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Why do incumbents fund startups? A study of the antecedents of corporate venture capital in China

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ABSTRACT

Established firms are instrumental in funding entrepreneurial ventures, a practice known as corporate venture capital (CVC). Yet, our knowledge of the reasons firms engage in CVC is calibrated mainly on data from the United States and Europe. Such a restricted focus limits our understanding of CVC practices and objectives. Accordingly, we adopt an abductive approach to study the antecedents of CVC in China. The country is a vibrant entrepreneurial setting, second only to the USA in total startup numbers and funding amounts. We construct a comprehensive data of Chinese CVCs during the late 2010s by integrate Chinese and international databases. Cross-industry analyses of CVC patterns underscore a novel objective; one that is predominantly associated with harnessing growth through market expansion rather than the prevailing view of CVC as a window on technology. The findings mirror the features of the Chinese setting, where entrepreneurs profit from the dramatic expansion in economic activity and serve as a vehicle to leverage the global innovation frontier.

Introduction

"We believe that the education industry will have a great development in the future. There are many opportunities in the industry. We intend to grasp these opportunities, but it's not suitable for us to develop some of them internally. Therefore, we use our capital, business, and resources to support the external ventures." (Bangxin Zhang, Chairman and CEO of TAL Group @ 2016 Annual Conference.)

"When evaluating the potential target, we consider: (1) whether the firm can help us acquire more users and improve their engagement, (2) whether the firm can help us improve customer's experience, (3) whether the firm can help us expand our products and services." (Joseph Tsai, Vice President of Alibaba @ 2017 Investor Day.)

Entrepreneurial ventures are an important source of economic growth and technological advance (Florida and Kenney, 1988; Aghion and Tirole, 1994; Kortum and Lerner, 2001; Breznitz, 2007). Increasingly, incumbent firms seek to harness innovative ventures through a practice known as corporate venture capital (CVC). Extant work suggests that large corporations pursue a 'window on novel technology' approach by making equity investments in entrepreneurial ventures (see Table 1 for a summary). However, most of what we know about CVC investors in general, and the antecedents of corporate venturing in particular, is based on data from the so-called developed world, and especially the United States and Western Europe (Maula, 2007; Dushnitsky, 2012; Da Gbadji, Gailly, and Schwienbacher, 2015). The geographical focus could limit the generalizability of extant literature (Autio, Kenney, Mustar, Siegel and Wright, 2014).

The implications go beyond geographical coverage and can fundamentally reshape our understanding of CVC strategy and its objectives. Extant work offers keen insights regarding the antecedents of incumbent-startup relationships; yet this may reflect a set of implicit boundary conditions and thus be myopic with respect to other corporate venturing objectives. The proliferation of CVC in China is a case in point; the opening quotes from Alibaba and TAL Group do not seem congruent with the traditional view of CVC as a window on technology. Hence, we set out to explore the antecedents to CVC in the world's second-largest economy, and in doing so expand the CVC literature. To that end, we adopt an abductive approach. It is a generative process that starts with an anomaly and proceeds to create and evaluate new explanations that render it understandable (Gelman and Imbens, 2013; Behfar and Okhuysen, 2018; Sætre and Van de Ven, 2021).

The purpose of this study is to understand what other strategic

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Table 1
Large-sample empirical studies of Corporate Venture Capital

AUTHOR	Dependent Variable	Independent Variable	Key Contribution
Alvarez-Garrido and Dushnitsky, SMJ, 2016	Count of startups' patents and scientific publications	1) Binary indicator of CVC-backing 2) CVC-startup geographical distance 3) Corporate's FDA regulatory knowhow	CVC-backed startups are associated with greater innovation output compared to IVC-backed peerss. The effect is sensitive to availability of corporate complementary assets
Basu et al., JBV, 2011	New CVC partnership	1) Industrial tech. change: ratio of industrial RandD expenditure to sales 2) Firm tech. resources: number of patents	Firms in industries with rapid technological change engage in greater CVC activity. Firms with strong technological and marking resource engage in greater CVC activity.
Belderbos et al., JBV, 2018	Number of patents by parent-corporation	1) CVC portfolio geographic diversity 2) Tech alliance geographic diversity 3) Knowledge redundancy	Geographic diversity in CVC portfolios enhances innovation performance as long as firms avoid geographic overlaps with technology alliances and managerial complexity.
Ceccagnoli et al., SMJ, 2018	Event history of CVC investment	Investor-partner technological distance: whether the partner firm has a patent in areas new to investor	The real option value of CVC is higher for investors with weaker scientific capabilities, engaging in distant technological fields, and with late stage innovation pipelines.
Chemmanur et al., RFS, 2014	Natural logarithm of patent numbers and patent citations	1) Binary indicator of CVC-backing 2) Nu. of CVCs invested the startup 3) CVC shareholding in the startup	CVC-backed firms achieve a higher degree of innovation output compared to IVC-backed firms.
Da Gbadji et al., ETP, 2015	Setting up a CVC program	RandD expense: RandD expenditures in all sectors by a country, as the percentage of GDP.	Corporates in countries with more developed market for early stage investments, more innovation resources, and friendly regulations are more likely to run a CVC program.
Di Lorenzo and van de Vrande, SEJ, 2019	Patent-weighted backward citations to corporate's patent	1) Binary indicator of CVC-backing 2) Whether there are inventor moving from corporate to the startup	CVC-backed startups tend not use the knowledge base of corporate. However, when inventor move from corporate to startup, the startup tend to use knowledge base of corporate.
Dushnitsky and Lenox, SMJ, 2005a	CVC investment amount	1) Technological opportunity: average number of citation-weighted patents 2) Absorptive capacity: patent stock	Firms conduct more CVC investments in industries high technological ferment. The greater a firm's cash flow and absorptive capacity, the more likely it is to invest.
Dushnitsky and Lenox, RP, 2005b	Corporate's forward citation-weighted count of patents	1) CVC investment amount 2) Industrial IP protection 3) Corporate absorptive capacity	Increased CVC investment is associated with higher corporate innovation rates. The association is stronger in weak-IPP-regime industries and when corporate has greater absorptive capacity.
Gaba and Bhattacharya, SEJ, 2012	Adoption of CVC and termination of CVC	Innovation performance: patent/RandD expenditure	Managerial aspirations for innovation goals are an important driver of CVC adoption and termination. Social aspirations matter more than historical aspirations.
Katila, Rosenberger, and Eisenhardt, ASQ, 2008	CVC investment relationship formation	(1) Startup's financial, marketing, and manufacturing resource needs (2) Patent defense, secrecy defense, and timing defense.	Entrepreneurs tend to choose CVC investors when they need financial and manufacturing resources that established firms possess, or when the startups can protect themselves from potential misappropriation behaviors (using trade secret or timing mechanism).
Keil, Maula, Schildt, and Zahra, SMJ, 2008	Number of patents by parent-corporation	(1) Nu. Of external corporate ventures (CVC, alliance, joint ventures, acquisitions). (2) Relatedness of corporate ventures	Alliance, joint venture, and CVC investments in related industries have significant positive influence on innovative performance of parent firm. Acquisitions provide greatest benefits while the target is in the same industry.
Kim, Steensma, and Park, JM, 2019	Formation of CVC deal	(1) Corporate-venture technological link (captured by patent citation) (2) Corporate's opportunistic tendency (3) Corporate-venture social tie	Technological links may promote or impede CVC deal formation, as a function of (i) the parent corporation's opportunistic behavior and (ii) whether the startups are aware of such behavior through social networks.
Ma, RFS, 2020	CVC entry: launch a CVC program in a year	1) Innovation quantity: patent applications 2) Innovation quality: average lifetime citations of all new patents	CVC entry concentrates in firms that experience deteriorations of innovation performance. At investment stage, CVCs select startups with similar but non-overlapping technological focus.

(continued on next page)

Table 1 (*continued*)

AUTHOR	Dependent Variable	Independent Variable	Key Contribution
Mohammadi andKhashabi, SEJ, 2021	CVC investment relationship formation	1) Time dummy: before or after American Inventor Protection Act 2) Biotech v.s. software	The implementation of AIPA facilitate the patent disclosure of startups, which in turn, promote CVC investment relationship formation.
Pahnke et al., ASQ, 2015	Number of patents and product approvals of startup	1) Whether the startup is funded by CVC/IVC/GVC 2) Number/ amount of funding partners	CVCs select new startups with strong technical innovation but these ties have a weak negative influence on technical innovation and no influence on commercial innovations of startups.
Paik and Woo, OS, 2017	Startup's R&D intensity (R&D expense/total asset)	1) CVC shareholding on the startup 2) Startup founder incumbency	CVC ownership and founder incumbency positively affect startup's R&D investment. CVC ownership effect is effectively amplified when the founder was an incumbent top manager.
Park and Steensma, SEJ, 2013	Startup's Patent application	Whether the startup is funded by CVC	CVC tend to fund startups with greater pre-funding innovative capabilities and startups receiving CVC investments exhibit greater post-funding innovation rates.
Sahaym et al., JBV, 2010	Industrial CVC intensity	R&D intensity: R&D expenditure expressed as a percentage of net sales in the industry	R&D investments increase the number of CVC deals in an industry, especially in the industries that are growing rapidly and changing technologically.
Uzuegbunam et al., ETP, 2019	Natural logarithm of patent, copyright, and trademark numbers	1) Binary indicator of CVC-backing 2) CVC shareholding on the startup	CVC investment is positively associated with the startup's patent and copyright applications, but negatively associated with the trademarks.
Wadhwa and Kotha, AMJ, 2006	Count of successful patent applications of the corporate	1) Nu. startups funded in year$_{(t-1)}$ 2) Corporate's involvement in CVC 3) Corporate's knowledge diversity	When investor involvement is low, number of CVC investments has an inverted U-shaped relationship with corporate innovation. When investor involvement is high, the relationship reverses.
Wadhwa et al., JBV, 2016	Corporate's forward citation-weighted patent counts	1) Knowledge diversity and depth of CVC portfolio in previous 4 years 2) Corporate's partnership with startups	There is an inverse U-shaped relationship between CVC portfolio knowledge diversification and corporate innovation. Knowledge depth and alliance relations improve benefits and reduce costs.

objectives could be driving CVC activity. Our study is motivated by a puzzling anomaly. Corporate venturing has expanded well beyond the U.S. setting. While CVC investments in North America accounted for more than 60% of global CVC deals in 2013, by 2018 the proportion had declined to 41%, and is now on par with CVC activity in Asia.[1] Yet, the CVC literature is informed by the study of corporate venturing in so-called developed countries. This lacuna gives rise to a puzzling observation. It is unlikely that CVC investors in developing countries pursue a 'window on technology' approach because startups in those countries are usually not a source of novel innovations (Minniti and Lévesque, 2010; Bruton, Zahra, and Cai, 2018). The observations point to an anomaly: the proliferation of CVC in China cannot be understood by means of the existing explanation.

