because of that, [we] want to continue this activity.’	Positive ‘The business units were part of helping us bolster our case that a company was strategic to [the parent’s] needs. And then they would also help us on the partnership side, whether it was a codevelopment type partnership or a channel partnership.’	Positive ‘In the wireless communication value chain, we were a very neutral party. So, for example, partnering with us would not preclude partnering with [the parent’s rivals]. So we played on that neutrality. We were the Switzerland of the value chain.’
Momentous	Strong	Positive ‘I have endorsement at the very top of the corporation. We have a CEO who is well aware of the urgency and the speed and innovation that can be realized via these outside investments; and so a great appreciation for what it is that we do and a great interest in it.’	Positive ‘I would say [the business units] are very deeply involved. When there is a specific product linkage, I want to make sure they have near day-to-day visibility. My team spends most of its time outside the walls of the garden area but ultimately that traction [has] to take place inside and that really is dependent upon a strong relationship with the business units.’	Positive ‘I sit on the ventures’ boards as a [parent] investor so I have to navigate both sides of everything. But it really has been designed to be a win-win; so that the companies I invest in win as well as [the parent]. I think we’ve done a pretty good job of that.’
Leading	Strong	Positive ‘The vice presidents of chemistry and biology, discovery, etcetera, in [the parent company] are keenly interested in the explore side of our investments. They see the venture capital group as being a great way for them to explore new areas of research in a very leveraged way.’	Positive ‘We found this little company and brought it to [our researchers’] attention, and so you know, we were very much the extra set of eyes and ears for them. On the other hand, this company that we’re looking at right now was brought to our attention by some of our early-stage discovery chemists who said ‘you know, there’s this really bright guy in Australia, and he desperately needs funding.’’	Positive ‘We have always demanded that if there is an asset within a portfolio company that’s open for being licensed, that someone pick up the phone and call someone at [the parent]. When I say ‘demanded’, it’s probably a strong term because we’ve never had anyone in our portfolio companies who’s anything other than delighted [to do so].’
Booming	Weak	Negative ‘Behind the scenes, people were going to the chairman and the CTO and whispering in their ears because everybody had their different agendas. When those guys disappeared because of other problems, there was nobody to manage the family disputes, and that’s when things really got ugly.’	Negative ‘Most of the product divisions resented us and were jealous. They actually viewed us as a tax. We were spending treasury money, which is money they generated, and we wouldn’t be in the top 10 things they would spend money on if they had a vote.’	Negative ‘Because we were big, [the VCs.] never trusted us. So if it went well, they’d say, ‘Well, that worked out better than we thought it would.’ And if it didn’t work out they’d say, ‘See, we thought it wouldn’t.’’
Advanced	Weak	Negative ‘If you talk to a [parent] partner, most of them would probably say, ‘I don’t think we did all that well [in CVC investing].’ I was asked that question six months ago by our CEO.’	Negative ‘A couple guys at headquarters start telling the practice, ‘Okay, here’s the solution [from a portfolio company] we’re going to use.’ And our practice is a bunch of free, independent guys who are going to say, ‘Bullshit. Nobody tells me what to do. I’m going to pick the best solution that I deem fit for this client.’ So we always had this battle going on for about four or five years on that front.’	Negative ‘Often times our portfolio companies were disappointed that even though they cracked the venture organization, it was very difficult to crack the consulting organization.’
Knockout	Weak	Negative ‘We’ve never had stronger support [than the present] because we almost died many times, believe me.’	Negative ‘[Tension with R&D groups] is really, really a hot button around here. It’s almost that the longer I drag my project out in the resources labs, the higher probability I have of guaranteed employment. Why in the world would I ever go outside? That along with the arrogance of a researcher who will never admit that you could get it outside better. So we struggle with that a lot.’	Negative ‘We’re experts in our industry, but we not going to bring an expert necessarily from some other industry to help the company, per se. Sometimes other people are concerned that if you have a potential customer as an investor, then other customers who are competitive with the investor might not come their way.’

units were able to transfer knowledge to and from portfolio firms.⁹ Building on prior research (e.g., Gomes-Casseres, Hagedoorn, and Jaffe, 2006), we used patent cross-citations to measure interfirm knowledge transfer. We collected bibliometric data on all U.S. patents issued from 2001 to 2006 (the five years prior to when we conducted our first round of interviews) to parent firms and their portfolio companies. Inbound knowledge transfer from a portfolio company was assumed when the focal corporate investor's patents cited the portfolio company's patents (at least once) after the investor's initial investment. Outbound knowledge transfer to a portfolio company was assumed when the portfolio company's patents cited the patents owned by the corporate investor (at least once). Parent companies of the strongly performing units generated inbound learning from 17 percent of their portfolio firms, while 27 percent of portfolio firms garnered outbound learning from these parents, which were significantly higher than corresponding figures for the average and weak performers. In contrast, weakly performing units' parents generated inbound learning from 7 percent of their portfolio firms, while 11 percent of the portfolio firms garnered outbound learning from the parents. Both values were significantly lower than those for the strong and average performers.

Step 3: Cross-case analyses using predictor-outcome matrices

Finally, we created 'case-ordered predictor-outcome matrices' (Miles and Huberman, 1994) to discern similarities and differences in adoption of processes among strong and weak performers. A focused comparison of only the polar cases enabled clearer contrasts to emerge and stronger inferences to be made (Yin, 1994). This exercise allowed us to identify key search and integration processes that appear to enhance unit performance (cf. Weber and Weber, 2011, for a similar approach). We also examined how average performers adopted these processes in combination. Throughout our analyses, we developed causal explanations for the observed relationships by theorizing about underlying mechanisms, consider-

ing existing evidence, and checking respondents' explanations for any linkages (Miles and Huberman, 1994).

FINDINGS: IMPORTANT UNIT PROCESSES

As discussed earlier, we first conducted within-case analyses to identify all search and integration processes adopted by units. This approach helped us uncover processes related to generating and selecting venture investment opportunities (aspects of a unit's search mission) and integrating specific ventures as well as overall unit activities with the mainstream. We summarize the primary links between these practices and the different dimensions of search and integration in Figure 1. We subsequently discuss how some practices have secondary links with other aspects of search and integration.

After identifying the strong, weak, and average performers as reported earlier, we conducted cross-case analyses to identify patterns in the adoption of each search and integration process. The results of these analyses are presented as a case-ordered matrix in Table 3, depicting the use of all observed search and integration practices by each sample unit, arrayed by unit performance.

Based on differences in adoption among sample units, we identified three types of unit-level processes that are also depicted in Figure 1. Four of the search processes and two integration processes were adopted by all units and were, therefore, termed as *universal* processes. Most CVC managers probably understand the benefits of these processes, resulting in their widespread adoption. Consequently, these processes appear to be necessary but not sufficient to ensure that a unit stands out as a strong performer. Our findings also highlighted a few *contingent* processes, of which one was in search and two in integration. For these processes, the links to unit performance appear to be ambiguous since some strong units did not adopt these processes and some weak units did. While these processes perhaps help unit performance in certain situations, they may impede performance in others.

While we briefly describe all identified universal and contingent processes in this section for the sake of completeness, we focus particularly on a third type of unit-level process, which all the strong performers but none of the weak performers had

⁹ Both inbound and outbound knowledge transfers are central to the performance of a CVC unit (Basu *et al.*, 2011). While inward learning is necessary to realize investor strategic objectives (Wadhwa and Kotha, 2006), outbound knowledge transfer indicates an investor's ability to nurture portfolio firms and, thereby, realize long-term collaborative goals (Keil *et al.*, 2008).

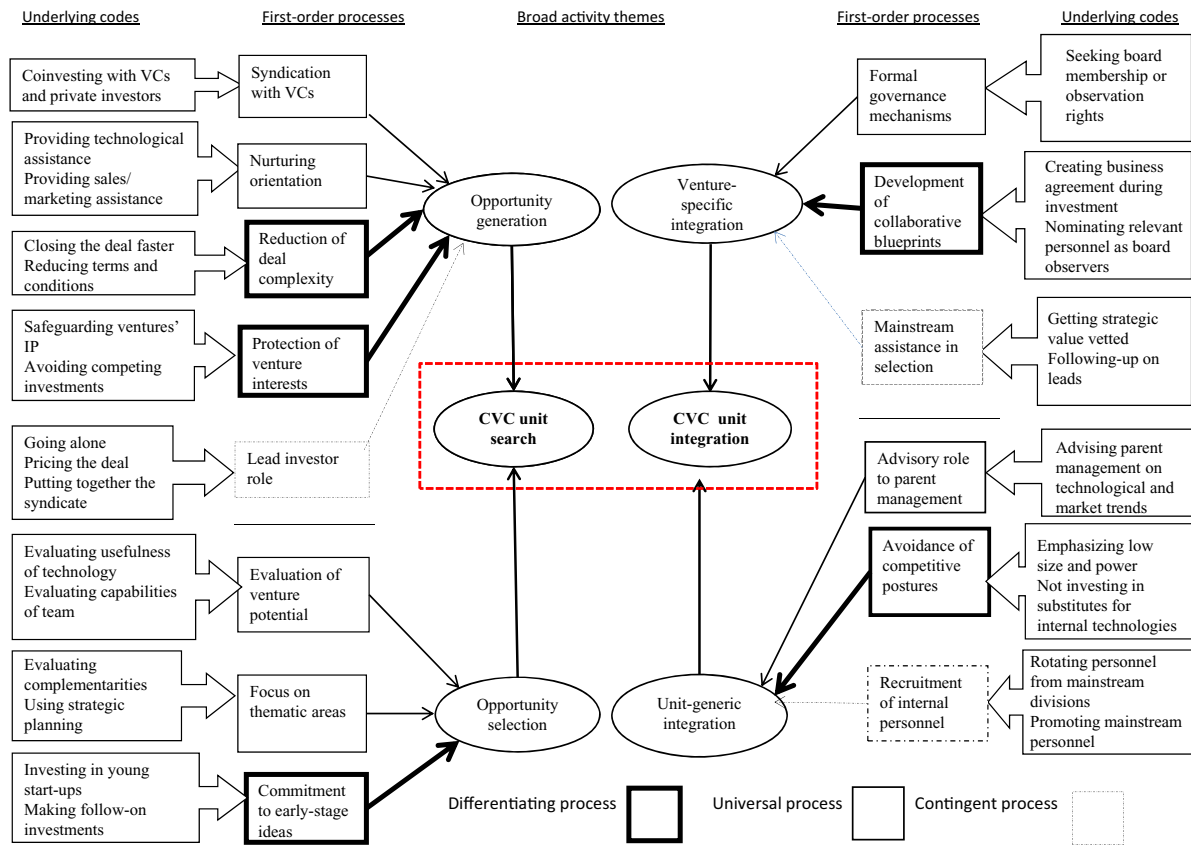


Figure 1. Framework of CVC unit search and integration processes

adopted.¹⁰ Therefore, processes of this type, which we term *differentiating*, appear to be strongly related to CVC unit performance. We identified three differentiating search and two differentiating integration processes. The qualitative evidence for the differences in adoption of these processes between strong and weak performers is provided in Tables 4 and 5.

Search processes

The formal role of a CVC unit is to search for new investment opportunities (Dushnitsky and Lenox, 2005). Effectively doing so ensures that valuable knowledge from portfolio firms is available to mainstream units and complements their internal competencies (Chesbrough, 2002). As vital aspects of the

¹⁰ We found evidence that either a weakly performing unit had not adopted a particular process or no evidence to show it had adopted the process, whereas we found strong evidence for the adoption of each process by all strongly performing units.

search function (Siggelkow and Levinthal, 2003), we found that CVC units adopted processes that helped in both generating adequate venture investment opportunities and selecting ventures for investment. All three types of processes—universal, contingent, and differentiating—were among the search processes observed.

Opportunity generation

We observed two *universal* processes, adopted by all units, for generating new investment opportunities. The first such fundamental approach was *syndication with traditional VCs*, that is, investing in partnership with such investors. This practice enabled units to gain visibility and legitimacy within the investor community and consequently increase deal flow. As the manager of Productive Ventures asserted:

‘We also happen to be a pretty nice syndication partner because we invest relatively small amounts.

Table 3. Case-ordered matrix of search and integration processes

CVC unit name	Search					Integration							
	Opportunity generation		Opportunity selection			Venture-specific integration			Unit-generic integration				
	Lead investor role	Nurturing orientation	Reduction of deal complexity	Protection of venture interests	Evaluation of venture potential	Focus on thematic areas	Commitment to early-stage ideas	Formal governance mechanisms	Mainstream assistance in selection	Collaborative blueprints	Advisory role to management	Avoidance of competitive postures	Recruitment of internal personnel
Strong performers	*	*	*	*	*	*	*	*	*	*	*	*	*
Impressive	*	*	*	*	*	*	*	*	*	*	*	*	*
Qualified	*	*	*	*	*	*	*	*	*	*	*	*	*
Momentous	*	*	*	*	*	*	*	*	*	*	*	*	*
Leading	*	*	*	*	*	*	*	*	*	*	*	*	*
Masterful	*	*	*	*	*	*	*	*	*	*	*	*	*
Average performers	*	*	*	*	*	*	*	*	*	*	*	*	*
Auspicious	*	*	*	*	*	*	*	*	*	*	*	*	*
Glorious	*	*	*	*	*	*	*	*	*	*	*	*	*
Ultimate	*	*	*	*	*	*	*	*	*	*	*	*	*
Joyous	*	*	*	*	*	*	*	*	*	*	*	*	*
Productive	*	*	*	*	*	*	*	*	*	*	*	*	*
Dynamic	*	*	*	*	*	*	*	*	*	*	*	*	*
Accomplished	*	*	*	*	*	*	*	*	*	*	*	*	*
Bountiful	*	*	*	*	*	*	*	*	*	*	*	*	*
Innovative	*	*	*	*	*	*	*	*	*	*	*	*	*
Booming	*	*	*	*	*	*	*	*	*	*	*	*	*
Weak performers	*	*	*	*	*	*	*	*	*	*	*	*	*
Advanced	*	*	*	*	*	*	*	*	*	*	*	*	*
Knockout	*	*	*	*	*	*	*	*	*	*	*	*	*
Total adoptions	17	17	9	9	17	17	9	17	11	7	17	10	12

* Adopted by unit

Table 4. Differentiating search processes

Aspect of search	Process	Adoption by strong performers	Adoption by weak performers
Opportunity generation	Reduction of deal complexity	<p>Impressive, Qualified, Momentous, Leading—Yes</p> <p><i>Impressive:</i> 'We typically heard [from ventures] that our deal process is too complex, we have a lot of terms and conditions. I think we're addressing and getting a lot better at [these areas].'</p> <p><i>Qualified:</i> 'We never tried to insert contractual clauses for privileged access. And actually that was deliberate because I had done enough research through various means to know how that kind of an approach is perceived by the investment community and by the companies themselves.'</p> <p><i>Momentous:</i> 'Contractual terms like the right to first refusal is rare [for the unit] because they create a financial impediment to the company and, quite frankly, most companies won't sign them.'</p> <p><i>Leading:</i> 'We try not to insert any sort of preferential contractual language in the term sheet because we think that has a tendency to reduce the value of an asset from an economics standpoint.'</p>	<p>Booming, Advanced, Knockout—No</p> <p><i>Booming:</i> 'To avoid losing the ability to control or influence as ownership dilutes, I'd negotiate things like warrants and things, so if the thing was going well we could take more in.'</p> <p><i>Advanced:</i> 'So if we had an opportunity that the practice said, 'Wow, this is really cool,' I said, 'Well, I'll tell you what, there's a way of making even more money on this: we'll have to do a warrant structure so we can extend the value of the cash investment.''</p> <p><i>Knockout:</i> 'We put in the right to participate should there be a change of control, such as an acquisition kind of thing. At times, we can't always get a board seat or observer seat, so we have done side letters where we'll ask for the board information separate.'</p>
Protection of venture interests		<p>Impressive, Qualified, Momentous, Leading—Yes</p> <p><i>Impressive:</i> 'We try not to have [the portfolio companies] be directly competitive. If an existing portfolio company strongly objects, we'll go meet with them to try and figure out if we can do this in a way that isn't a problem or not do the deal.'</p> <p><i>Qualified:</i> 'We would not invest in competitors of our portfolio company. We were very loyal to the company that we invested in. So that created a reputation of these companies wanting to have us on as an investor versus looking at us as a sort of necessary evil.'</p> <p><i>Momentous:</i> 'We don't want to invest in things that we have conflict with. We tell people, 'if you don't have the intellectual property on something yet, [we] don't want to see it.''</p> <p><i>Leading:</i> 'We will quite consciously segregate people who are involved in our activities. With respect to intellectual property, we really never let [parent] people look at the patent applications or anything like that, we use outside patent counsel for that.'</p>	<p>Booming—No, Advanced, Knockout—Not indicated</p> <p><i>Booming:</i> 'Clearly, it was a control issue [for the ventures]. Would our bureaucracy and our management support these things, or at the same time, would they stay away? And, of course, legal would come in and say, 'Well, no, we can't stay out of their hair because we have a legal responsibility.''</p>
Opportunity selection	Commitment to early-stage ideas	<p>Impressive, Qualified, Momentous, Leading—Yes</p> <p><i>Impressive:</i> 'For a reasonably healthy portion of our deals, we can look at something and say, 'that thing really looks like it has serious long-term potential.' And we're relatively patient money as long as the company is progressing and moving and doing the things that make sense. We can stick with it.'</p> <p><i>Qualified:</i> 'We would often focus on Series A rounds since we would look at companies with core and disruptive technologies. We would be able to better assess using our internal technical resources and the technical merit these investments had. By Series B, I would expect the company to have a prototype and a well thought out business or go-to-market plan.'</p> <p><i>Momentous:</i> 'Of the [selection criteria] that matter, No. 1 is the technology. Will it fit somewhere or intersect with [the parent] some day? That's what kept us out of dot-com investing, and we're thankful. In many instances, we ask ourselves what we could do for [the parent] three to four years out.'</p> <p><i>Leading:</i> 'Strategically our interest is in seeing enough early-stage innovation get funding. So we're trying to make closer alliances with the few very early-stage investors that remain in the life sciences, and we're trying to establish some capability for ourselves there.'</p>	<p>Booming—Partial, Advanced—No, Knockout—Not indicated</p> <p><i>Booming:</i> 'We never went beyond an A round. Once you get to an A round, other investors are coming in and your ownership is diluting. You're losing the ability to control or influence.'</p> <p><i>Advanced:</i> 'So we felt that we could get in earlier relationships with these companies as an investor, as opposed to a strategic partner, simply because as an A or B round investor, they don't have a marketable product. The [parent] consulting business is not going to recommend to our clients nonmarket proven solutions. So that was the dilemma and that's the approach we took.'</p>

Table 5. Differentiating integration processes

Aspect of integration	Process	Adoption by strong performers	Adoption by weak performers
Venture-specific integration	Development of collaborative blueprint	<p>Impressive, Qualified, Momentous, Leading—Yes</p> <p><i>Impressive:</i> 'It's relatively common for our deals to have a business agreement component involving the business units. We generally do it up front because we know we're doing it. Because, quite frankly, your negotiating position once the deal is done is significantly less than that when you're into it.'</p> <p><i>Qualified:</i> 'One of the things that the venture group did was develop fairly deep relationships with the companies that we invested in. The business development aspect of it was important for us regardless of whether we made the investment or not. And so, going in, we would be very focused on the relationship, the alliance aspect of it.'</p> <p><i>Momentous:</i> 'In many instances, the prospective holder of the commercial agreement will be the relevant observer. . . . because traction [has] to take place inside and that really is dependent upon a strong relationship with the business units.'</p> <p><i>Leading:</i> 'For example, in the investments that we made in health care II, nearly every one of those companies had a pretty substantial agreement with [the parent] immediately . . . for our investments in research tools, which was very hot a few years ago but turned into a financial dog, two of the three companies have significant commercial agreements subsequent to our venture capital investment.'</p>	<p>Booming—Not indicated, Advanced, Knockout—No</p> <p><i>Advanced:</i> 'Now, when it got into doing alliances and things like that, we were very careful to draw a line. Having run the alliance function, I was not going to dictate that 'because we did an investment we'll have an alliance.''</p> <p><i>Knockout:</i> 'We're always involved in monitoring the commercial situation because we are responsible for [the firm's] reputation in the space. We often will act kind of as an in-between, and it's certainly in our best interest to make sure that that commercial deal is pulled off.'</p>
Unit-generi integration	Avoidance of competing postures	<p>Impressive, Qualified, Momentous, Leading—Yes</p> <p><i>Impressive:</i> 'We have a small group of people from [the unit] who are assigned to the central research labs. Business units typically have a two to four year horizon on product planning and investing in stuff, and these guys have three to seven years.'</p> <p><i>Qualified:</i> 'If the opportunity was competitive or something that [the firm] would want to get into directly in the future, then it would be really hard to make investments outside that had a similar agenda. We didn't need a business unit check-off to make an investment, but if the business unit said no, then it became a politically uphill battle.'</p> <p><i>Momentous:</i> '[Our position] is that you can't do everything yourself in a big corporation fast enough to satisfy all your customers. But even more importantly, we tell the units you don't have to do everything yourself. So the things that we leverage outside are those that people might be able to get to more quickly or that they're not looking at.'</p> <p><i>Leading:</i> 'Because [the parent] has such a strong balance sheet, the capex constraints on these guys are relatively minimal. Opex constraints on them are very real, but my opex is about \$1.7 million; I mean, it's a rounding error. It's taken five and a half years, but that argument has, thankfully, just gone away.'</p>	<p>Booming, Knockout—No, Advanced—Not indicated</p> <p><i>Booming:</i> 'Here they viewed it as either their money or their technology or their people. And we'd end up talking to the executive vice president about things that he or she knew nothing about. Middle management would jump in there and wouldn't let go of things.'</p> <p><i>Knockout:</i> 'The struggle with people embracing this activity is because they're afraid that if I go outside, then I'm outsourcing my job.'</p>

We do add credibility due to our brand. Our venture friends tend to pick up the phone and show us a lot of stuff.'

Another universal process adopted by all units was to pursue a *nurturing orientation* toward their portfolio firms by transferring vital resources from their parent companies. Units using this approach built a reputation as a valuable partner, which again helped attract a greater volume of investment opportunities. As the manager of Dynamic Ventures remarked:

'I need to know that a strong connection is made that will continue. Then, the small company benefits because it knows somebody's going to help them exploit their technology while using [the investor's] customers or market access, whatever we agreed.'

One *contingent* process that some of our units pursued was to take a *lead investor role* in several investments. Different approaches to leading an investment involved being the only investor in a round, inviting other investors to form a syndicate, and deciding the terms of the deal. A lead investor role resulted in greater visibility in the investment community and thereby more invitations to participate in financing other ventures.¹¹ For example, the manager of Qualified Ventures remarked:

'As we had more visibility into the market and better understanding of the product or technology, we took on more of a colead role. We brought [in] the VCs, helped them understand the opportunity better from a technical and market standpoint, and influenced the terms of the investment.'

We now highlight two important *differentiating* processes that appeared to strongly help opportunity generation, but which prior research has not examined adequately. This first was to pursue *reductions in deal complexity* through efforts to simplify and minimize the terms and conditions of the investment contract. Units pursuing this process made investments more quickly, more transparently, and less restrictively for the portfolio venture. As the

manager of Impressive Ventures noted, such efforts were of high priority for his unit:

'We typically heard [from ventures] that our deal process is too complex; we have a lot of terms and conditions. I think we're addressing and getting a lot better at [these areas].'

The manager of Momentous Ventures suggested that restrictive contractual clauses made potential portfolio companies reluctant to form relationships. Therefore, the absence of such clauses resulted in a unit becoming more desirable for ventures as a partner. The manager said:

'Contractual terms like the right to first refusal are rare [for the unit] because they create a financial impediment to the company and, quite frankly, most companies won't sign them.'

Table 3 indicates and Table 4 provides further evidence that all strongly performing units recognized the importance of this process. However, respondents from the weakly performing units did not indicate that reducing deal complexity was an area of concern and further remarked that they often tried to insert contractual rights into a contract (with the often unintended effect of increasing its complexity).

The second differentiating opportunity-generation process was to ensure *protection of venture interests*, such that units' own or parent activities did not negatively impact a portfolio venture's prospects. This addressed entrepreneurs' concerns regarding investor opportunistic behavior and resulted in more entrepreneurial firms seeking investment in the future. For example, the manager of Momentous Ventures explained that he tried to protect the portfolio companies' intellectual property before they received funding from his unit:

'We don't want to invest in things that we have conflict with. We tell people 'if you don't have the intellectual property [protection] on something yet, [we] don't want to see it.'

The Qualified Ventures manager described another approach used to protect venture interests. He consciously avoided investing in ventures that directly competed with any of the unit's existing venture partners, signaling the unit's commitment to these partners.

¹¹ However, some of our respondents remarked that taking a lead investor role may be counterproductive if a corporate investor lacks the expertise or credibility to put together an investment deal, which might explain the mixed effects of this process.

'We would not invest in competitors of our portfolio company. We were very loyal to the company that we invested in. So, that created a reputation of these companies wanting to have us on as an investor versus looking at us as a sort of necessary evil.'

As Tables 3 and 4 indicate, all strong performers took deliberate steps to protect portfolio company interests while the weak performers did not undertake any such specific actions. Moreover, there were instances at Booming Ventures when their main-stream units violated a portfolio company's interests. The average performers were split between adopting these two differentiating opportunity-generation processes. Four average performers made efforts to reduce deal complexity and were also conscious of protecting venture interests. The joint adoption of these processes by some units suggests complementarities such that adopting one makes the other less costly or more valuable.

Our data suggests important reasons why reducing deal complexity and protecting venture interests result in the generation of quality investment opportunities. A common perception of entrepreneurs is that corporate investors are difficult to work with (Katila *et al.*, 2008), which can dissuade ventures from seeking CVC funding. Our respondents often faced similar concerns such as, 'corporations move too slowly,' and their 'deal process is too complex.' Potential portfolio companies were worried that the investor could be 'looking to potentially buy them,' 'infringing on the probability of raising more money,' and 'tainting in some form [through investment].' Simplifying the terms and conditions in the investment contract helped venture managers see that the investor had 'an ability to move quickly if necessary,' was foregoing 'any special rights,' and keeping investments at 'arm's-length where the company does not experience a bear hug.'

Further, the threat of intellectual property misappropriation by corporate investors is a major concern for entrepreneurial ventures, which can inhibit them from accepting CVC investments (Dushnitsky and Shaver, 2009). Many of our respondents similarly noted that their portfolio companies did 'sometimes have problems with technological leakage' and believed that their knowledge would be used to 'fill white spaces within the corporation.' The onus was usually on the CVC units to 'go out of [their] way to partner in a meaningful way' and 'clarify the intent of the investment model.'

Opportunity selection

The opportunity-selection aspect of search involves the development of criteria for evaluating ventures for investment. Following standard VC practices, a *universal* process that all our units tried to implement was a careful *evaluation of venture potential* prior to making an investment. In particular, they exercised due diligence in evaluating the quality of ventures' technology and management, which are often important predictors of subsequent performance. As our respondent from Ultimate Ventures remarked:

'We often evaluate a technology that's still trying to prove itself. Clearly their management's experience with that type of business opportunity is going to be important to us.'

Another universal process was a *focus on broad thematic areas* for investment by all units. Such thematic areas were often identified by considering the complementarity or relatedness with the investors' areas of expertise. Some units developed strategic plans to formally identify the sectors they would be focusing on in future. Our respondent from Joyous Ventures observed:

'We seek novel therapies, devices, or technology platforms that are strategically aligned with [the firm's] areas of focus. We proactively seek investments in such specific areas.'

In contrast to these well-known universal processes, a relatively novel *differentiating* selection process involved the *commitment to early-stage ideas*. Units adopting this process invested in ventures that possessed potentially valuable knowledge but which required significant further development, such as recently founded ventures and/or ventures that had not yet launched a product. Therefore, they focused on the long-term potential of portfolio companies as opposed to an immediate route to commercialization. The manager of Leading Ventures noted:

'Strategically our interest is in seeing enough early-stage innovation get funding. So we're trying to make closer alliances with the few very early-stage investors that remain in the life sciences, and we're trying to establish some capability for ourselves there.'

This process also included commitment to a venture's development as its early-stage ideas matured.

One approach that units used to display commitment was making follow-on investments in later funding rounds. Follow-on investments also prevented dilution of ownership in a venture to the point where access to its ideas became difficult for the corporate investor. The manager of Impressive Ventures noted his unit's committed approach:

'For a reasonably healthy portion of our deals, we can look at something and say 'that thing really looks like it has serious long-term potential.' And we're relatively patient money as long as the company is progressing and moving and doing the things that make sense. We can stick with it.'

As Tables 3 and 4 indicate, our respondents from strongly performing units mentioned a continuing commitment to ventures' development while their early-stage ideas matured. In contrast, none of our weak units reported an overriding emphasis on early-stage ideas or a patient approach to nurturing ideas. The former manager of Advanced Ventures explained that if he did invest in early-stage ventures, it was with the intent of increasing financial returns rather than gaining access to ventures' ideas. While the former manager of Booming Ventures did invest in early-stage ventures, he did not usually make follow-on investments, indicating a lack of continued commitment. Of the 10 average performers, only five adopted this process, as indicated in Table 3. Three of these five units also adopted both the differentiating opportunity-generation processes,¹² suggesting some complementarity between the earlier processes and this key opportunity-selection process.

In contrast to prior research that argues for the conditional benefits of making early-stage ideas for both corporate investors (Markham *et al.*, 2005) and ventures (Kann, 2000),¹³ our results also suggest that corporate investors can *always* benefit from investing in early-stage ideas once they have taken steps to protect venture interests, as discussed earlier. In such cases, CVC investments can be used beneficially as low-cost probes to evaluate uncertain but potentially valuable initiatives before further commitment is

made. Drawing from multiple interviews, our respondents mentioned that 'we use the minority equity model when we don't think we know enough about what the company has or what the technology could do for us,' or that 'the companies that we bring in for investment evaluation have a two- to five-year horizon in terms of things that might impact our business.' The CVC investment model is most appropriate when 'the risk profile of the asset is such that an equity stake is the most applicable tool for minimizing risk and maximizing future option value.'

Moreover, continued commitment to early-stage ideas in the form of participation in follow-on rounds, or 'staging' investments, can help a unit maintain access to collaborative opportunities with portfolio companies. Many respondents echoed similar reasons for staging their investments, such as enabling 'staying power through at least a couple of subsequent value inflection points,' ensuring that their ownership and leverage 'do not get diluted too badly' and signaling their commitment 'as long as the portfolio company still has strategic value.'

In sum, we observed that our units adopted five opportunity-generation processes, of which two were universal, one contingent, and two differentiating. We also observed the adoption of three opportunity-selection processes, of which two were universal and one differentiating. We now move to a discussion of the integration processes depicted in Figure 1.

Integration processes

Integration refers to the extent to which other organizational units will cooperate and coordinate activities with a CVC unit to help it achieve its organizational mission (Lawrence and Lorsch, 1967). When integration is ineffective, mainstream units may be disinterested in the knowledge generated by a CVC unit or perceive it as a threat (Weber and Weber, 2011). The integration processes our CVC units adopted helped link both specific ventures and overall unit activities with mainstream units of the parent firm. Again, these processes were a mix of universal, contingent, and differentiating processes.

Venture-specific integration

Some of the integration practices we observed were intended to establish effective cooperation and

¹² As will be discussed later, these units were deficient in one or more differentiating integration processes.

¹³ Despite its recognized benefits, the actual adoption of this process is rare since CVC managers tend to be relatively risk averse, perhaps because compensation structures do not incentivize taking risks (Dushnitsky and Shapira, 2010) or because of limited experience with VC investment processes (Dokko and Gaba, 2012).

coordination between specific ventures and mainstream units and functions. Of these, a *universal process* was the establishment of *formal governance mechanisms* such as board memberships and observer roles to monitor venture activities and ensure they are aligned with the strategic interests of units' parent firms. We found that all units had instituted such governance mechanisms, which they complemented with informal visits and meetings. For example, our respondent from Glorious Ventures remarked:

'I walk a bit of the gray area when I fill a board role for one of these companies. I'm there at the behest and for the care and loyalty of their shareholders. By the same token, I sit here as a [parent firm] investor, so I have to navigate both sides of everything.'

A *contingent process*, which was adopted by units with varying performance, was to seek *mainstream assistance in selection*, either to validate the strategic value of a potential partner or to obtain leads for investment opportunities. Respondents from these units indicated that these efforts made relevant business units more responsive to portfolio companies' activities.¹⁴ As our respondent from Masterful Ventures noted:

'Around 20 percent of our leads are generated from our external partners in operations and around 20 percent are proposed by the business units. We also use the expertise of the business units in doing technical evaluations [of potential portfolio companies], though some of our team members also have technical backgrounds.'

In addition to these universal and contingent processes for venture-specific integration, an important *differentiating process* that has not been documented in prior research was the proactive *development of collaborative blueprints*. Managers of units adopting this practice outlined plans for collaboration between relevant business units and individual portfolio companies, highlighting areas of mutual interest and the specific business unit personnel responsible for furthering this collaboration. As the manager of Qualified Ventures observed:

¹⁴ However, excessive mainstream involvement in venture selection might have an adverse side effect of resulting in conflicts with the interests of portfolio companies. Some of our respondents pointed out that it was necessary to create a 'firewall' between their portfolio companies and parent firms, which was not possible when such mainstream involvement was sought. This is perhaps one of the reasons why adoption of this process did not benefit all units strongly.

'One of the things that the venture group did was develop fairly deep relationships with the companies that we invested in. The business development aspect was important for us regardless of whether we made the investment or not. And so, going in, we would be very focused on the relationship, the alliance aspect of it.'

As an important aspect of a collaboration blueprint, units often requested that key business unit personnel work closely with a venture. For example, the manager of Momentous Ventures assigned such individuals to board observer roles in his portfolio firms.

'In many instances the prospective holder of the commercial agreement will be the relevant observer . . . because traction [has] to take place inside and that really is dependent upon a strong relationship with the business units.'

Tables 3 and 5 indicate that all strong performers emphasized such blueprints and made business unit personnel responsible for implementation. None of the weak performers developed collaborative plans at the time of investment, but attempted to forge informal post-investment communication between a portfolio company and relevant business units. As the quote from the manager of Knockout Ventures suggests, these unit managers hoped that informal communication would translate to subsequent collaborative activities, which did not often happen. Of the average performers, only three units tried to develop collaborative blueprints (see Table 3). None of these three units adopted more than one differentiating search process. A relative weakness in search, therefore, may have prevented them from extracting the full benefits of this venture-specific integration process.

Our data from multiple interviews suggested why such blueprints helped in venture-specific integration. Our respondents noted that the success of an investment is often determined by 'whether it ends up being a joint collaboration eventually,' when it is 'necessary to find opportunities for interactions within the organization.' 'Getting the business to buy in' to a venture is usually '[a unit's] first work,' as is figuring out 'the right time for [the venture] to have a conversation with key scientists in licensing and research groups.' Collaborative blueprints helped in 'identifying maps of how [the parent and the venture] are going to collaborate,' generate 'traction that is dependent on a strong relationship with the

business units,' and ensure 'some element of cooperation is built into the relationship.'

Unit-generic integration

The remaining integration practices were intended to establish effective cooperation and coordination between the generic activities of a CVC unit, independent of particular external ventures, and mainstream units. Through these practices, CVC units tried to reduce the resistance and hostility of powerful mainstream units that might perceive external venturing as a threat to their activities (Chesbrough and Rosenbloom, 2002). As an example of a *universal* process in this regard, all units adopted an *advisory role to parent management* to highlight their potential value to the mainstream organizations. Unit managers tried to regularly inform parent firm's top management of technological and market trends that they gleaned from their partnerships with external ventures. As the manager of Ultimate Ventures noted:

'We give [the top management] updates several times a year [on] some of the trends in the marketplace and our portfolio companies, as well as the companies we didn't invest in.'