Using an abductive approach, we proceed to develop new explanations for CVC objectives (see Table 2 for a summary). Anecdotal evidence from another large Asian economy, India, is instructive. Consider the 2011 Sequoia India case, where the leading U.S. investor, Sequoia, discovered that its Indian office invested in publicly traded companies in rapidly expanding industries, rather than funding private technology-based ventures.[2] This example, along with the examples of Alibaba and TAL represented in the opening quotes, suggests that many investors are attracted to entrepreneurial ventures that pursue growth by serving rapidly expanding market needs (market-based), rather than by developing novel technology (technology-based). Prior work finds that firms in developing countries can enjoy superior performance by leveraging rapid industry expansion; all while using technologies that already exist in the developed world (GEM, 2018; Minniti and Lévesque, 2010). Indeed, Lerner, Ledbetter, Speen, Leamon and Allen (2016) report that industry growth is a key driver of investments in the developing world. Accordingly, we introduce a market-based explanation alongside the traditional technology-based view of CVC activity. Another explanation is informed not by the nature of entrepreneurial pursuits, but rather by that of the prevailing institutions. Given the command-and-control nature of the Chinese context (Haveman, Jia, Shi, and Wang, 2017; Greve and Zhang, 2017), we advance a third government-based argument, whereby CVC is most salient in industries of national strategic priority. The explanation is consistent with the argument that venture activities differ across institutional settings (Chang and Wu, 2014; Colombo and Shafi, 2016).

Finally, we turn to evaluate and narrow the range of plausible explanations. This crucial part of the abductive study is facilitated by a major data effort (Behfar and Okhuysen, 2018). Specifically, we constructed a large, integrated dataset of CVC activity in China. Data on cross-industry investment activities were gathered from five databases: two international, professional venture capital databases (ThomsonOne and CapitalIQ), and three Chinese databases (CVsource, PEdata, and

[1] 'The 2019 Global CVC Report.' (www.cbinsights.com/research/report/corporate-venture-capital-trends-2019)

[2] *Fortune* magazine reports "Big shakeup for Sequoia Capital India" (Feb. 2011), "*Venture capital firm Sequoia Capital has broken up with the founding members of its India investment team, following a dispute over investment strategy.*" (https://fortune.com/2011/02/14/big-shakeup-for-sequoia-capital-india). A related article explains: "*The reason for the split is that the four want to focus on public equity investing as opposed to the parent Sequoia Capital's focus on private markets and early stage investing, sources close to the development told VCCircle.*" (www.vccircle.com/westbridge-team-splits-sequoia-india-focus-public-equity)

Table 2
The Alternative Views of Corporate Venture Capital Objectives

CVC Strategy as…	Window on Technology	Harness Economic Growth	Government Directive
Focus	Innovation-based growth	Consumption-based growth	Government's national Priorities
Views CVC	A strategy to gain awareness-of and learn-about innovative ventures and the new technologies they developed.	A strategy to access and leverage ventures in industries with fast growth in consumption	A strategy to access realize national priorities
Assumptions about incumbents	Incumbents seek growth and profits. Incumbents face innovation shortfall Incumbents interact with innovative ventures and draw on internal R&D to assimilate innovation	Incumbents seek growth and profitability.	Incumbents as channels to realize national objectives.
Assumptions about ventures	Ventures have an advantage in developing new technologies.	Ventures' products and services are in high demand.	Ventures have an advantage in new technologies.
Academic CVC literature	Focused on this view	Not focus of extant work	Not focus of extant work
Academic CVC findings from;	USA and Europe	Not focus of extant work	Not focus of extant work
Academic CVC mechanism and proxy	Innovation, patent-based measures	Not focus of extant work	Not focus of extant work

Table 3
Empirical Patterns consistent with the Alternative Views of CVC Objectives

CVC Objective CVC Objective Industry Factors	Window on Technology	Harness Economic Growth	Government Directive
Technological ferment and productivity gain	Positive	–	–
Rapid economic growth (munificent)	–	Positive	Positive
National Strategic Priority	–	–	Positive interaction with technological ferment
Industry R&D intensity	Positive interaction with technological ferment	–	–

ITjuzi). Whereas any single source has limited coverage, our integrated dataset offers a comprehensive view of CVC activity across all industries. Second, we follow a reverse causal-inference approach (Gelman and Imbens, 2013), which contributes to the literature through a data-driven rather than hypothesis-testing approach (Claussen, Essling, and Kretschmer, 2015; Birhanu, Gambardella, and Valentini, 2016; Lyngsie and Foss, 2017). Simply put, we investigate whether CVC patterns in China are consistent with the three explanations. As summarized in Table 3, we derive a set of tests that not only checks the viability of existing models, but also extends them to check the additional explanations advanced in this study.

The results suggest that a broad set of antecedents drive incumbent-startup interactions in the Chinese setting. While CVC activities in developed countries are usually driven by technological ferment and a strong corporate R&D base, we find only partial support for such factors in China. Specifically, technological advance can be an important inducement for CVC activities, but its effects do not rely on the R&D bases within a particular industry. In China, industries that provide firms with resources and opportunities to expand (namely, munificent industries) exhibit a substantial level of CVC activity. Notably, the cross-industry CVC patterns do not map onto industries designated by the government as sectors of national priority.

Taken together, the findings suggest that Chinese CVC activity predominantly follows a 'harness industry growth' rationale and, to a lesser extent, exhibits a 'window on technology' objective. The findings likely reflect structural differences between the U.S. and Chinese economies. Notably, the findings underscore the different roles of CVC (in particular) and incumbent-startup collaboration (more generally) in unlocking corporate growth. We believe the Chinese setting can offer insights into different evolutionary paths (Autio et al., 2014; Jia and Kenney, 2021). The conclusion section discusses the implications for incumbents and startups.

An abductive study of corporate venture capital objectives

The interaction between incumbent firms and entrepreneurial ventures is a subject of significant scholarly attention. This paper seeks to expand our understanding of the role and objectives of corporate venture capital. We adopt an abductive approach which is well suited for such an exercise (Gelman and Imbens, 2013; Mantere and Ketokivi, 2013; Behfar and Okhuysen, 2018; Sætre and Van de Ven, 2021). Abductive reasoning does not seek to deductively validate a pre-existing general theory; nor does it attempt to inductively build a new general theory. Rather, it is a process by which scholars create and evaluate plausible explanations (Gelman and Imbens, 2013; Lyngsie and Foss, 2017; Sætre and Van de Ven, 2021). Our study follows the abductive research design delineated in the aforementioned studies; highlighting an anomaly, generating viable explanations thereof, and evaluating the most plausible explanations. In the remainder of this section, we introduce an anomaly that forms the core motivation of this study. It underscores the opportunity to broaden the set of CVC objectives and better understand the industry inducements associated with them. The next two sections develop a set of viable explanations (summarized in Table 2), building on keen observations of CVC activities and extant literature (Section 3) and the Chinese setting (Section 4). To evaluate the most plausible explanations, we construct a large, integrated dataset of Chinese CVCs (Section 5). We check and expand existing industry-level models to facilitate the evaluation of the different explanations (Section 5, see Table 3 for a summary). We assess the explanations in light of CVC patterns (Section 6) and discuss the implications for our understanding of corporate venture capital (Section 7).

To establish the motivating anomaly, it is first useful to recognize extant work. A number of industry-level forces have been explored as possible inducements to corporate venture capital (e.g., Dushnitsky and Lenox, 2005a; Sahaym et al., 2010; Basu et al., 2011; Tong and Li, 2011). These studies, based mainly on data from the developed world, point in a similar direction: incumbent firms are more likely to pursue startups when they can gain a technological advance. The pattern is more robust where incumbents possess the R&D base necessary to assimilate novel technologies from innovative startups. Extant works test, yet find no support, for the role of industry munificence and growth (e.g., Sahaym et al., 2010). Accordingly, the prevailing view in the academic work is that the objective of CVC activity is to gain a 'window on technology.'

The focus on a single CVC objective unfolded over the past two decades. It was not always the case. Early work recognized alternative CVC objectives, such as the role of industry growth (i.e., industry munificence) as a key antecedent of CVC activity (Maula, 2007; Dushnitsky, 2012). For example, the CVC parent firm may be driven by the pursuit of lucrative financial returns on investment (Winters and Murfin, 1988;

Dushnitsky and Lenox, 2006; Hill and Birkinshaw, 2012), or leverage industry growth by funding commercially complementary products and services (Riyanto and Schwienbacher, 2006; Gaba and Meyer, 2008; Dushnitsky and Shaver, 2009; Maula, Keil and Zahra, 2013). The scholarly focus on the 'window on technology' explanation began from the early 2000s, and was partially a reflection of underlying business activity in the semiconductor and telecommunication industries as incumbent firms formed CVC units to pursue innovative startups. At the same time, the narrow focus is also an artifact of academic practices. At the early 2000s, patent data became readily available and scholars exploited the data to demonstrate that incumbent firms' innovation output is positively associated with their CVC activity (Dushnitsky and Lenox, 2005a; Wadhwa and Kotha, 2006). Numerous studies followed suit and utilized patent-based measures to portray CVC's chief objective as strategy to access innovative startups (Sahaym et al., 2010; Hallen, Katila and Rosenberger, 2014; Alvarez-Garrido and Dushnitsky, 2016; Wadhwa et al., 2016; Mohammadi and Khashabi, 2021). Table 1 presents an overview of empirical CVC works. It shows that many studies utilized patent and R&D measures; a practice that reinforced the view of CVC as an innovation strategy.[3]

Against this backdrop, we articulate the anomaly motivating our abductive investigation. First, anecdotal evidence documents a broad set of CVC objectives. The pursuit of new technologies consistently ranked as the top CVC objective in surveys of U.S. and Europe-based professionals during the 1990s and 2000s (e.g., Siegel et al., 1988; Dushnitsky, 2012). We conducted a similar survey of China-based CVC investors. Responses from 50 CVCs reveal that, contrary to peers in the West, their focus is not on assimilating new technologies and capabilities. Rather, they are focused on profiting by deploying their existing resources in rapidly growing settings, and building relationships with partners in their industry (see Appendix A for details).

Second, we observe that, by 2018, the magnitude of CVC activity in Asia is on par with North America.[4] It is a surprising observation given that startups in developing countries are usually not a source of novel technologies (Minniti and Lévesque, 2010; Bruton et al., 2018). The Global Entrepreneurship Monitoring Report (GEM, 2018) finds that a large share of entrepreneurs in innovation-driven economies (e.g., developed countries such as the U.S. and Western Europe) develop technologically novel products and services, while in efficiency-driven economies (e.g., developing countries such as China) only a small fraction of the entrepreneurs pursue such a path. It follows that the proliferation of CVC activity in China is incongruent with the view of CVC as a 'window on technology' because such a view is based on the implicit assumption that startups are the source of innovative technologies (Dushnitsky and Lenox, 2005a).

The anomaly motivates us to explore plausible explanations for CVC activities in the Chinese setting. The next section presents three explanations based on previous related literature and the features of our research setting. The following sections examine which of these explanations is most plausible in light of the empirical patterns we document.

2. Corporate venture capital: generating plausible objectives

A comprehensive investigation is warranted as scholars attempt to understand incumbent-startup interaction in countries that differ greatly from previously studied settings. This section generates a set of CVC objectives and derives the inducements associated with each objective. In particular, we focus on three plausible explanations of CVC activities in the Chinese setting: (a) 'Window on Technology'; the existing explanation that is dominant in the CVC literature, (b) 'Harness Economic Growth'; an explanation that has been present, even in the Western context, yet which has been neglected in the literature of the past couple of decades, and (c) 'Government Directive'; a new explanation that has not been discussed in prior CVC work but is appropriate for more centralized developing countries, such as China. To further establish the underlying mechanisms, we discuss not only the direct association between industry factors and CVC activity, but also consider industry-level attributes that affect these factors.

2.1. Industry technological advance and CVC activity

The pace of technological advance shapes the performance and actions of firms within each industry. The concept of technological advance is inspired by Solow's (1957) seminal work, which views growth in an industry's total factor productivity (TFP) as a manifestation of technological advance (Crafts, 1996; Terleckyj, 1980; Schilling and Steensma, 2001; Sahaym et al., 2007). TFP captures productivity gains due to new technologies, as well as improvements in operational and managerial practices. The effect on incumbents is twofold: it erodes current capabilities and creates opportunities that often arise in the form of innovative startups.

When a focal industry experiences rapid technology advances, the advantage of a firm's resource base quickly erodes. This, in turn, motivates established firms to search for new resources (Lavie, 2006). Moreover, the threat associated with technological advance is amplified because of the inherent uncertainty faced by all industry players. Accordingly, several studies argue that incumbents employ flexible search strategies, such as CVC, to replenish their capability base. These arguments are grounded in analyses of U.S.-based data; using either a firm-level study of Fortune 500 firms (Basu et al., 2011), or an industry-level analysis of all U.S. manufacturing industries (Sahaym et al., 2010).

The emergence of novel technologies also brings about business opportunities. Schilling (2000) explains that rapid technological advance generates novel knowledge in both the supply and demand sides of an industry. Entrepreneurs play an important role in developing novel knowledge and transforming it into profitable products and services (Aghion and Tirole, 1994; Hicks and Hegde, 2005; Braunerhjelm et al., 2010). That is, entrepreneurial ventures pursue technology-based growth. To that end, they are often funded by venture capitalists (Florida and Kenney, 1988). Dushnitsky and Lenox (2005a) and Da Gbadji et al. (2015) find that incumbent firms are more likely to pursue CVC in settings that experience technological advance. Namely, incumbents fund innovative startups to gain a 'window on technology' and subsequently capture the commercial opportunities that the technologies enable.

The CVC literature exploits the availability of patent data to substantiate this line of inquiry (Table 1). For example, Dushnitsky and Lenox (2005a) and Wadhwa and Kotha (2006) were the first to use the NBER patent database to investigate the innovation implications of CVC investments (Hall et al., 2001). They find the incumbent firms exhibit a positive association between CVC investment and subsequent innovation. These early studies have charted the way for numerous subsequent studies that used patent-based measures and advocated the innovation orientation of CVC activity (e.g., Sahaym et al., 2010; Alvarez-Garrido and Dushnitsky, 2016; Wadhwa, Phelps, and Kotha, 2016; Mohammadi and Khashabi, 2021). Table 1 is an overview of these works and illustrates the focus on R&D or patent measures; a practice that engrained the view of CVC as solely driven by an innovation objective. The focus on patent measures runs the risk of nurturing a myopic view of CVC's objectives. Below, we avoid such a myopic view and shift to consider a broader set of CVC objectives and the industry inducements associated with them.

In sum, extant work reports a positive association between industry technological advance and CVC investments in that industry. Notably,

[3] Table 1 lists numerous empirical studies using patent data to advocate the 'window on technology' view. A few influential studies advocated this view using text analysis-based measures (e.g., Maula, Keil and Zahra, 2013).

[4] 'The 2019 Global CVC Report.' (www.cbinsights.com/research/report/corporate-venture-capital-trends-2019)

these findings are based on U.S. data. A common assumption underlying these studies is that new ventures have higher marginal R&D productivity than incumbents (Dushnitsky and Lenox, 2005a); arguably because the former possess some disruptive technologies (Tushman and Anderson, 1986; Aghion and Tirole, 1994). This is a critical assumption that may not hold in other settings. As noted earlier, there is evidence that, outside the U.S.A., startups pursue market-based rather than technology-based growth (Bruton et al., 2018; GEM, 2018). For example, Minniti and Lévesque (2010) report that startups in emerging markets are not the source of novel inventions. Rather, they are especially active in transforming existing inventions into new products and fulfilling the growing demand in their respective industries.

2.2. Industry expansion and CVC activity

Another important industry characteristic is environmental munificence; namely, the extent to which an industry experiences dramatic growth in consumption and sales. A munificent industry provides firms with more resources and opportunities to expand (Aldrich, 1979; Dess and Beard, 1984; Rosenbusch et al., 2013). In such environments, firms will have a higher prospect of future growth and become risk-taking while exploring new initiatives (Barreto, 2012; Rosenbusch et al., 2013). Extant studies examined two mechanisms through which environmental munificence can induce established firms to engage in external search strategies, such as CVC.

First, environmental munificence represents a strong signal of abundant opportunities for future growth. As consumption and sales increase rapidly, managers are more confident and thus proactively explore growth opportunities (Karim et al., 2016). For example, Alessandri et al., (2012) draw on real-option theory and suggest that the rapid industry growth indicates “shared options” for all firms within it. The availability of these “shared options” could drive incumbents to invest in options for future growth (Smit and Trigeorgis, 2004). Moreover, Barreto (2012) illustrates that industry growth attracts the attention of the top management team and stimulates further investments in the industry. In short, firms are more likely to explore market-based growth opportunities—and fund the startups that pursue them—in munificent industries.

Second, munificent industries could create slack resources; such that incumbents have the flexibility to conduct external explorations (Rosenbusch et al., 2013). Searching in unfamiliar areas is associated with substantial cost and uncertainty. To the extent that a munificent industry presents incumbents with abundant resources and less competition, it enables them to allocate resources to explore emerging technologies and experiment with new initiatives (Sahaym et al., 2010).

To conclude, prior work suggests that industry munificence stimulates incumbents to conduct an external search by funding innovative startups. The literature points to two distinct effects of industry munificence: it either endows incumbents with more resources, which they direct to pursuing technology-based ventures; or it may be associated with market-based startup opportunities. Studies based on U.S. contexts mainly support the former view. Specifically, industry munificence has no direct effect on CVC activities and only a moderating impact on the relationship between industry R&D intensity and CVC activities (Sahaym et al., 2010). These findings indicate a ‘window on technology’ objective where CVC serves as a strategy to learn from technology-based startups. Alternatively, in contexts where startups conduct consumption-based growth, incumbents can capture market opportunities by investing in startups. Hence, incumbents follow a ‘harness economic growth’ objective where a strong R&D base is not necessary for CVC activity. Table 2 compares the different views of CVC objectives.

2.3. Moderators of CVC activity: industry R&D intensity and strategic priority industries

The discussion above highlights two different views of the strategic objectives of cvc. it indicates that cross-industry variation in cvc activity is associated with variation in industry-level technological advance and environmental munificence. the precise association can shed light on cvc objectives. to discern those objectives, we incorporate two additional factors that are known to moderate these associations. One factor reflects a bottom-up aggregation of firms’ R&D intensity in a focal industry; while the other captures top-down government policies and prioritization of specific industries.

First, consider the R&D intensity in a given industry. This denotes the share of resources that incumbent firms allocate to R&D. Some industries are characterized by high R&D intensity (i.e., firms undertake significant R&D expenditures). In contrast, other industries exhibit lower intensity (i.e., firms spend little or nothing on R&D). Notably, this factor departs from the previously discussed technological advance in several ways. First, R&D intensity reflects firms’ allocation of inputs that are directed towards building a knowledge base. In contrast, technological advance refers to realized total factor productivity (TFP) gains (i.e., the ratio of outputs to all inputs, including R&D expenditures as well as the cost of raw materials, employees, and so on). Second, industry R&D intensity captures firms’ efforts to develop new and existing technologies; yet it does not cover other viable sources of technological advance, such as non-firm R&D (e.g., university research and improvements in managerial practices).