A *contingent* process pursued by some units was the exclusive *recruitment of internal personnel* from within the parent organization, either through transfers or rotation of individuals working in business units. In doing so, these units expected unit members to use their social ties with mainstream personnel to avoid any hostility from, and build bridges with, mainstream divisions.¹⁵ For example, our respondent from Glorious Ventures noted:

'For the most part, we have found that having somebody who has lived the business gives [the unit] more power both in terms of credibility and the ability to influence the businesses.'

One important and yet little-explored *differentiating* practice through which units mitigated mainstream resistance was the deliberate *avoidance of competitive postures* with mainstream activities.

¹⁵ However, as prior research suggests (Dokko and Gaba, 2012) and some of our respondents noted, the network contacts that external recruits possess and their experience with beneficial VC practices might often be more valuable than the integration advantages of having purely internal members. This is perhaps why not all units adopting this process experienced strong performance benefits.

These units consciously fought perceptions that their activities were substitutes for mainstream initiatives by constantly emphasizing that their primary role was to complement and assist mainstream divisions. Some units made considerable efforts to understand current and future parent initiatives to avoid competing with these initiatives. The manager of Qualified Ventures stated:

'If the opportunity was competitive or something that [the firm] would want to get into directly in the future, then it would be really hard to make investments outside that had a similar agenda. We didn't need a business unit check off to make an investment, but if the business unit said no, then it became a politically uphill battle.'

Some units also downplayed any competitive threat by understating their relative size in terms of budgets and/or returns in comparison to mainstream divisions. For instance, the manager of Leading Ventures continuously emphasized that his CVC unit would never match the scale and scope of mainstream units and, therefore, should not be considered a threat:

'I literally sat down the five heads of all research including their boss, and went through Accounting 101 for them. [I] explained the difference between opex and capex and said 'look guys, what I'm spending is capex.' Because [the parent] has such a strong balance sheet, the capex constraints on these guys are relatively minimal. Opex constraints on them are very real, but my opex is about \$1.7 million; I mean, it's a rounding error. It's taken five and a half years, but that argument has thankfully just gone away.'

As seen in Table 5, all strong performers avoided investing in areas that overlapped or competed with mainstream unit activities. While all of the weak performers were confronted with mainstream indifference and hostility, they failed to formulate an approach to counter such resistance. The managers of some of the units seemed resigned to these negative attitudes, as the quote from the manager of Knockout Ventures indicates. Moreover, as shown in Table 3, six of the 10 average performers avoided competitive postures with the mainstream units. Two of the three units that developed collaborative blueprints were also able to avoid competitive postures, suggesting some complementarity among venture-specific and unit-generic integration processes.

Data from multiple interviews indicate why avoiding competitive postures was an important practice

in building acceptability for the CVC unit. A unit's activities of 'bringing learning into the organization' were 'dependent on the goodwill of all the other folks in [the parent]' and 'the real hurdle is always more internal.' 'There had to be a linkage within the organization . . . both in terms of credibility and ability to influence the business.' 'Strategic alignment had to be managed prudently and proactively' by 'maintaining close relationships with the various operating groups.'

CVC units avoided a competitive posture by 'asking business units for those things that will be impacting them in a two- to five-year time horizon.' This prevented a 'politically uphill battle if a business unit said no [to their investments].' Units 'avoided the likelihood of conflict' by not making investments 'in pathways where [the parent] currently has an active R&D program' and 'flying a little bit below the radar because of the group's small size and newness.'

In sum, our units adopted three processes relating to venture-specific integration, of which one was universal, one contingent, and one differentiating. We also observed three processes relating to unit-generic integration, of which one was universal, one contingent, and one differentiating. We now discuss how some of these processes may have multiple influences on different aspects of search and/or integration.

Interdependencies between processes

In the interest of parsimony, we categorized first-order processes based on their primary utility in helping a particular aspect of search or integration. However, as our interviews revealed, some processes had weaker secondary effects (sometimes negative) on other aspects of search and integration.¹⁶ We discuss these relationships to better understand the different ways in which a process can benefit or impede CVC unit performance.

Interdependencies within search or integration

From our interviews, it appeared that some opportunity-generation processes had secondary relationships with opportunity selection, since these processes often resulted in the creation of relevant selection criteria. For example, units usually selected a venture for investment if the invitation was

¹⁶ We thank an anonymous reviewer for pointing us in this direction.

extended by a prominent syndication partner. Units that sought to protect venture interests typically avoided selection of investments where the potential for violation of venture interests existed (such as with ventures that lacked adequate intellectual property protection). Opportunity-selection processes may, in turn, have had a favorable secondary impact on opportunity generation. As a unit focused on thematic sectors and early-stage ideas, it gained a reputation for being a valuable partner to relatively young ventures in these sectors, resulting in increased investment opportunities.

There were similar secondary relationships between venture-specific and unit-generic integration processes. The legitimacy of the CVC unit increased as more individual ventures were successfully integrated (through developing collaborative blueprints and establishment of governance mechanisms), causing the unit's positive performance to be more visible to mainstream units. Moreover, as unit managers advised parent management on external developments and their units' complementary activities, interest was often generated in specific ventures from which valuable knowledge could be accessed.

Interdependencies between search and integration

We also observed instances of positive and negative interdependencies between search and integration processes. First, while the process of nurturing portfolio ventures was primarily related to opportunity generation, we found it had a secondary link with venture-specific integration. As CVC units approached relevant business units for critical resources to support portfolio ventures, this resulted in a greater understanding and appreciation of ventures' activities within the mainstream organization. Second, the unit-generic integration process of avoiding competitive positions with the mainstream appeared to be secondarily related to selection—units adopting this process selected only those ventures for investment that did not potentially compete with mainstream units. This process also had a secondary effect on opportunity generation since the CVC unit better protected a venture's interests when the venture did not compete with the mainstream. Third, the venture-specific integration process of developing collaborative blueprints had a secondary effect on opportunity generation and selection. Greater collaboration with ventures helped create a favorable reputation for a unit as a reliable investor and, thereby, resulted in greater investment

opportunities. It also served as a selection mechanism since units adopting the process formed relationships only with ventures that were agreeable to such collaborative blueprints. Fourth, the venture-specific integration process of soliciting mainstream assistance also impacted opportunity selection by establishing mainstream involvement as a critical part of the selection process. However, as discussed earlier, this process may negatively impact opportunity generation since venture interests were harder to protect when the mainstream was closely involved in selection. Similarly, the unit-generic integration process of recruiting internal employees may negatively impact opportunity generation, as internal employees lack external networks that help generate investment opportunities.

In sum, the presence of interdependencies between processes suggests that there are often multiple and indirect ways to implement the different aspects of search and integration other than the direct relationships we highlighted in our framework. Moreover, while search and integration sometimes impede each other and are, therefore, difficult to implement concurrently, there are also several conditions where they could complement each other. As our findings highlight, this was particularly true of the differentiating processes we identified.

DISCUSSION

To examine how external venturing units generate valuable knowledge for their corporate parents, we studied how CVC units engaged in search and integration activities and the efficacy of their specific practices. Previous research on external venturing provides little insight into this important question and has, thus, overlooked the potential entrepreneurial role that unit managers may play in achieving effective search and integration. We identified and described a set of four universal practices that all sample CVC units used to facilitate the two components of their search mission—the generation and selection of new venture investment opportunities—and two universal practices used to achieve integration with mainstream units. We also identified three widely adopted practices that did not have a discernible relationship with unit performance, possibly because their influence was contingent on unobserved factors.

Differentiating processes

In addition to these well-known and widely adopted practices, we uncovered a set of five novel practices that varied in use across CVC units and were related to observed differences in the efficacy of unit search and integration. Specifically, units that focused on reducing deal complexity and protecting ventures' interests improved their reputation as attractive investors among start-ups and VCs, thereby increasing the number and quality of partnering opportunities, a primary component of search. Units that evaluated and selected ventures based on an early stage of development increased the search benefits they offered their parent firms by helping them probe potentially useful, but uncertain, technologies, markets, or business models before rivals. In terms of integration efficacy, CVC units that helped develop explicit collaborative blueprints between specific venture partners and mainstream businesses created social contracts between the parties, thereby increasing venture-specific integration. Finally, CVC units that sought to avoid a competitive posture relative to mainstream units and frame their role as complementary reduced internal political resistance to their activities, resulting in more effective unit integration.

Contributions and implications

Our study makes important contributions to the external corporate venturing literature. We extend and elaborate substantive theory of CVC by documenting the five differentiating unit practices we found to be valuable in improving the efficacy of units' search for external venture partners and integration with mainstream organizational units. Prior research has examined some of the universal and contingent practices we identified (Hill *et al.*, 2009; Maula *et al.*, 2013; Wadhwa and Basu, 2013), but has not highlighted the importance of our differentiating processes in much detail. We contribute to the external venturing literature by drawing from our data to provide detailed explanations for how and why these practices influence the efficacy of CVC unit search and integration. In doing so, we show how CVC units attempt to manage the trade-offs between achieving effective search and integration and accomplish both. Although studies show CVC investing can enhance a corporate investor's innovativeness by learning from its portfolio firms (Maula *et al.*, 2013; Wadhwa and Kotha 2006), the

conditions under which this happens are poorly understood (Dushnitsky, 2012). Our results suggest that an important source of heterogeneity in the effects of CVC investing on firm-level innovation is the efficacy of CVC units' search and integration mechanisms.

We further extend substantive theory of CVC by identifying and explaining complementarities among the observed CVC unit practices. Our analysis suggested the five differentiating practices complement each other and are, therefore, more effective when adopted as a bundle rather than as individual processes in isolation. Our analysis also indicated that the differentiating practices complement universal processes by enhancing the benefits of these processes. For example, syndication and nurturing portfolio companies (both universal processes) are more effective in stimulating opportunity generation when the investor's reputation is enhanced through protecting venture interests and reducing deal complexity. Similarly, the universal selection processes of venture evaluation and focus on thematic areas are more effective when complemented by a commitment to early-stage ideas. Board membership or observation rights work better at integrating particular ventures when collaborative plans with a mainstream unit have been developed; and an advisory role to parent management is more beneficial in integrating a CVC unit when competitive postures are avoided. In sum, our analysis suggests that an organizational configuration approach, in which variations in particular bundles of practices explain organizational outcomes (Miller, 1996), contributes to a better understanding of CVC unit performance relative to examining individual practices in isolation.

We also extend research on external corporate venturing by moving beyond its focus on top management in creating the structural context that enables and constrains program execution (e.g., Dushnitsky and Shapira, 2010). We instead focus attention on the role of CVC unit managers as entrepreneurial agents in pursuit of effective search and integration. Our results show how effective unit managers strive to increase the value of search initiatives for mainstream units by building bridges between specific ventures and relevant mainstream units and increasing the internal legitimacy and acceptance of their units' overall activities. Because they lack authority over many needed resources, CVC managers are involved in a variety of political processes that anticipate resistance from mainstream

units and seek to mitigate it through social influence. For example, our analysis suggests that CVC unit managers who pursued the practice of collaborative blueprinting facilitated a social exchange relationship (Starr and MacMillan, 1990) between a particular mainstream unit and a particular venture by creating a social obligation between them. The obligation is created when a mainstream unit manager agrees to pursue collaboration with a venture or agrees to participate as a board member or observer for the venture (Homans, 1958). Moreover, unit managers who pursued the avoidance of competitive postures focused much of their efforts on a political process of meaning construction (Kaplan, 2008). These managers acknowledged the potential for mainstream units to frame CVC programs as a threat, which would result in hostility and resistance toward their activities. However, they worked to replace the threat framing with an opportunity framing by mobilizing mainstream personnel around the complementary and value-enhancing nature of the CVC program. Similar to the case of effective venture integration, CVC unit managers that achieved effective unit integration were politically skilled organizational operatives.

Possible alternative explanations

We considered two characteristics of our sample CVC units as possible alternative explanations for the relationship between the five differentiating practices and the efficacy of CVC unit search and integration. First, we considered if the different objectives pursued by the units drove both the choice of practices and unit performance. To recall, our units had diverse and often multiple strategic objectives involving horizon scanning, ecosystem building, and gap filling. Next, we considered if the parent firm's primary industry generated the choice of practices and unit performance. Both of these arguments are inconsistent with the data (see Tables 1 and 3). Units that pursued the same objectives varied with respect to their adoption of differentiating practices and their performance. Similarly, CVC units of parent firms in the same primary industries varied with respect to both practices and performance. Therefore, we concluded that unit objectives and parent firm industry could not fully explain the relationships between the differentiating practices and unit performance.

We also considered the possibility that the causal direction of our results is the opposite of what we

inducted from our data¹⁷—i.e., do differences in CVC unit performance (in terms of their search and integration effectiveness) cause differences in their use of the five differentiating practices? While longitudinal data on practice adoption and unit performance and/or some source of exogenous variation in practice choice would help us investigate this possibility, we lack such data. However, we know from our data that some of the high performing units adopted some of the differentiating practices at the time their units were established. Consequently, these choices could not have been made in response to feedback about unit performance. Similarly, we know that one of our low performing units had never used any of the five differentiating practices, which suggests they did not abandon them in response to poor performance. Therefore, we concluded that unit performance did not cause the adoption of any differentiating practice.

Limitations and future research

An interesting follow-up question to our study is why more external venturing units did not adopt the differentiating processes identified here. Unit managers may not be aware of the nuanced interactions possible among these processes. Understanding such barriers to adoption would be a valuable endeavor for future research. While identifying differentiating processes by contrasting strong and weak performing units, we found interesting differences in the adoption of these processes by average performing units. Given the scope of this study, we did not explore the reasons for, or implications of, these differences. Neither did we fully examine the conditions under which the identified contingent processes positively impact unit performance. We believe these are also interesting opportunities for future researchers.

Our findings suggest that through effective integration, CVC units can often transform unfavorable corporate environments to become more receptive to their activities. Future research could dynamically examine if changes in corporate context alter the relative importance of the differentiating processes we identified. Finally, future research could examine whether our findings are relevant to other types of organizational units, such as internal venturing

¹⁷ Given that our data are essentially cross-sectional and we observe choices, which may be made in consideration of or response to performance (i.e., are nonrandomly assigned), reverse causality is a distinct possibility.

groups, to build more general theory on how autonomous units can help parent firms become ‘ambidextrous’ in balancing exploration and exploitation (Tushman and O’Reilly, 1996).

CONCLUSION

How can external corporate venturing units effectively search for valuable external venture partners, leverage the resources of internal mainstream units in the process, and facilitate learning between these two audiences, thereby contributing to corporate renewal and resilience? We investigated this important, yet largely unexplored, question through an inductive study of 17 corporate venture capital units. We documented a set of five practices that influence the efficacy of a unit’s external search and internal integration. We also identified complementarities between these five practices and other, more common, practices used by all sample CVC units. This study contributes to external venturing research by showing how unit managers can achieve both effective search and integration via entrepreneurial and politically savvy practices, and it provides insight into why some corporate investors are better at learning from external start-ups than others.

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STRATEGIC ALLIANCES OF ENTREPRENEURIAL FIRMS: VALUE ENHANCING THEN VALUE DESTROYING

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Research summary: Based on the RBV and dynamic capabilities, this study explains the relationship between alliance formation and the private (pre-IPO) entrepreneurial firm's market performance. Findings show that while alliance formation positively and significantly affects the market performance of venture-backed firms in the software industry, forming a comparatively large number of alliances hurts these firms' market valuations.

Managerial summary: Entrepreneurial firms are better off entering a select number of strategic alliances and focusing on enhancing the outcomes of those select alliances as well as developing a dynamic alliance management capability. Such firms benefit most from establishing a moderate number of alliances rather than depending on a small number of alliances or becoming overwhelmed with a great number of alliances.
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INTRODUCTION

Forming alliances is a particularly popular strategy entrepreneurial firms use to access resources in their attempts to create value. Unfortunately, the efficacy of this strategy remains unclear. A growing literature largely based on applications of the resource-based view (RBV) provides mixed findings, suggesting the effect of alliances on firm performance outcomes might be negative (Alvarez and Barney, 2001; Golden and Dollinger, 1993; Miles, Preece, and Baetz, 1999), positive (Baum, Calabrese, and Silverman, 2000; Chang, 2004; Li, 2013; Soh, 2003), positive and then negative (Coombs, Mudambi, and Deeds, 2006; Deeds and Hill, 1999), or nonexistent (Deeds, De Carolis, and Coombs, 1997). These prior studies examine the effect of alliances on a variety of firm outcomes such as new product development

(Rothaermel and Deeds, 2006; Soh, 2003), revenue growth (Golden and Dollinger, 1993), R&D spending (Baum *et al.*, 2000), and speed to IPO (Chang, 2004). While these outcomes are arguably associated with value creation, there is little direct evidence regarding the effect of alliances on the market assessment of the entrepreneurial firm value creation potential. Furthermore, the firms studied most in this literature are biotechnology firms in alliances with large pharmaceutical companies and firms that have recently gone public (e.g., Bosse and Alvarez, 2010; Coombs and Deeds, 2000; Deeds and Hill, 1996; Deeds and Rothaermel, 2003; Welter, Bosse, and Alvarez, 2013).

One of the seminal articles about the dynamic capability construct in the RBV uses strategic alliance formation as a classic, even definitional, dynamic capability (Eisenhardt and Martin, 2000). A recent systematic and comprehensive review of the empirical literature on dynamic alliance capabilities shows the construct is commonly operationalized as the number of alliances formed by the firm (Wang and Rajagopalan, 2015). Over time, this literature on alliancing as a dynamic capability has examined other aspects of the phenomenon, including different stages

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in the life cycle of the capability (Helfat and Peteraf, 2003) and examinations of alliance process articulation, codification, sharing, and internalization (Kale and Singh, 2007). While these advanced ideas are multiplying, the question remains about the basic relationship between the number of alliances and an entrepreneurial firm's market performance. Using RBV (Barney, 1991) and dynamic capabilities logic (Eisenhardt and Martin, 2000), this article examines the following research question: what is the effect of strategic alliances on the market performance of pre-IPO entrepreneurial firms? In this sense, this article is a response to the recognized need for continued attention on the effects of alliances on entrepreneurial firms (Alvarez, Ireland, and Reuer, 2006).

Results from our sample of 166 U.S. venture-backed software firms suggest a curvilinear relationship between the number of strategic alliances and the market's valuation of the entrepreneurial firm. In other words, firms with alliances are seen as more valuable than those without, but having too many alliances reverses this positive effect. It is argued that the reversal may be attributed to limited capability and capacity for alliance management. This study makes at least two main contributions to the strategic alliance literature in the context of entrepreneurial firms. First, it strengthens the explanatory framework based on RBV and dynamic capabilities perspectives by examining the direct effects of strategic alliances on the valuation of small entrepreneurial firms. Second, this study examines the effect of alliances on an important market-based outcome of pre-IPO venture market performance, which has been proven a more reliable value creation indicator than accounting measures in firms with high levels of intangible resources (Bonardo, Paleari, and Vismara, 2010; Shane and Stuart, 2002).

The remainder of this article is structured as follows: we next review the literature that sets up our research question. Hypotheses are then developed using logic provided by the RBV and dynamic capability perspective. Then, the methodology and operationalization of variables are presented, followed by empirical results. Finally, the article concludes with a discussion of scholarly and managerial implications of key findings.

STRATEGIC ALLIANCES IN ENTREPRENEURIAL FIRMS

Strategic alliances are 'any independently initiated interfirm link that involves exchange, sharing, or co-

development' (Kale, Dyer, and Singh, 2002: 748). Alliance structures include a wide range of inter-organizational arrangements, from more formal shared equity joint venture agreements to relatively informal cooperative agreements (Judge and Ryman, 2001). Appropriately structured alliance agreements provide access to the partners' knowledge, skills, and resources while preserving control and limiting loss of flexibility (Harrison *et al.*, 2001).

Researchers have examined alliances at least since the late 1970s when U.S. multinational firms started to form joint ventures for international expansion (Alvarez *et al.*, 2006). The size of this phenomenon is impressive. In 2000 alone, more than 10,200 strategic alliances were formed (Ireland, Hitt, and Vaidyanath, 2002). The top 500 global business firms were involved in an average of 60 major strategic alliances each (Dyer, Kale, and Singh, 2001), and the number of corporate alliances grows 25 percent a year (Hughes and Weiss, 2007). While established, large firm alliances have been studied extensively (e.g., Das, Sen, and Sengupta, 1998), small entrepreneurial firm alliances are now starting to receive more attention (Alvarez *et al.*, 2006; Coombs *et al.*, 2006).

In recent years, the growing literature on small and entrepreneurial firm strategic alliances has suggested that entrepreneurial firms pursue alliances to achieve strategic goals that are different from those of established firms; however, this literature is still in its infancy and, in some cases, exhibits contradictory results. Our examination of the extant literature on entrepreneurial firm alliances can be organized into four groups of studies based on their findings. First is the group of studies that reported no significant effect of alliances on entrepreneurial firms. Golden and Dollinger (1993) examined the cooperative alliances in small manufacturing firms and found that many small firms do engage in different types of alliances based on their different business strategies, but the direct effect of alliances on firm performance was not clear. DeCarolis and Deeds (1999) examined the effect of alliances (as a knowledge flow mechanism) on firm value (measured at the end of the IPO day) and also found no significant relationship. Although Deeds, DeCarolis, and Coombs (2000) hypothesized that the number of alliances has a positive effect on new product development, they reported no statistically significant relationship.

The second group of studies in the literature suggests a negative effect of alliances on entrepreneurial firms.

Golden and Dollinger (1993: 51) reported that alliance engagement negatively affected firm performance and explained that maybe alliance engagement 'does not produce profit maximization but provides a satisficing posture' for those firms. Analyzing several case studies in the computer industry, Gomes-Casseres (1997) suggested that small firms engaging in alliances, especially with larger firms, may not receive a fair share of the alliance benefits due to weak bargaining power. Alvarez and Barney (2001) then reported that 80 percent of entrepreneurs felt 'unfairly exploited' by their larger partners. In the same vein, Dickson, Weaver, and Hoy (2006) pointed out that despite the proposed positive effect of strategic alliances on the growth and survival of SMEs, both empirical and anecdotal reports illustrate a high failure rate for all types of alliances. In his blog, Marc Andreessen, founder of Netscape Communications Corporation, has addressed the risks of partnerships with established firms (Wang *et al.*, 2012: 5):

'A big company might study you for three months, then approach you and tell you they want to invest in you or partner with you or buy you, and then vanish for six months, then come out with a directly competitive product that kills you...or just make you waste a huge amount of time in meetings and get distracted from your core mission.'

The third group of studies advocates a positive effect of alliances on entrepreneurial firm performance. Brown and Butler (1995) pointed out that small entrepreneurial firms may sometimes establish an interorganizational network of alliances with their competitors so that they jointly capture some of the strategic advantages over the larger, more established competitors. Stuart, Hoang, and Hybels (1999) found that biotech firms that develop networks of equity-governed partnerships with well-known large firms exhibit faster transition to IPO and earn greater valuations at IPO than firms without such networks. They argue that higher valuation is mostly attributable to the transfer of reputation from larger firms to the small entrepreneurial firm. Baum *et al.* (2000), also examining the biotech industry, reported that alliance network efficiency (partner diversity) positively affects revenue growth and R&D spending. Soh (2003) investigated the role of alliances in information acquisition and reported a positive effect on the rate of new product development at entrepreneurial firms. Similarly, Rothaermel and Deeds (2006) investigated

2,226 R&D alliances by 325 global biotechnology firms and found that an increase in the number of R&D alliances is positively related to new product development.

Finally, a fourth group of studies points to an inverted U-shaped relationship between alliances and entrepreneurial biotechnology firm outcomes. Deeds and Hill (1996) find this relationship between the number of alliances and new product development outcomes. Flipping the question around, Rothaermel and Deeds (2006) contribute to the dynamic capabilities literature by showing the number of R&D alliances has an inverted U-shaped effect on alliance management capability.

In sum, studies of the relationship between entrepreneurial firm alliance formation and various performance outcomes have provided a wide range of findings. The published studies are growing toward a collectively exhaustive list of possible relationships: no relationship, negative relationship, positive relationship, and inverted U-shaped relationship. The inconsistent findings may be partially attributed to the variety of organizational outcomes examined in the prior studies. The current study offers clarity by building a direct argument based on the RBV and the dynamic capabilities construct and designing a straightforward test for this relationship. Next, we employ the theory to argue that entrepreneurial firms may benefit from alliances by gaining two main resources: (1) partners' resources such as market access, knowledge, and technology; and (2) reputation and partner endorsement to help pursue capital resources from investors (e.g., Coombs *et al.*, 2006; Stuart, 2000; Stuart *et al.*, 1999); however, the alliance benefits are constrained by the entrepreneurial firm's developing alliance management capability.

THEORY DEVELOPMENT

Seeking alliance benefits: a resource-based view

The RBV (Barney, 1991; Rumelt, 1984; Wernerfelt, 1984) posits that those firm resources that are valuable, rare, costly to imitate, and non-substitutable ('VRIN') serve as sources of sustainable competitive advantage (Barney, 1991). Entrepreneurial firms often form alliances with specific firms to access rare, costly to imitate, and non-substitutable resources they believe will be uniquely valuable in exploiting their target opportunity. Their alliance partners, in turn, can be attracted to the alliance with the promise of accessing VRIN resources at that specific entrepreneurial firm

that will, likewise, help them create more value. To the extent alliances achieve these objectives, the theory suggests both firms will create more value, all else equal (Eisenhardt and Schoonhoven, 1996; Kelley and Rice, 2001; Stuart and Sorenson, 2007; Wang *et al.*, 2012).

Through strategic alliances, entrepreneurial firms often use their partners' tangible organizational capabilities such as manufacturing, marketing, sales, or distribution that are necessary to commercialize new technologies, products, or services in their particular market (Alvarez and Barney, 2001; Baum *et al.*, 2000). Alliances also often provide access to intangible resources. The possibility of gaining access to partners' specialized knowledge and learning from those partners, for example, is considered a key reason for firms to engage in alliances as 'access relationships' (Stuart, 2000: 792). The development of interfirm knowledge-sharing routines aimed at dissemination, recombination, or creation of specialized knowledge (Grant, 1996) is an important source of inter-organizational relationship resources that qualify as VRIN (Dyer and Singh, 1998). The alliance engagement of an entrepreneurial firm may positively impact its value, especially if the alliance provides access to resources and knowledge required to realize the firm's target opportunity (Coombs *et al.*, 2006).

Reputation is another valuable intangible resource that entrepreneurial firms may seek to access through an alliance (Boyd, 2010; Obloj and Capron, 2011; Rindova, Williamson, and Petkova, 2010; Zyglidopoulos, 2001). Entrepreneurial firms sometimes seek to leverage their partner's reputation to signal legitimacy to other potential stakeholders (Lounsbury and Glynn, 2001). 'Becoming seen as legitimate by the external resource providers enables new ventures (...) to gain access to the resources necessary to exploit the perceived opportunity' (Deeds, Mang, and Frandsen, 2004: 12). It follows that having a reputation for being closely affiliated with other reputable firms can act as a resource that makes it easier to access other required resources (Lounsbury and Glynn, 2001). Lounsbury and Glynn (2001: 556) refer to the entrepreneurial firm's alliances as 'third-party endorsements.' Thus, the reputation of being a viable partner may significantly improve an entrepreneurial firm's value creation potential (Davies, Chun, and Kamins, 2010; Roberts and Dowling, 2002). A good reputation may even serve as an entry barrier keeping other firms from entering the focal firm's market (Walsh and Beatty, 2007).

Another type of resource that can become more accessible by entrepreneurial firms engaged in strategic alliances is financial capital. To the extent venture capitalists are industry specialists, which is often the case, they are particularly skilled at assessing the future value creation potential of entrepreneurial firms. The valuation process includes assessing the entrepreneurial firm's business relationships, and strategic alliances can be viewed as objective, third-party 'endorsements' of the entrepreneurial firm's potential (Stuart *et al.*, 1999: 315). Because each alliance partner can be expected to have also performed its own due diligence before entering the alliance, the endorsement is a difficult resource to imitate. Knowing this, venture capitalists view alliance relationships favorably because the alliance partners have signaled that they already view the venture as high quality and legitimate. In other words, positive reputational signals are attributable to the notion that other firms accept partnership with small firms with high quality, and they do so only after quality assessments (Stuart *et al.*, 1999). It seems that 'when there is uncertainty about the quality of someone or something, evaluations of it are strongly influenced by the social standing of the actors associated with it' (Stuart, 2000: 795); therefore, since there is considerable uncertainty about the quality of small entrepreneurial firms, strategic alliances of small entrepreneurial firms play a major role in their valuation assessment (Stuart, 2000), which facilitates gaining access to investment capital (Deeds *et al.*, 1997; Deeds *et al.*, 2004).

In summary, this study suggests entrepreneurial firms may utilize alliances to gain not only the partners' resources, but also financial capital resources from specialized investors who place a higher valuation on the firm (i.e., market performance) at the time of funding. Therefore, this study posits that entrepreneurial firms with alliances may exhibit a higher market performance.

Hypothesis 1: Entrepreneurial firms with alliances exhibit higher market performance than those without alliances.

The managerial capability development challenge in seeking alliance benefits

Relying solely on the RBV in dynamic environments and 'simply examining relationships between start-up resources and performance can produce misleading conclusions' (Wu, 2007: 549). This is arguably part

of the problem in the extant literature's mixed findings about the effectiveness of entrepreneurial firm alliances. This study seeks to enhance our understanding of the alliancing strategy by leveraging a nuanced explanation made possible by the dynamic capabilities perspective.

The dynamic capability perspective (Teece *et al.*, 1997) was developed as an extension of the RBV, particularly for fast-changing business environments, such as the technology-driven computer software industry. Several entrepreneurship scholars (e.g., Arthurs and Busenitz, 2006; Moghaddam, Provance, and Bosse, 2011; Newey and Zahra, 2009) support the notion that the dynamic capability perspective is a fruitful theoretical framework in examining entrepreneurial firms and call for capability-based studies. Furthermore, some entrepreneurship scholars highlight the importance of 'building capabilities to enable a venture to navigate difficult times' (DeCarolis *et al.*, 2009: 147).

Based on earlier studies (e.g., Hamel and Prahalad, 1990; Nelson and Winter, 1982), Teece, Pisano, and Shuen (1997: 516) define a dynamic capability as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.' In another foundational article in the development of dynamic capabilities logic, Eisenhardt and Martin (2000) identify alliancing as an example of a dynamic capability. Eisenhardt and Martin (2000: 1107) explain that alliancing is a dynamic capability 'to integrate, reconfigure, gain, and release resources.' The alliancing capability is dynamic and idiosyncratic because it requires continuous refinement with every partner. Forming and managing an alliance well requires, for example, defining the business arrangement for the two firms, developing working relationships among the individual stakeholders, creating appropriate metrics, productively addressing differences, and establishing formal and informal systems and work flows (Hughes and Weiss, 2007).

Alliance experience has been characterized as the critical antecedent in the development of an alliance capability (Heimeriks and Duysters, 2007). The literature suggests that the number of alliances formed with partners in one industry is positively related to a given firm's alliance capability in similar technological areas (Rothaermel and Alexandre, 2009), and a firm's capability for managing a portfolio of alliances can be conceptualized in terms of the number of alliances the firm pursues (Deeds *et al.*, 2000; Rothaermel and Deeds, 2006; Wang and Rajagopalan, 2015). Alliance experience supports

learning effects that accumulate in an alliance capability (Kale *et al.*, 2002). Considering that measuring the dynamic capability itself is a challenging task (since it is unobservable), the number of firm alliances is considered the next most practical indicator of alliance capability (Barney, Ketchen, and Wright, 2011; Godfrey and Hill, 1995).

Appreciating the uniqueness of an effective alliancing capability at any particular entrepreneurial firm—as is required for supporting the logic of inimitability—also draws attention to the limits of alliancing. The successful use of strategic alliances relies on 'the capacity of managers to create, extend, or modify the resource base of the organization' (Helfat, Finkelstein, and Mitchell, 2007: 3). Given heterogeneity among firms, continued use of alliances reflects a capability of coordinating different partner activities. Each alliance requires the entrepreneurial firm manager to identify potential alliance partners, negotiate the alliance agreement, conceptualize alliance stage of development, and navigate the firm through the activities that serve the alliance and its objectives (Kale *et al.*, 2002). In the entrepreneurial firm setting, acknowledged for its comparative lack of managerial capabilities, the accumulation of alliances can be expected to eventually outpace the enhancement of the managerial capability.

Entrepreneurial firms must develop their alliancing capabilities to balance the benefits of alliances with the risks of opportunistic behavior of their often larger partners (Dickson *et al.*, 2006). Liability of newness (Stinchcombe, 1965) and liability of smallness (Aldrich and Auster, 1986) suggest that small new entrepreneurial firms lack the necessary internal organizational learning and monitoring systems. Inadequate screening and monitoring raises not only 'the probability of poor partner selection', but also 'negative returns as the number of alliances increases past some critical point' (Deeds and Hill, 1996: 45). In other words, 'gaining access to complementary assets through strategic alliances is not without risks. Malperformance may occur when the firm discovers that the complementary assets provided by the partner are a poor match, fail to live up to the promises made by the partner, or a partner may opportunistically exploit an alliance, expropriating the firm's know-how while providing little in return. These problems arise because the effectiveness with which the firm can select and manage alliance partners is likely to be negatively related to the number of alliances the firm is managing' (Deeds and Hill, 1996: 42). Managerial attention is an exhaustable resource

(Ocasio, 1997; Ocasio, 2011) that may constrain the total number of alliances entrepreneurial firms can manage effectively.

Putting these arguments together, this study posits that increasing the number of strategic alliances may result in higher performance as long as it does not exceed a firm's alliance management capability (Rothaermel and Deeds, 2006). Therefore, if the number of alliances exceeds the firm's alliance management capability, it may result in alliance governance challenges or higher likelihood of partners' opportunistic behavior. It is plausible that entrepreneurs who have had success with previous alliances tend to focus more on the alliance opportunities and benefits and may underestimate the alliance risk (Tyler and Steensma, 1998). Therefore, they may engage in additional alliances that they can not manage effectively.

This study suggests that market performance of an entrepreneurial firm grows with the number of strategic alliances only to a level at which managerial capability can keep up. Adding alliances beyond this point would produce declines in entrepreneurial firm performance, since managers cannot focus their attention on too many issues related to numerous alliances at the same time (Ocasio, 1997; Ocasio, 2011).

In sum, the dynamic capability logic suggests that small entrepreneurial firms may benefit the most by holding a manageable number of alliances and engaging in too many alliances will be risky since small entrepreneurial firms usually lack the managerial capability to manage a large portfolio of partnerships (Larson, 1991; Miles *et al.*, 1999; Rothaermel and Deeds, 2006; Uzzi, 1999). In other words, a moderate number of alliances within the managerial capability of entrepreneurial firms may result in the most beneficial scenario.

Hypothesis 2: The relationship between the number of alliances formed by an entrepreneurial firm and its market performance exhibits an inverted U-shape, such that the market performance reaches its maximum level with a moderate number of alliances.

DATA AND METHODOLOGY

Considering the difficulties in comparing firms across industries (Chakravarthy, 1986), a single industry—software—is the focus of our study. The software industry is selected as an appropriate setting because

it sees much entrepreneurial firm activity, and companies in this industry exhibit more variation in their use of strategic alliances relative to other industries. This industry is also one that attracts many VC investments and, therefore, provides a market-based measure of firm performance following start-up but prior to IPO.

Data collection

Alliance and market performance data were collected from two separate databases to create the sample for this study. Data on small entrepreneurial firms were collected from the VentureXpert database, which provides data on venture valuation by their venture capitalists at the time of funding, firm age at the valuation date, total number of institutional investment transactions received prior to the valuation date, and the number of venture capitalists involved in the last funding round. The second database is the SDC Platinum database, from which alliance data were collected. SDC provided comprehensive data on strategic alliances of U.S. companies from 1988 onward (Wang *et al.*, 2012), which included the alliance partner name and announcement dates. Consistent with prior research (e.g., Das *et al.*, 1998), joint ventures were not considered in this study because they have an essentially different ownership structure.

The VentureXpert database includes 7,625 funding rounds for 2,412 software firms. The initial sample of this study included 1,050 companies for which the valuation data was reported for their last round of funding. Since the focus of this study is on U.S. firms, non-U.S. firms were excluded, reducing the sample size to 965 firms. Consistent with prior research (Chang, 2004; Wang *et al.*, 2012), the data collected from two databases (i.e., VentureXpert and SDC) were pooled together by company name in the Microsoft Access program. The related alliance data prior to the last round of funding for each firm were collected from SDC. Subsequently, the aggregated data was divided into two groups. Out of 965 firms, 882 firms (91.4%) had no alliances and were included in the first group. The remaining 83 firms (8.6%) in the initial sample were included in our second group, for which 270 alliances were reported in SDC. The percentage of entrepreneurial firms (8.6%) that engaged in alliance formation in our sample is similar to the percentage reported in previous studies (e.g., Nicholson, Danzon, and McCullough, 2005). This percentage is lower than that (15%) of IPO firms

and that of publicly traded firms (Nicholson *et al.*, 2005). One explanation is that private targets are associated with higher transaction costs (due to the higher likelihood of adverse selection problems) than their public counterparts; therefore, alliance partners are more interested in public rather than private firms (Jung-Chin and Reuer, 2005) which, in turn, reduces the number of alliance engagement opportunities for small private firms.

For the final sample of this study, all 83 small entrepreneurial firms in our second group were reserved, and then 83 firms were randomly drawn from the 882 firms in our first group (i.e., firms without alliances). The randomly selected 83 firms were compared with all firms in the first group based on firm age, size, location, and number of venture capitalists involved, and no significant difference was found. This indicates that the randomly selected 83 firms are representative of all firms in the first group. Since this study is interested in relatively small and new entrepreneurial firms, 10 firms which had received more than \$100 million¹ in investment from venture capitalists were dropped. Consistent with prior similar studies (e.g., Ceccagnoli *et al.*, 2011), four firms that were more than 20 years old were also excluded. Within the remaining firms in our sample, no firm had more than ten alliances, except one firm (with 25 alliances), and it was excluded from our final sample.² Therefore, the final sample includes 151 firms within the time period of 1990 through 2010. Ordinary least squares (OLS) regression was used to estimate the effect of strategic alliances on the firm market performance. The sample average age was used to replace the missing age data of 17 firms.³

Variables

Dependent variable

Small entrepreneurial firm performance is affected by the firm's ability to access knowledge and other resources (Deeds *et al.*, 2000). Small entrepreneurial firms, particularly those engaged in the development of technology-based products and services, are largely

comprised of intangible assets (e.g., knowledge) and may often reach states of outside funding prior to the generation of meaningful rents. Since many small entrepreneurial firms are not public firms, their financial performance information is not available. Alternatively, this article employs the entrepreneurial firm valuation assessed by venture capitalists as a proxy for their market performance. The capital flow from institutional investors into entrepreneurial firms usually occurs via VC funds as intermediaries (Baum and Silverman, 2004; Groh and Liechtenstein, 2011). Venture capitalists examine and evaluate small entrepreneurial firms and fund them according to their value creation potential. In fact, venture capitalists are specialized financial intermediaries who connect investors and entrepreneurs (Wang *et al.*, 2012). For example, Matusik, George, and Heeley (2008) examined the worth of founders' human capital as perceived by venture capitalists. Consistent with previous empirical studies (e.g., Nicholson *et al.*, 2005), the natural logarithm of valuation is used in order to normalize the distribution. Therefore, the dependent variable is the natural logarithm of post-money valuation for the latest investment transactions in entrepreneurial firms included in the sample. Post-money valuation refers to the valuation an entrepreneurial firm receives after the final round of funding received from the venture capitalists (Yang, Narayanan, and Zahra, 2009).

Independent variables

Consistent with previous studies (e.g., Nicholson *et al.*, 2005) the count of all alliances formed by each firm is used as the independent variable to examine the main effect of alliances on entrepreneurial firm performance. The squared term of the alliance count variable was also used to test the nonlinear relationship.

Control variables

This study includes three types of control variables: firm-specific, transaction-specific, and context-specific controls. The firm-level controls are firm age, size, and location. The investment transaction control variable is concerned with effects of negotiations between investors at the time of firm evaluation. The contextual control variable is a dummy variable to account for the software bubble period (1997 through April 2000).

Firm age appeared as a control variable in many previous studies (e.g., Baum *et al.*, 2000; Soh, 2003).

¹ The \$100 million cutoff point is consistent with prior studies of small entrepreneurial firms that report similar amounts of investment for research and development (Deeds *et al.*, 1997).

² Excluding these outliers from the sample (either individually or collectively) did not have any significant effect on the results of the statistical analyses.

³ Excluding those 17 firms from the sample did not have any significant effect on the results of the statistical analyses.

The firm age represents a measure of the uncertainty about the firm quality and capabilities (Coombs *et al.*, 2006). The older firms have had a longer opportunity to develop their resources and capabilities. Consistent with Wang *et al.* (2012), firm age is calculated as the monthly difference between the company founding date and the date of firm evaluation by the VC in our sample.

Firm size as another firm-specific control variable has also been included in many previous studies (e.g., Soh, 2003). There is evidence in the literature that investors value firm size (Coombs *et al.*, 2006). Stuart *et al.* (1999) argued that when all of the firms in a sample are venture backed and performing in the same industry, the amount of previous funds received by a firm is a good approximation of the firm size. Therefore, firm size is measured in terms of the total dollar amount of funds the firm received prior to its evaluation date.

The final firm-specific control variable is firm location. Entrepreneurial firms are known to be clustered in certain regions (Coombs *et al.*, 2006; Wang *et al.*, 2012). This study uses a dummy variable in order to control for the effect of location on firm valuation. For each firm, dummy variable is coded as '1' if the firm is located in software hotspots of Silicon Valley, Austin, Boston, New York, or Seattle and coded as '0' otherwise.

The effect of the alliance negotiation process on the firms' valuation has also been addressed in the literature (Nicholson *et al.*, 2005). The number of venture capitalists involved in funding a small entrepreneurial firm affects the decision-making

process of the entrepreneurs (Wang *et al.*, 2012). In order to capture the sophistication of the negotiating process and its effect on the valuation, this study included the total number of venture capitalists involved in the valuation process as a transaction-specific control.

Contextual factors such as environmental shocks may affect firm valuations. A well-known environmental shock in the software industry occurred when the dot-com bubble burst in April 2000. A dummy variable is used to capture the software bubble. It is coded as '1' if the valuation occurred within the bubble period from January 1, 1997 through March 31, 2000 or '0' otherwise.

RESULTS AND ANALYSIS

Table 1 shows descriptive statistics and pair-wise correlation matrix of the variables. The minimum and maximum valuations in the sample are \$1.75 and \$369.9 million, respectively. The sample average firm valuation is \$58.24 million. It is important to bear in mind that the average firm valuation (i.e., \$85 million) for those firms that received their valuations during the dot-com bubble period was considerably higher than the average firm valuation (i.e., \$47 million) of those firms that received their valuations outside the dot-com bubble period. The latter figure is comparable to the average firm valuation reported in biotechnology industry studies (Deeds *et al.*, 1997: 40).

With a sample average of 0.78, the number of alliances varies from 0 to 9. This sample average is

Table 1. Descriptive statistics and correlations

Variables	Mean	S.D.	Min.	Max.	1	2	3	4	5	6	7	8
1. Valuation	58.24	66.86	1.75	369.90								
2. Valuation in natural log	3.44	1.19	0.56	5.91	0.84***							
3. Total alliance count	0.78	1.27	0.00	9.00	0.17*	0.28***						
4. Alliance count squared	2.21	8.29	0.00	81.00	0.03	0.12 [†]	0.88***					
5. Age	69.39	50.88	0.00	240.00	0.01	0.06	0.15*	0.09				
6. Size (total VC funding)	22.7	23.13	0.25	100.00	0.63***	0.65***	0.14*	0.01	0.08			
7. Location	0.52	0.50	0.00	1.00	0.16*	0.07	0.01	0.03	-0.02	0.08		
8. Negotiation	5.42	4.10	1.00	20.00	0.47***	0.52***	0.16*	0.08	0.06	0.70***	0.12 [†]	
9. Bubble period	0.30	0.46	0.00	1.00	0.26***	0.22**	-0.15*	-0.12	0.07	0.08	0.07	0.17*

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 2. Firm valuation descriptive data statistics in two subsamples

	N	Mean*	Min*	Max*
Firms without alliances	79	37.72	1.75	221.40
Firms with alliances	72	80.75	3.30	369.90
Total	151	58.24	1.75	369.90

* Values are reported in \$ millions.

Table 3. ANOVA test of difference in valuation of firms with alliances and firms without alliances

	Sum of squares	DF	Mean square	F	Sig.
Between groups	69,731.94	1	69,731.94	17.29	0.000
Within groups	600,877.88	149	4,032.73		
Total	670,609.83	150			

lower than that (i.e., 4.8) of post-IPO firms in previous studies (DeCarolis and Deeds, 1999), which was expected given that our sample includes pre-IPO firms. The sample average firm age is 5.7 years, which is consistent with prior similar studies (e.g., Deeds *et al.*, 2000). The firms in the sample had received VC funding with an average of \$22.7 million and ranging from \$250,000 to \$100 million. In addition, the correlation table shows a positive significant relationship between firm valuation and both variables capturing the negotiation process and dot-com bubble period.

Table 2 shows the descriptive statistics of the ANOVA test of the firm valuation.⁴ The average valuation is approximately \$37 million and \$80 million for firms without alliances and firms with alliances, respectively. Table 3 provides support ($F = 17.29$, $p < 0.001$) for Hypothesis 1, which predicts that entrepreneurial firms with interorganizational alliances will receive higher valuations.

Table 4 reports the regression analysis results. Model 1 includes all the control variables. Among control variables, firm size and industry bubble period are significant. Control variables account for approximately 43 percent of the variation in the dependent variable, the natural log transformation of firm valuation.

Model 2 shows that the total alliance count variable is positive and statistically significant ($\beta = 0.217$, $p < 0.001$), indicating that after controlling for firm age, size, location, funding negotiation, and contextual

effects, entrepreneurial firms with higher numbers of interorganizational alliances receive greater levels of valuation. Model 3 shows that the coefficient of the square term of the alliance count variable is negative and statistically significant ($\beta = -0.041$, $p < 0.05$), while the coefficient of the alliance count variable remains positive and statistically significant ($\beta = 0.460$, $p < 0.001$). These results support Hypothesis 2, which states that the relationship between the number of interorganizational alliances and firm market performance exhibits an inverted U-shape such that valuation reaches its maximum level with a moderate number of alliances. The adjusted R-squareds in models 2 and 3 increase to approximately 0.48 and 0.50, respectively; this shows a significant change from 0.43 in model 1 and provides support for the notion of significant explanatory power of alliance effect on firm valuation beyond control variables.

Post hoc tests of the coefficient for the nonlinear term confirm that the inflection point in the concave shape of this curve occurs within a reasonable range (i.e., 0 to 9) for the data used here, strengthening the finding that the effects of strategic alliance formation on entrepreneurial firm valuation are, in fact, curvilinear. Figure 1 shows that the maximum valuation in our sample is associated with approximately six alliances.

DISCUSSION

The results raise several points worth discussing about the impact of alliance formation on entrepreneurial firm market performance. First, the analysis reveals

⁴ The results of the ANOVA test were similar when the natural logarithm of firm valuation was used.

Table 4. Results from regression on natural logarithm of valuation

Variables	Model 1		Model 2		Model 3	
Controls variables						
Intercept	2.504***	(0.174)	2.422***	(0.168)	2.357***	(0.168)
Age	-0.001	(0.002)	0.001	(0.001)	-0.001	(0.001)
Size	0.029***	(0.004)	0.029***	(0.004)	0.027***	(0.004)
Location	0.005	(0.148)	0.001	(0.142)	0.015	(0.140)
Negotiation	0.027	(0.026)	0.017	(0.025)	0.020	(0.024)
Bubble period	0.406*	(0.164)	0.520***	(0.160)	0.538***	(0.158)
Total alliance count			0.217***	(0.058)	0.460***	(0.121)
Alliance count squared					-0.041*	(0.018)
R square	0.451***		0.500***		0.518***	
Adjusted R square	0.432***		0.479***		0.494***	
R square change			0.049***		0.018*	

Standard errors are in parentheses.

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

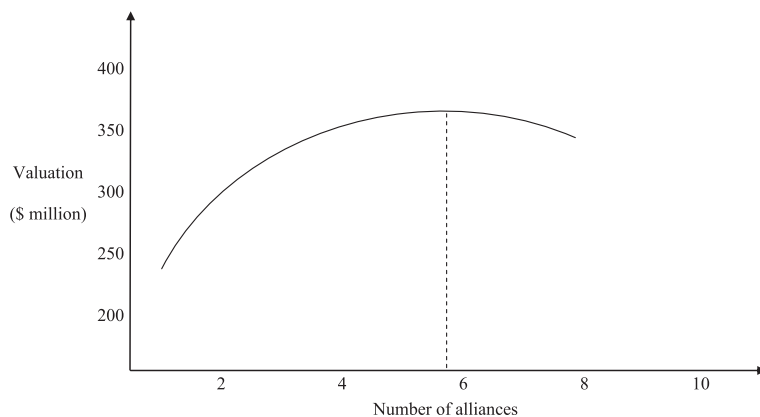


Figure 1. *Post hoc* analysis of the effect of alliance number on firm performance

that alliance formation positively and significantly affects firm valuations in the software industry. Whereas prior studies of entrepreneurial alliance outcomes have looked at new product development, post-IPO valuations, and speed to IPO, this study was designed to match the direct logic of the RBV and firm market performance. In other words, the resources accessed and capabilities developed through alliancing in pursuit of an entrepreneurial firm's chosen opportunity seem to be assessed by the venture capitalists who are the most practical analysts for this phenomenon. These results suggest that entrepreneurial software firms that form alliances signal greater value creation potential to their venture capitalists.

Second, results support our hypothesized curvilinear relationship between the number of alliances and firm market performance. Whereas prior studies showed an

inverted U-shaped relationship between number of alliances and: (1) new product development (Deeds and Hill, 1996); and (2) alliance management capability (Rothaermel and Deeds, 2006), the present model focuses on the firm's market valuation. In the case of a small entrepreneurial firm, a moderate number of alliances positively affects the market performance, provided that the number of alliances is perceived within the alliance management capability of the entrepreneurial firm. Our results are consistent with Miles *et al.* (1999), who examined strategic alliances in a sample of 112 high-tech entrepreneurial firms and found that firms that are highly dependent on their strategic partners exhibited lower performance, while firms with a choice among a set of available strategic alliance partners demonstrated higher performance.

The *post hoc* analysis shows that market performance reaches its peak when the average entrepreneurial firm in our sample reaches a portfolio of six alliances. Different firms, as they develop and grow their dynamic alliancing capabilities, will create more or less value with their alliances over time. Dyer *et al.* (2001), for example, report that the 500 largest global corporations have an average of 60 alliances each. It is conceivable that firms surviving the journey from venture-backed start-up to large global corporation undergo a shift in their dynamic alliancing capability as a matter of evolution. In their theorization of a dynamic capability, Helfat and Peteraf (2003) suggest that a dynamic capability may reach a retirement (death) or retrenchment stage in its life cycle; however, there are alternative stages such as renewal, replication, redeployment, or recombination that may be considered to improve the level of the dynamic capability and its effect on firm performance. *Capability renewal* may involve major as well as minor modifications and improvements to a capability. As entrepreneurial firms progress into public firms and become more experienced in working with partners, they may better manage opportunistic behaviors and enjoy more favorable alliance outcomes (Dyer and Singh, 1998; Judge and Dooley, 2006).

Capability replication entails ‘reproducing the same capability in another geographic market’ (Helfat and Peteraf, 2003: 1006). For example, entrepreneurial firms may improve their alliance management capability by engaging in international alliances (Colombo *et al.*, 2009; Coombs and Deeds, 2000; Nakos, Brouters, and Dimitratos, 2014).

Unlike replication (the same capability in a different geographic market), *redeployment* involves a ‘market for a different but closely related product or service’ (Helfat and Peteraf, 2003: 1006). For example, entrepreneurial firms may enter alliances with different types of partners such as competitors, customers, research institutes, or marketing firms (Baum *et al.*, 2000). Finally, *capability recombination* entails integrating the original capability with another capability. For example, entrepreneurial firms may improve their alliance management capability by integrating managerial and technological capabilities as addressed by Welter, Bosse, and Alvarez (2013).

Figure 2 illustrates alliance management capability evolution over time as small pre-IPO firms grow and become large publicly traded firms. While the alliance management capability is developing through renewal, replication, redeployment, and recombination stages, firms may effectively manage a larger portfolio of alliances.

Implications for practitioners

This study enhances our understanding about the effectiveness of strategic alliances in small venture-backed entrepreneurial firms and, therefore, contributes to managerial practices (Ireland *et al.*, 2002) in such firms. Entrepreneurial firms often suffer from negative cash flows during the early stages of new product or technology development and, subsequently, may participate actively in strategic alliances to access necessary financial and organizational resources (Coombs *et al.*, 2006). While such strategic alliances potentially can be

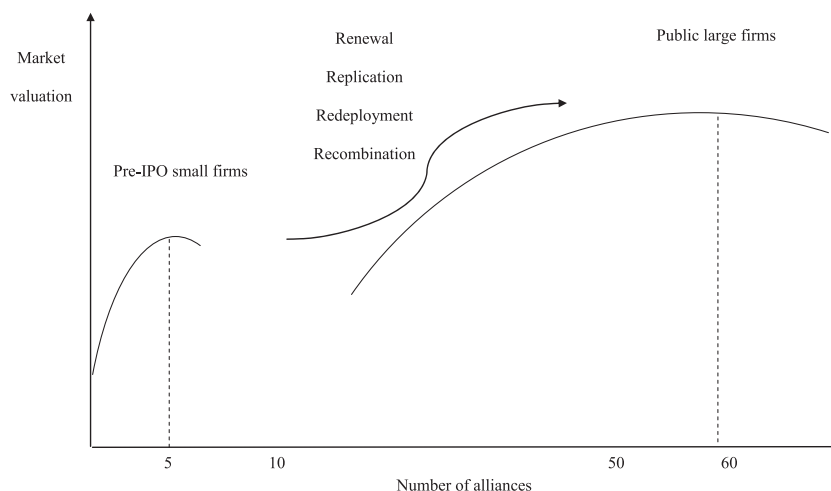


Figure 2. Alliance management capability development

beneficial for entrepreneurial firms, these alliances can easily become detrimental if entrepreneurs fail to manage the strategic alliances effectively (Alvarez and Barney, 2001). Our results show that small entrepreneurial firms benefit most from establishing a moderate number of alliances rather than depending on a small number of alliances or becoming overwhelmed with a great number of alliances.

Our advice to entrepreneurial firms seeking venture backing is to enter a select number of strategic alliances and to place focus on enhancing the outcomes of those select alliances *as well as* the development of a dynamic alliancing capability. Kale *et al.* (2002) show large firms that build a dedicated alliance function to purposely capture and use alliance-related knowledge get better outcomes from their alliances. If the entrepreneurial firm is to survive and grow to global leadership proportions, it may also seek to expand its reputation as an alliance partner such that it transfers from being the recipient of legitimacy signals in an alliance to being the sender of such signals. Avoiding pitfalls along the way will require appropriate use of alliancing best practices such as writing detailed contracts, building trust, limiting a large firm partner's access to specific aspects of joint research activities, protecting access to knowledge of their core competencies, and bringing a stream of new opportunities, rather than a single one, into the alliance (Alvarez and Barney, 2001).

Limitations and future research

Considering that this study is one of the first attempts to examine the effect of strategic alliances on the market performance of private (pre-IPO) entrepreneurial firms, it has encountered the challenge of data availability and access to variety of variables such as revenues, top management team composition, employee numbers, and firm investments in R&D, which may also affect the firm valuation. This study acknowledges that data availability is a major challenge in the context of private (pre-IPO) firms.

Like the entrepreneurial alliance studies that have come before, another limitation of this study is associated with the generalization of the results. The sample includes only one industry and the latest valuation information of each firm. Industry-related factors might encourage or discourage alliance formation. For example, the literature suggests that downsizing within the industry creates gaps for large firms that can be filled by alliances with smaller

businesses (Street and Cameron, 2007). Industry characteristics, such as environmental uncertainty, increase the attractiveness of alliances and influence the choice of alliance strategy types pursued by small firms (Dickson and Weaver, 1997; Weaver, Dickson, and Gibson, 1997). Future research can advance scholarship on the relationship between alliances and market performance by examining multiple industry samples and applying a longitudinal analysis. As more studies provide us with extra empirical evidence about the small entrepreneurial firms in different industries, it is also important to operationalize the firm market performance and/or the number of alliances as a deviation from industry averages in a multiple industry sample.

Our results also open some avenues for future research. Although the result of this study provides an answer to the question of how alliances affect entrepreneurial firm market performance, future research may examine how alliance challenges change as entrepreneurial firms pass through different points in their growth stages (Alvarez *et al.*, 2006). In other words, future studies might go beyond the quantitative analysis of alliances and pay more attention to the alliance quality in terms of strength and depth. For example, Uzzi and Gillespie (2002) found that 'embedded ties' positively influence firm performance.

While in this study the RBV and the dynamic capability perspective are employed in the theoretical analysis of the relationship between alliances and firm performance, other theoretical lenses such as the resource dependence perspective (Pfeffer and Salancik, 1978) and the options theory perspective (Dixit and Pindyck, 1994; McGrath, Ferrier, and Mendelow, 2004) may also shed light on aspects of this relationship. In addition, the economic law of diminishing returns suggests that 'the more alliances a firm engages in, the more likely it is to enter some alliances whose marginal contribution is relatively minor' (Deeds and Hill, 1996: 42). Therefore, this study calls for future studies that consider alternative theoretical lenses and further examine alliance effects on firm performance.

Furthermore, several authors pointed out the importance of considering the alliance partner's capabilities, especially in alliances between young entrepreneurial firms and larger firms (e.g., Alvarez and Barney, 2001; Alvarez *et al.*, 2006). Through both surveys and interviews, Meyer, Alvarez, and Blasick (1997) found that forming relationships with larger

firms that were described to be reliable and trustworthy was associated with smaller entrepreneurial firms' survival. In the same vein, Stuart (2000) argued that the degree of the capabilities of partners positively affects the rate of small entrepreneurial firm innovation (measured in terms of patent counts). Thus, future studies of entrepreneurial firm alliances are encouraged to account for the specific resources and capabilities provided by firms' larger partners.

Finally, the role of entrepreneurs or their top management teams (TMT) in strategic alliance formation decision making requires further examination. For example, Eisenhardt and Schoonhoven (1996) found that TMT size, the number of previous employers of TMT members, and the number of TMT members serving at managerial levels in previous positions were all positively and significantly related to the number of alliances formed by firms in a sample from the semiconductor industry. In other words, larger, more well connected, and higher status TMTs play important roles in alliance formation. The TMT personal relationships with other senior-level executives in potential partner firms provide awareness of alliance opportunities. These personal relationships also contribute to better implementation, less opportunistic behavior, and lower risk of knowledge appropriation (Larson, 1992). Thus, TMT social capital is an important key driver of alliance formation and value creation potential at entrepreneurial firms.

CONCLUSION

Creating value is the ultimate goal of all firms (including large public firms and small private entrepreneurial firms), and managers must formulate and implement related strategies as best they can. Small private entrepreneurial firms sometimes engage in strategic alliances to access complementary resources and send positive reputational signals to potential investors and partners. The results of this study show that after controlling for firm-specific, transaction-specific, and contextual control variables, the number of strategic alliances positively and significantly affects the valuation of entrepreneurial firms receiving VC funding. However, as the size of their alliance portfolio increases, managerial capability seems to constrain the benefits of their alliances. Thus, the relationship between the number of alliances and firm valuation exhibits a concave (inverted U) shape. This study suggests that the

relationship between the number of a small entrepreneurial firm alliances and its market valuation is curvilinear such that a moderate alliance portfolio results in the highest firm valuation.

These results shed important light on entrepreneurial firms' strategic actions early in their formation processes in pursuit of value creation. Alliances represent sources of value creation potential, but also sources of constraint when entrepreneurs and their management teams overcommit to these relationships or stretch beyond their managerial capabilities. The evidence provided here clarifies and reinforces existing explanations about the role of strategic alliances in start-up growth and extends our understanding of this phenomenon by exploring hidden pitfalls in entrepreneurial firms' use of alliances.

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EVOLUTION OF ENTREPRENEURIAL JUDGMENT WITH VENTURE-SPECIFIC EXPERIENCE

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Research summary: This study advances research on entrepreneurial cognition by investigating how entrepreneurial judgment evolves during new venture creation. We conceptualize entrepreneurial judgment as a cognitive process in the minds of entrepreneurs that operates on the causal map—i.e., a knowledge structure concerning what factors they believe will help the chances of profitability under uncertainty. At the time of initial epiphany, entrepreneurs construct cognitive causal maps, which guide resource allocation decisions. Over time, venture-specific experience accumulates and entrepreneurial judgment evolves in response to their observations. Using a dataset of 524 nascent entrepreneurs, we find that entrepreneurs with more venture-specific experiences have more selective judgments, and they have stronger conviction in those judgments. We also find that perceived uncertainty and cognitive dispositions of the individuals affect entrepreneurial judgment.

Managerial summary: Entrepreneurs often have to exercise judgment due to limited information and resources when creating new businesses. Because they cannot effectively make progress in all aspects of a new venture at once, entrepreneurs choose the important success factors to focus on. Our findings suggest that it is important to understand the cognitive mechanisms underpinning their judgments. As entrepreneurs gain more experience with the venture, their chosen set of success factors narrows and their confidence increases. Additionally, their self-efficacy and decisiveness encourage them to make stronger judgments. This may imply a precarious scenario because of the risk of overconfidence in their judgments. Similarly, investors are also advised to check if the entrepreneur's conviction is supported by accumulated experience in the context of the venture. Copyright © 2016 Strategic Management Society.

'The business man himself not merely forms the best estimate he can of the outcome of his actions, but he is likely also to estimate the probability that his estimate is correct...The action which follows upon an opinion depends as much upon the amount of confidence in that opinion as it does upon the favorableness of the opinion itself.' (Knight, 1921: 227)

INTRODUCTION

Entrepreneurship entails constructing the belief (or the opinion) that allocating resources in a particular, novel way will lead to a profitable enterprise (Foss and Klein, 2012; Knight, 1921). The opinion needs construction by the entrepreneur due to the uncertainty experienced at the time of launching a new venture (Alvarez and Barney, 2007; McMullen and Shepherd, 2006). In many cases, a new venture will introduce an element of novelty or a high degree of uniqueness that will render some of the previous experiences irrelevant (Knight, 1921). This, in turn, prohibits a rational probabilistic analysis, and the entrepreneur faces uncertainty rather than risk.

Keywords: entrepreneurial judgment; knowledge structure; causal map; experience; entrepreneurial cognition

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The entrepreneur's cognitive response to the uncertainty is judgment. After a comprehensive review of key theories of entrepreneurship, Foss and Klein (2012) identify judgment as an entrepreneur's distinctive function. The individual imagines a new way of organizing resources such that the offering of the new venture is worth more than the associated costs (Klein, 2008; Mahoney and Michael, 2005). During the period of venture development, the judgment of the entrepreneur guides the resource allocation decisions since reliable data about the operations of the venture is not available to her¹ (Dimov, 2007). We posit that such judgment concerning the future success of the venture is a cognitive act in the mind of the entrepreneur.

In this research, we model entrepreneurial judgment as a cognitive process that operates on the knowledge structures of the entrepreneur as she responds over time to her own 'image of a future state of affairs' (Knight, 1921: 201). Subsequently, such knowledge structures guide her resource allocation decisions for the success of the venture. Previous research in entrepreneurial cognition examined several knowledge structures individuals employ as they make decisions under conditions of uncertainty. Cognitive scripts (Mitchell *et al.*, 2000), prototypes (Baron and Ensley, 2006), and structural mapping (Grégoire and Shepherd, 2012) are some examples of knowledge structures in use. However, scripts, prototypes, and structural mapping do not emphasize causality directed at profits, whereas entrepreneurial judgment invariably contains an appreciation of the entrepreneur's subjective opinions about what key factors should be favored. Hence, we propose that entrepreneurial judgment as determining resource allocation under uncertainty can be better theorized using a different type of knowledge structure—a causal map. The causal map is not judgment itself, but a knowledge structure that is employed as one exercises entrepreneurial judgment. As Knight alludes in the opening quote, the two attributes of the causal map play an important role, as her judgment guides the entrepreneur in allocating resources toward the new venture. The shape of the causal map (i.e., selectivity of entrepreneurial judgment) refers to the discriminating nature of the key factors in affecting success for the particular venture and guides the entrepreneur in prioritizing investment areas. The strength of the causal map (i.e., conviction in entrepreneurial judgment) refers to the

confidence of the entrepreneur in the map itself and encourages action.

We contribute to entrepreneurship research by first developing a theory of entrepreneurial judgment as a cognitive process operating on a causal map and examining its two attributes: selectivity and conviction. Second, we develop an empirically testable model of entrepreneurial judgment that reflects what success factors would lead to profitability (cf. Michael, 2007). Despite its prominence in conceptual discourse, entrepreneurial judgment in this sense has not been empirically modeled and tested before. Using a dataset of 524 U.S. nascent entrepreneurs collected in the Panel Study of Entrepreneurial Dynamics (PSED) II project, we find that venture-specific experience, along with the uncertainty of the venture and the cognitive disposition of the individual, affects entrepreneurial judgment. Third, our findings demonstrate that as entrepreneurs accumulate venture-specific experience, their causal maps evolve with respect to their shape and strength. Fourth, we identify specific conditions of uncertainty and cognition that will affect the shape and strength of the causal maps differently.

THEORY AND HYPOTHESES

When the entrepreneur believes she discovered or created an opportunity, she constructs a belief or an opinion about the future prices of a product that has not been produced yet (Alvarez and Barney, 2007). This opinion is a forward-looking belief or foresight, and the way to get there successfully is mostly an imagination in the mind of the entrepreneur (Foss and Klein, 2008). The entrepreneur has to choose strategic actions based on the imagined consequences (Batstone and Pheby, 1996; Shackle, 1970). A more rational decision-making method to choose actions would be to predict the outcomes and calculate the expected values; however, the lack of relevant, objective historical data constrains this calculation severely (Knight, 1921).² Therefore, the entrepreneur

¹ We use female pronouns when referring to the individual entrepreneur throughout the article only to improve readability. Our theory is gender neutral.

² According to Knight (1921), imperfect knowledge of the future presents three types of unknowns: (1) outcome is unknown, but a probability distribution can be computed *a priori* (e.g., throwing a die); (2) outcome is unknown, but a probability distribution can be constructed reasonably based on empirical observation of similar past events (e.g., destruction of a building by fire); (3) outcome is unknown and a set of similar past events is not available (e.g., many entrepreneurial decisions in a new business setting). Knight (1921) classifies the first two types as risk and calls only the third type uncertainty. In uncertain situations, entrepreneurs make subjective estimates to guide their decisions.

is forced to make judgments based on the venture idea and her subjective knowledge of the relevant environment (Eckhardt and Shane, 2003; Knight, 1921; Mahoney and Michael, 2005). She tries to make sense of the ambiguous signals in the new venture environment, update her knowledge structure, and imagine a course of strategic actions that will lead the venture to profitability in an uncertain future.

The entrepreneur has to bear the burden of uncertainty in order to act on a novel opportunity, and uncertainty manifests itself as *relative ignorance* and *doubt* in the mind of the entrepreneur (McMullen and Shepherd, 2006). The entrepreneur is partially ignorant with an imperfect knowledge of the future (Knight, 1921) and she does not know the probability distribution of the potential outcomes of her actions (Langlois, 2007). When she is entirely ignorant, the entrepreneur might not perceive even the necessity to consider and judge what strategic factors might affect the profitability of the new venture. Ignorance of the entrepreneur is partially alleviated when the entrepreneur is exposed to new venture environment so that the consideration set of possible actions is augmented with new elements. In a complementary but separate manner, the entrepreneur experiences doubt because it requires a certain level of willingness to bear the burden of uncertainty to act on it (Knight, 1921; Schumpeter, 1934). The more confident she feels about her judgment, the less doubtful, hence, the more willing she will be to bear the uncertainty (McMullen and Shepherd, 2006). Next, we discuss how entrepreneurs use alternative cognitive mechanisms against ignorance and doubt in entrepreneurial judgment.

Causal map as the underlying knowledge structure

We conceptualize entrepreneurial judgment as a cognitive process through which venture-specific knowledge of the entrepreneur is organized to guide resource allocation decisions. Entrepreneurial cognition literature in recent years has begun to investigate the puzzle of knowledge structures in the mind of the entrepreneur (Grégoire, Corbett, and McMullen, 2011; Mitchell *et al.*, 2007). In fact, Mitchell and colleagues (2007: 97, emphasis added) define entrepreneurial cognition as '*the knowledge structures that people use to make assessments, judgments, or decisions involving opportunity evaluation, venture creation, and growth.*' Previous research investigated several types of knowledge structures as potential cognitive devices entrepreneurs use when they make decisions. For example, when they make opportunity discovery and

feasibility assessments, entrepreneurs are shown to access certain cognitive scripts (Mitchell *et al.*, 2002). In a cognitive psychology based model, Baron and Ensley (2006) develop the concept of an opportunity prototype. According to this research stream, entrepreneurs use pattern matching when they assess economic events around them and compare the events against their opportunity prototype. Structural alignment and analogies constitute another set of cognitive devices that entrepreneurs operate on their knowledge structures. According to the former theory, entrepreneurs make similarity comparisons between technology and market combinations. They identify opportunities depending on the strength of superficial and structural similarities (Grégoire, Barr, and Shepherd, 2010; Grégoire and Shepherd, 2012). According to the results of another real-time experiment, individuals consider analogical properties such as the cognitive distance between domains when they evaluate the profit potential of opportunities (Uygun, forthcoming).

This recent literature highlights the significance of knowledge representation for entrepreneurial cognition; however, it does not capture the notion of entrepreneurial judgment which guides resource allocation in the face of uncertainty (Casson, 1982; Foss and Klein, 2012; Knight, 1921). Extant theories are incomplete because of their relative inattention to uncertain causal connections. Entrepreneurial judgment reflects an internal negotiation concerning what strategic investments are most likely to lead new ventures to profit. This internal negotiation relies on not only the entrepreneur's existing knowledge, but also subjective beliefs and opinions. We advance that entrepreneurs employ a knowledge structure like a causal map that represents their judgments about the most critical factors for profitability.

In cognitive sciences, a causal map is 'an abstract representation of the causal relationships among kinds of objects and events in the world' (Gopnik and Glymour, 2002: 118). It is a specific type of cognitive map (Kitchin, 1994; Thagard, 1992; Tolman, 1948) that associates causal connections between concepts and it expresses 'the judgment that certain events or actions will lead to particular outcomes' (Nadkarni and Shenoy, 2001: 480). Individuals construct causal maps that represent their theories of how things work so they can predict and determine a course of action *ex ante* under complexity and uncertainty. In an entrepreneurial situation, entrepreneurs make judgments by employing their causal maps that connect several aspects of an opportunity to expected profitability (Castrogiovanni,

1996; Delmar and Shane, 2006). A causal map of entrepreneurial judgment would hold subjective probability assessments of key success factors in relation to the expected profits from a venture. We focus on two attributes of the causal map that connects factors to expected success: the shape and the strength.