The impact of environmental factors can interact with the knowledge base of a focal industry. In particular, the technology-based view would predict that industries where R&D intensity is high would exhibit an even stronger positive association between technological advance and CVC activity. This is because previous R&D activities strengthen established firms’ search and use of external technologies (Cohen and Levinthal, 1990). For example, Dushnitsky and Lenox (2005a) suggest that a strong internal R&D base increases incumbents’ ability to recognize and absorb novel knowledge from technology-based startups. The greater the accumulated knowledge, the more firms are inclined to explore and absorb new technological opportunities by investing in new ventures. A complementary argument emphasizes the attractiveness of incumbents’ knowledge base (Basu et al., 2011). A strong knowledge base implies that corporate investors are attractive to technology-based startups because they can better understand and support nascent ventures. This means that high-quality startups will flock to CVC investors, which in turn induces established corporations to engage in CVC investments.

Next, consider the top-down role of government policy. The government-based view recognizes that CVC investments may follow national directives. Governments across the globe often launch policies to catapult and prioritize specific industries. Developing countries have adopted this approach to catch up with developed economies (Hirschman, 1958; Gerschenkron, 1962). For example, in our research setting the Chinese government put forward the “strategic emerging industry” plan in 2010 to prioritize the development of specific industries (Prud’homme, 2016). In those industries, technological innovation is regarded as a key impetus to development, and national and local governments direct and support entrepreneurship and venture capital activities within them (Prud’homme, 2016). Established firms may follow an explicit directive and engage in CVC investment. Alternatively, the increase in CVC may simply reflect that supportive government policies stimulate entrepreneurial activity in those industries and thus create many attractive investment opportunities for corporations (Da Gbadji et al., 2015). In other words, the government-based view suggests that industries of national priority would show a stronger association between technological advance and CVC activity.

A final observation is that market-based CVC activity would exhibit minor sensitivity to the moderators. Recall that market-based growth refers to a rapid increase in consumption and overall industry expansion. In contrast to technology-driven growth, the expansion is usually fueled by population size, growth in per capita income, and related growth in consumption. This pattern is typical of many developing countries. The discussion informs the inferences we can make about CVC objectives. If

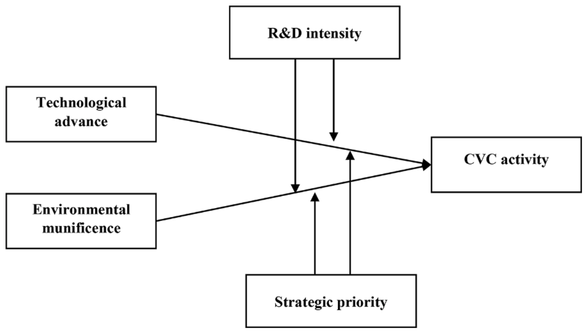


Fig. 1. Industry Factors and CVC activity

one observes that CVC activity is associated with munificence but not moderated by proxies of incumbents' knowledge, then it is unlikely to be induced by a 'window on technology' objective. Rather, the patterns are more consistent with a market-based view and a 'harness economic growth' objective. A similar inference can be applied to the second moderator. If CVC investment patterns are associated with industry munificence but not moderated by national strategic priorities, it is unlikely that the patterns reflect a 'government directive' objective (Table 2). Rather, the patterns are more consistent with a market-based view.

Fig. 1 depicts the likely interaction between these industry characteristics and CVC activity. Table 3 derives insights into CVC objectives.

In summary, past works explored the factors driving incumbents to fund entrepreneurial ventures. By and large, the works conclude that CVC is undertaken as a strategy to gain a 'window on technology' by backing technology-based startups. At the same time, it is important to note that these insights are calibrated on investment patterns in Europe and the U.S. and capture the period of the late 1990s to early 2000s. As noted earlier, other parts of the world may be characterized by entrepreneurial ventures—and incumbent firms—that are driven by different objectives. Therefore, we conduct an additional inquiry that explores a broader set of CVC objectives: technology, market, and government-based objectives. To that end, we focus on the second-largest country in terms of GDP, China, which is known to be a hotbed for startups and is also home to some of the most prolific CVC investors (Breznitz and Murphree, 2011; Huang et al., 2015; Eesley, 2016; Lewin et al., 2016). We ask: What explains cross-industry variation in CVC activities in China? What does it tell us about the key drivers of and strategic rationale for Chinese corporate venturing?

3. Context: China's economic and entrepreneurship growth

A large body of work details the rise of China and its entrepreneurial ecosystem. Rather than replicating the discussion, we highlight a few observations below. This section reviews the economic expansion, technological progress, and the role of the government in the rapid development of entrepreneurship and the venture capital market in China. These attributes make the Chinese market an attractive place for corporate investors. At the same time, the nature and scope of innovation in China remain fundamentally different from that in the U.S.A. (Bruton et al., 2018). Hence, the Chinese market is an ideal context to study a broader set of CVC antecedents.

First, the Chinese economy experienced dramatic growth over the past couple of decades. The domestic market is home to a large population. During the period 2009 to 2018, per capita disposable income in China almost tripled (from 10,978 to 28,228 RMB).[5] These factors resulted in a demand surge across many industries. The economic munificence led to a parallel growth in entrepreneurship and venture capital activities as entrepreneurial ventures sought to serve and profit from the surge in demand. For instance, Alibaba, the digital retailing platform founded in 1999, facilitated total sales of 268 billion RMB (around $38.4 billion) in just one day (the "double 11" shopping festival of November 11, 2019); around five times the aggregate sales volume of "Black Friday" in the U.S.A. These factors, and the enormous mobile phone market (Jin and von Zedtwitz, 2008), stimulated entrepreneurial activity in digital retailing as well as other industries, including education, health and financial services.[6] The growth is not limited to digitally orientated sectors, as China is also the world's largest market for a range of products, such as automobiles, electronic devices, and films. At the end of 2018, consumption was the primary driver of the Chinese economy, contributing 76.2% of GDP growth.

Second, Chinese entrepreneurs embrace innovative technologies but focus less on pioneering new technologies. Historically, the government led investments in technological innovation and infrastructure (e.g., roads and wireless broadband). Similar to other developing economies, such as India, Brazil, and Malaysia, only a small fraction of the local startups develop breakthrough innovations (GEM, 2018). Rather, most entrepreneurial ventures utilize and customize existing technologies and deploy them in the domestic market. They often rely on knowledge transfer from multinational corporations and returnee entrepreneurs to that end (Kenney et al., 2013). Recent Chinese statistics echo these observations; established firms are the main drivers of technological innovation, with only a third of novel innovation outcomes originating in startups.[7] This pattern is rooted in historical reasons, when startups lacked the resources and talent necessary to develop new-to-world innovations (Lu and Tao, 2010).

Finally, the recent decade has seen a deliberate effort by the Chinese government to cultivate entrepreneurship. Through a set of directives and policies, the government emphasized the advantages of entrepreneurship. A big push towards that end took place during the mid-2010s, as reflected in the words of Premier Li's speech at the 2014 summer Davos meeting:

"Just imagine how big a force it could be when the 800 or 900 million laborers among the 1.3 billion population are engaged in entrepreneurship, innovation and creation. I believe the key to realizing that is to further liberate our mind, further liberate and develop the creativity of society, further energize businesses and the market, and remove all institutional obstacles to development so that everyone interested in starting a business is given more space for entrepreneurship and the blood of innovation could flow unhampered."

A number of policies and governmental directives followed in 2016. Their goal was to remove institutional and structural obstacles to entrepreneurship. The policies were aimed at cultivating the market for venture capital, which originated in China during the middle of the 1980s and remained under-developed through most of the following years (Breznitz and Murphree, 2011).

In sum, it is the policy reform, combined with demand growth and technology and mobile penetration, that are the impetus for the development of a professional venture capital market in China (Eesley, 2016;

[5] The data are extracted from China Statistical Yearbook (2019).

[6] For example, in mid-2020, China had 381 million online education users, 276 million online medical treatment users, and 802 million mobile payment users. (www.chinadaily.com.cn/a/202011/23/WS5fbae8-c0a31024ad0ba95ae4.html)

[7] The data are extracted from China Statistical Yearbook on Science and Technology (2019).

Table 4
Top CVC Industries*

SIC code	Industry description	CVC intensity	Notable CVC investors
5961	Catalog and Mail-Order Houses	22.75	JD.Com, Vipshop
7370	Computer Programming, Data Processing, and Other Computer Related Services	15.12	Tencent, Alibaba
3944	Games, Toys, and Children's Vehicles, Except Dolls and Bicycles	14.8	Rastar Group, Alpha Group
2711	Newspapers: Publishing, or Publishing and Printing	9.75	Huawen Media, Zhejiang Daily Digital
8200	Educational Services	8.56	Tal Education Group, New Oriental Ed and Tech
7812	Motion Picture and Video Tape Production	6.43	Beijing Enlight Media, Huayi Brothers Media
4812	Radiotelephone Communications	6	China United Telecommunication
5140	Groceries and Related Products	5.75	Baofeng Group
3711	Motor Vehicles and Passenger Car Bodies	5.61	Saic Motor Corp, Baic Motor Corp
5700	Home Furniture, Furnishings and Equipment Stores	5.5	Suning.Com

* In this table, we list the top 10 industries with most active CVC activities across 2013-2017. CVC intensity is calculated as the total CVC investment rounds of all firms in the industry during 2013-2017 divided by the number of unique firms in the industry. We only list the industries with 3 firms or more.

Cong et al., 2018).[8] In that context, incumbent firms may view CVC as a productive way to comply with policies and capture entrepreneurial opportunities. Table 4 lists notable examples of CVC investors across a range of industries.