First, by shape, we mean the relative importance of the factors and how they compare against each other. A flat-shaped causal map would suggest that the entrepreneur believes out of ignorance that all factors are equally important for potential success of the venture. By contrast, a rugged-shaped causal map would imply some refinement such that it identifies subjectively the most critical factors for success from a larger set of all possible factors. We call this *selectivity of entrepreneurial judgment*. The more rugged the causal map is, the more discriminating of the key success factors the entrepreneur has become for the venture.³ Nonetheless, knowing something is both conceptually different and neurologically separate from the ‘feeling of knowing’ (Burton, 2009) or ‘the amount of confidence’ in judgment (Knight, 1921). Second, by strength, we mean how clear or blurry the causal map is to the entrepreneur. A map that is free of doubt will appear stronger and clearer than a highly doubtful one. We capture the entrepreneur’s faith in her judgment and call this *conviction in entrepreneurial judgment*. The more conviction the entrepreneur possesses in her causal map, the more likely her strategic investment decisions will reflect those judgments.

Evolution of entrepreneurial judgment

Previous literature suggests that opportunity ideas evolve over time. In criticizing the singular discovery view, Dimov (2007) argues that entrepreneurial insight does not happen only once; rather, the ideas change over time through a series of insights. When the opportunity is first identified, the entrepreneur constructs a causal map and exercises judgment. During the period immediately following the initial epiphany, we expect the knowledge of the entrepreneur specific to this venture to be limited and the causal map to be simple. However, as the entrepreneur works for the development of the

³ It is possible that highly selective judgment (or rugged causal map) turns out accurate and results in a positive outcome *ex post*. However, at the time of judgment, it is also possible that focusing on fewer critical factors is ungrounded and mistaken. In this study, we do not theorize on the normative implications, but examine how entrepreneurs make judgments *differently* in the present.

venture, her experience accumulates and induces learning, which implies a change in the underlying knowledge structure (Holcomb *et al.*, 2009) into a more refined causal map. In agreement with entrepreneurial cognition literature (Corbett, 2002), we next hypothesize how venture-specific experience, entrepreneurial uncertainty, and cognitive dispositions affect this process.

Venture-specific experience

Experience turns into expertise when the underpinning knowledge structure is refined in the context of the new venture. As the entrepreneur accumulates venture-specific experiences, learning occurs as those experiences cause a transformation of existing knowledge structures in the mind (Holcomb *et al.*, 2009; Kolb, 1984). Feedback from stakeholders and the entrepreneur’s insights from personal endeavors will facilitate such transformation. In particular, the individual will have a richer set of experiences to update her subjective assessment of what factors are likely to lead to profitability. Haynie, Shepherd, and Patzelt (2012) demonstrate that entrepreneurs actually change the way they think in response to feedback. Specifically in our conception, we propose that the causal map is modified after the initial discovery as the entrepreneur accumulates experience. The more time an entrepreneur spends working for the venture, the more learning occasions there will be (Corbett, 2005). In turn, the shape of the causal map will look more rugged than flat as the entrepreneur’s opinions reflect her venture experiences. It is possible that some of these experiences might be misleading and inaccurate due to sustained uncertainty. Nevertheless, their refined causal map will be more selective so that the entrepreneur will be able to judge a smaller set of success factors as critical.

Hypothesis 1a (H1a): More time invested in working for the venture leads to more selective entrepreneurial judgment.

Similarly, we expect that increased experience with the venture will help the entrepreneur be certain in her judgment. Effective assimilation of new experiences by the entrepreneur into the existing knowledge structure set deepens understanding of the most critical factors for new venture success. When the new experiences are more tightly coupled with the existing knowledge set (Holcomb *et al.*, 2009), such assimilation would strengthen the

entrepreneur's conviction in that judgment. Moreover, the intensity of the entrepreneur's effort makes a difference. If the entrepreneur spends a lot of time and energy on the venture, the connections in the memory will be stronger, and she will see the causal map more clearly. Hence, we posit that:

Hypothesis 1b (H1b): More time invested in working for the venture leads to stronger conviction in entrepreneurial judgment.

The amount of time invested in the venture may not fully differentiate among the very varied types of venture-specific experiences the entrepreneur might have had. Different experiences lead to 'increasingly focused and refined mental frameworks' (Baron and Ensley, 2006: 1341). From initial conception to implementation, any 'act of entrepreneurship is a change in the content of the entrepreneur's knowledge in some area' (Minniti and Bygrave, 2001: 7). One common activity entrepreneurs go through is the preparation of a business plan (Brinckmann, Grichnik, and Kapsa, 2010; Brinckmann and Kim, 2015). Business planning activities are directed at validating new business ideas, anticipating future developments, and determining an appropriate course of action (Mintzberg, 1991). The business planning approach reflects an entrepreneur's belief that careful analysis prior to entrepreneurial action helps in developing better insights and useful knowledge that can improve new venture performance (Delmar and Shane, 2003). Business planning is based on the assumption that entrepreneurs have preexisting goals (Sarasvathy, 2001). Initial beliefs and goals, however, may change over time with business planning experience. Collecting and evaluating the evidence to justify initial claims in a business plan under conditions of uncertainty is likely to affect the subjective assessment of critical factors and the causal map in the mind of the entrepreneur. As the entrepreneur articulates the details of the venture idea in formal business planning, some causal factors will lose their importance while others will gain, resulting in a change in the shape of the entrepreneur's causal map. Hence, we posit that:

Hypothesis 2a (H2a): Formal business planning in venture development leads to more selective entrepreneurial judgment.

From a learning perspective, business planning is characterized as a deductive learning approach that is internally directed, relying on an entrepreneur's own

judgment and prediction, which contrasts to an inductive approach that is externally oriented and seeks to derive insights from the interactions with various stakeholders (Regnér, 2003). Further, business planning reflects a proactive learning activity as the entrepreneur establishes causal relationships prior to action (Castrogiovanni, 1996). If the business planning experience supports the validity of the new business idea, the confidence of the entrepreneur in the venture will augment (Dimov, 2010). Hence, in parallel to the earlier hypotheses, we expect that formal business planning will also lead to stronger conviction in judgment. In a complex environment, deep knowledge structures developed in various experiences can be helpful in trusting one's own judgments (Weick and Roberts, 1993). This will be the case especially when the entrepreneur's knowledge structure is subjectively supported by business planning experience, regardless of the time spent on the venture. Subsequently, the exercise of formal business planning itself will lead to a cognitively more salient causal map and, thus, a stronger feeling of knowing.

Hypothesis 2b (H2b): Formal business planning in venture development leads to stronger conviction in entrepreneurial judgment.

Entrepreneurial uncertainty

In uncertain situations where a set of similar past events is not available, entrepreneurs need to act according to opinion, which is 'neither entire ignorance nor complete and perfect information, but partial knowledge' (Knight, 1921: 199). Entrepreneurs acquire some partial knowledge as they overcome complete ignorance and construct their estimates for imagined outcomes. However, perceived uncertainty by an individual can lead to doubt, disbelief in the feasibility of the business idea, or distrust in own ability to successfully develop a new venture (Dimov, 2010). In order to overcome these adverse states of mind, entrepreneurs exercise judgments about future business environments, key success factors in the business, and their effects on the new venture.

Our expectations about the effect of uncertainty on judgment are more complex than our expectations about experience. When the entrepreneur perceives high uncertainty, it will be difficult to make sense of new experiences (Weick and Roberts, 1993). Hence, we expect those entrepreneurs who perceive high

uncertainty would not effectively discern the most critical factors for the success of the venture, leading to less focused causal maps. The shape of their causal maps will remain flatter because they will continue to experience difficulty in subjectively assessing which factors are more likely to affect profitability than others. As a result, we expect the way they exercise their judgment in resource allocation will be less selective. Our expectation is consistent with the Minniti and Bygrave (2001) model, which suggests that the difficulty of the problem determines whether the entrepreneur can find the optimal knowledge combination or not.

More specifically, we investigate two different types of uncertainty in a given entrepreneurial situation. One is to look at it from the perspective of task uncertainty the entrepreneur perceives, as this will influence the 'uniqueness of the instances' subjectively experienced by the entrepreneur. If the new venture is an outgrowth of the entrepreneur's current work activity, then she will classify some of the activities as previously encountered decisions and perceive less uncertainty in the venturing tasks. Her causal map will likely reflect the characteristics of similar previous experiences and she will be able to make discriminating judgments rapidly. In contrast, a completely new domain will represent a high task uncertainty situation, and her judgment will remain less selective for a longer time.

Hypothesis 3a (H3a): Task uncertainty of the venture leads to less selective entrepreneurial judgment.

Another way to conceptualize the uncertainty is to consider the novelty of the product from the customer's perspective in the market (Dahlqvist and Wiklund, 2012). If the product is completely unknown to the customers, the entrepreneur will be facing high customer uncertainty. Lack of reliable information about future customer reactions will make it difficult for the entrepreneur to determine what to focus on (Shackle, 1970). Due to the novelty of the offering, the entrepreneur may receive diverse and mixed feedback from prospective customers. In such a situation, assimilating newly acquired information with the existing knowledge structure is challenging (Holcomb *et al.*, 2009). Regardless of the entrepreneur's familiarity with the task, customer uncertainty can hamper or delay refinement of the causal map. With a flatter rather than rugged causal map, we expect that the entrepreneur will find it

difficult to discern the most critical factors for the success of the venture.

Hypothesis 4a (H4a): Customer uncertainty of the venture leads to less selective entrepreneurial judgment.

In contrast, we expect the relationship between uncertainty and conviction to be the opposite. In a venture with high task uncertainty, the entrepreneur's causal map, however unfocused it may be, will be more 'valuable' for judgment. Knight had the intuition that an entrepreneur's subjective feeling of confidence, which we call conviction, was a significant determinant of action. Recent research in cognitive sciences has identified the factors and circumstances influencing an individual's conviction. For instance, when it is necessary to form a judgment under high uncertainty, people do not usually retrieve all their knowledge (Schwarz and Vaughn, 2002). Prior research on availability heuristic suggests that people stop cognitive processing when they bring adequate knowledge to working memory (Tversky and Kahneman, 1973). Instead, they resort to a sense of certainty along with the judgment that is based on incomplete knowledge (Holcomb *et al.*, 2009). Similarly, Minniti and Bygrave (2001) suggest that entrepreneurs prematurely converge on actions that promise desirable outcomes early in the process. They claim that in highly uncertain circumstances, the risk of settling on underdeveloped knowledge is higher. When the entrepreneurs' causal maps remain ambiguous due to highly uncertain tasks, their limited knowledge will be used intensively to discern the critical success factors. In other words, the entrepreneur's causal map will be stronger regardless of its shape when the perception of task uncertainty is higher. Therefore, we expect a positive relationship between task uncertainty and conviction in the judgment of the entrepreneur.

Hypothesis 3b (H3b): Task uncertainty of the venture leads to stronger conviction in entrepreneurial judgment.

Similarly, we conceive of customer uncertainty having a positive effect on conviction in judgment. While individuals are relatively comfortable in situations when the probability distributions are known (i.e., Knightian risk), cognition research demonstrates that people react differently in different contexts of Knightian uncertainty. The Ellsberg paradox (1961) shows that individuals feel more

comfortable when the probability distributions are completely unknowable by anyone than in a situation in which the probability distributions might be available to others (Chow and Sarin, 2002). When the venture's offering is entirely new to the world, the probable outcomes are unknowable to others, and this will create a feeling of comfort for the entrepreneur and trigger various cognitive responses.

Perceived uncertainty can influence cognitive processing by the way of excessive reliance on heuristics (Holcomb *et al.*, 2009). When facing novel settings such as an unknown product offered to the customers, entrepreneurs will use heuristics instead of deliberate analysis. In addition to the availability heuristic, entrepreneurs may use anchoring and adjustment heuristics (Tversky and Kahneman, 1974). Even though their knowledge may be limited, they will use their prior experience with other product categories to anchor their expectations (Holcomb *et al.*, 2009) and justify their judgments. Such cognitive responses will not help the entrepreneur refine her causal map, which will remain relatively flat. However, the entrepreneur's feeling of knowing will be stronger with the use of heuristics. That, in turn, will lead to a sense of confidence and stronger conviction in judgment of the entrepreneur.

Customer uncertainty captures a more exogenous nature of uncertainty than task uncertainty. When the product is truly unique in the market and unknown by prospective customers, it is difficult for the entrepreneur to predict their reactions. In contrast, facing task uncertainty, entrepreneurs can focus on internal activities over which they have some control and can exert efforts to improve their judgments. Facing customer uncertainty, however, entrepreneurs have limited prospects to affect or learn in order to refine their causal maps. Thus, we expect they would often resort to the aforementioned heuristics to cope with customer uncertainty.

Hypothesis 4b (H4b): Customer uncertainty of the venture leads to stronger conviction in entrepreneurial judgment.

Cognitive dispositions

Entrepreneurial judgment is a cognitive process, and we expect the individual's cognitive dispositions to influence it. Cognitive dispositions consist of 'consistent individual differences in preferred ways of organizing and processing information and experience' (Messick, 1976: 5). Previous research identified several cognitive dispositions as influential in decision making

in entrepreneurial situations. Allinson, Chell, and Hayes (2000) found a difference between intuitive and analytical cognitive styles when individuals engaged in entrepreneurial behaviors. Similarly, Corbett (2002) found that intuitive cognition was more conducive to opportunity identification than analytical cognition. Similarly, we expect cognitive characteristics to have an effect on entrepreneurs' refinement of their causal maps and their conviction in those judgments. Specifically, we examine two characteristics that have been investigated previously in the entrepreneurship literature: entrepreneurial self-efficacy and decisiveness.

Entrepreneurial self-efficacy refers to 'a person's confidence about his/her ability to perform the various tasks and roles relevant to entrepreneurship' (Cassar and Friedman, 2009). It is a domain-specific application of the broader social cognitive theory on self-efficacy (Bandura, 1986). Individuals with higher entrepreneurial self-efficacy are more confident in their abilities to perform the activities related to new business venturing (Drnovšek, Wincent, and Cardon, 2010). When entrepreneurs are more confident in their abilities, they spend more effort toward judgment tasks, for example collecting and analyzing data and identifying risks associated with the venture (Trevelyan, 2011). In this regard, we expect that highly self-efficacious entrepreneurs are more likely to refine their causal maps and discern the most critical success factors in the venture.

Hypothesis 5a (H5a): Entrepreneurial self-efficacy leads to more selective entrepreneurial judgment.

Beyond helping the entrepreneur discern among critical factors for venture success, entrepreneurial self-efficacy will also augment an individual's feeling of knowing (Burton, 2009). A high level of self-efficacy leads to a sense of control the individual has over the process (Bandura, 1986). Highly self-efficacious individuals are more likely to engage in practices that will remove doubts about entrepreneurial judgment (Baron and Henry, 2010). The doubt surrounding the uncertainty is one of the critical barriers to further entrepreneurial behavior (McMullen and Shepherd, 2006). When the entrepreneurs experience less doubt and more confidence in their abilities to perform the venturing tasks, they are more likely to settle on or believe the validity of their own judgments of the key success factors. Higher levels of confidence tend to reduce search effort (Cooper, Folta, and Woo, 1995), as people

usually form 'opinions as to their own capacity to form correct judgments' (Knight, 1921: 228). Hence, we propose that highly self-efficacious entrepreneurs will perceive stronger conviction in their judgments.

Hypothesis 5b (H5b): Entrepreneurial self-efficacy leads to stronger conviction in entrepreneurial judgment.

Entrepreneurial decisiveness is the tendency of individuals to make decisions quickly in venturing tasks. The broader concept of decisiveness in the psychology literature is a component of the need for cognitive closure. An individual with a high need for cognitive closure is more likely to form judgments based on a limited information set (Kruglanski, 1989). Decisive individuals can make decisions more easily and commit to them cognitively because they terminate search for further information quickly (Dougherty and Harbison, 2007). It should be noted again that we do not presume any validity of the decisions the entrepreneur makes. Depending on how knowledge is used (i.e., cognition), it may help or stifle the entrepreneurial path (Ward, 2004). When decisive individuals perceive high levels of information determinacy in their environments (Forbes, 2007), they can easily make sense of why some factors of competition are more important than others. Hence, we hypothesize that someone who identifies as decisive is more likely to have a narrow causal map of success factors than others who identify themselves as indecisive. Regardless of its accuracy, the refined causal map is critical to the judgments (such as resource allocation decisions) the entrepreneur makes.

Hypothesis 6a (H6a): Entrepreneurial decisiveness leads to more selective entrepreneurial judgment.

Similarly, entrepreneurial decisiveness is expected to strengthen the conviction of the entrepreneur in her judgment. Highly decisive individuals have less fear of making judgmental errors. They make decisions under uncertainty quickly and without such fear (Neuberg, Judice, and West, 1997). As part of the need for closure characteristic, decisiveness is likely to lead to 'inclinations to seize and then freeze on early judgmental cues' (Kruglanski and Webster, 1996: 278). That effect will increase entrepreneurs' confidence in their understanding of key success factors in the venture. Potentially conflicting information that may lead to doubt with the causal map is less likely to arise because the decisive entrepreneur will cease searching for new information

sooner (Leaptrott and McDonald, 2008). That, in turn, will lead to a sense of certainty and stronger conviction in the judgment of the entrepreneur, regardless of its accuracy.

Hypothesis 6b (H6b): Entrepreneurial decisiveness leads to stronger conviction in entrepreneurial judgment.

METHOD

Data and sample

This study uses a dataset from the Panel Study of Entrepreneurial Dynamics (PSED) II, which was designed to offer valid and reliable data on the process of new business formation. PSED II began in 2005 with the identification of a cohort of 1,214 nascent entrepreneurs chosen from a representative sample of 31,845 adults from the U.S. population (Reynolds and Curtin, 2008).

To identify nascent entrepreneurs from initial telephone surveys, each respondent was asked a series of questions about his or her current activities. Specifically, the following three criteria were employed in the PSED II project (Screener): they performed some start-up activity in the past 12 months, they expect to own all or part of the new firm, and the initiative had not had a period of profitability in the past 12 months (Reynolds and Curtin, 2008). Those who satisfied all three criteria were considered nascent entrepreneurs and invited to participate in a detailed interview. About 87 percent of those identified as active nascent entrepreneurs agreed to participate in the PSED II interviews. Data from the initial interview (Wave A survey until March 2006) are used for empirical analysis and robustness tests in this study. From the initial sample, we identified 524 single-owner entrepreneurs for the purpose of this study.

In the final sample, 60 percent are men, and the average age is 44. Thirty-five percent have finished college, and 36 percent of them are married. Fifty-six percent have no prior start-up experience, and 17 percent have no industry experience of the new business. Only 5 percent of the sample entrepreneurs own more than one business, and 58 percent are employed in full-time work. Seventy-five percent have spent more than 100 hours in the new venture, and only 14 percent have developed formally rewritten business plans for their new venture.

Regarding the characteristics of the new ventures, 23 percent are reported as R&D intensive. While 16 percent (26%) of the new ventures are from the entrepreneurs' current (previous) work, 29 percent are from research or ideas from other people. Seventeen percent of the ventures offer completely new or unfamiliar products or services to target customers, but 50 percent offer existing ones. While there is substantial diversity in the amount of resource endowments, only 7 percent have received external funding from financial institutions or other investors.

Measures

In measuring individual-level knowledge structures, survey-based measures have been considered appropriate for assessing knowledge acquisition (Yli-Renko, Autio, and Sapienza, 2001) and have been used effectively in entrepreneurship research (e.g., Naldi and Davidsson, 2013; Zahra, Ireland, and Hitt, 2000). As shown in Figure 1, we measure refinement of the causal maps (i.e., selectivity and conviction in entrepreneurial judgment) with 10 survey questionnaires reflecting nascent entrepreneurs' assessments of key success factors in their new ventures. In particular, the dependent variables should represent the evolution of the entrepreneur's entrepreneurial judgment on business opportunity and important factors of competition in the markets of new ventures. Two cognition measures were constructed to capture different components of entrepreneurial judgment: selectivity and conviction.

Selectivity of entrepreneurial judgment

First, in order to measure *selectivity* of the entrepreneur's judgment, the respondents were asked to assess 10 factors that may be important for success



Figure 1. Illustrations of the dependent variables

of their ventures. In order to capture the theoretical construct of the selectivity of judgment we developed a measure based on how selective the entrepreneur was in choosing among the 10 factors. According to our reasoning, individuals who have absolutely no knowledge about an opportunity would not be able to make discerning judgments among the 10 factors. In Figure 1, which illustrates some hypothetical judgments, Individual A represents an 'ultimate novice.' This entrepreneur answered all questions as 'neither important nor unimportant.' In contrast, individuals C and D made some discerning judgments about which factors may lead to the success of the venture. To capture that variation, we first calculate the standard deviation across the 10 items. Then, in order to normalize with respect to the mean, we calculate the coefficient of variation (COV) by dividing the standard deviation by the mean. We maintain that this score reflects *selectivity* of the entrepreneur's judgment since it is sensitive to the ruggedness of the individual's causal map. For instance, individual B, who claimed that all factors were very important, still receives a zero score since her judgment is not discriminating at all.

Conviction in entrepreneurial judgment

The difference between the assessments of individual A and individual B, however, is important to capture. The shapes of their causal maps are identical, with zero selectivity, but they are the extreme opposites in the strength of the causal map. As the ultimate novice, individual A represents having no opinion at all. However, individual B has strong opinions, even though those opinions do not constitute a refined judgment in terms of selectivity. More generally, lacking selectivity does not mean lacking a 'strong opinion' or *conviction* in the judgment. For instance, a novice may represent having no opinions at all by choosing 3s ('neutral') for all 10 factors, while another novice may have stronger opinions by choosing all 5s ('highly important'). To capture that variation in *conviction*, we calculate the sum of absolute differences from the neutral position of three for all 10 factors.

Venture-specific experience

Our measures of venture-specific experience are in line with the entrepreneurship literature of the experiential learning perspective (cf. Delmar and

Shane, 2006; Dokko, Wilk, and Rothbard, 2009; Huckman and Pisano, 2006). We measure venture-specific experience by considering both quantitative (i.e., time spent) and qualitative (i.e., business planning) aspects of entrepreneurs' experience in the new venture. Because the distribution of the measure of total hours spent in the new venture was skewed, we performed log transformation procedures (Delmar and Shane, 2006). We measure the existence and form of business planning by using a dummy variable with a value of '1' if a business plan is formally prepared and a value of '0' otherwise (Castrogiovanni, 1996; Delmar and Shane, 2003).

Entrepreneurial uncertainty

Drawing on prior research (e.g., Sapienza and Gupta, 1994), we measure two different types of uncertainty in the new venture: internal task (operational) uncertainty and external customer (market) uncertainty. Since uncertainty in effectively performing venture-specific tasks can influence nascent entrepreneurs' judgment, we measure task uncertainty based on respondents' self-reported explanations about the origin of the new business on a Likert-like scale with values equal to 1 (from your current work: lowest task uncertainty), 2 (from your previous work), 3 (from your separate business), 4 (from your hobby or recreational pastime), or 5 (from others' research or idea: highest task uncertainty). Following Newbert, Tornikoski, and Quigley (2012), we operationalized customer uncertainty using a dummy variable with a value of '1' for high customer uncertainty if all potential customers consider this venture's product or service new and unfamiliar and a value of '0' otherwise.

Cognitive disposition

Among the cognitive characteristics identified in prior PSED-based research (e.g., Cassar and Friedman, 2009; Townsend, Busenitz, and Arthurs, 2010), we measure two different cognitive dispositions of nascent entrepreneurs: entrepreneurial self-efficacy and decisiveness. Both variables are measured and coded in a Likert scale from '1' (strongly disagree) to '5' (strongly agree) and represent highly self-efficacious and decisive individuals with higher values. To be consistent with the previous literature, the average value of the three PSED II items is used to measure entrepreneurial self-efficacy (Cronbach's alpha = 0.70).

Control variables

In order to control for effects that might otherwise influence a nascent entrepreneur's judgment on the most critical factors for profitability in the new venture, we use the following individual-level, venture-level, and environment-level control variables.

To be consistent with recent empirical approaches (e.g., Uy, Foo, and Song, 2012), we control for prior founding experience by using the number of business ventures an entrepreneur helped start as an owner or part-owner. To control for prior managerial experience, we include a continuous variable of the years of managerial, supervisory, or administrative responsibilities. In order to control for the intensity and transferability of venture-specific learning by portfolio entrepreneurs (Westhead, Ucbasaran, and Wright, 2005), we measure business scope with a continuous variable of the number of other businesses owned by each respondent. In addition, we include a dummy variable representing current employment status. Since formal academic education is the most common operationalization of general human capital in the entrepreneurship literature (Brüderl, Preisendörfer, and Ziegler, 1992), we control for the entrepreneur's educational attainment with a dummy variable indicating a minimum of a four-year college degree (Naldi and Davidsson, 2013).

Following Naldi and Davidsson (2013), we control for the extent to which entrepreneurs need to learn different skills and insights to serve target customers outside their local markets. We include two continuous variables that represent the percent of target customers being either local or international. Further, since a supportive founding environment can affect domain experiences (Powell and Eddleston, 2013), we control for the characteristics of the respondents' communities by including a composite variable consisting of the following five items: (1) the social norms and culture encouraging entrepreneurial risk taking; (2) the social norms and culture emphasizing individuals' responsibilities; (3) helpful bankers and other investors; (4) friends with entrepreneurial experience; and (5) relatives with entrepreneurial experience. We also control for opportunity attractiveness in two different ways: entrepreneurs' growth expectancy on the new business (2006, 2010) and investors' expectancy based on external funding received from financial institutions or other people. Further, we control for respondents' growth intentions (Newbert *et al.*, 2012).

To control for the development phase of the new venture and thereby reduce bias due to left censoring (Yang and Aldrich, 2012), we include a dummy variable indicating whether a federal income tax return has ever been filed for the new business. Finally, we control for the effects of industry similarity between new ventures by using respondents' assessments of R&D intensity with a dummy variable indicating whether spending on R&D is a major priority for this new business and by including two-digit SIC codes (Toft-Kehler, Wennberg, and Kim, 2013).

RESULTS

Table 1 provides the descriptive statistics and the correlations of the variables utilized in the analysis. Correlation coefficients are generally modest, and no signs of collinearity are detected in the analysis. In particular, the two measures of entrepreneurial judgment are not significantly correlated ($r = 0.04$). This suggests that selectivity and conviction indeed represent different aspects of entrepreneurial judgment, although they are calculated from the same PSED II items based on respondents' assessments of key success factors in their new businesses. Accordingly, we examine the two aspects of judgment separately and use hierarchical multiple regressions to test hypotheses.

Table 2 reports the main regression findings for the relationships between a set of independent variables and the first dependent variable—selectivity of entrepreneurial judgment (i.e., the coefficient of variations in relative importance of 10 different factors of competition in the market of new venture). Column 1 presents the estimates of the base model that includes only control variables. Columns 2 to 7 differ from column 1 in that each model includes an explanatory variable of experience (time spent in the venture or formal business planning), uncertainty (task or customer uncertainty), or cognition (entrepreneurial self-efficacy or decisiveness) examining the hypothesized relationships.

The estimates presented in Table 2 suggest that the hypothesized effects on selectivity of entrepreneurial judgment are explained in part by venture-specific experience and cognition of nascent entrepreneurs. Specifically, the coefficients of experience measures (time spent and formal business planning in columns 2 and 3) are both positive and statistically significant, providing support for Hypotheses 1a and 2a. Further,

the coefficient of our measure of cognition (entrepreneurial decisiveness in column 7) is also positive and significant as predicted, supporting Hypothesis 6a. However, we do not find empirical support for Hypothesis 5a (entrepreneurial self-efficacy in column 6) or Hypotheses 3a and 4a (task uncertainty and customer uncertainty in columns 4 and 5).

The results of control variables in Table 2 are also noteworthy. Our measure of growth intention has a negative and significant effect on selectivity of entrepreneurial judgment in all models. In contrast, academic experience measured by college education shows a positive and significant effect consistently across all models. We also find that challenging founding environment has a positive and significant effect on selectivity of entrepreneurial judgment, while the effects of external funding and R&D intensity are negative and significant in all models.

Table 3 provides the regression results explaining the relationships between the same independent variables and the second dependent variable, *conviction* in entrepreneurial judgment (i.e., the sum of the absolute difference from the neutral value for 10 different factors of competition in the market of the new venture). The results in Table 3 indicate that the hypothesized effects on conviction in entrepreneurial judgment are explained by venture-specific experience, cognitive disposition of entrepreneurs, and entrepreneurial uncertainty. Specifically, the coefficients of experience measures (time spent and formal business planning in columns 2 and 3) are both positive and statistically significant, supporting Hypotheses 1b and 2b. The coefficient of entrepreneurial decisiveness in column 7 is also positive and significant, supporting Hypothesis 6b. Hence, we find that venture-specific experience and entrepreneurial decisiveness have similar impacts on selectivity and conviction in nascent entrepreneurs' judgments. In addition, we find different results between selectivity and conviction in entrepreneurial judgment. The coefficient of customer uncertainty in column 5 is positive and significant in Table 3, supporting Hypothesis 4b. Further, the coefficient of entrepreneurial self-efficacy is positive and significant in column 6, which provides support for Hypothesis 5b. However, we do not find empirical support for Hypothesis 3b regarding the negative impact of task uncertainty, as the corresponding coefficient in column 4 is not statistically significant.

The results of control variables in Table 3 suggest that in contrast to what we find in Table 2 about selectivity of entrepreneurial judgment, the measure

Table 1. Descriptive statistics and correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1 Selectivity of ent. judgment	1.00																								
2 Conviction in ent. judgment	0.04	1.00																							
3 Time spent (log)	0.14	0.09	1.00																						
4 Formal business plan	0.10	0.08	0.15	1.00																					
5 Task uncertainty	-0.07	0.02	-0.08	-0.03	1.00																				
6 Customer uncertainty	0.00	0.20	0.01	0.07	0.12	1.00																			
7 Self-efficacy	-0.07	0.19	0.07	0.07	-0.14	0.01	1.00																		
8 Decisiveness	0.12	0.11	0.04	0.16	-0.08	-0.09	0.05	1.00																	
9 Founding experience	0.07	0.02	0.04	0.00	-0.03	0.04	-0.05	0.05	1.00																
10 Managerial experience	0.10	0.01	0.10	-0.02	-0.08	-0.10	0.02	0.20	0.23	1.00															
11 Business portfolio	0.04	-0.06	0.01	-0.03	-0.02	0.05	-0.08	0.07	0.63	0.09	1.00														
12 Employed full-time	0.05	0.03	0.11	0.06	-0.05	-0.05	0.06	0.03	0.07	0.02	0.13	1.00													
13 College education	0.14	0.02	0.08	0.16	-0.09	0.00	-0.11	0.14	0.06	0.20	0.07	0.06	1.00												
14 Married	0.03	-0.08	-0.05	0.00	-0.11	-0.03	-0.02	0.08	-0.01	0.06	0.01	0.02	0.01	1.00											
15 Female	-0.04	-0.01	-0.06	-0.03	0.07	-0.08	-0.07	-0.02	-0.04	-0.06	0.01	-0.13	0.07	0.09	1.00										
16 Opportunity expectancy (log)	-0.08	0.13	0.07	0.08	0.01	0.05	0.01	0.00	0.02	0.00	-0.02	0.03	-0.01	-0.11	-0.19	1.00									
17 Growth intention	-0.11	0.18	0.01	0.09	0.02	0.16	0.06	0.08	0.11	-0.05	0.08	0.04	0.04	-0.06	-0.11	0.26	1.00								
18 Local customers (%)	-0.03	-0.04	-0.11	-0.03	-0.01	-0.11	-0.01	-0.07	-0.11	-0.08	-0.12	0.00	-0.13	0.02	0.12	-0.09	-0.09	1.00							
19 International customers (%)	-0.04	0.05	0.01	0.07	0.03	0.10	-0.01	-0.03	0.05	-0.05	0.05	-0.06	0.04	-0.09	-0.09	0.13	0.16	-0.36	1.00						
20 Founding environment	0.10	-0.18	0.03	0.01	0.06	0.02	-0.10	-0.03	-0.07	-0.13	0.05	0.12	-0.05	-0.02	-0.03	-0.10	0.00	0.05	-0.11	1.00					
21 External funding	-0.07	-0.04	0.13	0.11	-0.01	-0.02	0.05	0.04	0.02	0.00	0.03	0.18	0.04	0.02	-0.04	-0.04	0.07	0.00	0.04	-0.01	1.00				
22 Development phase	0.10	-0.02	0.27	-0.01	-0.11	-0.07	-0.10	0.00	0.07	0.09	-0.01	0.05	0.06	0.11	0.06	-0.10	-0.04	-0.01	-0.08	-0.01	0.05	1.00			
23 R&D intensity	-0.15	0.16	0.06	0.01	-0.03	0.10	0.10	-0.10	-0.07	-0.13	-0.08	0.03	-0.08	-0.08	-0.04	0.14	0.07	-0.02	0.02	-0.02	0.00	-0.06	1.00		
24 Industry SIC	0.03	0.03	0.01	0.06	0.02	-0.06	0.00	0.00	0.02	-0.03	-0.02	-0.05	0.03	-0.05	0.04	-0.10	-0.04	0.04	0.05	0.04	-0.02	0.00	-0.03	1.00	
M	0.25	10.84	2.56	0.14	3.29	0.17	4.29	3.83	0.98	10.58	0.26	0.58	0.35	0.36	0.40	0.25	0.17	61.52	2.17	2.77	0.07	0.13	0.23	8.77	
SD	0.11	3.82	0.77	0.35	1.50	0.37	0.66	1.00	1.88	9.87	0.70	0.49	0.48	0.48	0.49	0.41	0.38	33.19	6.94	0.63	0.25	0.34	0.42	4.22	

Statistically significant correlations at the 5 percent level (p < 0.05) are marked bold; two-tail tests.

Table 2. Selectivity of entrepreneurial judgment

Variables	Control	Experience		Uncertainty		Cognition	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Time spent (log)		0.0163*** (0.0062)					
Formal business plan			0.0317*** (0.0132)				
Task uncertainty				-0.0036 (0.0030)			
Customer uncertainty					0.0097 (0.0123)		
Self-efficacy						-0.0037 (0.0069)	
Decisiveness							0.0099** (0.0046)
Founding experience	0.0040 (0.0032)	0.0040 (0.0032)	0.0039 (0.0032)	0.0041 (0.0032)	0.0040 (0.0032)	0.0040 (0.0032)	0.0043 (0.0032)
Managerial experience	0.0004 (0.0005)	0.0003 (0.0005)	0.0005 (0.0005)	0.0004 (0.0005)	0.0005 (0.0005)	0.0004 (0.0005)	0.0003 (0.0005)
Business portfolio	-0.0043 (0.0084)	-0.0040 (0.0084)	-0.0032 (0.0084)	-0.0045 (0.0084)	-0.0044 (0.0084)	-0.0045 (0.0085)	-0.0050 (0.0084)
Employed full-time	0.0075 (0.0095)	0.0059 (0.0095)	0.0066 (0.0095)	0.0072 (0.0095)	0.0080 (0.0095)	0.0079 (0.0095)	0.0073 (0.0095)
College education	0.0287*** (0.0098)	0.0277*** (0.0097)	0.0250** (0.0098)	0.0277*** (0.0098)	0.0285*** (0.0098)	0.0281*** (0.0098)	0.0267*** (0.0098)
Married	0.0015 (0.0095)	0.0032 (0.0095)	0.0011 (0.0094)	0.0004 (0.0095)	0.0015 (0.0095)	0.0015 (0.0095)	0.0001 (0.0095)
Female	-0.0146 (0.0095)	-0.0138 (0.0095)	-0.0145 (0.0095)	-0.0136 (0.0096)	-0.0142 (0.0096)	-0.0148 (0.0096)	-0.0143 (0.0095)
Opportunity expectancy (log)	-0.0084 (0.0119)	-0.0110 (0.0119)	-0.0104 (0.0119)	-0.0083 (0.0119)	-0.0082 (0.0119)	-0.0087 (0.0119)	-0.0081 (0.0119)
Growth intention	-0.0283** (0.0125)	-0.0273** (0.0124)	-0.0298** (0.0125)	-0.0280** (0.0125)	-0.0295** (0.0126)	-0.0278** (0.0125)	-0.0308** (0.0125)
Local customers (%)	-0.0001 (0.0001)	0.0000 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
International customers (%)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0004 (0.0007)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0002 (0.0007)
Founding environment	0.0181** (0.0073)	0.0171** (0.0073)	0.0177** (0.0073)	0.0186** (0.0073)	0.0180** (0.0073)	0.0177** (0.0074)	0.0184** (0.0073)
External funding	-0.0325* (0.0181)	-0.0380** (0.0181)	-0.0366** (0.0181)	-0.0323* (0.0181)	-0.0322* (0.0181)	-0.0321* (0.0181)	-0.0335* (0.0180)
Development phase	0.0237* (0.0135)	0.0136 (0.0140)	0.0242* (0.0135)	0.0222 (0.0136)	0.0242* (0.0135)	0.0230* (0.0136)	0.0245* (0.0135)
R&D intensity	-0.0288*** (0.0110)	-0.0310*** (0.0109)	-0.0287*** (0.0109)	-0.0295*** (0.0110)	-0.0295*** (0.0110)	-0.0283*** (0.0110)	-0.0272** (0.0109)
Industry SIC	0.0004 (0.0011)	0.0003 (0.0011)	0.0002 (0.0011)	0.0004 (0.0011)	0.0004 (0.0011)	0.0004 (0.0011)	0.0003 (0.0011)
Constant	0.1934*** (0.0277)	0.1570*** (0.0308)	0.1941*** (0.0275)	0.2050*** (0.0294)	0.1909*** (0.0279)	0.2009*** (0.0426)	0.1567*** (0.0324)
N	524	524	524	524	524	524	524
F	3.09	3.35	3.28	2.99	2.95	2.92	3.20
Probability > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R2	0.09	0.10	0.10	0.09	0.09	0.09	0.10

Continues

Table 2. (Continued)

Variables	H12a	H34a	H56a	H1234a	H1256a	H3456a	H123456a
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Time spent (log)	0.0146*** (0.0062)			0.0142** (0.0062)	0.0151*** (0.0062)		0.0147*** (0.0062)
Formal business plan	0.0276** (0.0133)			0.0268** (0.0133)	0.0248** (0.0134)		0.0239** (0.0135)
Task uncertainty		-0.0039 (0.0031)		-0.0033 (0.0030)		-0.0040 (0.0031)	-0.0036 (0.0031)
Customer uncertainty		0.0115 (0.0124)		0.0090 (0.0123)		0.0140 (0.0124)	0.0115 (0.0124)
Self-efficacy			-0.0047 (0.0069)		-0.0072 (0.0069)	-0.0061 (0.0070)	-0.0084 (0.0070)
Decisiveness			0.0101** (0.0046)		0.0086** (0.0046)	0.0103** (0.0047)	0.0088** (0.0047)
Founding experience	0.0039 (0.0032)	0.0040 (0.0032)	0.0042 (0.0032)	0.0039 (0.0032)	0.0040 (0.0032)	0.0042 (0.0032)	0.0040 (0.0032)
Managerial experience	0.0004 (0.0005)	0.0005 (0.0005)	0.0003 (0.0005)	0.0004 (0.0005)	0.0003 (0.0005)	0.0003 (0.0005)	0.0003 (0.0005)
Business portfolio	-0.0031 (0.0084)	-0.0047 (0.0084)	-0.0053 (0.0084)	-0.0036 (0.0084)	-0.0043 (0.0084)	-0.0059 (0.0084)	-0.0049 (0.0084)
Employed full-time	0.0053 (0.0094)	0.0077 (0.0095)	0.0078 (0.0095)	0.0055 (0.0095)	0.0059 (0.0094)	0.0083 (0.0095)	0.0063 (0.0095)
College education	0.0246** (0.0098)	0.0274*** (0.0098)	0.0259*** (0.0098)	0.0236** (0.0098)	0.0220** (0.0099)	0.0243** (0.0099)	0.0207** (0.0099)
Married	0.0027 (0.0094)	0.0003 (0.0095)	0.0001 (0.0095)	0.0016 (0.0095)	0.0015 (0.0094)	-0.0012 (0.0095)	0.0003 (0.0095)
Female	-0.0138 (0.0095)	-0.0130 (0.0096)	-0.0146 (0.0095)	-0.0124 (0.0095)	-0.0139 (0.0095)	-0.0129 (0.0096)	-0.0124 (0.0095)
Opportunity expectancy (log)	-0.0124 (0.0118)	-0.0080 (0.0119)	-0.0085 (0.0119)	-0.0120 (0.0119)	-0.0126 (0.0118)	-0.0081 (0.0119)	-0.0121 (0.0118)
Growth intention	-0.0288** (0.0124)	-0.0294** (0.0126)	-0.0303** (0.0125)	-0.0296** (0.0125)	-0.0300** (0.0125)	-0.0316** (0.0126)	-0.0310** (0.0126)
Local customers (%)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	0.0000 (0.0001)	0.0000 (0.0001)	-0.0001 (0.0001)	0.0000 (0.0001)
International customers (%)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0002 (0.0007)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0002 (0.0007)	-0.0003 (0.0007)
Founding environment	0.0168** (0.0073)	0.0184** (0.0073)	0.0178** (0.0074)	0.0172** (0.0073)	0.0162** (0.0073)	0.0180** (0.0074)	0.0164** (0.0073)
External funding	-0.0410** (0.0181)	-0.0319* (0.0181)	-0.0330* (0.0180)	-0.0402** (0.0181)	-0.0410** (0.0181)	-0.0322* (0.0180)	-0.0400** (0.0181)
Development phase	0.0150 (0.0140)	0.0226* (0.0136)	0.0236* (0.0136)	0.0143 (0.0140)	0.0139 (0.0140)	0.0223 (0.0136)	0.0129 (0.0141)
R&D intensity	-0.0307*** (0.0109)	-0.0304*** (0.0110)	-0.0265*** (0.0110)	-0.0319*** (0.0109)	-0.0284** (0.0109)	-0.0281** (0.0110)	-0.0297*** (0.0110)
Industry SIC	0.0002 (0.0011)	0.0004 (0.0011)	0.0003 (0.0011)	0.0002 (0.0011)	0.0002 (0.0011)	0.0004 (0.0011)	0.0002 (0.0011)
Constant	0.1613*** (0.0307)	0.2030*** (0.0295)	0.1777*** (0.0451)	0.1706*** (0.0326)	0.1614*** (0.0464)	0.1931*** (0.0478)	0.1761*** (0.0492)
N	524	524	524	524	524	524	524
F	3.43	2.87	3.05	3.16	3.32	2.88	3.11
Probability > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R2	0.11	0.09	0.10	0.11	0.12	0.10	0.12

Positive coefficients indicate greater selectivity of venture-specific knowledge by the entrepreneur in the new venture.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Table 3. Conviction in entrepreneurial judgment

Variables	Control	Experience		Uncertainty		Cognition	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Time spent (log)		0.4326** (0.2222)					
Formal business plan			0.6614* (0.4759)				
Task uncertainty				0.0550 (0.1092)			
Customer uncertainty					1.8185*** (0.4360)		
Self-efficacy						0.8974*** (0.2461)	
Decisiveness							0.4644*** (0.1653)
Founding experience	0.1172 (0.1148)	0.1164 (0.1144)	0.1140 (0.1147)	0.1165 (0.1148)	0.1063 (0.1130)	0.1257 (0.1134)	0.1277 (0.1140)
Managerial experience	0.0018 (0.0175)	-0.0008 (0.0175)	0.0028 (0.0175)	0.0022 (0.0176)	0.0085 (0.0173)	-0.0013 (0.0173)	-0.0063 (0.0176)
Business portfolio	-0.5482* (0.3030)	-0.5414* (0.3022)	-0.5268* (0.3031)	-0.5439* (0.3033)	-0.5739* (0.2983)	-0.4943* (0.2997)	-0.5838* (0.3012)
Employed full-time	0.5124 (0.3410)	0.4689 (0.3408)	0.4944 (0.3409)	0.5167 (0.3414)	0.5963* (0.3362)	0.4147 (0.3380)	0.5009 (0.3387)
College education	0.0644 (0.3499)	0.0389 (0.3492)	-0.0132 (0.3540)	0.0795 (0.3515)	0.0281 (0.3445)	0.2114 (0.3481)	-0.0270 (0.3491)
Married	-0.4736 (0.3407)	-0.4286 (0.3405)	-0.4827 (0.3404)	-0.4567 (0.3426)	-0.4790 (0.3353)	-0.4677 (0.3366)	-0.5379 (0.3391)
Female	0.2288 (0.3427)	0.2507 (0.3420)	0.2324 (0.3424)	0.2133 (0.3443)	0.3140 (0.3379)	0.2650 (0.3389)	0.2426 (0.3404)
Opportunity expectancy (log)	0.4165 (0.4269)	0.3475 (0.4272)	0.3766 (0.4274)	0.4146 (0.4272)	0.4619 (0.4203)	0.4803 (0.4221)	0.4312 (0.4240)
Growth intention	1.6458*** (0.4486)	1.6714*** (0.4476)	1.6134*** (0.4488)	1.6410*** (0.4490)	1.4159*** (0.4450)	1.5432*** (0.4442)	1.5278*** (0.4476)
Local customers (%)	-0.0028 (0.0053)	-0.0019 (0.0053)	-0.0028 (0.0053)	-0.0027 (0.0053)	-0.0012 (0.0052)	-0.0021 (0.0052)	-0.0020 (0.0053)
International customers (%)	-0.0077 (0.0255)	-0.0071 (0.0255)	-0.0093 (0.0255)	-0.0079 (0.0255)	-0.0118 (0.0251)	-0.0039 (0.0252)	-0.0037 (0.0254)
Founding environment	-1.0741*** (0.2634)	-1.1012*** (0.2630)	-1.0820*** (0.2632)	-1.0813*** (0.2640)	-1.1016*** (0.2593)	-0.9644*** (0.2620)	-1.0612*** (0.2617)
External funding	-0.8948 (0.6487)	-1.0406 (0.6513)	-0.9808 (0.6511)	-0.8981 (0.6492)	-0.8282 (0.6387)	-0.9894 (0.6415)	-0.9416 (0.6446)
Development phase	-0.0444 (0.4851)	-0.3150 (0.5034)	-0.0353 (0.4847)	-0.0208 (0.4877)	0.0467 (0.4780)	0.1355 (0.4819)	-0.0072 (0.4821)
R&D intensity	1.2352*** (0.3931)	1.1772*** (0.3932)	1.2364*** (0.3928)	1.2456*** (0.3940)	1.1021*** (0.3882)	1.1155*** (0.3898)	1.3100*** (0.3914)
Industry SIC	0.0428 (0.0386)	0.0410 (0.0385)	0.0392 (0.0386)	0.0425 (0.0386)	0.0519 (0.0380)	0.0405 (0.0381)	0.0415 (0.0383)
Constant	12.7938*** (0.9924)	11.8242*** (1.1079)	12.8070*** (0.9915)	12.6141*** (1.0553)	12.3163*** (0.9834)	8.6126*** (1.5085)	11.0721*** (1.1607)
N	524	524	524	524	524	524	524
F	3.85	3.86	3.74	3.63	4.76	4.49	4.14
Probability > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R2	0.11	0.11	0.11	0.11	0.14	0.13	0.12

Continues

Table 3. (Continued)

Variables	H12b	H34b	H56b	H1234b	H1256b	H3456b	H123456b
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Time spent (log)	0.3988** (0.2241)			0.3854** (0.2213)	0.3366* (0.2214)		0.3273* (0.2177)
Formal business plan	0.5494 (0.4791)			0.4411 (0.4732)	0.2587 (0.4782)		0.1122 (0.4709)
Task uncertainty		0.0051 (0.1081)		0.0189 (0.1081)		0.0813 (0.1073)	0.0882 (0.1073)
Customer uncertainty		1.8161*** (0.4392)		1.7662*** (0.4391)		1.8930*** (0.4317)	1.8654*** (0.4329)
Self-efficacy			0.8584*** (0.2451)		0.8134*** (0.2464)	0.8748*** (0.2436)	0.8389*** (0.2448)
Decisiveness			0.4296*** (0.1638)		0.4124*** (0.1655)	0.5002*** (0.1616)	0.4903*** (0.1636)
Founding experience	0.1138 (0.1144)	0.1062 (0.1131)	0.1351 (0.1128)	0.1035 (0.1128)	0.1324 (0.1128)	0.1245 (0.1108)	0.1228 (0.1108)
Managerial experience	0.0003 (0.0175)	0.0085 (0.0173)	-0.0087 (0.0175)	0.0068 (0.0174)	-0.0098 (0.0175)	-0.0024 (0.0172)	-0.0040 (0.0173)
Business portfolio	-0.5242* (0.3025)	-0.5734* (0.2987)	-0.5296* (0.2983)	-0.5514* (0.2984)	-0.5174* (0.2985)	-0.5545* (0.2932)	-0.5462* (0.2936)
Employed full-time	0.4574 (0.3408)	0.5966* (0.3366)	0.4083 (0.3361)	0.5447 (0.3367)	0.3728 (0.3364)	0.4986 (0.3306)	0.4661 (0.3311)
College education	-0.0236 (0.3533)	0.0296 (0.3462)	0.1205 (0.3478)	-0.0402 (0.3496)	0.0663 (0.3518)	0.0938 (0.3436)	0.0599 (0.3474)
Married	-0.4397 (0.3405)	-0.4774 (0.3373)	-0.5274 (0.3354)	-0.4391 (0.3375)	-0.4939 (0.3360)	-0.5176 (0.3310)	-0.4818 (0.3318)
Female	0.2520 (0.3418)	0.3124 (0.3398)	0.2858 (0.3369)	0.3282 (0.3391)	0.3014 (0.3368)	0.3545 (0.3329)	0.3663 (0.3328)
Opportunity expectancy (log)	0.3197 (0.4277)	0.4616 (0.4207)	0.4912 (0.4197)	0.3718 (0.4219)	0.4181 (0.4218)	0.5390 (0.4123)	0.4762 (0.4146)
Growth intention	1.6425*** (0.4481)	1.4158*** (0.4454)	1.4385*** (0.4434)	1.4221*** (0.4451)	1.4553*** (0.4436)	1.1722*** (0.4393)	1.1955*** (0.4396)
Local customers (%)	-0.0020 (0.0053)	-0.0012 (0.0052)	-0.0014 (0.0052)	-0.0004 (0.0052)	-0.0007 (0.0052)	0.0005 (0.0051)	0.0012 (0.0052)
International customers (%)	-0.0085 (0.0255)	-0.0118 (0.0252)	-0.0003 (0.0251)	-0.0123 (0.0251)	-0.0008 (0.0252)	-0.0042 (0.0247)	-0.0042 (0.0247)
Founding environment	-1.1064*** (0.2630)	-1.1022*** (0.2599)	-0.9572*** (0.2605)	-1.1333*** (0.2597)	-0.9876*** (0.2609)	-0.9924*** (0.2560)	-1.0196*** (0.2565)
External funding	-1.1007* (0.6532)	-0.8286 (0.6394)	-1.0285 (0.6380)	-1.0185 (0.6444)	-1.1692* (0.6433)	-0.9730 (0.6268)	-1.0946* (0.6324)
Development phase	-0.2863 (0.5038)	0.0488 (0.4805)	0.1620 (0.4792)	-0.1828 (0.4987)	-0.0553 (0.4998)	0.3006 (0.4739)	0.0910 (0.4938)
R&D intensity	1.1827*** (0.3931)	1.1032*** (0.3894)	1.1898*** (0.3886)	1.0586*** (0.3895)	1.1484*** (0.3892)	1.0758*** (0.3832)	1.0386*** (0.3838)
Industry SIC	0.0382 (0.0385)	0.0518 (0.0381)	0.0395 (0.0379)	0.0476 (0.0381)	0.0369 (0.0380)	0.0483 (0.0373)	0.0464 (0.0374)
Constant	11.9108*** (1.1102)	12.3001*** (1.0416)	7.2014*** (1.5935)	11.4133*** (1.1588)	6.7257*** (1.6526)	6.1005*** (1.6613)	5.5576*** (1.7215)
N	524	524	524	524	524	524	524
F	3.73	4.49	4.67	4.28	4.36	5.40	5.03
Probability > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R2	0.12	0.14	0.14	0.15	0.15	0.18	0.18

Positive coefficients indicate greater conviction in venture-specific knowledge by the entrepreneur in the new venture.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

of growth intention has a positive and significant effect on conviction in entrepreneurial judgment, but the effect of college education is not significant. Further, our measure of business portfolio (serial entrepreneurs) in Table 3 shows a negative and significant effect on conviction in entrepreneurial judgment. The effects of founding environment and R&D intensity are reversed from those in Table 2.

An estimation problem arises in testing the causal effects of cognitive disposition of nascent entrepreneurs since entrepreneurial judgment is a cognitive process. Standard OLS regressions of observational data may fail to yield reliable estimates of the hypothesized relationships due to potential endogeneity. In particular, there could be omitted variable bias where other unobserved cognitive characteristics of the individual are correlated with cognitive disposition and entrepreneurial judgment simultaneously. When such omitted variables are observable but missing in the test model, there could be respondent selection bias.

In order to ensure that our findings are robust to such biases, we performed the Durbin-Wu-Hausman test for endogeneity. This helped us decide whether it was necessary to use an instrumental variable (IV) approach (Davidson and MacKinnon, 1993). From PSED II's 'Section Y: Respondents' Characteristics,' we identified the following six variables suitable for instruments both conceptually and statistically (Stock, 2001): *AY1* ('I consider myself a loner'); *AY2* ('Whatever emotion I feel on the inside tends to show on the outside'); *AY5* ('If I start this new business, it will help me achieve other important goals in my life'); *AY13* ('I enjoy the uncertainty of going into a new situation without knowing what might happen'); *AY15* ('I dislike it when a person's statement could mean many different things'); and *AY16* ('When thinking about a problem, I consider as many different opinions on the issues as possible'). The Durbin-Wu-Hausman test indicates that the OLS estimates are consistent and IV regressions are not necessary. Based on the test results, we believe our findings are robust to potential biases.

We did not theorize any particular relationship between the explanatory variables in hypothesis development. As a *post hoc* analysis, however, we further investigated whether the test results were robust to their additive or multiplicative relationships and potential omitted variables bias. First, we examined 14 different additive models, ranging from including two explanatory variables at once to all six

variables entered together. Although there existed some significant correlations between explanatory variables as reported in Table 1, they did not cause serious collinearity problems in additive models as measured by variance inflation factor (VIF) scores of explanatory variables and regression models.

We find in columns of 8 to 14 of Tables 2 and 3 that the test results are consistent across different additive models of selectivity and conviction, except for the coefficients of formal business planning, which are not significant in additive models of conviction. Unlike the consistently positive and significant relationship between formal business planning and selectivity, the relationship between formal business planning and conviction is getting weaker when entered with other explanatory variables.

As multiplicative models, we investigated potential nonlinear forms or complementary (or substitutive) relationships between the explanatory variables. We find a positive interaction effect of task uncertainty and entrepreneurial decisiveness on selectivity in which the conditional effect of task uncertainty on selectivity is negative and significant. In contrast, we find a negative interaction effect of task uncertainty and entrepreneurial decisiveness on conviction where the conditional effects of task uncertainty and entrepreneurial decisiveness on conviction remain positive and significant.

Figure 2 presents plots of the marginal effects of venture-specific experience and entrepreneurial uncertainty based on the results in Tables 2 and 3. The marginal effects of experience variables (i.e., time spent in the venture and formal business planning) and uncertainty variables (i.e., task uncertainty and customer uncertainty) are calculated with all other variables held at their means. As hypothesized, we find positive effects of the two experience variables on selectivity of entrepreneurial judgment, as shown in the overall positive slopes of the lines. Similarly, we find negative effects of the uncertainty variables on selectivity in a decreasing slope and negative effects on conviction in an increasing slope.

The marginal effect analysis extends our insights by exploring how different variables of venture-specific experience and entrepreneurial uncertainty affect selectivity and conviction, respectively. First, we find that formal business planning has a complementary effect on selectivity in early (less than 100 hours spent in the venture) and later (more than

1,800 hours) stages of venture development. In contrast, their complementary effect on conviction is found mostly in-between (100 to 600 hours). Second, we find that the negative effect of task uncertainty on selectivity is strengthened with customer uncertainty, but their complementary effect disappears when task uncertainty is very high (i.e., the new business originated from other people’s research or idea, not from the entrepreneur’s current or previous work). Finally, we find a consistent and complementary effect of the task and customer uncertainty variables on conviction regardless of different origins of new ventures.

DISCUSSION

This study contributes to entrepreneurship research by developing a cognitive model of entrepreneurial judgment as reflected in the shape and strength of

the entrepreneur’s causal map. The results of our empirical analysis demonstrate how entrepreneurial judgment evolves after the initial epiphany as the entrepreneur accumulates experience in the venturing process. In the face of uncertainty, the entrepreneur’s venture-specific experience and cognitive dispositions, along with customer uncertainty, influence selectivity and conviction in entrepreneurial judgment.

Implications for research

First, we investigated the *selectivity* of entrepreneurial judgment as it relates to the key success factors of the entrepreneur’s particular venture. We conceptualized entrepreneurial judgment as a cognitive process operating on a causal map entrepreneurs construct regarding the success of their ventures. We find that as entrepreneurs invest more time working for their ventures, their causal maps become more refined. Out of the 10 factors that the entrepreneurs assess in

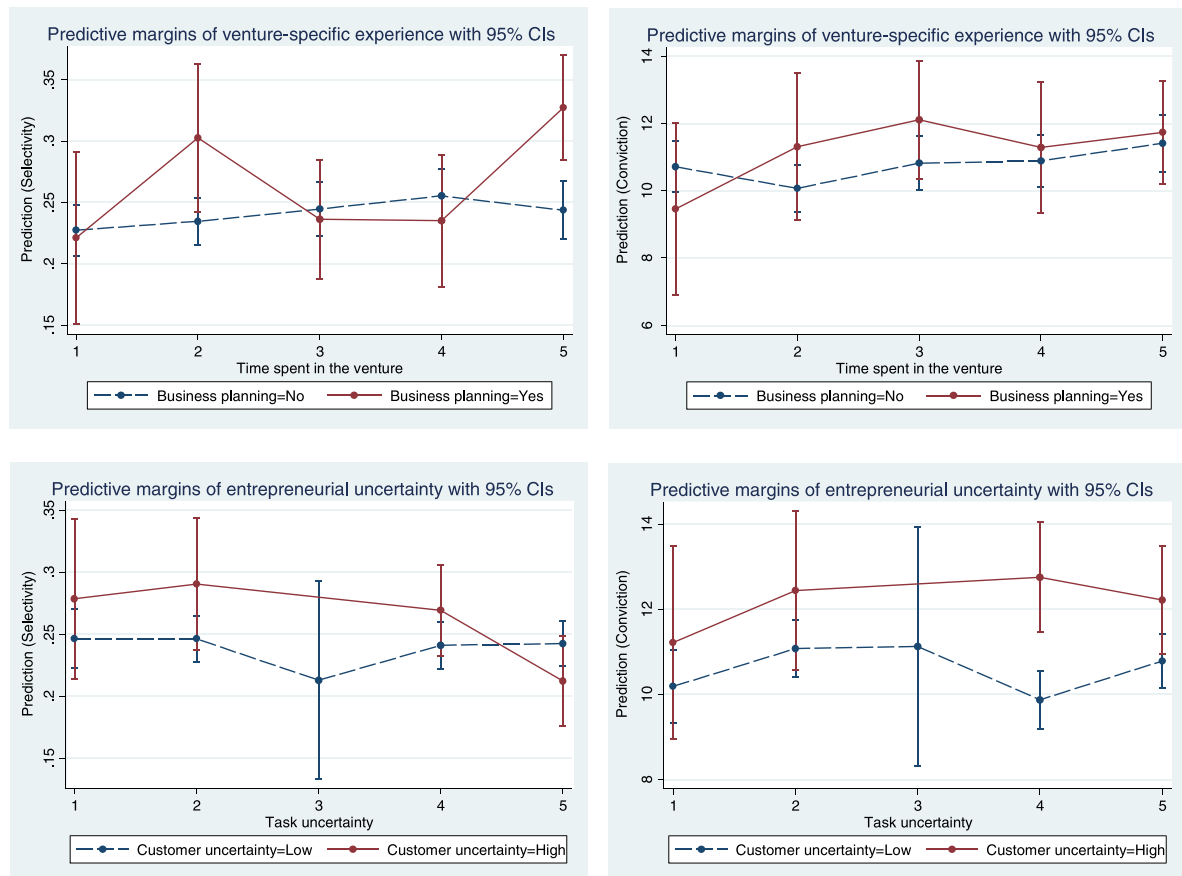


Figure 2. Marginal effects of experience and uncertainty on entrepreneurial judgment

our empirical study, they settle on fewer important predictors of success as they spend more time on their ventures. Their experience leads to the elimination of alternative theories for the successful venture. Similarly, the effort they spend on writing a formal business plan makes their judgment more selective as well. The results indicate that those entrepreneurs who prepared formal business plans have more refined causal maps than those who did not. Taken together, these findings support the entrepreneurial learning literature, as they demonstrate how time and effort spent for the venture transform the cognition of the entrepreneurs (Holcomb *et al.*, 2009). As experiential learning theory suggests, for learning to occur, there has to be a change in ideas and habits (Kolb, 1984). This study demonstrates how that change in entrepreneurial judgment occurs at a hard-to-measure cognitive level. In general, we posit that the knowledge structure in the mind of the entrepreneur shapes the exercise of judgment during the entrepreneurial process (Ardichvili, Cardozo, and Ray, 2003; Corbett and Hmieleski, 2007).

We proposed that venture uncertainty and the cognitive dispositions of the entrepreneurs would influence entrepreneurial judgment as well. Our findings about uncertainty provide only partial support of our theory. We did not find that the entrepreneurs had difficulty identifying the key success factors in an opportunity defined by high uncertainty. An explanation is that our uncertainty measures do not capture Knightian uncertainty as intended by our model fully. Alternatively, we conjecture that entrepreneurs make selective judgments because they resort to effectuation strategies in highly uncertain ventures (Sarasvathy, 2001).

In terms of cognitive disposition, we find that individuals who identify themselves as decisive are more likely to have selective judgments. We interpret that finding by referring to their comfort level in making decisions under uncertainty. When taken collectively, these determinants of a refined causal map have implications for broader theory of entrepreneurial judgment and cognition. When defined as resource allocation or exploitation decisions, entrepreneurial judgment relates very strongly to the knowledge structures we examine in this study. This is a novel contribution to the entrepreneurial judgment perspective since our empirical study opens the cognitive black box of judgment in the mind of the entrepreneur (Sarasvathy and Dew, 2013). As the entrepreneur identifies a smaller set

of factors that will lead to profitability, we would expect her resource allocation decisions to follow suit. The entrepreneur will be in a better position to make investment decisions as the causal map becomes more focused.

The second aspect of entrepreneurial judgment we investigated is the entrepreneur's *conviction* in her judgment. Having an opinion about the key success factors is different from the strength of that opinion. Consistent with our theoretical approach to experiential learning, we find that spending more time with the venture strengthens the entrepreneur's conviction in judgment. Similarly, preparing a formal business plan makes her conviction stronger as well. That conviction is important because when the entrepreneur firmly believes in the plausibility of a success factor, she is more likely to invest resources in that direction (Minniti and Bygrave, 2001). At a cognitive level, this is made possible by alleviating doubt that would otherwise hinder entrepreneurial actions (McMullen and Shepherd, 2006).

In our sample of nascent entrepreneurs, we find that uncertainty has mixed effects on conviction. Task uncertainty, which we postulated to increase the entrepreneur's conviction, has no significant effect. However, when the product is unknown to the customers, we find that the entrepreneurs have stronger conviction in their judgments. This finding is particularly interesting given that those two constructs represent opportunity uncertainty from two different viewpoints. Task uncertainty is what the entrepreneur faces in the new venture provided her prior work experience and knowledge base. Given the distance between the prior knowledge and the new venture tasks, the entrepreneur may realize that new learning is necessary. This, in turn, will lead to doubt rather than conviction in their causal maps.

In contrast, a novel and unknown product is what the customer will be facing in the market. This finding is consistent with the previous findings of optimism (Cassar, 2010). When the product is a novel one, entrepreneurs are more strongly opinionated about their own judgments. In those situations of high customer uncertainty, entrepreneurs will rely on cognitive heuristics and interpret customer uncertainty as a sign of the product's novelty in their judgment. When the product is truly novel and the entrepreneur believes that the uncertainty will present unknowns to others as well (i.e., unknowable unknowns), this creates a more comfortable cognitive state for the entrepreneur (Chow

and Sarin, 2002). As such, customer uncertainty can reinforce the entrepreneur's conviction in her judgment.

Finally, we find strong support for our hypotheses on cognitive dispositions and conviction. Entrepreneurs who report higher levels of self-efficacy and decisiveness also show higher levels of conviction. According to the theoretical model by Minniti and Bygrave (2001), a positive outcome early in the process may lock in the dynamics, sometimes prematurely. Our finding about entrepreneurial self-efficacy and conviction can be the underlying cognitive mechanism. It is important to underline that the observed correlations between the cognitive dispositions and the conviction in judgment are not driven by a common method bias in self-reported data. That could be the case if our conviction measure were simply a direct question of confidence in the venture's success. In fact, independently from those measures, we operationalize conviction using a completely separate set of the PSED II items. Conviction in entrepreneurial judgment is a pure cognitive measure without any common emotional component driving a spurious correlation. Therefore, our finding must be interpreted as a form of cognitive commitment in contrast to an emotional state. We find that such cognitive commitment is highly correlated with entrepreneurial self-efficacy and decisiveness of the entrepreneur.

Implications for entrepreneurs, educators, and investors

For entrepreneurs it is important to understand the cognitive mechanisms underpinning the judgments they make. Our findings suggest that their decision patterns can be understood and predicted partially based on their experience with the venture and their cognitive dispositions. Entrepreneurs learn in different ways (Corbett, 2005). To the extent that the refinement in judgment is useful, the entrepreneurs are advised to increase the range of start-up activities (cf. Gielnik *et al.*, 2012). Furthermore, the significant roles of entrepreneurial self-efficacy and decisiveness may imply a precarious scenario. When the entrepreneurs are formulating a strategy to guide their resource allocation decisions, these cognitive attributes may help them in narrowing down important options for attention. However, their strong effect on conviction may also suggest that there is a risk of overoptimism or overconfidence in their judgments regardless of the accuracy of their judgments. Further research is necessary to delineate the performance implications of entrepreneurial judgment *ex post*.

This study also provides important implications for those who assess the entrepreneurs' judgments. Investors and venture capitalists need to examine the accuracy of the entrepreneurs' judgments and their underlying knowledge structures about the critical success factors. The impact of self-efficacy and decisiveness on conviction can be a warning sign for the entrepreneurs' ungrounded judgments. Our findings imply that investors are advised to explore the sources of cognitive commitment by the entrepreneur and check if the conviction is supported by accumulated experience in the specific context of the venture.

For entrepreneurship education, our findings may be referred to show the reality of entrepreneurship in practice, as nascent entrepreneurs often have to exercise judgment with limited information. When entrepreneurship is seen as novel resource combinations under scarcity and uncertainty, the selectivity of entrepreneurial judgment matters. It seems that practicing entrepreneurs are aware that they cannot effectively make progress in all aspects of a new venture at once. As they get more experienced with the venture, they choose the more important success factors on which to focus. Students of entrepreneurship would benefit from knowing that learning is context specific and entrepreneurial judgment evolves in the venturing process.

Boundary conditions and future research

It is important to understand the boundary conditions of our findings, as they also provide ideas for extension and future research. First, inferences about the observed relationships should be made with caution, as the study used the PSED II data only up to the Wave A survey. In the follow-up surveys, there are sample selection issues due to venture disbanding decision and various filtering used in the PSED II survey (such as becoming a profitable business). As such, a dynamic modeling approach is recommended in future research.

Second, because our focus is on the evolution of entrepreneurial judgment, we do not investigate its effect on entrepreneurial action or venture performance (cf. Baron and Henry, 2010). However, the intensity of entrepreneurs' efforts in experiential learning and knowledge acquisition may be influenced by their intended goals and expected outcomes. Although we include several control variables in estimation to rule out possible endogeneity issues, it

is clear that examining actions and goals on outcomes in a systematic manner is a natural extension.

Third, our sample entrepreneurs were in venture development for about 18 months on average at the time they participated in the first PSED II survey. Respondents' perceived uncertainty and their cognitive dispositions may persist through time, but they may be affected by the changing circumstances in later stage of venture progress. With respect to the PSED II sampling, we also have to note that we focused on nascent entrepreneurs who had the general intention to start a new business. Thus, our findings might be generalizable only to this group of individuals sharing such entrepreneurial intentions and backgrounds. Furthermore, it is also likely that our findings can be generalized only to a particular phase of the entrepreneurial process in which the entrepreneur has already acquired some level of knowledge to form an intention and start a new business. This might reduce the variance in our measures of the evolution of entrepreneurial judgment, which, in turn, might weaken the effect size and statistical significance of the empirical results. Nonetheless, we find that most of our results are statistically significant.

Future research can extend our causal map model and application of cognitive mechanisms on the entrepreneurial judgment theories. One way forward might be to compare entrepreneurial judgment with analytical decision-making situations such as location or funding decisions based on verifiable information. They are likely to be associated with different entrepreneurial attributes, cognitive characteristics, decision-making capabilities, and experience bases. In our empirical analysis, we found some interesting patterns involving college education and growth intention, as shown in Table 1. Notably, however, we find that general (founding and managerial) experience variables are not significant in their relationships with entrepreneurial judgment.

Upon imagining a new venture organization, the entrepreneur has to make resource allocation decisions in order to exploit the perceived opportunity. We propose that the causal map is the knowledge structure in the mind that guides these difficult decisions. For example, when the entrepreneur believes that price is more important than marketing for profitability of the venture, she is more likely to invest resources that will reduce operating costs than to increase advertising expenses. While the causal map serves as a guide, however, it is not a snapshot of resource allocation decisions as imagined by Foss and Klein (2012). The causal map developed

in this study is a precursor to actual resource allocations. Further empirical research is needed to bridge the gap between cognitive constructs and financial investments as hinted by Knight (1921) a century ago.

CONCLUSION

The theory and evidence presented in this research contributes to the entrepreneurship literature in several ways. First, we develop a conceptual model of entrepreneurial judgment operating on the causal map and examine how this important knowledge structure in the mind of the entrepreneur evolves with experience in the context of the new venture. According to the model, venture-specific experience, as opposed to general industry experience or human capital, can make a difference in the way entrepreneurs make decisions under uncertainty. We report considerable empirical support of the causal map model using a representative sample of nascent entrepreneurs. Second, we advance the construct of entrepreneurial judgment both theoretically and empirically. Most of the literature on the evolution of venture-specific knowledge and judgment is theoretical (e.g., Cope, 2005; Corbett, 2005; Foss and Klein, 2012; Holcomb *et al.*, 2009; Klein, 2008; Minniti and Bygrave, 2001). We draw on a publicly available dataset and provide a first attempt at operationalizing entrepreneurial judgment in terms of selectivity and conviction using entrepreneurs' subjective assessments of a set of success factors in the venture. We hope that future research will build on our cognitive approach to entrepreneurial judgment in the mind of the entrepreneur.