4. Methods

We study CVC activity in China, the second-largest venture capital market in the world. To the best of our knowledge, there is no work on the topic. Hence, we overview CVC activity in China and present analyses at the industry level; studying cross-industry variation in CVC activity.

The decision to present industry-level analyses was guided by the following reasons. First, this approach allows us to uncover cross-industry variations in CVC activity across the full range of industries in the Chinese economy. Therefore, our research design provides flexibility in testing the 'Window on Technology' objective delineated in previous literature, as well as exploring the 'Harness Economic Growth' and 'Government Directive' objectives discussed in our study. To see this, consider that previous CVC studies in the U.S. context focused on hi-tech industries such as the ICT sector (i.e., semiconductor, computer, telecommunication) and the pharmaceutical sector. In contrast, we observe that CVC activity in China takes place across a wider and different set of industries (see Table 4).

Second, the industry-level approach maps onto the realities of the CVC objectives we investigate. Each of the three explanations has to do with an industry-wide factor that induce incumbents to invest in startups; (i) industry-wide technological ferment driving incumbents to back innovative startups to learn from them, (ii) industry-wide munificence that induce incumbents to harness startups for further growth, or (iii) government directive to develop certain industries which stimulates incumbents to fund startups. Consider the latter; 'Government Directive' objective. Because the directive is at the level of the industry, it lends itself to industry-level analysis. Similarly, the objective 'Harness Economic Growth' refers to the growth in consumption and economic activity in specific industries. Hence, it lends itself to industry-level analysis.

Finally, industry-level analysis is informed by seminal studies in the venture capital literature (e.g., Gompers et al., 1998; Kortum and Lerner, 2001; Sahaym et al., 2010). This approach captures the general drivers, while minimizing the effects of idiosyncratic firm factors. In other words, we recognize that some firms may disburse more funds than their industry peers for idiosyncratic reasons (e.g., geographical location, political connectedness). By aggregating analysis at the industry level, we can focus on general economic and technological conditions that motivate incumbents to engage and fund startups.

In line with the abductive approach (Behfar and Okhuysen, 2018), our study is facilitated by a major data effort that entails new data and measures. A comprehensive, cross-industry panel of CVC activities was constructed by integrating information from five major databases (see Data and Sample sections for details). Our abductive analytical approach adopts a large-N study (Gelman and Imbens, 2013; Lyngsie and Foss, 2017; Behfar and Okhuysen, 2018; Sætre and Van de Ven, 2021). It is a quantitative approach that distills key facts from a comprehensive dataset in search of the most plausible explanation. In other words, the approach does not attempt to estimate "effects of causes", but rather seeks to understand the "causes of effects" with statistic models. This approach is increasingly common in strategy research (Mantere and Ketokivi, 2013; Claussen et al., 2015; Birhanu et al., 2016). It follows that our study is positioned at the mid-point between the testing of specific hypotheses and an open-ended, exploratory contribution.[9] In line with Gelman and Imbens (2013), Behfar and Okhuysen (2018) and Sætre and Van de Ven (2021), we engage in model checking and hypothesis generation.[10]

We adopted a regression specification closely related to Sahaym et al. (2010) because of its flexibility. The specification allows us not only to test for the prevailing 'window on technology' view, but also to compare and contrast views of CVC activity using the logic delineated in Table 3. We adopted and developed the specification by retaining the industry-level proxies for (i) technological ferment, (ii) industry growth and munificence and, (iii) R&D intensity, as well as adding a proxy for national strategic priorities.

Building on the insights in Table 3, we illustrate how the different objectives map onto distinct empirical patterns. The left-most column depicts a technology-based view. Following the CVC literature, established firms turn to entrepreneurial ventures when their industry experiences technological ferment (Dushnitsky and Lenox, 2005a, 2005b; Sahaym et al., 2010; Basu et al., 2011). Moreover, a strong base in innovation, as proxied by R&D expenditure, is necessary to assimilate the technologies and benefit from CVC activity. Because the focus is on novel technologies and the absorptive capacity to assimilate them, the prevailing 'window on technology' view does not expect firms to deploy CVC in response to a general, non-tech-based surge in consumption.

Using this specification, we can also expand the conversation and

[8] Both the fundraising and exit channels for VC investments in China were under-developed in early times (Armanios et al, 2017). The 2016 policies were aimed at expanding those channels. Detail measures are available at: http://english.www.gov.cn/policies/latest_releases/2016/09/20/content_281475446836280.htm

[9] The latter is associated with qualitative small-N research design common in inductive studies (Eisenhardt, 1989).

[10] Gelman and Imbens (2013) explain that extant work undertakes a forward causal inference and further highlight the distinct nature of reverse causal questions: "Forward causal inference is about estimation; reverse causal questions are about model checking and hypothesis generation." (page 2). Accordingly, we undertook a model checking approach whereby we start off with an extant model (e.g., Sahaym et al., 2010). As noted in the next paragraph, we do not merely replicate the model. Rather, we use it as a bridge, as we first test the prevailing explanation, then proceed to a set of new explanations.

Table 5
Basic information on the five databases used in this research*

Database	CVsource	PEdata	ITjuzi	ThomsonOne	CapitalIQ
Founding year	2008	2000	2013	1960s**	1998
Publisher	China Venture Group	Zero2IPO Group	Suiyue Juzi Tech	Thomson Reuters	SandP Global
Coverage Focus	Focused mainly on China-based ventures and only those funded by China-based investors	Focused mainly on China-based ventures and only those funded by China-based investors	Focused mainly on China-based ventures and only those funded by China-based investors	Focused mainly on China based investors, irrespective of location of venture	Focused mainly on China based investors, irrespective of location of venture
Coverage Scale***	Lists 7,978 unique investors and 21,756 unique ventures	Lists 14,130 unique investors and 37,991 unique ventures	Lists 6,078 unique investors and 29,098 unique ventures	Lists 14,356 unique investors and 85,896 unique ventures	Lists 90,953 unique investors and 139,158 unique ventures
Language	Chinese	Chinese, English	Chinese	English	English
Main clients	Chinese VC, LP, government, etc.	Chinese VC, LP, Government, strategic investors, etc.	Chinese Internet industrial practitioners	Global financial community	Global financial community

* Information correct as of 27/05/2018.
** The history of Thomson Reuters was displayed in the website www.thomsonreuters.com/en/about-us/company-history.html, while no exact founding year was disclosed.
*** In order to compare these five databases, we collected the investments of five databases in 1998-2017 and cleaned the investor and venture lists to count these numbers.

consider other objectives. Consider the alternative market-based view. The focus is on industry munificence, which takes place irrespective of technological advance and may arise due to population, social, or economic factors (Porter, 1990). To the extent that the growth is not technologically driven, it is appealing even where a strong base in innovation is absent. The middle column of Table 3 captures this pattern. Finally, the right-most column describes the third, government-based, view. We recognize that industry munificence can be driven by economic policies. As discussed below, we are mindful that political considerations may be relevant in the Chinese context, which is characterized by a strong central administration (Yiu et al., 2014; Greve and Zhang, 2017; Zhou et al., 2017). To the extent that the dominant mechanism for CVC in China is 'government directive,' we should observe that the effect of technological ferment is moderated by industries of strategic priority. If, however, there is evidence of the munificence main effect but no interaction with strategic priority, then a market-based view seems warranted.

5. Data and sample

We construct a proprietary dataset of CVC activity across all major industries during the period 2013-2017. Our dataset includes financial and investment information for all Chinese public firms, including CVC-investing firms and their industry peers. The dataset is unique in that it requires the integration of five different sources of CVC investment, as well as financial information on Chinese firms that are publicly listed in mainland China, Hong Kong and the U.S.A. Because our goal is to explore cross-industry patterns of CVC activity, the analyses are conducted at the industry level (i.e., based on the Standard Industrial Classification (SIC)).[11]

We focus on CVC investment from 2013 onwards because it is regarded as a watershed moment for the Chinese economy. It is around the time that the Chinese government coordinated a major emphasis on entrepreneurship and marks the beginning of a vibrant period of entrepreneurship and VC activity. Moreover, a large proportion of Chinese public firms reports R&D investment only from 2012; hence, our time period enjoys complete data coverage. Finally, our approach is consistent with prior work that focused on periods of substantial CVC activity (e.g., Gaba and Meyer, 2008; Sahaym et al., 2010; Dushnitsky, 2012).

Industry and Firm Data. During our time-period, some notable China-focused firms chose to list on more mature stock exchanges in Hong Kong and the U.S. For example, among three of the leading Chinese digital platforms, Baidu and Alibaba were publicly listed in the U.S. (on the NASDAQ and NYSE, respectively), while Tencent was publicly listed in Hong Kong (on HKEX). It follows that studying only firms listed on Chinese exchanges could result in an omission error. To secure full coverage of all major Chinese CVC-investing firms, we undertook a comprehensive approach to data collection. That is, we collected information for every publicly listed firm that is headquartered in China, irrespective of the stock exchange on which it is listed.

The result was a major data collection effort whereby we amassed data for China-based public firms across five stock exchanges in three regions: (1) mainland China: Shanghai Exchange (SHSE) and Shenzhen Exchange (SZSE); (2) Hong Kong: Hong Kong Exchange (HKEX); and (3) the United States: New York Exchange (NYSE) and NASDAQ. We began

[11] The decision to use SIC codes was motivated by granularity, compatibility, and coverage. As for granularity, the official industry classification of Chinese public firms is based on a 2-digit GB code, which includes only 63 unique industries. By using data from the 4-digit SIC, there are 286 unique industries in our sample. Next, consider compatibility. Our study aims to inform the CVC literature, which utilized Western industry classifications such as SIC and NAICS (Sahayan et al., 2010; Da Gbadji et al., 2015). By using the same classification scheme, we are able to present findings that are based on a similar unit of analysis and level of granularity. This increases the compatibility with prior work. Finally, as for coverage, our sample consists of publicly listed firms in mainland China, as well as Chinese firms listed in Hong Kong and the U.S. (e.g., Alibaba, TAL, and Baidu). For the public firms listed in Hong Kong and U.S., we could not find a GB code either through CSMAR/WIND databases or the China Security Regulatory Commission (CSRC). Hence, we obtained SIC codes using the COMPUSTAT database.