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APPENDIX

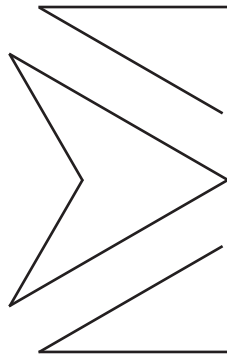
PSED II section F. Attitude toward competition

Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with each of the following statements as it applies to this new business.

_____ are important for this new business to be an effective competitor.

PSED II	Variables	Survey questions	Mean	S.D.
AF1	Price	Lower prices	2.99	1.78
AF2	Quality	Quality products or services	1.44	1.06
AF3	Niche	Serving those missed by others	2.03	1.49
AF4	Timing	Being first to market a new product or service	3.08	1.85
AF5	Marketing	Doing a better job of marketing and promotion	1.97	1.29
AF6	Access	A superior location and customer convenience	2.85	1.83
AF7	Design	More contemporary, attractive products	2.93	1.88
AF8	Know-how	The technical and scientific expertise of the start-up team	2.86	1.88
AF9	Innovation	Developing new or advanced product technology or process technology for creating goods or services	3.36	1.95
AF10	IP	Development of intellectual property such as a patent, copyright, or trademark	3.90	1.93

Ind.	Price	Quality	Niche	Timing	Marketing	Access	Design	Know-how	Innovation	IP	Selectivity	Conviction
A	3	3	3	3	3	3	3	3	3	3	0	0
B	5	5	5	5	5	5	5	5	5	5	0	20
C	4	2	4	5	4	4	5	4	5	4	0.21	13
D	1	1	1	4	2	5	1	1	2	5	0.74	17



DIRECT AND INDIRECT EFFECTS OF PASSION ON GROWING TECHNOLOGY VENTURES

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Research summary: Entrepreneurial passion has gained credence in recent years in explaining entrepreneurial efforts, yet examination of the dynamics of this emotion and its effects on venture growth is still in its infancy. Building on the literature on entrepreneurial motivation and entrepreneurial passion, we develop and test a model of entrepreneurial passion, goals, and venture growth. We utilize path analysis on a two-wave sample of founders from 122 high technology firms. We find direct positive effects of passion for developing on venture growth and an indirect positive effect mediated by goal commitment, but not goal challenge. Implications for research and practice are discussed.

Managerial summary: In this study, we show that entrepreneurs' positive feelings of entrepreneurial passion are positively associated with venture growth. We focus on a specific type of entrepreneurial passion—passion for developing a venture. Based on the findings from our study, we suggest that it is important for entrepreneurs to channel their passion for developing toward identifying challenging business goals and increasing commitment to business goals. We show that entrepreneurs who increase commitment toward business goals based on passion for developing realize higher venture growth. However, developing challenging goals based on passion does not lead to higher venture growth. Copyright © 2016 Strategic Management Society.

INTRODUCTION

Several researchers have examined the relationship between a founder and a firm at multiple points in the venture's life cycle, from the founding process (Gartner, 1990; Venkataraman, 1997) until the separation of the entrepreneur from the venture (Shepherd, 2003; Shepherd and Haynie, 2009), to find that 'the overall enterprise is not viable without the entrepreneur' (Gartner, 1990: 18). This may be especially salient in the case of technology ventures (Beckman *et al.*, 2012) because a high tech entrepreneur is seen

as a cornerstone in the development of technology-related opportunities and, ultimately, in venture success (Arthurs and Busenitz, 2003).

One of the qualities associated with entrepreneurs, and one often referred to in work on individual motivation (e.g., Duckworth *et al.*, 2007), is the emotion of entrepreneurial passion. Entrepreneurial passion involves positive and intense feelings focused on particular roles that are central to the identity of an entrepreneur (Cardon *et al.*, 2009). Academics and practitioners concur that passion is a critical aspect of the entrepreneurial process (Cardon *et al.*, 2009; Smilor, 1997), with important implications for the motivation and energy (Bierly, Kessler, and Christensen, 2000; Brännback *et al.*, 2008), persistence (Cardon and Kirk, 2015; Smilor, 1997), and work effort (Chang, 2001) of entrepreneurs. Much of the published work on passion in entrepreneurship is

Keywords: entrepreneurial passion; goal commitment; goal challenge; venture growth

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theoretical or focused on outcomes involving individual behavior (Murnieks, Mosakowski, and Cardon, 2014), rather than venture outcomes. The notable exception is a study by Baum and Locke (2004), who found support for an indirect relationship between passion for work and firm performance.

In this research, we build on prior work on entrepreneurial passion (Cardon *et al.*, 2009), goal pursuit (Baum, 2013), and entrepreneurial motivation (Foo, 2011; Uy, Foo, and Ilies, 2014) to propose a theory of how entrepreneurial passion relates to venture growth through a motivated process of an individual's goal pursuit in high technology ventures. Drawing from Cardon *et al.*'s (2009) conceptual framework, we emphasize the role of passion for developing firms. The focus on entrepreneurial passion for developing stems from our interest in technology ventures that have multiple growth goals, including taking a technological idea from its inception to a commercial use and, later, market adoption. We theorize that an entrepreneur's passion for developing will evoke those goal-setting mechanisms that facilitate engagement of entrepreneurial skills and acquisition of resources that are needed for attaining entrepreneurial growth (Cardon *et al.*, 2009).

Our first contribution is to the current literature on growth of high technology ventures by acting on the call of Baum, Locke, and Smith (2001: 299) who suggested that 'perhaps researchers ought to look again at traits and motives, but through mediation models that test more complex casual chains.' By developing an integrative model of the motivation mechanisms that connect individual-level variables and venture growth, we respond to this call and extend their work. While Baum *et al.* (2001) previously found that passion for work has an impact on venture growth, and this impact is fully mediated by growth goals of the entrepreneur (Baum and Locke, 2004), we build on this finding by examining the relationship between passion and venture growth using passion for developing, which is specific to the entrepreneurship domain (Cardon *et al.*, 2009). We also contribute to the literature exploring how cognitive and affective processes of entrepreneurs together relate to firm-level outcomes. In particular, we extend current knowledge about the specific role of goal-related processes as they relate to venture growth. While Baum and Locke (2004) explored the effects of static quantitative goals that entrepreneurs set for a venture's sales performance and employment, the focus of our study is on the more qualitative aspect of goal-related motivation

that occurs through setting challenging goals and an entrepreneur's commitment to these goals. In addition, we expand the nature of goals that entrepreneurs may have beyond growth goals and focus on the level of goal challenge and goal commitment entrepreneurs experienced for goals they have for their ventures. For the majority of them, this involved multiple goals, rather than just a single focus on growth goals. This approach gave us a more personalized and precise set of goals that entrepreneurs focus on, and it allowed us to focus our tests on the potential association between passion for developing and venture growth.

Our second contribution is to the literature on emotions, where the majority of extant work examines how emotions of individual entrepreneurs impact their cognitions (i.e., self-efficacy) and behaviors (i.e., persistence), but does not link entrepreneurial emotions to firm outcomes. Although firm growth is central to entrepreneurship research, we still do not know enough about how entrepreneurs' cognitive processes shape growth through goal commitment and goal challenge (Davidsson, Delmar, and Wiklund, 2006; Wright and Stigliani, 2013). The broader (economic) relevance of firm growth as a strategic option was recently empirically supported in a study of technological regimes of industries (Delmar, Wennberg, and Hellerstedt, 2011). Our specific contribution to firm growth research is in establishing empirical support for the relationship between entrepreneurial passion and venture growth. This relationship manifests through the specific type of passion; entrepreneurial passion for developing, where the role identity of 'developer' is central to the intense feelings the entrepreneur experiences. The notion of identity has become a prominent construct in entrepreneurship research, including both a generalized identity as an entrepreneur (Murnieks, 2007; Murnieks *et al.*, 2014), identities focused on more specific roles within the domain of entrepreneurship (e.g., Cardon *et al.*, 2009; Fauchart and Gruber, 2011; Ho and Pollack, 2014), and the ease within which an individual can hold multiple identities (Powell and Baker, 2014). We contribute to this growing work on entrepreneurial identity by focusing on the implications of passion for the role identity of venture developer on growth of high tech ventures. Technology entrepreneurs are heroic individuals (Schumpeter, 1942) with a full-blown ability to discover, create, and exploit opportunities that lie beyond the reach of most people (Garud and Karnøe, 2003). In the context of technology entrepreneurship, several individual related

mechanisms by which entrepreneurs effectively shape their ventures have been explored, such as talent and experience (Eesley and Roberts, 2012), personal networks (Vissa and Bhagavatula, 2012), and entrepreneurial bricolage (Garud and Karnøe, 2003). The role of individuals' emotions and cognitions has not yet been examined in this context, despite the notion that technology entrepreneurs can become deeply emotionally embedded in their ventures (Kotler, 2014). While past research on high tech ventures has focused on the role of experience and talent of entrepreneurs (Eesley and Roberts, 2012), our study emphasizes the role of emotional and cognitive elements, which may also be important.

ENTREPRENEURIAL EMOTIONS AND PASSION

Entrepreneurship practitioners and academics agree that entrepreneurial emotion is instrumental in influencing entrepreneurial cognitions, behaviors, and outcomes (e.g., Baron, 2008; Cardon *et al.*, 2012; Foo, 2011). Entrepreneurial emotion refers to 'the affect, emotions, moods, and/or feelings—of individuals or a collective—that are antecedent to, concurrent with, and/or a consequence of the entrepreneurial process, meaning the recognition/creation, evaluation, reformulation, and/or the exploitation of a possible opportunity' (Cardon *et al.*, 2012: 1). Understanding entrepreneurs' emotions and incorporating information from those emotions into cognitive processes seems specifically important in demanding contexts, such as technology entrepreneurship.

Recently, there has been an increasing interest in a specific emotional experience, entrepreneurial passion, that has a significant impact on entrepreneurial behaviors (Murnieks *et al.*, 2014). Entrepreneurial passion is important because it increases entrepreneurs' beliefs that their work is meaningful, leads to greater levels of persistence in venture activities (Cardon and Kirk, 2015), improves creativity in problem solving (e.g., Bierly *et al.*, 2000), and increases ownership of experiences related to venture successes and failures (Bird, 1989). Entrepreneurial passion increases exhibition of transformational leadership and emotional display, which may influence employee passion and engagement (Cardon, 2008) and, in general, increases investor interest in the firm (Mittens, Sudek, and Cardon, 2012).

There are divergent conceptual perspectives on what entrepreneurial passion is and how it influences venture outcomes in the current literature. An early passion-as-trait approach (e.g., Baum and Locke, 2004; Baum *et al.*, 2001) sees passion as a relatively stable trait across the life cycles of entrepreneurs. A large body of work in psychology done by Vallerand and colleagues (Vallerand, 2008; Vallerand and Houliort, 2003; Vallerand *et al.*, 2010), views passion a bit differently, treating it as an emotional experience one has for a specific activity in his/her life, such as his/her profession (nursing) or a hobby (coin collecting). This stream of work focuses on the extent to which one's passion for this particular set of activities is in balance with the rest of one's life (harmonious passion) or whether this passion overpowers the other aspects of one's life (obsessive passion). In entrepreneurship, scholars have shown that harmonious passion for the career of entrepreneur can have a functional impact on the amount of time one spends working on the venture (Murnieks *et al.*, 2014), but that many entrepreneurs are, in fact, obsessive about their ventures (Fisher, Maritz, and Lobo, 2013). Scholars have also emphasized potentially negative effects of obsessively passionate entrepreneurs in attaining financial performance (Ho and Pollack, 2014).

Recently, a definition of entrepreneurial passion has emerged that argues that positive and intense feelings of passion are focused upon specific roles within entrepreneurship, rather than upon the overall role of entrepreneur (Murnieks, 2007) or the work as a whole (Baum *et al.*, 2001). In this perspective, entrepreneurial passion exists for one or more meaningful roles that are salient to the self-identity of the entrepreneur and correspond to intense positive feelings that are focused on the specific entrepreneurial roles. In this definition, entrepreneurial passion involves both: (1) intense positive feelings for something specific; and (2) strong identity centrality of the object of those feelings. This perspective suggests that entrepreneurial passion can remain stable or can fluctuate over the life cycle of the entrepreneur or venture depending on differing levels of passion entrepreneurs have for different role identities. Both dimensions of passion are important for understanding what passion is and how it is associated with entrepreneurial efforts (Cardon *et al.*, 2013). Since feelings of passion are focused on a specific object (passion for something), passion is distinct from one's core affect or generalized emotional state that has a certain level of valence (pleasant/unpleasant) and level of intensity (strong/weak) in

accord with the circumplex model of emotions (Watson and Tellegen, 1999). This suggests that entrepreneurial passion, as defined in our study, is not a trait because the amount of passion a person experiences is dependent on the specific object invoking that passion, rather than on a generalized attitude or disposition.

A key part of the recent conceptualization of passion is the identity centrality of the object of an entrepreneur's passion (Cardon *et al.*, 2009; Murnieks *et al.*, 2014). Identity theory (Stryker and Burke, 2000) views the self as a collection of identities that are based on a particular role. Identities answer the question of 'who am I?' (Stryker and Serpe, 1982) by making a connection to the role in which an individual engages. Role identities put individuals in social categories, such as 'I am a company founder' and influence behavior through the expectations that a specific role has for the self (Burke and Reitzes, 1981). Recently, in elaborating the link between entrepreneurial passion and identity, Murnieks *et al.* (2014) found that the centrality of the entrepreneurial role identity impacted the level of entrepreneurial passion experienced and the subsequent extent of entrepreneurial behavior.

Meaningful role identities that have been associated with entrepreneurial passion in the literature are: (1) an inventor identity that involves activities related to seeking out new ideas, tinkering with new product development, and scanning the environment for new opportunities; (2) a founder identity that involves activities of assembling the resources necessary to create a firm and the actual founding of the firm; and (3) a developer identity that concerns activities related to firm and market development (e.g., finding new customers) and firm growth (Cardon *et al.*, 2009). In this study, we focus on entrepreneurial passion for developing a business,

which stems from activities related to growing and expanding a firm after its founding that are associated with the role identity of developer. Many entrepreneurs are motivated to grow and expand their ventures (Cliff, 1998) by finding new markets and customers, developing new business models, planning financial growth, and harvesting, thereby suggesting that passion for developing is of central interest to researchers and practitioners.

Challenges related to achieving sustainable returns and financial profitability are even more present in high technology ventures because these ventures need to overcome distinct developmental conjunctures—research phase, opportunity-framing phase, pre-organization phase, and reorientation phase (Vohora, Wright, and Lockett, 2004)—to become a viable growing venture. Extant literature suggests that high technology firms suffer from financial and nonfinancial constraints that hinder their survival and growth (for a review, see Colombo, Croce, and Murtinu, 2014), hence, the developer identity in such firms is of central importance.

THEORY AND HYPOTHESES DEVELOPMENT

In Figure 1, we suggest that the experience of entrepreneurial passion for developing activates entrepreneurial action, primarily through goal-setting motivational mechanisms that are associated with venture growth. This model is developed based on goal-setting theory (Locke and Latham, 1990), theory of the nature and experience of entrepreneurial passion (Cardon *et al.*, 2009), and empirical evidence from psychology and entrepreneurship (Cardon and Kirk, 2015; Uy *et al.*, 2014). The processes in the model

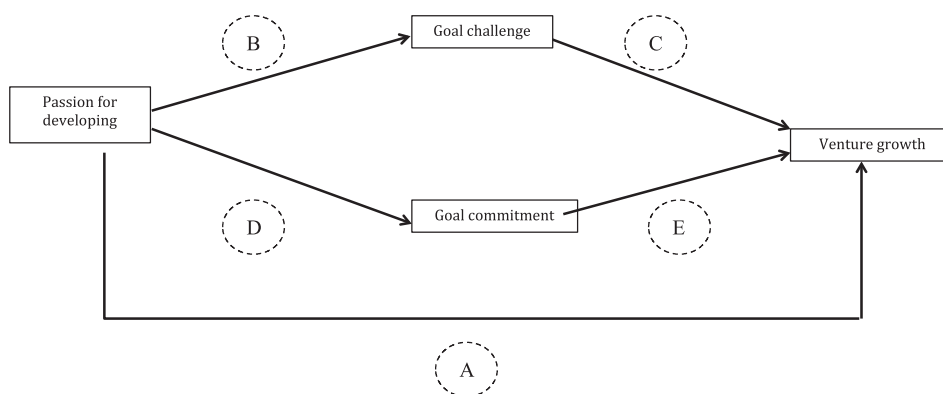


Figure 1. Conceptual model

are triggered when entrepreneurial passion is activated. When entrepreneurial passion is activated, it engages full-blown emotional, cognitive, and physical responses (Cardon *et al.*, 2009; Russell, 2003) that are coherent and coordinated. The experience of entrepreneurial passion for developing, thus, regulates efforts of high tech entrepreneurs in coping with environmental challenges when developing their ventures. We suggest that the experience of entrepreneurial passion is associated with venture growth, both directly (path A) and indirectly (path B/C and path D/E) through goal-setting mechanisms. Consistent with work by Uy *et al.* (2014), we include goal challenge and goal commitment in our model since the two variables are recognized as the key elements of motivation (Lewin, 1943). Later we develop theory concerning each of the proposed paths in the model.

Direct effects of passion on venture growth

We hypothesize that the experience of entrepreneurial passion is positively associated with venture growth (path A in Figure 1). There are two distinct arguments supporting the hypothesized relationship, based on the two dimensions of entrepreneurial passion (Cardon *et al.*, 2013; Cardon and Kirk, 2015; Cardon *et al.*, 2005, 2009). First, positive feelings associated with entrepreneurial passion for developing provide high tech entrepreneurs with information that communicates positive assessment of the current status and gives a green light to engage in further entrepreneurial activities (Schwarz and Clore, 1996). Because feelings can be retrieved as cohesive mental constructions long after the stimuli have ended (Schwarz and Clore, 1983), entrepreneurs may consciously experience (positive) feelings of entrepreneurial passion for developing because of past experiences or future desires for their ventures. Because of the positive information conveyed through positive feelings of entrepreneurial passion for developing, the scope of thought-action repertoires broadens and enhances the entrepreneur's personal resources, ranging from physical and intellectual to social and psychological resources (Fredrickson, 1998). These expanded and more heterogeneous resources of a high tech entrepreneur that occur from the positive feelings of passion are associated with venture growth (e.g., Wiklund and Shepherd, 2003).

Second, positive feelings of entrepreneurial passion for developing are related to enhanced venture growth because of the identity centrality of such feelings. Identity theory (Burke and Reitzes, 1981)

and prior work on role identities in entrepreneurship suggest that entrepreneurs think about their role identities (Cardon *et al.*, 2013; Fauchart and Gruber, 2011), act in ways to realize their identity as an entrepreneur (Shepherd, Wiklund, and Haynie, 2009), and seek to protect that identity as it reinforces their self-concept (Murnieks *et al.*, 2014). When entrepreneurs experience strong feelings such as entrepreneurial passion for activities associated with role identities that are important to them (such as those associated with developing the venture), they work hard to preserve and reinforce those identities and often engage in more creative problem solving and exhibit persistence toward their goals (Albert, Ashforth, and Dutton, 2000). Entrepreneurs clearly experience an entrepreneurial role identity (Murnieks, 2007) and they act in ways to reinforce and promote that identity (Fauchart and Gruber, 2011; Murnieks *et al.*, 2014). Despite this evidence (Fauchart and Gruber, 2011; Murnieks *et al.*, 2014), none of the theoretical or empirical work to date has directly examined the link between passion (a form of entrepreneurial identity) and venture growth.

More general research on emotions suggests that emotional reactions will be particularly motivating when the stimulus or event being experienced is a personally significant one (Izard, 2009), as it is when an entrepreneur experiences passion for a particular role identity. In addition, Albert and colleagues (2000: 14) argue that 'theories of identity and identification are infused with motivation and feeling, which helps explain the direction and persistence of individual and more collective behaviors.' If a high tech entrepreneur is particularly passionate about developing a venture, this suggests he/she will be especially driven to grow and develop his/her firm, rather than just accepting its current performance levels. Passion for developing would, therefore, lead to greater motivation to engage in behaviors associated with venture growth, such as increasing performance on different goals, such as venture size, sales, market share, or profitability. These arguments lead to the following hypothesis:

Hypothesis 1: Entrepreneurial passion for developing is positively related to venture growth.

The mediation effects of motivation mechanisms

Entrepreneurial passion may also be associated with venture growth because it enhances motivation through goal-setting processes of entrepreneurs. Goal-setting theory argues that an individual's conscious goals

impact his/her performance by directing personal attention to the task, by increasing effort and persistence, and by encouraging the development and use of action plans and strategies to attain one's goals (Locke and Latham, 1990). Following Austin and Vancouver (1996), we define goals as internal representations of desired outcomes, events, and processes that work together in provoking behavioral and affective responses. For example, entrepreneurs' wealth attainment-related goals have been shown to impact initiation of growth-oriented technology ventures (Amit, MacCrimmon, and Zietsma, 2001).

The central role of goals in entrepreneurship is well acknowledged (see Baum, 2013, for a review; Dunkelberg *et al.*, 2013). Goals are important to entrepreneurs (Kuratko, Hornsby, and Naffziger, 1997), as they direct attention, effort, and action in pursuit of desired outcomes (Locke and Latham, 2006). Entrepreneurs use goals 'to exploit their opportunities through activities such as human and financial resource gathering, business start-up planning and organizing, and market entry' (Baum, 2013: 2). The mediating role of goals has been supported in prior entrepreneurship research. For example, Baum and Locke (2004) found that growth goals significantly predicted future growth of a venture and fully mediated the effects of passion for work on venture growth. While this study explored effects of static quantitative goals that entrepreneurs set for a venture's sales performance and employment, the focus of our study is on a potentially broader set of goals and goal-related motivation from the challenge and commitment to such goals.

In line with goal-setting theory (Locke and Latham, 1990; Locke and Latham, 2006) and the theoretical framework concerning the nature and experience of entrepreneurial passion (Cardon *et al.*, 2009), we hypothesize that the relationship between entrepreneurial passion and venture growth is mediated by setting challenging goals (path B/C in Figure 1) and through goal commitment (path D/E in Figure 1). Next, we develop theory concerning the specific mechanisms for these relationships.

The mediation effect of goal challenge

Entrepreneurial passion impacts venture growth because it facilitates setting challenging goals (Plemmons, 2013). *Goal challenge* is defined as a level of difficulty in a set goal (Locke and Latham, 1990). The productive role of positive emotions in setting challenging goals is advanced by the broaden-and-build theory (Fredrickson, 1998). According to this theory,

positive emotions, such as entrepreneurial passion, broaden one's awareness and encourage exploratory thoughts and actions. Over time, these broadened cognitive and behavioral activities build one's skills and resources, which positively impact the level of challenge in set goals. Positive emotions also serve as a source of feedback on progress toward goal attainment (Emmons and Kaiser, 1996) because according to the 'feeling-as-information' theory (Schwarz and Clore, 1996), people make decisions and direct behavior based on the information conveyed through what they feel. Entrepreneurs who experience strong positive feelings of entrepreneurial passion for developing interpret those positive feelings as positive diagnostic information about the target of judgment, such as the challenging goal of increasing market share, believing their positive feelings indicate that they are making satisfactory progress toward their challenging goal.

In turn, offsetting challenging goals typically result in better performance (Seijts *et al.*, 2004). More specific and more difficult goals lead to higher performance than do vague or abstract goals. This is because challenging goals motivate one to attain more rather than to remain satisfied with achieving easier goals (Locke and Latham, 2002). Support for this relationship has been found in entrepreneurship. For example, Baum and Locke (2004) found that entrepreneurs with passion for work invested more resources, effort, and time toward attainment of their ventures' goals. Our theoretical reasoning also has support in the role identity literature, in which role centrality has been linked to individuals' voluntary activities. Burke and Reitzes (1981) suggest that the subjective importance of a specific role (e.g., role centrality) leads individuals to spend more time in that role. When entrepreneurs set goals for their ventures, these goals are voluntarily set and undertaken, so pursuit of such goals serves to reinforce their role identities (Hoang and Gimeno, 2010). Thus, prior literature suggests that since the positive feelings and role centrality components of passion for developing lead to the setting of more challenging goals and that setting challenging goals leads to higher venture growth, we propose:

Hypothesis 2: Setting challenging goals partially mediates the positive relationship between entrepreneurial passion for developing and venture growth.

The mediation effect of goal commitment

Furthermore, entrepreneurial passion can stimulate venture growth by promoting an entrepreneur's

commitment to set goals. *Goal commitment* means 'one's determination to reach a goal' (Locke and Latham, 1990: 125) or how willing they are to tenaciously pursue goals in the face of setbacks and obstacles (Hollenbeck and Klein, 1987). Because self-set goals reflect the entrepreneurs' values and/or long-range objectives they want to attain (Locke, 1996), it is expected that entrepreneurs will be strongly committed to these goals. Entrepreneurs' commitment to the set goals in the domain of developing a venture is further stimulated because of the intrinsic value of such goals. Goals associated with developing a high tech venture affirm the role identity of a developer (Cardon *et al.*, 2009). In addition, intrinsically motivated entrepreneurs, such as those experiencing passion, more effortfully engage in pursuit of goals (Baron and Ward, 2004) and are more committed to those goals. This is because intrinsic rewards have a higher value than extrinsic ones (Klinger, 1977) and increase commitment to such goals (Ryan and Deci, 2000). This suggests a positive relationship between passion for developing and goal commitment due to both the identity centrality and positive feelings dimensions of passion for developing.

Goal commitment, in turn, is associated with better venture growth. A meta analytic review of empirical studies that examined relationships between goal commitment and other variables (Klein *et al.*, 1999) demonstrated a positive direct relationship between goal commitment and performance. By being committed to a specific goal, an entrepreneur persists in the planned course of actions leading to that goal and/or adapts these actions when needed, ultimately leading to better performance outcomes (Klein, Cooper, and Monahan, 2013). Because evidence suggests that positive feelings and identity centrality associated with passion lead to higher goal commitment and that goal commitment leads to better venture growth, we propose:

Hypothesis 3: Goal commitment partially mediates the positive relationship between entrepreneurial passion for developing and venture growth.

METHOD

Sample description

We tested our hypotheses using a two-wave survey and archival venture performance data from U.S. high tech firms. The first wave of data collection was conducted between October 2009 and January 2010, to collect information on entrepreneurial passion,

and the second wave was conducted about 15 months later, in April 2011, to collect information on goal commitment and goal challenge.

We draw on high tech companies for two reasons. First, a majority of high growth ventures in the U.S. are founded in the high technology sector. Entrepreneurs in such firms are less likely to be lifestyle entrepreneurs and more likely to exhibit passion for developing. Furthermore, a successful launch of a high tech business requires passion for inventing and founding; thus, allowing us to control for these types of passion to more conservatively predict the relationship between passion for developing and venture growth. Second, several past studies have drawn on the Corptech directory (e.g., Lee, 2007; Lee and Lieberman, 2010; Sine, Mitsuhashi, and Kirsch, 2006), and the information could be triangulated with the Dun and Bradstreet directory. As there are no formal requirements for private firms in the U.S. to make their performance information public, relying on two different databases to derive performance information on sales and number of employees allows for more reliable estimates.

Wave 1 data collection

From the 2009 Corptech directory, we drew 719 high technology manufacturing ventures that were 10 years or younger, had founder CEOs, were located in Midwestern U.S. states (Illinois, Indiana, Kentucky, Ohio, and Missouri), and that had 10 to 250 employees. These ventures represented 30 different six-digit North American Industry Classification System (NAICS) industry codes.¹ The Corptech

¹ 334111 Electronic Computers; 334112 Computer Storage Devices; 334113 Computer Terminals; 334119 Other Computer Peripheral Equipment; 334210 Telephone Apparatus; 334220 Radio and TV Broadcasting and Wireless Communications Equipment; 334290 Other Communications Equipment; 335921 Fiber Optic Cables; 334310 Audio and Video Equipment; 334411 Electron Tubes; 334412 Bare Printed Circuit Boards; 334414 Electronic Capacitors; 334415 Electronic Resistors; 334416 Electronic Coils, Transformers, and other Inductors; 334417 Electronic Connectors; 334418 Printed Circuit Assembly; 334419 Other Electronic Components; 334413 Semiconductor and Related Devices; 333295 Semiconductor Machinery; 334511 Search, Detection, Navigation, Guidance, Aeronautical, and Nautical Systems and Instruments; 334512 Automatic Environmental Controls; 334513 Industrial Process Control Instruments; 334514 Totalizing Fluid Meter and Counting Devices; 334515 Electricity Measuring and Testing Equipment; 334516 Analytical Laboratory Instruments; 334519 Other Measuring and Controlling Instruments; 334510 Electromedical and Electrotherapeutic Apparatus; 334517 Irradiation Apparatus; 333314 Optical Instrument and Lens; 333315 Photographic and Photocopying Equipment

directory is a reliable source of venture listings and has been used widely in studies related to small ventures (e.g., Baron, Hannan, and Burton, 1999; Freear and Wetzel, 1990; Lee, Peng, and Barney, 2007). A packet containing our survey, along with a cover letter and prepaid business reply envelope, was sent to CEOs who were founders. After the first mailed survey, three follow-up reminders were sent from October 2009 to January 2010. We received responses from 164 CEOs, for a response rate of 22.8 percent, which is in line with average response rates cited for mailed surveys to top executives (e.g., Bartholomew and Smith, 2006; Hmieleski and Baron, 2009). In the final dataset for Wave 1, we excluded one firm with incomplete data. This yielded a final sample of 163 firms and their founders.

We tested nonresponse bias for early versus late respondents and respondents versus nonrespondents based on firm age, sales revenues, firm size (number of employees), industry, CEO age, CEO gender, and CEO industry experience. We found no significant differences, leading us to conclude that non-response bias was not a likely threat to validity. We also calculated sampling error based on the population of ventures in the high tech manufacturing sector listed in Corptech during 2009. Assuming a sampling proportion of 10 percent and a confidence interval of 95 percent, our sampling error was 5.13 percent, which is within the acceptable range (Sarndal, Swenson, and Wretman, 1992). Heckman's two-step residual estimation confirmed that our sample did not suffer from selection bias based on number of employees, age, or firm sales ($\rho = 0.19, p = 0.48$).

Wave 2 data collection

We measured goal mechanisms in Wave 2. In April 2011, we sent a survey along with a cover letter and prepaid business reply envelope to each CEO who had completed the survey in Wave 1. To enhance the response rate, we informed the CEOs we would donate \$10 for every completed survey to a charity of their choice. After the first mailed survey and one follow-up reminder, we received responses from 122 CEOs, a retention rate of 74.4 percent. We found no significant differences between participating versus nonparticipating firms based on firm age, sales revenue, firm size (number of employees), industry, CEO age, CEO gender, or CEO industry experience. We also found no self-selection bias for participating versus nonparticipating respondents between Wave

1 and Wave 2 on these variables ($\rho = 0.16, p = 0.54$) (Heckman, 1979). There was no significant difference in passion for developing between the 122 entrepreneurs who continued to participate in Wave 2 and the 41 entrepreneurs from Wave 1 who did not participate in Wave 2 (mean difference = 0.86, t -test = 1.212, $p > 0.10$).

Although our measures were collected at three different points in time, this is not a longitudinal study of passion or goal setting, as we are not conceptually interested in changes in passion, goals, or performance. Instead, we utilize a multi-wave approach to data collection to assess the stability of passion over time and to ensure that goal-related variables are reported after the passion is reported in Wave 1 and that the performance outcomes are after Wave 2.

Measures

Passion for developing [t]

To measure entrepreneurial passion for developing, we use one of the three entrepreneurial passion scales developed by Cardon *et al.* (2013). Each entrepreneurial passion scale was validated to measure passion in one of three domains: (1) opportunity recognition (inventing); (2) venture creation (founding); and (3) venture growth (developing). Each scale incorporates two dimensions: (1) positive intense feelings for activities associated with the role; and (2) the identity centrality of the role. The feelings dimension of each scale is a reflective measure consisting of multiple items, whereas the identity dimension is a one-item measure of the identity centrality of each entrepreneurial role. For example, passion for developing is measured by multiplying the identity centrality item: 'Nurturing and growing my company (or companies) is an important part of who I am,' by the average of the feeling for developing items. The measure of intensity of positive feelings for activities associated with the role of a developer is measured using five items (i.e., assembling the right people to work for my business is exciting; trying to convince others to invest in my business motivates me; I really like finding the right people to market my product/service to; I really enjoy commercializing new products/services; and pushing my employees and myself to make our company better motivates me). The feelings items are averaged and multiplied by the identity item, per the scale development and validation guidelines (Cardon

et al., 2013). The alpha for the feelings component of the measure is $\alpha_{\text{developing}} = 0.84$.

Goals [t+ 2]

Drawing from goal-setting theory (Locke and Latham, 1990; Locke and Latham, 2006), we aimed to make our goal measures specific to the respondents; therefore, we first asked respondents to list eight venture-related goals they had in the past three years. Based on the goals they listed for themselves, we measured goal challenge and their commitment to those goals. Furthermore, in order to increase respondents' cognitive involvement in the goal statement process we asked them to assess the relevance of each goal in five functional areas: (1) marketing; (2) manufacturing; (3) R&D; (4) finance; and (5) human resources. Next, we asked the respondents to assess the financial impact on company sales for not meeting each particular goal. Finally, we ask respondents to rank each goal in terms of its importance relative to the remaining seven goals. Sample goals listed by the respondents were 'increasing market share to 30 percentage,' where the assessed effect of not meeting this goal was '\$2 million decline in sales,' and this goal was ranked second in importance. Other examples of goals were 'developing retail distribution channels,' 'developing new products in collaboration with a local university,' and 'establishing organizational recruitment and control systems.' After assessing their specific goals and their intrinsic importance, we proceeded by measuring goal challenge and commitment associated with the goals.

Goal challenge [t+ 2]

Goal challenge is related to the degree of difficulty in realizing the stated goals. Goal challenge was measured using the inventory developed by Sheldon and Elliot (1999), where:

$$\text{Goal challenge} = \frac{\sum_{g=1}^G N_{\text{functional Areas}, g} \times \ln(\text{Sales impact})_g}{G}$$

Goal challenge for each goal consists of the impact of the goal on different functional areas and the resulting impact on a decline in sales if the goal was not met. Respondents reported up to eight goals, ranging from g to G . Each goal, g , affects one or more of the five functional areas. The value of $N_{\text{functional Areas}}$ ranged from 1 to 5

(1 = marketing; 2 = manufacturing; 3 = R&D; 4 = finance; and 5 = human resources). Degree of goal challenge was summed for up to eight total goals listed by the respondent. The final sum was standardized by dividing the sum with the total number of listed goals, G . The final goal challenge measure ranged from 9.05 to 56.24, with a mean of 21.72 (s.d. = 10.46).

Goal commitment [t+ 2]

Goal commitment is measured using a seven-item scale based on Klein *et al.* (1999). Respondents were asked to assess their level of commitment toward the goals listed, rated on a five-point (1 = completely disagree to 5 = completely agree) rating scale. Sample scale items were: 'It wouldn't take me much to abandon these goals' (reverse coded), 'I think these goals are good goals to shoot for,' 'It's hard to take this goal seriously,' 'It is unrealistic for me to expect to reach this goal,' 'It is quite likely that this goal may need to be revised, depending on how things go,' 'I am strongly committed to pursuing this goal,' and 'Quite frankly, I do not care if I achieve this goal or not.' The scale reliability was 0.82.

Venture growth [t+ 3]

We triangulate information on venture sales and employees in 2011 and 2012 from the CorpTech and Dun and Bradstreet directories. Past studies in entrepreneurship have used sales and employee growth as a measure of firm performance (Chandler, McKelvie, and Davidsson, 2009). Our measure of growth is based on Hmieleski, Corbett, and Baron (2013). Goal challenge and goal commitment measured at $t+2$ use the reference point of goals in the past three years, and goal challenge and goal commitment are expected to have a short-term impact on growth. Excluding the past three years during which goal challenge and goal commitment were reported, we measure change in performance for two years after measurement of goal challenge and goal commitment. We calculated percentage change in sales (employee) from 2011 to 2012, and from this percentage change, we subtract industry median percentage change in sales (employee) from 2011 to 2012. We then take a mean of industry-adjusted

changes in sales and employee as the measure of venture growth.

Control variables

As liabilities of newness (related to firm age) and liabilities of smallness (related to firm size) could affect venture sales, we include *firm age* as the number of years since establishment to 2010. *Firm size* is measured by the average of the number of employees during 2008, 2009, and 2010. Environmental conditions in an industry can also significantly affect firm growth. *Environmental dynamism*, following Dess and Beard (1984), was calculated as the antilog of standard error of the regression slope for the natural log of net sales on time (2007 to 2011). Higher values of standard errors indicate greater instability in sales over time. We also control for *past venture growth*, using the same operationalization as for the outcome variable, but for years 2008, 2009, and 2010. Finally, we control for passion in two other domains, *passion for inventing* and *passion for founding* (details of scale items in Appendix), since they can be correlated with *passion for developing* (Cardon et al., 2013) and we did not want this to conflate our results.

Construct validity

Exploratory factor analysis reported in the Appendix shows that the scale items for the passion and goal challenge measures load strongly onto their respective scales. All scale item loaded

significantly at $p < 0.01$ (Anderson and Gerbing, 1988). The highest modification index was below the recommended cutoff of 5.0 (Hair et al., 2006). Furthermore, all the composite reliability values were above the recommended value of 0.70. In our tests for discriminant validity, no confidence intervals of the correlations for constructs included 0 (Anderson and Gerbing, 1988), and the difference in chi-square between constrained and unconstrained constructs was $p < 0.001$ (Fornell and Larcker, 1981). Overall, the measures are internally consistent and distinct from one another.

Table 1 shows the correlations among the variables. We observe low to moderate levels of correlations. A variance inflation factor (VIF) > 10.0 indicates a multicollinearity problem (Hair et al., 2006). The highest VIF in our study was 6.030, which further suggested that the effects of multicollinearity were not significant.

Method of analysis

We use path analysis in Mplus 5.1 (Muthén and Muthén, 2008) to test the proposed mediation model. To maintain model stability due to a small sample of 122 firms, we use the residual covariance matrix approach that allows for preserving degrees of freedom in small samples (Bollen et al., 2010; Haagen and Vittadini, 1991). The control variables are used to predict covariances among *all* remaining variables in the model, and the resulting residual covariance matrix is used as input in the final model. We test the proposed path analysis model

Table 1. Means, standard deviations, and correlations

	Mean	SD	1	2	3	4	5	6	7	8	9
1. Venture growth (2011-2012)	0.09	0.77	1								
2. Firm age	8.93	1.38	0.12	1							
3. Firm size	27.86	17.62	0.27	0.33	1						
4. Environmental dynamism	0.84	0.12	-0.19	0.05	0.04	1					
5. Past venture growth	0.11	0.91	0.72	0.11	0.36	-0.41	1				
6. Passion for inventing	7.73	5.26	0.03	0.01	0.04	0.04	0.02	1			
7. Passion for founding	6.99	4.83	0.09	0.02	0.08	0.07	0.11	0.29	1		
8. Passion for developing	7.19	3.40	0.19	0.05	0.02	0.02	0.24	0.18	0.35	1	
9. Goal commitment	2.26	0.84	0.22	0.06	0.04	0.03	0.20	0.34	0.28	0.37	1
10. Goal challenge	21.72	10.46	0.21	0.03	0.17	0.24	0.16	0.03	0.13	0.16	0.29

All correlations at or above 0.09 are significant at $p < 0.05$ or below (two-tailed test). N = 122; repeat measurements 15 months apart.

TMT size is the number of people in the top management team of the venture.

using robust weighted least squares (RWLS) with 1,000 bootstrap samples. RWLS is robust to non-normality and increases validity of findings in smaller-sized samples (Marsoulides and Saunders, 2006). Results for alternate model tests are reported in Table 2, and path analysis results are reported in Figure 2.

The fit of the proposed model is acceptable ($\chi^2/\text{df}=4.821$; CFI=0.934; TLI=0.913; RMSEA=0.084 (95 percentage C.I. = 0.072, 0.095)). According to Hu and Bentler (1999), the threshold values for model fit are >0.95 for CFI or TLI and <0.06 ($N \geq 250$) and <0.08 ($N < 250$) for RMSEA. As our sample has fewer than 250 firms, a RMSEA of 0.084 is close to acceptable. Furthermore, recent work by Heene *et al.* (2011) cautioned against using strong cutoffs for fit indices.

In addition, compared to alternative models, the proposed model represents a better fit to the data. The null model, with no relationships among the variables, was significantly different from the proposed model ($p < 0.001$). Next, we compared the proposed model with a direct effects model where all constructs were linked directly to sales ($\Delta\chi^2/\Delta\text{df}=8.304$ (2), $p < 0.001$; CFI=0.861; TLI=0.842; RMSEA=0.142 (95 percentage C.I. = 0.081, 0.202)) and with a full mediation model ($\Delta\chi^2/\Delta\text{df}=5.627$ (1), $p < 0.05$; CFI=0.890; TLI=0.874; RMSEA=0.107 (95 percentage C.I. = 0.071, 0.145)). Both the direct effects model and full mediation model had worse model fit than the proposed model.

RESULTS

Hypothesis 1 predicts a positive relationship between passion for developing and venture growth ($\beta=0.220$, $p < 0.05$) and is supported. Hypothesis 2 proposed a mediation of goal challenge on the relationship between passion for developing and venture growth ($\beta=0.080$, $p=0.126$; Sobel test=1.529, Aroian test=1.454, Goodman test=1.616) and is not supported. Finally, the mediation effect of goal commitment between passion for developing and venture growth proposed in Hypothesis 3 is supported ($\beta=0.175$, $p < 0.05$; Sobel test=2.154, Aroian test=2.106, Goodman test=2.209). The indirect path between passion and venture growth through goal commitment is significant, and the direct path between passion for developing and firm growth is also significant, indicating partial—rather than full—mediation for Hypothesis 3.

DISCUSSION

Although the body of literature on the role of passion in the entrepreneurship process has grown substantially over the past few years and entrepreneurial passion has been validated as a distinct individual-level construct (Cardon *et al.*, 2013), there remain several unanswered theoretical and empirical questions concerning the role of passion in the entrepreneurial process. In this study, we theorized and empirically

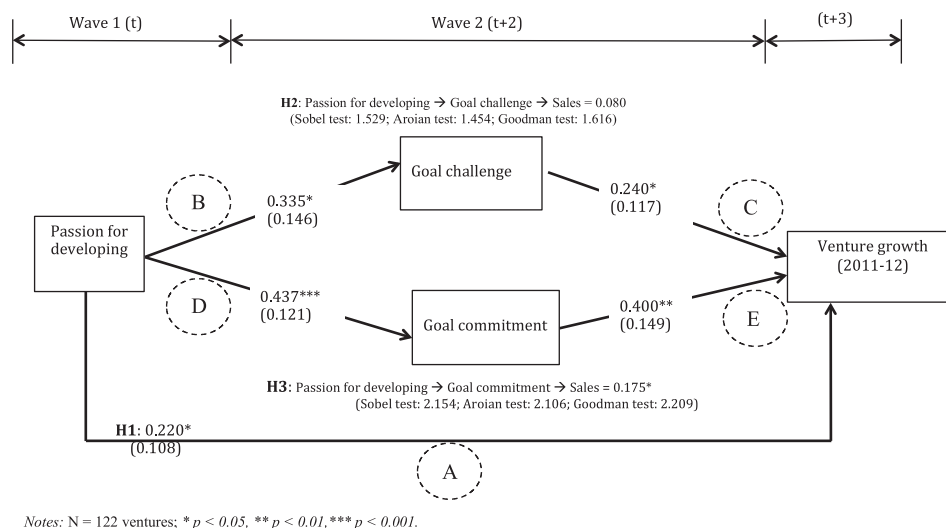


Figure 2. Path analysis

examined the association between experience of entrepreneurial passion for developing and goal setting that, in turn, is related to growth of high tech ventures. In particular, drawing from one of the influential theories of work-related motivation, goal-setting theory (Locke and Latham, 1990), we examine how entrepreneurs' goal challenge and goal commitment are related to venture growth. We suggest that venture growth is associated with passion for developing firms, both directly and indirectly. The indirect relationship of entrepreneurial passion for developing with venture growth occurs through goals as goals direct attention, effort, and action, and this ultimately positively relates to venture growth. While several studies in entrepreneurship have so far emphasized the role of goals in improving venture performance (Locke and Latham, 2006; Rauch and Frese, 2000), our study is one of a few that empirically analyzes the mediating role of entrepreneurs' goals in achieving venture-related outcomes. In addition, while Baum and Locke (2004) previously found that passion for work has an impact on venture growth and that this impact is fully mediated by growth goals of the entrepreneur, we expand this line of work by focusing on passion specific to the entrepreneurship domain—passion for developing firms; but, we find support for partial mediation effects. We also incorporate current conceptualizations of passion as having two primary dimensions: intense positive feelings for a specific role and the identity meaningfulness of that role (Cardon *et al.*, 2013; Cardon *et al.*, 2009; Vallerand and Houlfort, 2003). In addition, we expand the nature of goals that entrepreneurs may have beyond just growth goals and allow entrepreneurs to indicate the level of goal challenge and goal commitment they have for different types of goals they have for their firms. This is important because we recognize that even when entrepreneurs are passionate for developing their firms, they may have other goals in addition to their growth goals.

Our findings suggest that entrepreneurial passion for developing firms is positively associated with venture growth and that this relationship is partially mediated by goal commitment. Interestingly, we did not find support for mediation of goal challenge on the relationship between entrepreneurial passion and venture growth. In line with the theoretical reasoning advanced by the 'broaden and build' theory (Fredrickson, 1998), the direct relationship between entrepreneurial passion and goal challenge was

supported. Similarly, the direct positive relationship between goal challenge and venture growth suggested by identity literature (Burke and Reitzes, 1981) was also supported, likely because the voluntary setting of challenging goals works as reinforcement toward the role identity of entrepreneurs (Hoang and Gimeno, 2010). It appears that passion for developing firms, which is defined as experiencing positive and intense feelings for growth-oriented activities along with identity centrality of being a developer, is particularly motivating for entrepreneurs to do whatever it takes to ensure that the venture is indeed growing. While this clearly involves goal commitment, as evidenced by the significant mediation effect, and in part by goal challenge, other activities outside the scope of our study may also help explain this relationship. For example, Cardon and Kirk (2015) found a significant relationship between passion for developing and persistence, which we did not model in the present study.

Theoretical implications

Our first contribution is to the growing body of empirical work exploring cognitive and affective processes of entrepreneurs. Our finding that passion for developing is, in fact, positively related to venture growth provides evidence of a relationship believed to be true but not yet confirmed in an empirical setting. Further, prior work has suggested that entrepreneurial passion is associated with goal challenge and goal commitment (Cardon *et al.*, 2009), but did not theorize how those associations might be related to venture growth. In addition, Baum *et al.*'s work (2001) on the relationships among passion for work, goals, and growth utilized a generalized perspective of passion for work, rather than passion specific to entrepreneurship (e.g., Murnieks *et al.*, 2014) or for specific roles (Cardon *et al.*, 2009). Looking at specific types of entrepreneurial passion is important because different roles and activities entrepreneurs engage in may elicit different types of passion that are uniquely associated with outcomes of interest. For example, while a venture's expansion is most often pursued by entrepreneurs who are also founders, there are many great examples of non-founding entrepreneurs who experienced passion for developing a venture by stepping into an existing start-up and growing it into a more lasting, valuable, or sustainable venture (e.g., Ray Kroc of McDonald's). While these pathways were alluded to

in prior work in entrepreneurship (Cardon *et al.*, 2009) and more generally in the goals literature (e.g., Locke and Latham, 2006), empirical confirmation in this context has been scant.

Our second contribution concerns the relationship between entrepreneurial emotions and venture outcomes. The model we empirically test builds on prior findings of Baum and Locke (2004) that the relationship between ‘passion for work or love of one’s work’ (Baum and Locke, 2004: 588) and venture growth was mediated by venture growth goals. Finding support for mediating effects of entrepreneurs’ goals on venture growth is important because this provides more empirical evidence that understanding an entrepreneur’s personality, emotional experiences, and cognitions is key to understanding entrepreneurial ventures. Our results indirectly suggest that one potential key for understanding the link between individual and venture is identity. Specifically, the identity centrality of a particular role, such as developer, within the overall entrepreneurial identity (Murnieks *et al.*, 2014) is a key aspect of the experience of passion for that identity (Cardon *et al.*, 2013), and further understanding of how the overall entrepreneurial identity works is needed (Fauchart and Gruber, 2011; Hoang and Gimeno, 2010). Recent work also suggests that entrepreneurs may hold multiple identities, and understanding how they keep such identities in balance, especially if they are incongruent with one another, is critical (Powell and Baker, 2014). We contribute to the growing body of work on identity in entrepreneurship by looking at the relationships among passion for a specific identity (firm developer), goal setting, and venture growth. While not the focus of our theorizing, our empirical results also indicate that passion for developing has a different relationship with venture growth than does passion for founding or inventing, further supporting the idea that better understanding of specific role identities and emotions experienced for them is a fruitful avenue of inquiry in the entrepreneurial domain.

Finally, our study adds to the literature on the connection between founder and venture in the context of high technology ventures. The notion of a tight link between entrepreneur- and venture-related outcomes is well ingrained in the entrepreneurship literature (e.g., Gartner, 1990). For example, Chandler and Hanks (1993) argue that the performance of a business founder is measured by the performance of the organization, which is influenced by the

environment within which the organization emerges and operates. Similarly, in a longitudinal study of Finnish entrepreneurs, Arenius and Laitinen (2008) demonstrated that the connection of entrepreneurs to their ventures is inherently different than the connection of employees to traditional organizations. This is because entrepreneurs often experience deep identity connections with their ventures, they feel profound psychological ownership (Murnieks, 2007), and they become intertwined with the firm such that the performance of one is intertwined with the performance of the other (Pierce, Kostova, and Kirks, 2001). Based on our findings, we can suggest that passion for a particular role identity may be one link between the founder and the venture. Previous research on technology ventures has examined talent and experience (Eesley and Roberts, 2012) and personal networks (Vissa and Bhagavatula, 2012) of founders, but has not examined the potential affective or cognitive aspects of the relationship between individual and firm. Our study addresses this gap. Our results suggest that there is an important relationship between individual passion of the entrepreneur and growth of the venture in high technology contexts.

Practical implications

Our results suggest several practical implications for high tech entrepreneurs who aspire to grow their ventures. First, if entrepreneurial passion facilitates venture growth directly and indirectly, then how can we encourage entrepreneurs to find and fully embrace their passion? Cardon *et al.* (2009) suggest that one cannot teach entrepreneurs to be more passionate, but instead the goal should be to teach them how to become aware of what gives them positive feelings so that those feelings can be harnessed toward productive ends. Other scholars have suggested that passion may be teachable, or at least increased, through exposure to entrepreneurship education or other experiences (Gielnik *et al.*, 2015). According to research on experiences of emotions (Frijda, 1993), people experience emotions when they conceptualize an instance of affective feeling and categorize it. In addition, the emotion regulation framework suggests that individuals can control the experience of emotions (anticipatory-focused regulation) as well as the expression of emotion (response-focused regulation) to others (Barrett, 2004). Our study suggests that if entrepreneurs can

be trained to be attentive to the positive feelings of passion they experience, this can then be positively related to venture growth. Further, if entrepreneurs are taught to develop venture goals that are consistent with their passion, they should be even more productive in achieving those goals. In working with practicing entrepreneurs who are already inclined toward more positive emotional experiences, our focus should be perhaps on helping such individuals figure out what would make them most passionate. One could help entrepreneurs examine their self-identity, particularly what aspects of their identity are most salient and central, and then explore potential business ideas that capitalize on those identity components. This is akin to the work of Haynie and Shepherd (2011), where wounded veterans were trained to explore hidden aspects of their identities and then taught how to identify potential business opportunities in line with those identities. This could also be done for existing entrepreneurs, helping them remember why they started their firms originally and the connection the firm has to their self-identity and, therefore, rekindling their passion for developing the firm further.

Second, numerous studies on goal setting and individual performance (e.g., Hollenbeck and Brief, 1987; Locke and Latham, 2002) have underscored the importance of setting challenging goals because of positive performance appraisals that follow. Based on the findings from our study, we suggest that it is important for entrepreneurs to cognize their personal goals and appraise their goal-related performance. Setting challenging goals will drive overall competitive strategies and enhance a venture's long-term growth and sustainability (Locke and Latham, 2002). In addition, in pursuing competitive strategies and adapting them to environmental changes, personal goal setting becomes an important self-regulation mechanism. Consistent with social cognitive theory, individuals who engage in self-regulation more effectively cope with personal and environmental obstacles in pursuit of goals (Locke and Latham, 2002). This is specifically important in bouncing back from failure experiences, which are unfortunately even more common in technology-based ventures than in non-tech firms (Storey and Tether, 1998). Engaging entrepreneurs in explicit goal-setting activities might help enhance venture growth, because the articulation of goals increases goal commitment, especially when such goals are shared publicly rather than kept to oneself. The public sharing of goals among

a group of entrepreneurs might also encourage setting more challenging goals. An important activity for entrepreneurs is formation of implementation intentions (Gollwitzer, 1999), including both setting a goal (e.g., 'I intend to increase my company's market share by 30 percent') and forming implementation intentions (e.g., 'If we encounter fierce response from competition in our domestic market, we will partner with our major competitor abroad') to realize that goal.

Limitations and future research

As with all research, there are some limitations of our study. First, we collected data from a fairly limited population of high technology manufacturing ventures located in five states in the Midwestern U. S. Our sample has survivor bias, as we include surviving and stable ventures, and it also has potential unobserved heterogeneity, where among surviving ventures, due to variations in age and number of samples, efficacy of passion for developing could vary. For example, entrepreneurs with passion for developing in older and/or larger ventures may have honed their passion for developing, whereas others in younger and/or smaller ventures may be in the process of honing their passion for developing. While honing passion for developing is a self-regulatory process, in older and/or larger ventures motivation related to passion for developing may also reduce over time, as a stable and established venture may impede passion to further develop the venture. We call on future studies to explore these intertemporal dynamics of entrepreneurial passion over the course of venture development. Second, we examined the effects of CEO characteristics on goals and venture growth. Future research could use multilevel data (including top management team-level data) focusing on the impact of passion for developing on employees and/or the strategic direction of the firm. Other individual-level characteristics could also be examined. Third, we measure firm growth using percentage change in sales and employees over two years. The impact of goal challenge and goal commitment on performance is likely to be in the short term, and immediate impact on growth is a more reliable measure, as such growth is less confounded by entrepreneurs' changing aspirations and goals. Long-term growth outcomes, ranging from 'steady sales growers' to 'super relative growers' (Delmar, Davidsson, and Gartner, 2003), are less directly applicable in the current context. Nevertheless, future

studies could focus on the relationships between different types of entrepreneurial passion and different types of growth outcomes for ventures. Finally, based on the current research design, causality cannot be inferred. Due to the episodic nature of entrepreneurial efforts, the underlying nature of causality between entrepreneurial passion and venture outcomes is contingent on the strength of this relationship in different contexts. As passion drives effort, motivation, and regulation before, during, and after venture formation in a potentially cyclical manner, additional studies are necessary to assess the underlying nature of the relationship between entrepreneurial passion and venture outcomes.

These limitations also open avenues for future research. First, the proposed model and hypotheses need to be empirically tested on other samples of entrepreneurs, across different industries and contexts, preferably through longitudinal designs. Second, growing knowledge on entrepreneurial emotion and entrepreneurial passion suggests that it would be useful to consider the impact of multiple emotional experiences on venture growth. Despite the practical experiences of entrepreneurs and the broader management and psychology literatures on the experience of mixed emotions (Ersner-Hersfield *et al.*, 2008), the simultaneous effect of different types of emotion has seldom been empirically examined in the entrepreneurship literature (Foo, Uy, and Baron, 2009). A clearer understanding of contingently managing different emotional experiences would help us understand how entrepreneurs can selectively leverage different types of entrepreneurial emotion. Such empirical testing of the simultaneous occurrence of different types of emotions might require careful and thorough qualitative research, where entrepreneurs can be regularly shadowed and observed with a focus on the extent to which they simultaneously experience different types of affect, and how they manage those situations. Third, anecdotal evidence suggests that 4entrepreneurial teams often disband at some point during the early venture growth stage, often due to disagreements over venture goals (reinvest profits to grow more or stabilize and pull funds out, for example). Exploration of how each team member's passion (level and/or focus) (Drnovsek, Cardon, and Murnieks, 2009) or the collective team's passion diversity (Cardon, Post, and Forster,) impacts individual and firm goals, goal conflict, and firm outcomes would be particularly interesting and relevant. We also encourage additional research on the relationships between passion for

inventing and passion for founding on venture outcomes. While research on each domain of entrepreneurial passion (inventing, founding, developing) is promising, examining the shared influence of these domains on the venture throughout its life cycle could also help uncover additional avenues and obstacles on the path toward venture success.

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APPENDIX

Scaled description ^a	Items	Exploratory factor analysis (Varimax rotation)				Item loading
		Factor 1	Factor 2	Factor 3	Factor 4	
CFA for feelings subscales (controlled for covariance among three subscales): $\chi^2/df = 3.197$; CFI = 0.936; TLI = 0.915; RMSEA = 0.083						
Passion for inventing						
Feelings	Finding new ways to solve unmet market needs that can be commercialized is exciting.	0.654	0.017	0.089	0.104	1
	Searching for new ideas for products/services is enjoyable.	0.404	0.245	0.135	0.179	0.733
	I feel energized when I am developing product prototypes.	0.526	-0.105	0.134	0.129	0.855
	I am motivated to figure out how to make existing products/services better.	0.502	0.028	0.107	0.238	0.820
	Scanning the environment for new opportunities really excites me.	0.317	0.192	-0.030	0.084	0.637
	Inventing new solutions to problems is an important part of who I am.	0.429	0.209	0.148	0.150	0.745
	Discovering new business ideas or opportunities is an important part of who I am.	0.574	0.090	-0.102	-0.230	
Identity importance						
Passion for founding						
Feelings	Establishing a new company excites me.	0.326	0.460	0.096	0.097	1
	Owning my own company energizes me.	0.147	0.572	-0.006	-0.006	0.816
	I did not enjoy creating my own firm.	0.234	0.633	0.028	0.122	0.847
	Creating something out of nothing is exciting.	-0.048	0.434	0.121	0.221	0.682
	Nurturing a new business through its emerging success is enjoyable.	0.145	0.505	0.250	0.145	0.793
	Being the founder of my business is an important part of who I am.	0.040	0.420	0.087	-0.244	
Identity importance						
Passion for developing						
Feelings	Trying to convince others to invest in my business motivates me.	0.048	0.346	0.435	0.092	1
	I really like finding the right people to market my product/service to.	0.004	0.099	0.404	0.408	0.667
	Assembling the right people to work for my business is exciting.	0.016	0.217	0.511	0.135	0.815
	I really enjoy commercializing new products/services.	0.108	0.140	0.337	0.025	0.606
	Pushing my employees and myself to make our company better motivates me.	0.091	-0.003	0.548	0.362	0.860
	Nurturing and growing my company (or companies) is an important part of who I am.	0.110	0.131	0.405	-0.018	
Identity importance						
Goal commitment						
	It's hard to take this goal seriously.	0.119	0.148	0.310	0.410	1
	It is unrealistic for me to expect to reach this goal.	0.274	0.103	-0.008	0.647	0.863
	It is quite likely that this goal may need to be revised, depending on how things go.	0.021	0.132	0.330	0.319	0.616
	I am strongly committed to pursuing this goal.	0.025	0.283	0.010	0.532	0.830
	It wouldn't take me much to abandon this goal.	0.083	0.216	0.099	0.596	0.844
	I think this goal is a good goal to shoot for.	0.006	0.063	0.305	0.433	0.772
	Quite frankly, I do not care if I achieve this goal or not.	0.054	0.317	0.089	0.404	0.681

^aFive-point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree. N = 122 responses ***p < 0.001.



Research Pioneers

THE FOUNDATIONAL CONTRIBUTION TO ENTREPRENEURSHIP RESEARCH OF WILLIAM J. BAUMOL

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William J. Baumol has made an impressive number of important contributions to our understanding of entrepreneurship. This article presents an interview in which Baumol discusses the role and importance of innovation in the economy, as well as his views on methodological and pedagogical issues. In addition to summarizing briefly Baumol's classic argument on productive, unproductive, and destructive entrepreneurship, the article highlights some areas of his work that are less known among entrepreneurship scholars. In particular, the article discusses Baumol's work on economic growth and his theory of contestable markets. Both topics offer fruitful research venues for those interested in the relationship between strategic entrepreneurship, market entry, and innovation. Copyright © 2016 Strategic Management Society.

INTRODUCTION

In 2003, the Swedish Foundation for Small Business Research and the Swedish Board of Industrial and Technical Development awarded the International Award for Entrepreneurship and Small Business Research to William J. Baumol.¹ In 2014, the Entrepreneurship Division of the Academy of Management awarded him the Foundational Paper

Award.² While these prestigious recognitions (to cite two among the many he has received) acknowledge and celebrate Baumol's contribution to our understanding of entrepreneurship, they do not sufficiently convey the magnitude and importance of such contribution. With more than 50 authored books and more than 500 articles in leading journals, Baumol is undoubtedly one of the foundational figures of the field.

William J. Baumol was born on February 26, 1922, in the Bronx, New York. He attended public schools in New York City and received his undergraduate degree from the College of the City of New York. After a few years working at the U.S. Department of Agriculture and after getting out of the army in 1946, Baumol attended the London School of Economics, where he received a PhD in economics in 1949 working with Lionel Robbins. Upon graduation, he joined the department of economics at Princeton University, where he worked closely with economists such as Jacob Viner and Lester Chandler and mathematicians such as Harold Kuhn and Albert Tucker. In 1971, Baumol accepted a joint appointment with New York University and

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¹ The Prize citation reads: 'His insistence that the entrepreneurs should have a key role in the theory of the firm;' 'his studies of the role of institutions for the channeling of entrepreneurship into productive use;' and 'his early formulation of a competition policy emphasizing the disciplinary effect of dynamic entrepreneurship.'

² The Award was given for the paper *Entrepreneurship: productive, unproductive, and destructive* originally published in the *Journal of Political Economy* in 1990 and reprinted in 1996 in *Journal of Business Venturing*.

begun splitting his time between the two schools. After a long and remarkably productive academic career, William J. Baumol retired from Princeton in 1991 after 42 years of service and from New York University in 2014 after 43 years of service. He is now Professor Emeritus at NYU and continues living and working in his native New York City.³

Today, in the field of entrepreneurship, we associate Baumol's work primarily with his classic article on productive, unproductive, and destructive entrepreneurship (Baumol, 1990). The paper is highly cited and has inspired a significant amount of research in entrepreneurship. Yet, there is much more to Baumol's work which, spanning over seven decades, extends across disciplinary boundaries and levels of analysis. Thus, my goal is to highlight some of his contributions beyond what is already widely known among entrepreneurship researchers. In addition, I hope to show how, throughout his work, Baumol put innovation and the entrepreneur who brings it to the market, at the center of the whole economic system and at the origin of economic growth. During his long and prolific career, Baumol never lost sight of what matters: his preoccupation remained the elimination of poverty and the belief that innovative entrepreneurs are the only people who can reduce it. But innovation and innovative entrepreneurs are elusive. In Baumol's vision, our fundamental quest is, in his own words, 'to invent the analysis of invention.'

The rest of the article is organized around a conversation I had with Professor Baumol in his Manhattan apartment, other personal exchanges we have had over the years, and my own reading and interpretation of his work. Our recent conversation spanned entrepreneurship, innovation, poverty, history, and pedagogical issues, and it illustrates his views on these topics as well as describes his more recent research interests. Professor Baumol's answers are all presented verbatim with only minimal editorial changes, which are included in square brackets.⁴ While it is impossible to do justice to the scope and applications of his work in

a single article, my goal is to highlight some of William Baumol's contributions in areas that are of interest to the readership of this journal, such as entrepreneurship and innovation and his methodological insights, as well as suggest ways we can build upon them to push the boundaries of the field forward.

REPLICATIVE AND INNOVATIVE ENTREPRENEURS

For more than four centuries, economists have developed the theory of entrepreneurship. Cantillon (1755) identified the willingness to bear the personal financial risk of a business as the defining characteristic of an entrepreneur. Say (1803) stressed the role of the entrepreneur in creating value by moving resources from less productive to more productive activities. Mill (1848) described the entrepreneur as someone who assumes both the risk and management of a business, thereby making explicit the distinction between the entrepreneur and other business owners. Finally, Schumpeter (1947) stressed the role of the entrepreneur as an innovator and a disruptive economic force, since the introduction of innovations leads to the obsolescence of existing products and markets.

From the 1960s, however, most economists began focusing on formal models in which entrepreneurship is implicitly subsumed under technological innovation. There were, of course, exceptions. Among them, Kirzner and Baumol emerged as the most notable. They are recognized as the main architects of the resurgence of interest in entrepreneurship recently observed in economics. Their work has inspired much of the significant amount of research developed in recent years on the economics of entrepreneurship (see Parker, 2009, for a comprehensive bibliography and extensive review of this literature). Within the context of the Austrian school, Kirzner (1973, 1979) emphasized the encompassing nature of entrepreneurial alertness as the mechanism that creates new ends-means relationships. Baumol, too, put the entrepreneur at the center of the market. However, he also reconciled the classical tradition with the neoclassical methodological developments of the 1980s by introducing the distinction between replicative and innovative entrepreneurs.⁵

⁵ Throughout his writing, Baumol uses different (although largely overlapping) terminology to distinguish between replicative and innovative entrepreneurs. For example, in his 1993a paper, he uses the terms 'firm-organizing entrepreneur' and 'Schumpeterian-innovating' entrepreneur. In other cases, he uses 'imitative' and 'innovating.' For consistency, in this article, I use the terminology he chose to use during our conversation.

³ For more bibliographic details on Baumol's interesting life, see Krueger's (2001) very enjoyable article and Griffiths *et al.* (2012). Readers interested in learning more about Baumol's work will find a concise (albeit not up to date) overview in Bailey and Willig (1992). A summary of his contributions to the economics of entrepreneurship can be found in Eliasson and Henrekson (2004).

⁴ Because of space constraints, I do not report the entire conversation. Also, to enhance the coherence of the overall argument, the sequence of questions has been slightly modified from the original. A copy of the original recording has been made available to the editors. Kalindi Dinoffer transcribed the interview.

Innovative entrepreneurship refers to the introduction of products and production techniques that were not available before. Replicative entrepreneurship, instead, refers to the diffusion of these innovations after their utility has been demonstrated by the innovators.⁶ I asked Baumol to describe his view of the entrepreneur.

Minniti (M thereafter): In many of your writings related to entrepreneurship, you have made a sharp distinction between replicative and innovative entrepreneurs. Does the importance of this distinction rest on the fact that the latter generates productivity changes?

Baumol (B thereafter): *That's right. And I would say this: for short-run problems like a recession, you need the replicative entrepreneurs above all. The people who are jobless, they can open a little shop and make it work, even if there are a thousand other little shops like it. He's no longer losing his house, or whatever, but he is not increasing the productivity of the economy. But, if you are going to get rid of the poverty of Africa and Latin America, that isn't enough. That's where you need the breakthroughs that change productivity and that have increased real per capita income in the United States over a century by a factor of six or seven. I mean, these are things neither you nor I can imagine. What was it like to live when you had one-sixth of the purchasing power today in your weekly salary, in your bank account, in any other source of funding? And not just numbers, but actually in terms of real purchasing power. It is totally incredible to us.*

M: Still, don't you agree that the adoption of innovation developed elsewhere increases the standard of living in those countries enormously?

B: *Oh yes, oh yes! You've caught the point exactly. So you need them both. And one (replicative entrepreneurship), we know how to teach at least pretty well. I'm not saying that we have the final answer. The other we do not know...And the whole point in studying innovative entrepreneurship is that that is the only way by which humanity has ever reduced poverty over broad stretches of geography. And the thing is that you need that sort of activity in Africa, in Latin America. China has learned about it. See, China now is inventing very little. It used to be the*

leader of the world in invention, but it had no entrepreneurs who dared to bring these things to market because they feared what the emperor would do. Now it's the opposite. The government is encouraging the Chinese entrepreneurs to learn from Italy, from France, from the United States, and take the ideas and produce them a little more cheaply, a little more prettily, whatever, and in that way they are catching up, but they will also run into trouble. Because as Jean Baptiste Say said in 1803, you need all three of them: you need the inventor, you need the manufacturer, and you need the entrepreneur to bring them together. So China today is well supplied with entrepreneurs. Though I have in one paper that was sent to me from China an estimate that more than half of the Chinese billionaires are in prison. Literally. I mean that's still not the right way to do it.

Thus, according to Baumol, both types of entrepreneur are important for the performance of the economy, but they differ profoundly in their roles, the nature of their influence, and the type of analysis their role requires. Baumol's distinction among entrepreneurial types also has important methodological implications. Baumol (1968: 66) famously wrote that 'the theoretical firm is entrepreneurless—the Prince of Denmark has been expunged from the discussion of Hamlet.' As a result, he is sometimes incorrectly cited as having argued that formal economic models are not suitable to study entrepreneurship. However, this is inaccurate, as he never made that claim.⁷ In Baumol's view, the process of replicative entrepreneurship can be described formally and its requirements of optimality in decision making can be usefully determined. But, the range of options available to the innovative entrepreneur at any given time is unknown, and the consequences of any decision (and the resulting outcomes) is unexplored and unknowable. As a result, the calculation of optimality conditions is not feasible.

Much of the standard theory of the firm is based on the premise of optimization. Firms are viewed as profit-maximizing agencies able to plan optimal inventories, hire the optimal number of employees, and produce the products that optimize their market position. This approach to the theory of the firm provides a number of surprising results and useful applications as tools for consulting and management.

⁶ It is easy to interpret this distinction as akin to that between Schumpeterian innovators and Kirznerian arbitrageurs. This, however, would be incorrect since Kirzner's concept of alert arbitrageurs is very broad and Schumpeterian innovators can be viewed as a subset of the latter (Koppl and Minniti, 2010).

⁷ Baumol is one of the main scholars responsible for popularizing the use of mathematical modeling in economics and the social sciences (Eliasson and Henrekson, 2004). For some examples of his early work based on the use of mathematical methods see, among other publications, Baumol (1966, 1964).

Thus, Baumol argues, optimization models provide a rich treatment of the replicative entrepreneur. For example, in Williamson's (1985) transactions-cost analysis, the important problems of negotiating contracts and organizational structure are represented with acts of optimizing calculations. Even if, in reality, the replicative entrepreneur's decisions are not necessarily optimal, this representation serves as an important guide for the improvement of those decisions. However, this is precisely why optimization models may not be suitable to describe the innovative entrepreneur.

As Baumol (1993a: 200) argues, 'because it must constantly change, we have difficulty in providing any sort of general description of what [the innovative entrepreneur] does, except in the broadest and generic of terms...And that largely rules out systematic optimization calculations.' While it is possible to describe *ex post* what an innovative entrepreneur did in the past, Baumol (1993a) admonishes, that description, necessarily, can explain only an activity that would qualify as innovative entrepreneurship at the time, but it is no longer so and, if re-enacted, could be viewed only as replicative entrepreneurship. The acts of innovating entrepreneurs entail the introduction of something unprecedented and unexpected that cannot be easily formalized. According to Baumol, the mechanism set in motion by innovation creates incentives for further innovations, and this is the activity at the center of productivity increases and economic growth.⁸

Baumol's view, which he further develops in his theory of contestable markets, points out that innovative entrepreneurs are not casual contributors of new products and services but, individuals who are forced to maintain the flow of innovation in order to protect their entrepreneurial rents. Thus, in addition to clarifying the emphasis he puts on distinguishing the replicative from the innovative entrepreneur, Baumol's methodological distinction underlies the important point that innovative entrepreneurship is incomputable in nature and, therefore, cannot be planned (Koppl, 2008). Furthermore, Baumol's position on the formalization of entrepreneurship at

the individual level highlights how his analysis of the innovative entrepreneur links organically to his work on institutions and aggregate economic activity (Baumol, 1990).