Table 6
Number of CVC investments across databases during 2013-2017*

	CVsource	PEdata	ITjuzi	ThomsonOne	CapitalIQ	Integration
2013	70	139	139	13	30	222
2014	137	313	387	25	66	532
2015	263	638	809	39	156	1094
2016	246	571	720	24	106	998
2017	249	431	516	38	118	725

* In this table we only count the CVC deals of public firms within the sample industries of this study.

by identifying all the firms listed on these exchanges, then focused only on the firms headquartered in mainland China. We further excluded firms in the real-estate and financial sectors (SIC 6000 to 6999).

Accounting and financial information were predominantly collected through the COMPUSTAT international database. To complement COMPUSTAT, we also used two Chinese databases, CSMAR and WIND. These are mainstream financial data providers in China and have been frequently used in prior work (e.g., Greve and Zhang, 2017; Zhou et al., 2017). Finally, we verified the information by cross-checking the data with the annual report of the firms and further supplementing some missing data (e.g., R&D investment, employee number). The final database covers 3,298 publicly listed, China-headquartered firms across 286 industries.

Corporate Venture Capital Data. CVC investment data was gathered from five different databases; two international VC databases (ThomsonOne and CapitalIQ), and three Chinese databases (CVsource, PEdata, and ITjuzi). Table 5 summarizes the key attributes of each database. CapitalIQ and ThomsonOne[12] are frequently used in VC and Private Equity (PE) research in international contexts (Dushnitsky and Lenox, 2005a; Davis et al., 2014; Kaplan and Lerner, 2016; Röhm et al., 2020).[13] However, the two databases have only limited information for Chinese VC firms. As a result, we collected data from three prominent Chinese databases. PEdata and CVsource are the two longest-standing VC databases in China, launched in 2000 and 2008, respectively. Many of the prior studies are based on these databases (e.g., Gu and Lu, 2014). The third Chinese database, ITjuzi, launched in 2013, focuses on VC investments in the IT industry.

To identify CVC investors, we undertook an intense, five-step data collection procedure. The procedure is described briefly below; Appendix B provides further details. Our study does not rely on the CVC designation provided by the individual databases. This is because each of the five databases uses different criteria to identify corporate investors. Moreover, their CVC categories do not necessarily capture all CVC activity. Consider, for example, the coverage of Alibaba in CapitalIQ. The CVC investments of Alibaba appear under three different entities: “Alibaba Capital Partners”, “Alibaba.com Limited”, and “Alibaba Group Holding Limited”, and it is only the former (“Alibaba Capital Partners”) that is included in the “Corporate Investment Arm” category. If we were to count only the investments of Alibaba Capital Partners, we would have missed about 38% of Alibaba’s venture capital investments.[14]

To avoid such errors of omission, we undertook the following procedure. Per extant work, we defined an investor as a CVC if it was an industrial company or the affiliated sub-unit (such as a wholly-owned subsidiary or a majority-owned subsidiary) of an industrial company (Maula, 2007; Dushnitsky, 2012; Da Gbadji et al., 2015). We used the definition to identify CVC investors in each database. Specifically, we first collected all the venture capital/private equity (VC/PE) investments recorded in each database through the end of 2017. Second, for every database we generated a complete list of all investors, and for each investor we recorded the investment rounds information. We dropped investors with less than three rounds in China. The third step included manual checks of every investor to discern whether it was a CVC investor. We searched for the main business line and shareholder information to ascertain the nature and identity of the investors, and whether they were part of an established corporation (where a match was identified, we collected financial and accounting information for the parent firm). Further, we compared our classification with the investor’s type field in the databases and ran another check to confirm whether any CVC investors were erroneously omitted. Next, we checked whether a focal CVC appeared in all five databases. This extensive process resulted in a final list of CVC investors. We believe it avoids ‘false positives’ and offers a complete and accurate list of Chinese CVCs.

Fourth, we proceeded to compile an integrated dataset for the final list of CVC investors. In particular, we gathered investment information for the CVC investors from the five databases, then merged the information and deleted duplicate records (i.e., all investment records listing the same CVC investor and venture in the same month).[15] To facilitate the integration, we constructed a ‘standardized key’ of major venture characteristics; e.g., venture’s location and industry, as well as investment stage. Finally, we restricted our sample to the China-based firms that are publicly listed in Shanghai, Shenzhen, Hong Kong, and the U.S., and their investment deals during 2013-2017. The detailed data collection and cleaning procedures are summarized in Appendix B.

In sum, our integrated dataset covers 3,298 public firms in 286 industries; of which 173 firms in 70 industries disbursed 3,571 CVC investments between 2013 and 2017. Table 6 presents a summary of the CVC investment rounds for each of the five databases.

5.1. Measures

The analysis and variables are defined at the industry level. Table 7 describes the key variables and the databases used for their construction.

[12] Thomson Reuters acquired the standalone venture capital database VentureXpert over 15 years ago. The PE/VC data was accessed as Thomson VentureXpert and then through ThomsonOne Banker module. A detailed description is available in the first paragraph of the following: www.thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/fact-sheet/private-equity-solutions.pdf.

[13] Another source of PE/VC data is Bureau van Dijk’s Zephyr database (Hain et al., 2016; Schertler and Tykvová, 2011).

[14] During 2013-2017, CapitalIQ recorded 88 investments by Alibaba, although only 55 investments were recorded under the entity “Alibaba Capital Partners”.

[15] One challenge was to reconcile conflicting investment-round information for a focal investor across different databases. For example, CVsource and CapitalIQ record “Tencent’s investment in Wangluo Tianxia” at September 2011, while PEdata records the same event at October 2011. In order to address this issue, we pooled the investments of a focal CVC. We sorted them by date and compared the investment records with same-round information (i.e. same investor and target) but different dates, as follows: (a) if the gap between two records was within 3 months, we regarded them as the same event and kept one record; (b) if the gap was 4-6 months, we manually confirmed whether they were the same event; (c) if the gap was over 6 months but recorded a similar amount, we ran a manual check; (d) if the gap was more than 6 months and recorded different amounts, we regarded them as different events and kept them as separate rounds.

Table 7
Description of key variables

Variable	Definition	Source
Dependent variable		
CVC activity	The number of CVC investment rounds divided by the number of firms in the industry. Specifically, the denominator is the number of firms in the SIC industry in year t, while the numerator is the aggregated CVC investment rounds conducted by these firms in year t+1.CVC activity = (CVC deals$_{t+1}$)/(No of Firms)(t∈{2012, 2013, 2014, 2015, 2016})	CVsource, PEdata, ITjuzi, ThomsonOne, CapitalIQ
Independent variables		
Technological Advance	The natural logarithms of industry TFP in (t-3), (t-2), (t-1), and t were put into OLS regression, with the year as independent variable. The antilog of the resulting regression slope coefficient is the proxy of technological advance in year t.	COMPUSTAT,CSMAR, Wind
Tech advance (patent)	Log (1 + total number of patents of firms in the industry in year t)	ORBIS
Environmental munificence	The natural logarithms of industry sales in (t-3), (t-2), (t-1), and t were put into OLS regression, with the year as independent variable. The antilog of the resulting regression slope coefficient is the proxy of environmental munificence in year t.	COMPUSTAT, CSMAR, Wind, Firm's annual report
R&D intensity	The total R&D investments of all firms in a given industry divided by the total sales of all firms in the industry in year t. R&D intensity = (Industry R&D investments in year t)/(Industry sales in year t)	
Strategic priority	We assign a value of 1, 0.5, or 0 to a focal 4-digit SIC industry depending on whether the 4-digit SIC industry is fully, partially, or not strategic. The strategic emerging industry variable of each SIC industry is the average strategic value of all 4-digit SIC industries it contains.	National Bureau of Statistics
Control variables		
Slack resource	Total current assets of all firms in the industry divided by the total current liabilities in year t.	COMPUSTAT, CSMAR, Wind, Firm's annual report
Average firm size	Log (total assets ($B) / number of firms in the industry) in year t.	
Industry size	Total number of firms in industry i in year t.	
Industry standard	Dummy variable: 1 if there is a separated category in SAC website administrating the activities in the industry; 0 otherwise.	SAC official website
Heterogeneity of demand	One minus output concentration ratio.	National Bureau of Statistics
Heterogeneity of input	One minus input concentration ratio.	National Bureau of Statistics
Competition	One minus market concentration ratio.	COMPUSTAT, CSMAR, Wind
SOE ratio	The percentage of SOEs in a focal industry in year t.	

Dependent variable. The dependent variable captures the CVC investment intensity for the focal industry in the year t+1. The variable CVC activity is the number of CVC investment rounds divided by the number of firms in the industry (Sahaym et al., 2010). Specifically, the numerator is the aggregated CVC investment rounds conducted by firms in the industry in year t+1, and the denominator is the number of firms in the industry in year t (t∈{2012, 2013, 2014, 2015, 2016}). If none of the firms in a focal industry engaged in CVC investment that year, the focal industry is assigned the value zero.

Independent variables. The independent variable Technological Advance is calculated as the growth in industry's Total Factor Productivity (TFP). TFP growth is a proxy for technological advance in a focal industry (Crafts, 1996; Terleckyj, 1980; Sahaym et al., 2010). To derive TFP growth data for Chinese industries, we followed extant studies. First, annual firm-level TFP was calculated using firms' financial data (İmrohoroğlu and Tüzel, 2014; Giannetti et al., 2015; Rovigatti and Mollisi, 2018).[16] We then calculated the annual industry TFP as the weighted average value of firm-level TFP weighted by the total asset of each firm in the industry (Hsieh and Klenow, 2009). Next, the natural logarithms of industry TFP in (t-3), (t-2), (t-1) and t were regressed against the year. The antilog of the resulting regression slope coefficient is the estimation of TFP growth in year t. Following past work, we use this as the main proxy of industry-level technological advance (Crafts, 1996; Terleckyj, 1980; Sahaym et al., 2010).