ENTREPRENEURSHIP: PRODUCTIVE, UNPRODUCTIVE, DESTRUCTIVE

In one of the most widely cited papers in the entrepreneurship literature, Baumol (1990) provides a typology of entrepreneurship based on the unintended consequences of individual action at the aggregate level and links explicitly the quality of institutions to the distribution of entrepreneurial activity across different types. Baumol's contribution is significant because it fundamentally shifts the focus of academic inquiry toward the role institutions have on entrepreneurship. While Baumol's (1993a) individual-level analysis focuses on the characteristics of the activity, whether innovative or replicative, and their relative effects on productivity, his 1990 paper reverses the causal linkage and focuses on the effect the macroeconomic environment has on entrepreneurship.

In his theory, Baumol makes a distinction between the total supply of entrepreneurs and the allocation of entrepreneurs between productive and unproductive activities. When comparing different countries or geographic areas, he argues, there are factors that may influence the total supply of entrepreneurs, for example, the age distribution, the income, or the education level of the population. Governments have limited ability to influence the size of this total supply, at least in the short run. Within a specific geographic area, however, governments do have the power to influence how this total supply of entrepreneurship is distributed across alternative economic functions. This is the case because changes in the allocation of entrepreneurial talent are largely caused by the incentive structure, not by the population's underlying propensity to be entrepreneurial. Governments do have the power to alter those incentives. Thus, Baumol makes a fundamental distinction between overall supply and distribution of that supply across entrepreneurial types, which he then classifies as productive, unproductive, and destructive.

Baumol's productive entrepreneurship is based on the Schumpeterian description of entrepreneurship and refers to the 'carrying-out of new combinations' of all types of resources (Baumol, 1990: 896). Productive entrepreneurship can be replicative or innovative but it is always of value to society.

⁸ Baumol's position with respect to the suitability of analytical methods for the study of entrepreneurship is best understood by reading together his 2010 book (Baumol, 2010) and his 1968 and 1993a papers. Importantly, in his 1993a paper and 2010 book, Baumol also noted that optimization models in general may be useful for studying how innovative entrepreneurship is necessary for the enhancement of profits, which, in turn, constitute a stimulus for replicative entrepreneurs to enter and compete away the innovator's rents.

Unproductive entrepreneurship, however, refers to activities focused on developing new forms of rent seeking. It is of questionable value to society since it produces merely a welfare transfer. Finally, destructive entrepreneurship refers to activities that produce only a welfare transfer and that, in doing so, result also in a net reduction of social well-being. Warfare and slavery are two such examples. Thus, the important and distinctive feature of all productive entrepreneurship is its value creation potential and its ability to contribute positively to well-being. Productive innovative entrepreneurship, in addition, pushes this contribution further by generating productivity improvements. These improvements contribute to outward shifts of the production possibility frontier of a country and, ultimately, generate economic growth. Consistent with a long-standing tradition in economics, Baumol defines entrepreneurship broadly and reasons that entrepreneurship is a universal characteristic of human nature. He notes that what differs across countries is not the quantity of entrepreneurial orientation across the population, but the way this orientation is expressed.⁹

Extensive empirical evidence across countries supports Baumol's view. For example, albeit merely descriptive, the analysis of a large sample of GEM data shows, among other things, a significantly wider discrepancy between aggregate nascent entrepreneurship rates than between average individual-level entrepreneurial propensity (Singer, Amoros, and Moska, 2015). As Sobel (2008) points out, Baumol's theory stems from the idea that individuals respond to a variety of incentives and that entrepreneurs exploit not only profit opportunities in private markets, but also rents within political and legal arenas. As a result, differences in aggregate rates of entrepreneurship across countries are largely due to the different incentive structures created by prevailing economic and political institutions, whether formal or informal. Among those institutions, a significant amount of research in management and entrepreneurship has shown property rights to be of particular importance (for example, see Acs and Audretsch, 2005, and Foss and Foss, 2005, among

many). Given his extensive work on patents and property right systems, I asked Baumol to describe his view on this point.

M: In your famous 1990 paper, you argued that institutions are important because they may encourage or deter productive entrepreneurship which, in turn, drives economic growth. During your career, you have written extensively on the patent system. Is the latter such an institution? Is it important?

B: *Well, right now I am working on a book on the patent system because there are now many complaints, especially in the United States, about how slow it is, how uninformative it is, etcetera, etcetera. I have a coauthor, and our basic position is that in any really efficient organization (that is, any field of operation or study), you need a partnership between government and the market. In places where you have had government alone, you end up as in [WW II] Germany, in communist China, etcetera, etcetera, whereas if you have no government intervention, you get the monopolist taking over, you get all sorts of impediments to free exchange, accurate information, and the like. Now there are many problems with patent systems throughout the world and the United States in particular. For example, if you file for a patent today, before you get a decision, it is likely to take two years or three years, and the value of the invention is going down all the time because others are getting similar ideas, etcetera. There are other great problems with the patent system as it is run today. For example, there is no incentive for everyone who applies for a patent: you must write a description of the technology, of the manner in which it works, etcetera, but there is no incentive for writing it clearly, for writing it so others can use it. And the result is that if I want to take an invention of yours and pay you for its use, I have to do it without knowing what it is exactly that your invention does. First of all, I may not even recognize that your invention is the right one for me and, second, it loses an opportunity for you to make a profit and, more importantly, it loses an opportunity for society to get full usage of the new idea.*

M: Wouldn't people be concerned about providing accurate and complete descriptions of their ideas fearing they would be stolen more easily?

B: *Yes. But there is the opposite problem, too. And that is, suppose I run a company that is very good at inventing, but we are not manufacturers, and you are a very efficient manufacturer, and I come to you and say 'I have a wonderful invention. It's just right for you to start a subdivision.' And you say 'Give me the description please, I can't make a contract without a description.' If that description is not covered by the*

⁹ Within this context, Baumol's broad view of entrepreneurship is close to much of the Austrian theory, where entrepreneurship is viewed as a universal feature of human action influenced by contextual incentives, and to the public choice approach to interactions between individuals and political systems. For a review on this topic, see Koppl and Minniti (2010).

patent, I can't show it to you. So you will not buy it from me, and I will not manufacture it. So you need that [description]. In addition, as the law says, once I have patented the invention, you can read the full description, but you cannot use it without my permission. So, that is a place in which there is need for compromise. The government says you must write a description when you apply for a patent, and the question is—what incentive do you have to write a clear, extensive description? And that's where the market comes in.

M: Is the U.S. system better or worse than other countries' systems? Is there a flight of patents to any particular country?

B: *The answer is, all of them have problems. See, from the very beginning, patents were run by governments and often in bizarre ways. In England, in the eighteenth century, you had to go to seven different government agencies, each had to approve it, the king had to sign the patent twice—it was unbelievable—and the charge was higher than average per capita income. So, it was no wonder that English inventiveness slowed down. I mean, I'm not saying that's the full story, but [it] surely must have played some role.*

M: In several of your writings, patents and property rights are often identified as important drivers of innovation. What else do you think is important?

B: *Well, I'm thinking more of the preparatory institutions: [the] education of innovative entrepreneurs. And the point is, nobody knows how to carry it out. Furthermore, there is very little work being done to find it out. That is to say, we are teaching it to prospective, innovative entrepreneurs doing exactly what our teachers did for us, who did what their teachers taught them. It's like medicine in the eighteenth century when they used leeches because others had used leeches. And there is very little testing. Just now there is work beginning in this area, but very little systematic testing of how you teach innovative entrepreneurship. You know, Jean Baptiste Say in 1803 pointed out that to have effective technological change, you need three people: the inventor, the manufacturer, and the person who connects the two—the entrepreneur. And we have business schools all over the country, and they teach very good courses that are good primarily for entrepreneurs who are going to do what others have done before them. And that's important, too. I'm not suggesting that we give up the one, but we also need the other, and the problem is, I don't know yet how to do it.*

While stressing again the distinctive importance of innovativeness, Baumol answers clarify his view that

productive entrepreneurship can emerge only when the economic system allows the inventor, the manufacturer, and the entrepreneur to coexist and their incentives to be aligned. In countries characterized by well-defined rules of laws and effective limits on a government's ability to capture entrepreneurial rents (through taxation and regulation), individuals are more likely to engage in productive entrepreneurship. In countries without those institutional characteristics, the same individuals will still be creative, but, in order to extract entrepreneurial rents, they will attempt to manipulate the political or legal process. That is, individuals will undertake costly activities that do not create wealth but, at best, redistribute it, such as lobbying and lawsuits, and possibly destroy it, such as crime.

As Sobel (2008) noted, to appreciate Baumol's contribution to entrepreneurship theory requires understanding opportunity costs and the difference between positive, zero, and negative-sum economic activities. Activities yield positive sum gains when net wealth is created, such as when innovative entrepreneurs increase consumers' choice by introducing a new product of superior quality. Instead, government actions that transfer wealth by subsidizing or protecting an industry from competition yield zero sum gains since wealth is redistributed but no net wealth is created. Importantly, when obtaining a transfer requires the investment of resources into lobbying, then the overall impact on the economy is a negative sum, since wealth is not only not created but is, instead, reduced by the allocation of resources to unproductive uses. Unproductive entrepreneurship is unproductive precisely because in the process of capturing zero-sum transfers, it allocates resources that could have been allocated to an alternative productive use. I asked Baumol to comment on some of his work that specifically addresses this point.

M: In your 2002 book, you argue that twelfth century China is a very good example of how institutions may go wrong. What happened?

B: *The answer, as far as I know, and I have gotten this from a Chinese correspondent, is that inventors were literally afraid that people would take notice of their invention because if the emperor found that you had a better way of making porcelain, he would forbid you from selling it to anyone but the royal court. He would wait, more than that, he would take all the workers in your workshop, make them work at the royal workshops for slave wages and slave commission. So there is an example of government without markets. There was no market for invention, but*

plenty of government intervention. And that's my hypothesis. I mean, I have one example, but there is no reason to think that that example is extraordinary. We do know what powers the emperors had. We do know that they loved toys. I mean, you know when the Italian Catholics came over and brought clocks to the emperor, the emperor only wanted the clocks with dolls, dancing dolls. He didn't care at all about whether it gave accurate time or inaccurate time. And one thing you clearly learn is that government without some sort of market countervailing power can sometimes do good, but is so dangerous. From the example of Stalin, of Hitler, whatever, down to the twelfth century in China, where you were all the property of the emperor, and if the emperor liked your invention, you were in terrible trouble.

M: How was the twelfth century in China different from the Italian states during the Renaissance? Both were military states with not much democracy, but in Italy we saw a lot of creativity and inventions. Perhaps the fact that many small states competed with each other was important?

B: Yes, and aside from the Pope, the governments—the Medici governments—did not last. They really did not control individual activities.

M: Were entrepreneurs seen with a more benevolent eye?

B: I believe that is true...But you see, that's for research. What I would like to see people do is to get some of the documents of the thirteenth century, fourteenth century, the rise of the house of Medici and see what was going on in invention, see what happened to a new idea once it appeared.

As evidenced from his references to specific historical contexts, Baumol's theory has significant policy implications. Specifically, it implies that entrepreneurship is truly a bottom-up phenomenon and that governments do not have the informational advantage necessary to pick winners. Rather than focusing on expanding narrowly targeted government programs, such as subsidized loans for special types of businesses or industries, the only effective way to encourage productive entrepreneurship is through institutional reforms that are compatible with individual-level incentives (Minniti, 2008). Institutions providing secure property rights, certainty of the law, effective recourse against contract infringement, and reliable limits to the exploitation of rents from the public sector offer lower returns for rent-seeking behavior and higher returns to productive entrepreneurship. In countries without good institutions,

instead, the return to rent seeking is higher, and individuals attempt to capture transfers of existing wealth through unproductive entrepreneurship. Prior to Baumol's theory, researchers focused only on the relationship between entrepreneurial inputs and entrepreneurial outcomes, without considering the role that the rules of the game played in the entrepreneurial process. In an alternative, Baumol's theory helps to explain which contexts are more conducive to entrepreneurship and why several top-down interventions have shown little success in actually promoting entrepreneurship.¹⁰

Sobel (2008) provided a robust test of Baumol's theory and found that the data support his predictions. Specifically, Sobel (2008) finds institutional quality to be highly correlated with the measures and proxies for the aggregate quantity of productive and unproductive entrepreneurship. An important implication of Baumol's argument—and a crucial one for entrepreneurship research—is that while institutions are an important cause of economic change and progress, entrepreneurship is the mechanism that allows economic change to take place (Boettke and Coyne, 2003; Sobel, 2008). The intuition behind this argument is that since entrepreneurs are present in all settings, it is different institutional structures that generate the large variances in standards of living across countries. In summary, Baumol's (1990) theory puts the innovative entrepreneur who engages in productive entrepreneurship at the core of the economic process and, therefore, positions him/her as the main engine of economic growth.

INNOVATIVE ENTREPRENEURSHIP AND ECONOMIC GROWTH

Citing extensive evidence from Maddison (1982, 2001) and Summers and Heston (1984); Baumol (1986, 2004c) identifies four common patterns that have characterized the history of developed countries since the Industrial Revolution. These patterns consist of a remarkable growth in productivity, the convergence of productivity levels, the similarity and predictability of economic growth rates, and the simultaneous failure of many developing countries to catch up and converge with the industrialized ones. It is in this context that Baumol makes yet another pivotal contribution by focusing on the analysis of comparative economic systems and the role

¹⁰ Boettke (2001) and Boettke and Coyne (2003) provide policy-oriented extensions of Baumol's theory.

entrepreneurship plays in the elimination of poverty and in fostering economic growth.¹¹ I asked Baumol to comment on the value of comparative analysis and what scholars can learn from it.

M: You have written extensively on macroeconomic phenomena such as capitalism, the free market innovation machine, and poverty. Does entrepreneurship really reduce poverty? Do you think researchers should appreciate more the lessons history teaches us?¹²

B: *The answer is, I couldn't agree with you more. I think history is the only way we are going to get evidence on the subject because it's very hard to experiment with people. You don't really want to do that. But you can compare China in the twelfth and thirteenth centuries with China today. And, in fact, I've written or coauthored a paper on the subject because in the earlier period, you had this enormous outpouring of invention that seems never to have helped the economy, whereas the twenty-first century China is not a great inventor at all, but has entrepreneurs who copy ideas from other places and is growing at a rate which China has not experienced before. It is my hypothesis that you need them both. That is, that you need the people who create the ideas, who are not entrepreneurs (in general, they can be sometimes), and entrepreneurs who recognize the importance of the idea, who notice that it isn't quite ready to be used, who see what modifications have to be made to market them effectively, and then you need the people who then turn this into practice. So, in all of this, see, the entrepreneurs play an important part and, to me, who believes with George Bernard Shaw that poverty is the world's most critical problem, you need both innovative and replicative entrepreneurs.¹³ You need the replicative entrepreneurs today, during the recession, not coming through with speculative ideas that will take 10 years to develop, but a better way to manufacture what we're already getting, and giving jobs to immigrants,*

giving jobs to people whose parents were not educated, as we used to do at the end of the nineteenth, beginning of the twentieth century. Whereas today, we try to keep all the immigrants out without thinking how much we are denying them and denying ourselves.

M: Most economists suggest that immigrants play an important role in a country's wealth and productivity. You seem to agree with that.

B: *Well, you look at the people who live in this building, all of whom are very comfortable, and I'll say nine out of 10 had parents who were immigrants, came here, opened up businesses, learned a trade. My parents, my wife's parents. I and you need them. They need the opportunity, and we need them. So we are certainly on complete agreement on that—as I expected.*

In Baumol's view, the key to explaining the patterns that have characterized the history of industrialized countries in the last 250 years is, again, the distinction between innovative and replicative entrepreneurship. Throughout his career, Baumol has remained passionate about the innovative productive entrepreneur because of his belief that the entrepreneur alone can ignite the process conducive to the elimination of poverty. Baumol (2002b) argues that throughout history, innovative entrepreneurship has been a key feature of free markets and industrialized economies. In contrast, he continues, imitative entrepreneurship has been a more widespread phenomenon, widely observed in industrialized economies, but also in transition, emerging, and even some centrally planned economies.

For example, Baumol (2002b) discusses extensively the mechanisms that explain why and how capitalism has produced economic growth and living standards unparalleled by any other economic system in history. Most often, arguments used to explain this observation rest on the idea that competition, by pushing prices down, forces firms to be efficient, thereby yielding the most productive use of resources and the highest benefits to consumers. In an alternative, and while still giving price competition its due credit, Baumol focuses on innovation and firm dynamics as the basic engine behind both growth and competition. In his view, and regardless of structure, industries are highly dynamic environments where firms face a continuous arms race not to fall behind (Baumol, Panzar, and Willig, 1982). This pressure encourages continuous innovation and, as a result, increases productivity and pushes outward the economy's production possibility frontier (Baumol

¹¹ For some examples of Baumol's writings on economic growth, see, among others, Baumol (2003, 2002, 2002a, 1986) and Baumol, Litan, and Schramm (2007). A version of Baumol (2002a) was also used as the acceptance lecture for the 2003 FSF-NUTEK Prize held at the Stockholm School of Economics in May 2003.

¹² In his writings, Baumol has used history extensively, both through the use of long-term longitudinal data and through comparative cases. For some specific examples, see Baumol (2002, 2004b), Baumol *et al.* (2007) and the edited volume by Landes, Mokyr, and Baumol (2010).

¹³ Here Baumol is referring to Shaw's famous quote 'The greatest of our evils and the worst of our crimes is poverty.'

and McLennan, 1985). It is this process, in Baumol's view, that accounts for the unparalleled growth of modern capitalist economies, at least in societies where the rule of law prevails (as described earlier).¹⁴

The linkage between innovative and replicative entrepreneurship and the economic growth characteristics of Baumol's view of the economic process now becomes clear: as important as the actual process of invention is, the activity of those who translate the inventions into practical and commercializable new products and services is the real lubricant of economic activity (Audretsch and Keilbach, 2007). In Baumol's logic, the inventor and the innovative entrepreneur are both necessary for economic growth to take place, and without either one of them, the process cannot unfold. Still, a fundamental role also exists for the imitative entrepreneur who is responsible for the massive expansion of markets and for the creation of competitive pressures that push innovative entrepreneurs toward further innovations.

In the last few decades, and in spite of massive technological innovations, the growth rates and per capita GDP of several developing and emerging economies have converged toward those of historical economic leaders. This suggests that in the former group of countries, a sufficiently large number of entrepreneurs have specialized in adopting and replicating the leaders' innovations. In other words, replicative entrepreneurs are spearheading the growth process of those countries.

Baumol (2004c, 2002b) also argues that this convergence phenomenon has been stimulated by the coexistence of several other circumstances: (1) the reduction of cross-country impediments to the free exchange of scientific and technical information; (2) the increasing reliance of countries' economies on international trade and, therefore, their need to avoid lagging technologically behind their foreign competitors; (3) the exponential growth in the number of people engaged in information-related activities, which has put an unprecedented number of

individuals in the position to diffuse information; (4) the improvement of communication techniques, which has greatly reduced the lags involved in the dissemination of relevant knowledge. Taken together, these factors have allowed replicative entrepreneurs to succeed in large numbers and contribute to growth in an unprecedented way.

If replicative entrepreneurship is the key to the convergence of living standards observed across industrialized and many developing countries, then it is reasonable to conjecture that other countries' failure to converge may be attributed, at least in part, to their lack of a sufficient number of replicative entrepreneurs. This argument is consistent with Baumol (1990)'s theory of productive and unproductive entrepreneurship. Lacking any specific non-contextual reasons why the total supply of entrepreneurs should be lower in some countries than in others, a country's failure to produce a sufficient quantity of productive entrepreneurship, whether innovative or replicative, suggests the presence of cultural or political impediments to its exercise. Thus, once again, important policy implications emerge from Baumol's work (Audretsch, Baumol, and Burke, 2001).

First, replicative entrepreneurship is less sensitive than innovative entrepreneurship to the economic and political constraints characterizing a country. This explains why, as long as replicative entrepreneurship is present, even some nonmarket economies have benefited from innovation initially developed in market economies. It is also consistent with Mulligan, Gil, and Sala-i-Martin (2004), who found little difference in economic policy between democracies and non-democracies. Second, the encouragement and support of a critical mass of replicative entrepreneurship may be a sufficient condition to enable a developing country's convergence on the living standards of industrialized economies. This is consistent with Minniti and Levesque (2010), who developed a model of economic growth in which, given prohibitive R&D costs, convergence can be driven by replicative entrepreneurship. Third, the development of institutional arrangements that preserve incentives to innovation emerges as one of the main goals of economic policy—not only domestically, but from the viewpoint of world economic welfare as well.

In sum, the focus of Baumol's vision of the economic system centers on the strategic behavior of innovative productive entrepreneurs. Because of the costs of R&D and the risk of obsolescence, firms do not necessarily wish to innovate. Nevertheless, the pressure to remain competitive forces them to do so,

¹⁴ In this journal, Baumol and Strom (2008: 233) wrote: 'Since Adam Smith's articulation of the invisible hand, these scholars have contended that the market mechanism grew by itself, that it runs by itself, and that there is no one who operates or controls it. A close look at the extraordinary economic growth of the last two centuries, however, suggests that the market mechanism does not do its work without the input of individual actors. In fact, we can identify a group of people who play an indispensable role for operation of the market mechanism and for driving these unparalleled levels of growth: the entrepreneurs who bring cutting-edge innovations to market.'

not only with respect to products, but also with respect to how their innovation is used and disseminated (Baumol, 2004a). Thus, in Baumol's analysis of capitalism, the strategic actions of innovative productive entrepreneurs and the industry dynamics they produce are at the core of economic growth because they generate a huge surplus for the economy as a whole.

CONTESTABLE MARKETS AND THE COST DISEASE

The historical evidence on the market's accomplishments emphasizes its dynamic nature and its ability to stimulate a flow of new products and processes. This explains the unprecedented growth in productivity and per capita GDP experienced since the Industrial Revolution. Within this context, Baumol's view of the economy considers the innovative productive entrepreneur as the key agent of change and origin of growth in the economy. Still, the mechanism through which the actions of this agent influence industrial dynamics and the economy needs to be clarified. The goal of this part of the paper is precisely to close the loop by highlighting two of Baumol's main contributions to our understanding of industry dynamics. Once again, both contributions emphasize, whether implicitly or explicitly, the role of the entrepreneur.

Sustained growth requires the rapid dissemination of technological advances so that all firms can make use of the new products and processes. The standard depiction of the innovating firm is often that of an organization that uses patents, trade secrets, and other available means to prevent other firms from using its ideas. And yet, the reality of industrial strategy and relations paints a different picture. Innovations are rarely developed in isolation or kept secret for a long time. While the pressure to innovate forces firms to strive to stay ahead, it also creates incentives for that knowledge to be shared so that all firms benefit from a larger pool of R&D investment (Baumol 2000, 1993b). In his 2001 interview with Alan Krueger, for example, Baumol refers explicitly to IBM and Toshiba sharing practices and the extent to which they would go to remain involved with each other's portfolios of innovations (and those of the other competitors). Dissatisfied with static depictions of industrial dynamic, Baumol tackles the analysis of innovation and its resulting strategic implications at the industry and entry levels in his theory of contestable markets (Baumol, 1982; Baumol *et al.*, 1982; Baumol, Panzar, and Willig, 1983).

While well known in economics, the theory of contestable markets is not yet well known in the entrepreneurship and management literature. According to Baumol, a contestable market is a market that, although characterized by the presence of a small number of established firms, is also characterized by a high degree of competition due to the presence and churning of many potential short-term entrants. In other words, the basic idea is that certain features of the market allow new entrants to 'contest' the incumbents' dominance.

A perfectly contestable market has three main features. Namely, it has no entry or exit barriers, no sunk costs, and all firms (new and incumbent) have access to the same level of technology. The absence of sunk costs is important because if new entrants cannot reuse or transfer resources, exit barriers are present, and firms will not enter the market. Access to the same level of technology, instead, is relevant since it is an important determinant of production costs. New firms with insufficient knowledge or technology will face higher average costs and be unable to compete.

While very few markets may be perfectly contestable, many markets are highly contestable, especially those in which smaller and newer firms are more likely to enter. For example, traditionally considered one of the most concentrated in the economy, even the U.S. steel industry turned out to be a contestable market thanks to the emergence of small steel mills in the 1970s and 1980s. Similarly, deregulation and the emergence of low cost carriers rendered the airline industry a highly contestable market, at least for a period of time. From the point of view of the economy as a whole, contestable markets are important because they allow for outcomes that, in spite of significant market concentration, yield outcomes that are similar to those delivered by competition. Competition, however, is not taken as a given and inescapable feature of the market. Instead, it emerges organically and endogenously from the strategic decisions of firms.¹⁵

Contestable markets are characterized by what Baumol *et al.* (1982) call 'hit and run' competition. If a firm in a contestable market raises its prices well above the average price level of the market and, thus, begins to earn above economics profits, potential rivals will enter that market. When the original incumbent firms respond by lowering prices to levels

¹⁵ For related arguments, see also Arora, Fosfuri, and Gambardella (2002) and Lamoreaux and Sokoloff (1996).

consistent with normal profits, the new firms will exit. Thus, an important implication of the theory of contestable markets is that industry structure is explained endogenously by the strategic decisions of firms rather than accepted as existing exogenously. Baumol's contribution goes beyond standard industrial organization and shows that pricing and production decisions are not actually dependent solely on market structure, but on the threat of competition (Baumol, 2000).

The competitive dynamic described in the theory of contestable markets has important implications for our understanding of strategic behavior (which remains largely unexplored). In particular, Baumol's logic allows us to better understand the double-edge strategic pressure that innovative entrepreneurs face in contestable markets where they are caught between strong incumbents and potentially short-lived entrepreneurial rents. The theory of contestable markets has significant implications also for the development of appropriate antitrust laws and, in general, for the analysis of what property rights and regulatory structure may be more conducive to innovation.

In addition to the theory of contestable markets, Baumol's work on industrial organization and the theory of the firm spans contributions on the use of rules of thumb (Baumol and Quandt, 1964), the behavioral theory of the firm (Baumol and Stewart, 1971), and the analysis of the performing arts industry (Baumol and Bowen, 1966), to cite just a few. Baumol's work on the economics of the arts is particularly important and at the origin of his theory of productivity differentials across sectors. Normally referred to as 'Baumol's cost disease,' the theory of productivity differentials also has implications for strategic entrepreneurship.

The intuition behind the cost disease is that some industries, such as many sectors in manufacturing, have a potential for sustained long-term productivity growth, while other industries, such as the performing arts, cannot increase productivity significantly, even in the long run (Baumol and Bowen, 1966). This asymmetry implies that in industries whose productivity cannot increase, output prices will increase indefinitely compared to prices in industries where productivity grows. This explains why, for example, the price of surgical procedures keep rising while the price of automobiles does not. In turn, this means that the demand for the output in relatively low productivity industries will either decrease over time or become an increasingly larger share of consumers' total expenditures. The nature of the output (whether it

be theater performances or surgical procedures) and the elasticity of its demand will determine which scenario will emerge.

Baumol's cost disease is important because it reconciles the neoclassical economics view that wages are closely tied to labor productivity changes with the real-world observation that this is not the case in many labor intensive sectors, especially those characterized by complex productive structures where labor is combined with a web of complementary factors. The ramifications of the cost disease are evident everywhere in the economy, from health care to education to elder care and the arts.¹⁶ Baumol's theory of productivity differentials has significant implications for strategic entrepreneurship because innovative entrepreneurs tend to be disproportionately located precisely in those knowledge- and labor-intensive sectors that are more susceptible to the cost disease. Thus, while still relatively unknown among entrepreneurship scholars, Baumol's insight on the implications of productivity constraints provides a useful model for the study of entry, survival rates, profitability, performance, competition, and other strategic entrepreneurship issues.

Importantly, although the theory of contestable markets and the cost disease argument both focus on strategic issues related to the market, they still put the entrepreneur at the center of the economic process. For example, the threat of entry in contestable markets forces incumbents to continue innovating and behave entrepreneurially. In a different scenario, the lack of entry due to, say, regulatory behavior or other impediments that cannot be overcome by innovation and enterprise, results in the cost disease.

INVENTING THE ANALYSIS OF INVENTION

Baumol's focus on innovation, his theory of productive entrepreneurship, and his work on contestable markets are just a few of the many

¹⁶ Importantly, Baumol's cost disease is consistent with the observation that even in some sectors where labor is combined with a web of complementary factors, wages may decline for a subset of workers. This is due to the combined effect of excess entry together with low elasticity of demand toward a portion of the participating workers generated by reputational effects that increase the marginal product of those workers. In other words, it is possible to have an Oscar-winning actor receive a \$50 million engagement contract in spite of there being thousands of underemployed actors.

avenues for further research that his work offers us. In addition to a wealth of research topics, Baumol's work also offers an enlightening example of how it is possible to create a meaningful and direct bridge between research and teaching and how they can benefit each other. Throughout his career, Baumol remained very committed to teaching. In particular, as evidenced from references he made throughout our conversation, Baumol strongly believes that teaching matters for fostering innovation and entrepreneurship. Baumol, Schilling, and Wolff (2009) provide empirical evidence to back up this conviction. Using an original and detailed dataset of well-known inventors and entrepreneurs, they found that, over time and across countries, the share of both inventors and entrepreneurs who have attained high school, college, masters, and PhD degrees has increased, probably to keep up with increased technological complexity (Baumol *et al.*, 2009). In addition, they found inventors and entrepreneurs to be better educated than the general population in the United States.¹⁷ I asked Baumol to comment on the importance of teaching and on the relationship between teaching and research.

M: Almost by definition, the difference that the innovative entrepreneur really makes is a non-replicative process. How can we teach that?

B: *The answer is that what you need to do is to stimulate creativity and imagination. And Einstein said that the way universities are now operated, they tend to destroy both of them. And you see this, say, in Japan, in China, in France, where people are taught with great care to do what was done yesterday, maybe a little bit better, and they make very good craftspeople, but their imagination has not been stimulated. And how one does it is not clear, but it is time that we started to experiment to find out...But it means that [it is] you and I who are in the best position to observe how we prepare these innovative entrepreneurs who need not do what our teachers did. And who need to get evidence that what we're trying does a better job than what our teachers did.*

M: Do you really think we can learn by working directly with students?

B: *Well, I would urge you to think of it as an almost controlled experiment. I mean for their benefit and*

recording of what you have learned from what works and what does not work as well in the process. It's that opportunity to turn medicine from taking leeches into testing new pharmaceuticals. It is only from experiences such as yours and historical analysis. Those, as far as I can see, are the only two ways that are available to us to find out how to stimulate and prepare innovative entrepreneurs...And maybe there is no way to teach, except to bring a bunch of students together and say 'I will give a prize for the best idea in this group. You can help each other, you can keep it from one another. Just see what your imagination can produce.'

M: Are you suggesting that courses focusing specifically on innovative entrepreneurship are important?

B: *We can study in your courses and mine when you have a group of 20 students if it's a course in innovative entrepreneurship, not replicative entrepreneurship. And I don't classify one as better than the other, but they are different. In the replicative entrepreneurship, we know what to teach. We do a good job at teaching them. We teach them bookkeeping. We teach them how to deal with tax laws. We teach them all sorts of things that they need, and we need them during a recession, we need when immigrants come into a country who go out and start new shoe shops, and new stationary stores, whatever. They need to know what laws apply, and they need to know how to keep records, and we know how to teach that. And the business schools do a good job of that. So it's not unimportant, and we have information. But the really critical thing for the long run, if we are going to continue to fight poverty in the world, is productivity enhancing inventions. And not only inventing, but making sure that it is used efficiently.*

M: Do you think this is an area that needs to be investigated more carefully than done so far?

B: *Oh, I think as you know, it's an important field, and it's one in which especially on the innovative entrepreneur side, standard methods don't work. By definition, you can't add up two inventions to a third invention and get a total, you know. By definition, it's easy to find out what happens to cost when you produce two dozen apples instead of one dozen apples because there is homogeneity. But, by definition, if it's homogeneous, it isn't an invention. That is, if two products can be added, they are merely replications of the other. So the standard method doesn't work because it is the ultimate field in which heterogeneity predominates. Every unit of every commodity*

¹⁷ For more discussion on the relationship between education and innovation, see Baumol *et al.* (2009). For a discussion focusing on the explicit introduction of the entrepreneur in principles of economics courses, see Phipps, Strom, and Baumol (2012).

produced has to be different from every other, so you can't add them, you can't subtract them, you can't use the letter n to represent the number because the number doesn't mean anything. So that is why we are driven back to history. You see, we can conduct experiments very well, we can in teaching, and there I do argue that we're not doing enough, but in analyzing the work of the entrepreneur, there's a limit to what rigorous analysis can do. That does not mean no analysis; imagination and the analysis is also possible, but you can never really construct a model in which 'n' is the number of inventions and 'h' is the number of hours the inventor worked on them. It makes no sense because by very definition, the product, the process has to be heterogeneous. So, in a sense, I think it's an opportunity.

Entrepreneurs are made, not born. Baumol argues this is true for innovative entrepreneurs as well. Although much recent research has addressed issues related to entrepreneurial cognition and creativity, Baumol's work invites us to explore and leverage the lesson of history, and he stresses the importance of pushing our investigations across disciplinary boundaries. Eliasson and Henrekson (2004: 1) appropriately have written that: 'Although basically neoclassical, Baumol's ambition has been to extend mainstream economics to be compatible with a wider range of theoretical assumptions and economic phenomena than the received model is capable of addressing in a relevant way. In doing so, Baumol has constantly built new bridges that link theory, policy, and practice. In many ways, Baumol can be seen as a revolutionary from within in that he masters the tools of the trade and insists that they be used, as far as possible, to address real-life problems of great urgency.'

CONCLUSIVE REMARKS

In sum, William Baumol is well known for the quality and theoretical rigor of his work. He is also known for having always focused on important, real questions. Among other things, Baumol has written on the cost of health care and education (Baumol, 1993c), the development of a proper set of patent laws and property rights (Baumol and Ordober, 1988), the support and distribution of the arts (Baumol and Bowen, 1966), the political economy of procurements (Baumol, 1947), and the importance of R&D expenditures (Braunstein, Baumol, and Mansfield, 1980). His strong ethics have always compelled him

to make sure the practical implications of his research were well fleshed out. Even in the brief thank you message he recorded for receiving the 2014 Entrepreneurship Division Foundational Paper Award from the Academy of Management, William Baumol reminded us that what we do matters and that there is nothing intrinsically virtuous about innovation: it is what people innovate and how the innovation is used that matters. Toward the end of our conversation I asked:

M: Innovation is so important, but how do we know what is more conducive to innovativeness?

B: *The answer is, you don't know and neither do I. I mean, it's a field that is ready for us to invade. We have to invent the analysis of invention.*

M: This seems like a very difficult problem that you plan on continue working on and worrying about in the future...

B: *Yes, yes. So that's one of the hard parts that you and I have to worry about. Yes. And enjoy worrying about.*

M: I guess one of the great advantages of our profession is being able to ask important questions that we really care about.

B: *Exactly right!*

On October 1, 2014, the Stern School of Business and the College of Arts and Sciences at New York University gathered to celebrate William J. Baumol on the occasion of his retirement. Now well into his 90s, Will remains an active researcher. He continues to enjoy worrying about important questions he really cares about.

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