We created an alternative proxy of technological advance using patent data. To construct the variable tech advance (patent), we collected patent information from the intellectual property database. ORBIS traces public and private firms' patent information issued by both local and international intellectual property offices (Alkemade et al., 2015; Gopinath et al., 2017). Because our sample covers Chinese firms publicly listed in China, Hong Kong or the U.S., the coverage provided by the database is ideal for our purposes. The variable tech advance (patent) is the log of the total number of annual patent applications by firms in a given industry, plus one.

The second independent variable is environmental munificence. A munificent environment denotes an industry where sales growth is substantial and therefore generates an abundance of opportunities and resources for firms to expand (Dess and Beard, 1984). We follow Keats and Hitt (1988) and Sahaym et al. (2010)'s operationalization of this measure. Namely, we regress the natural logarithms of industry sales during the past four years, with the time trend serving as the independent variable. Next, we use the antilog of the resulting regression slope coefficient as the measurement of environmental munificence. The panel analysis utilizes sales information for the preceding four years (e.g., the analysis of CVC in 2017 employs a munificence measure based on industry sales for the years 2013-2016).

The variable industry R&D intensity is calculated as the total R&D investments of all firms in a given industry divided by the total sales of all firms in that industry [Industry R&D investments / Industry Sales]. This approach follows Keats and Hitt (1988) and Sahaym et al. (2010). We collect R&D investment from COMPUSTAT, CSMAR, and Wind databases. Together, the three databases cover R&D information for almost all the firms during 2015 and 2016, but slightly fewer firms before 2014. We supplement the information using firms' annual reports.[17]

Finally, we constructed an independent variable strategic priority to capture the role of the Chinese government in catalyzing entrepreneurship and growth in certain industries. As noted in Premier Li's speech (2014 Davos summer meeting), the Chinese government has led a major push to remove obstacles to entrepreneurship and catalyze transformation across the economy. The "strategic emerging industries" plan was introduced in 2010 to nurture a group of world-leading

[16] We adopted the Olley-Pakes (OP) method to estimate firm-level TFP, with the latest estimation approach introduced by Rovigatti and Mollisi (2018). The mean of estimated firm-level TFP value is 10.188; while the standard deviation is 1.296, which is close to other Chinese studies (e.g., Lu and Lian, 2012; Yang, 2015).

[17] The reason for doing so is twofold. First, the availability of accounting and financial data was limited through part of the time window. Second, we included publicly listed Chinese CVC investors where the parent firm may be listed on a China, Hong Kong or U.S.-based exchange. These two issues implied that there were a few cases where relevant data was missing from mainstream databases; whereas it was actually reported by the firms.

Table 8
Descriptive statistics and correlations matrix

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) CVC activity	0.18	0.88	1												
(2) Tech advance	1.00	0.02	0.05	1											
(3) Tech advance (Pat.)	4.45	2.33	0.07	0.01	1										
(4) Environ. munificence	1.19	0.27	0.23	0.26	0.05	1									
(5) R&D intensity	0.02	0.03	0.06	-0.02	0.42	0.04	1								
(6) Strategic priority	0.28	0.31	0.00	0.04	0.38	-0.01	0.41	1							
(7) Slack resource	1.63	0.81	0.00	0.00	-0.09	0.11	0.30	0.08	1						
(8) Industry standard	0.75	0.43	-0.11	0.02	0.20	-0.11	-0.10	0.14	-0.30	1					
(9) Average firm size	1.76	1.10	0.12	-0.04	0.29	-0.11	-0.19	0.02	-0.46	0.20	1				
(10) Industry size	9.86	13.68	0.07	0.00	0.54	-0.02	0.21	0.22	-0.09	0.10	0.12	1			
(11) Hetero. of demand	0.85	0.16	0.07	-0.01	-0.21	0.07	-0.10	-0.15	0.04	-0.21	-0.15	-0.12	1		
(12) Hetero. of input	0.86	0.11	0.06	0.02	0.04	0.02	0.16	0.16	0.14	-0.12	0.02	-0.01	-0.02	1	
(13) SOE ratio	0.65	0.32	0.03	-0.01	0.03	0.15	0.22	0.00	0.26	-0.20	-0.40	0.01	0.05	-0.02	1
(14) Competition	0.60	0.35	-0.03	0.02	0.49	0.00	0.18	0.15	-0.02	0.08	-0.06	0.49	-0.06	0.01	-0.01

companies in specific industries. The plan was formally outlined in the 13th National Five-Year Plan in 2016 (chapter 23). The latest strategic industry index consists of nine general categories: new-generation IT industry, high-end equipment manufacturing industry, new-materials industry, biological industry, new-energy automobile industry, new-energy industry, energy-saving industry, digital creative industry, and related services industry. The National Bureau of Statistics of China published an index in 2018 which specifies whether a 4-digit Guo Biao (GB) industry is fully strategic, partly strategic, or not strategic. We used the index to create the strategic priority variable. To that end, we created a GB-SIC correspondence dictionary at the 4-digit level. For each 4-digit SIC industry, we assigned a value of 1, 0.5 or 0 according to whether the industry is fully strategic, partly strategic, or not strategic, respectively. Finally, for each industry, strategic priority is the average strategic value of all 4-digit SIC industries it covers.

Control variables. We control for factors that could influence CVC activities. First, extant work suggests that firms with abundant resources are more likely to engage in CVC (Dushnitsky and Lenox, 2005a; Basu et al., 2011). We control for slack resources in the industry by dividing the total current assets in the industry by the total current liabilities.

Second, the complexity dimension of the industry environment may also influence firms' resource-allocation behaviors (Dess and Beard, 1984). Specifically, competition in a focal industry affects the real option value of CVC investments (Tong and Li, 2011). We calculate competition as one minus the Herfindahl Index in the industry:

$$\text{Competition} = 1 - \sum_{1}^{N} \left(\frac{\text{Sales of firm i}}{\text{Total sales of all N firms in the industry}} \right)^2$$

Similarly, others have illustrated that the heterogeneity of industry may influence firms' incentive to form external relationships, such as alliances and CVC investments (Schilling and Steensma, 2001; Sahaym et al., 2010). To this end, we control for the heterogeneity of demand and heterogeneity of input of each industry. Per Dess and Beard (1984), we calculate the heterogeneity in demand as one minus output concentration ratio:

$$\text{Heterogeneity of demand} = 1 - \frac{\sum_1^n (\text{Output amount to industry i})^2}{\left(\sum_1^n (\text{Output amount to industry i})\right)^2}$$

The heterogeneity in input is calculated as one minus input concentration ratio:

$$\text{Heterogeneity of input} = 1 - \frac{\sum_1^m (\text{Input value from industry i})^2}{\left(\sum_1^m (\text{Input value from industry i})\right)^2}$$

The input-output data of each industry is collected from the National Bureau of Statistics website.[18] We adopt the input-output table in 2012 to calculate the variables for this study (we also used the table in 2017 as a double-check and obtained similar results).

Finally, we control for the average firm size in a focal industry. We divide total firm assets in an industry by the number of firms, then take the log of this value. We also use the total number of firms in the industry as the proxy of industry size. Moreover, industry standards can serve as a foundation for cooperative explorations (Schilling and Steensma, 2001). Hence, we construct the variable industry standard, operationalized as a dummy variable (1, 0) to demonstrate whether there is a specific category of standards in the Standardization Administration of China (SAC) administrating the activities in the focal industry. We also follow extant studies in the Chinese context to control for the institutional development level of each industry (Zhou et al., 2017). The variable SOE ratio captures the percentage of state-owned enterprises (SOEs) in each industry, where SOEs are defined as firms controlled by the state or a state-owned firm (i.e., the state is the ultimate owner) (Greve and Zhang, 2017; Jia et al., 2019).

5.2. *Econometric approach*

We employ panel data at the industry level. Our data offers comprehensive coverage of CVC activities across all Chinese industries between 2013 and 2017. We estimate a Tobit analysis because our dependent variable, CVC activity, has a minimum value of zero (the number of CVC investment rounds does not take a negative value). Specifically, we adopt a random-effects Tobit model. The reasons are twofold. First, we aim to understand CVC activity across all industries in China. To that end, we gain insights by investigating not only the industries that did experience CVC activity, but also those that did not.[19] A random-effects model allows us to realize this objective; whereas a fixed-effects model would force us to drop industries with no variation in CVC intensity (e.g., industries with no CVC investment). Second, the estimates of an unconditional fixed-effects Tobit model is biased due to a downward bias in the variance parameter (Greene, 2004; Stata[20]). Therefore, recent works report a random-effects Tobit specification (e.g., Benner and Ranganathan, 2012; Moeen et al., 2013; Li et al., 2018). We follow this practice and use a random-effects Tobit panel model in

[18] http://data.stats.gov.cn/files/html/quickSearch/trcc/trcc06.html

[19] Analysis of the population of Chinese industries makes full use of all the information in our empirical setting. That is, our analysis exploits variation across 100% of Chinese industries, rather than focusing solely on the 70 industries (25%) that did experience CVC activity. Put differently, there are valuable insights to be gained by understanding the characteristics of the 216 industries where CVC did not materialize.

[20] www.stata.com/manuals13/xtxttobit.pdf

Table 9
Tobit panel regression analysis based on five individual databases and the integrated dataset

	CVsource		PEdata		ITjuzi		ThomsonOne		CapitalIQ		Integrated dataset	
Variables	Model A1	Model B1	Model A2	Model B2	Model A3	Model B3	Model A4	Model B4	Model A5	Model B5	Model A6	Model B6
Technological advance	11.963**	15.681**	1.027	-4.870	8.853	7.887	-6.830	2.563	0.462	-1.103	12.086†	10.65
Environmental munificence	-1.260*	-2.234**	0.539†	0.758†	1.144***	1.049*	0.123	-1.577	0.436**	0.252	1.129**	1.084†
Technological advance × R&D intensity		221.074		308.340		108.519		-329.372		-6.856		212.536
Technological advance × Strategic priority		-37.684†		2.834		-3.658		-2.774		11.406		-9.89
Environmental munificence × R&D intensity		7.850		2.696		26.592		7.827		15.202		27.743
Environmental munificence × Strategic priority		2.635†		-2.851*		-3.884**		3.147		-2.229*		-4.295**
R&D intensity	2.386	-225.238	1.518	-307.479	2.647	-132.639	5.423	324.980	1.236	-7.547	3.419	-236.503
Strategic priority	0.958*	35.570†	0.740	1.207	0.800	8.991	1.785†	1.012	0.049	-8.822	1.183	16.074
Slack resource	0.013	-0.008	0.358*	0.359*	0.304	0.285	0.126	-0.002	0.144	0.124	0.38	0.365
Industry standard	-0.768*	-0.676*	-0.709†	-0.678†	-0.958†	-0.890†	-0.343	-0.457	-0.231	-0.205	-0.936†	-0.862
Average firm size	0.323**	0.322**	0.846***	0.796***	1.073***	1.044***	0.565*	0.563	0.342**	0.302**	1.231***	1.199***
Industry size	0.025***	0.023**	0.032**	0.031**	0.033*	0.029*	0.022†	0.025	0.018**	0.017**	0.047**	0.044**
Heterogeneity of demand	1.399	1.367	2.843*	2.852*	3.680*	3.658*	2.099	2.190	2.758*	2.711*	4.612*	4.596*
Heterogeneity of input	-1.228	-1.283	1.820	1.680	2.832	2.685	-2.504	-2.608	1.012	1.025	2.796	2.606
SOE ratio	0.349	0.310	0.569	0.466	1.051†	1.015	0.681	0.681	0.408	0.319	1.104	1.033
Competition	0.471	0.487	0.748	0.694	1.107*	1.150*	0.394	0.429	0.910*	0.878*	1.214†	1.278*
Constant	-14.22**	-16.71**	-11.59*	-5.65	-23.06***	-21.82*	0.71	-6.69	-7.87†	-5.86	-28.14***	-26.46**
Number of observations	1357	1357	1357	1357	1357	1357	1357	1357	1357	1357	1357	1357
Log likelihood	-235.398	-231.096	-497.347	-494.371	-544.207	-539.674	-64.682	-64.071	-137.087	-134.401	-672.756	-668.714
Chi-square	38.071	45.218	54.191	60.226	76.906	86.487	9.794	5.348	31.474	35.073	77.536	85.243

† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

main analyses.[21]

The next section reports two sets of analyses: (a) estimating the same regression specification across each of the individual databases; and (b) estimating the specification using the integrated dataset of CVC activities.

6. Results and analysis

Table 8 presents the descriptive statistics and correlations matrix. The average CVC intensity is 0.18. It has substantial variation; many industries record zero CVC activity, while the maximum intensity is over 15. Some significant correlations between variables may raise concerns about multicollinearity. The results are robust to the removal of highly correlated variables.

6.1. Comparing results across the five VC databases

The first objective of this study is to establish the generalizability of CVC analysis across different databases. We examine whether the results are sensitive to the choice of a data provider. We estimated a Tobit regression specification for each of the databases individually. That is, the dependent variable is constructed using CVC information from a single VC database, while the independent variables draw on financial and accounting databases that are common across the regressions. We are well aware that this design may give rise to spurious results. Our goal in comparing the results across the five databases is to underscore the nature and magnitude of this effect.[22] It further serves the goal of motivating the need for an integrated dataset.

We observe notable discrepancies across the databases (Table 9). Models A1 through A6 report the main effects of the key independent variables. Models B1 through B6 add the interaction effects. Consider the direct main effects reported in Model A. The coefficient of technological advance is positive and significant in the analyses based on integrated dataset and CVsource, while it is not statistically different from zero for the other four databases. In contrast, the effect of environmental munificence is positive and significant in the analyses based on the integrated dataset and the other three databases (PEdata, ITjuzi, and CapitalIQ), yet it is not significant in the ThomsonOne analysis and is significantly negative in the results from CVsource. The direct effect of strategic priority has a positive and significant coefficient in CVsource and ThomsonOne, yet remains insignificant for the other databases as well as the integrated dataset.

[21] As robustness checks, we followed existing literature (Benner and Ranganathan, 2012; Moeen et al, 2013) and estimated a fixed-effects linear panel model (“etreg” command in Stata). The results remain fully robust and are available from the authors upon request.

[22] The reasons for the side-by-side analyses are threefold. First, the purpose is to highlight the superfluous nature of results when analysis is based on a single database. Our objective is not to make inferences, but rather to motivate the need for the integrated database. Second, and relatedly, we aim to caveat scholars from using any single database. We are aware that many CVC studies are based on a single database; VentureXpert. Hence, it is likely that future studies of Chinese CVC may use a single database. The decision may also be driven by resource availability; the databases are expensive and scholars may lack the resources to engage in multi-database data effort. Third, commercial databases are not always clear about the scope of coverage. For example, ITjuzi does place some emphasis on IT industry, but it advocates coverage of VC in other industries. Thus, scholars may misunderstand the scope of a database and erroneously use it beyond its appropriate scope.

Table 10
Tobit panel regression analysis based on integrated dataset

Dependent variable	Annual CVC activity [total CVC investment rounds/total firm number]						
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Technological advance		12.086†	8.672	13.982	11.955†	12.733†	10.65
		-7.05	-9.256	-8.906	-7.048	-7.008	-9.732
Environmental munificence		1.129**	1.129**	1.122**	0.925†	1.519***	1.084†
		-0.376	-0.376	-0.376	-0.554	-0.407	-0.587
Technological advance × R&D intensity			182.149				212.536
			-315.535				-402.388
Technological advance × Strategic priority				-8.756			-9.89
				-25.189			-30.209
Environmental munificence × R&D intensity					11.195		27.743
					-21.846		-25.423
Environmental munificence × Strategic priority						-3.612*	-4.295**
						-1.508	-1.61
R&D intensity	2.324	3.419	-177.34	3.321	-8.134	3.194	-236.503
	-3.922	-3.808	-313.165	-3.816	-22.877	-3.78	-389.682
Strategic priority	1.25	1.183	1.118	9.978	1.112	5.567**	16.074
	-0.816	-0.773	-0.777	-25.312	-0.784	-1.981	-30.046
Slack resource	0.495*	0.38	0.382	0.383	0.372	0.379	0.365
	-0.24	-0.233	-0.233	-0.234	-0.233	-0.233	-0.232
Industry standard	-1.015†	-0.936†	-0.908	-0.937†	-0.901	-0.976†	-0.862
	-0.583	-0.554	-0.553	-0.554	-0.557	-0.553	-0.551
Average firm size	1.353***	1.231***	1.214***	1.237***	1.221***	1.240***	1.199***
	-0.226	-0.214	-0.215	-0.214	-0.214	-0.213	-0.213
Industry size	0.050**	0.047**	0.047**	0.048**	0.047**	0.046**	0.044**
	-0.016	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015
Heterogeneity of demand	4.839*	4.612*	4.570*	4.620*	4.587*	4.706*	4.596*
	-2.016	-1.893	-1.884	-1.896	-1.886	-1.897	-1.874
Heterogeneity of input	2.926	2.796	2.76	2.783	2.771	2.726	2.606
	-2.617	-2.462	-2.452	-2.464	-2.46	-2.455	-2.434
SOE ratio	1.239	1.104	1.061	1.105	1.075	1.138	1.033
	-0.754	-0.725	-0.724	-0.725	-0.725	-0.715	-0.708
Competition	1.303*	1.214†	1.176†	1.213†	1.178†	1.375*	1.278*
	-0.647	-0.626	-0.628	-0.627	-0.628	-0.629	-0.626
Constant	-15.69***	-28.14***	-24.59*	-30.05**	-27.69***	-29.38***	-26.46**
	-3.302	-7.758	-9.928	-9.505	-7.794	-7.75	-10.259
Number of observations	1357	1357	1357	1357	1357	1357	1357
Log likelihood	-679.324	-672.756	-672.6	-672.694	-672.624	-669.867	-668.714
Chi-square	60.528	77.536	78.418	77.547	78.283	81.872	85.243

† p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Moreover, the economic magnitude of the effects varies greatly across databases. It is possible to compare coefficients across the regression because the analyses differ only in the value of the dependent variables, yet each regression covers all major Chinese industries and includes the full set of values for the independent and control variables. The analysis based on CVsource data exhibits the highest economic effect of technological advance (with a coefficient of 11.963). Three other databases (PEdata, ITjuzi, and CapitalIQ) also record positive effects, with CapitalIQ suggesting the smallest economic effect. The IT-focused database ITjuzi features the highest economic effect of environmental munificence (with a coefficient of 1.144). Notably, this effect is almost tenfold smaller when using ThomsonOne, a widely used database in VC studies.

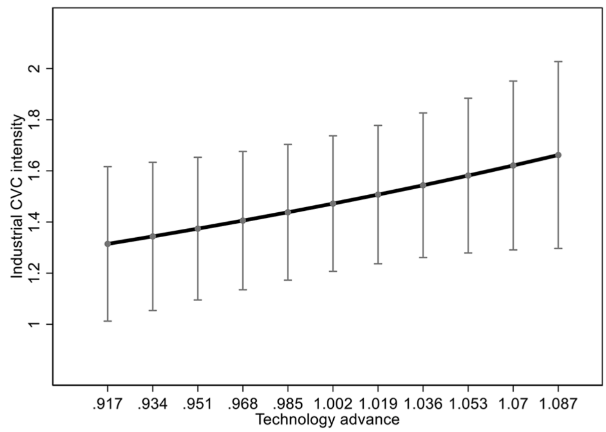
Second, we shift to the full specification, which includes direct effects and interaction terms (Model B of Table 9). The differences across the regression persist. For example, the interaction effect of technological advance and strategic priority is significantly negative using CVsource data; while the analyses based on the integrated dataset and other four databases suggest an insignificant result. By comparison, the interaction of munificence and strategic priority is negative and significant for the integrated dataset and other three databases (PEdata, ITjuzi, and CapitalIQ), but has an opposite sign for CVsource and CapitalIQ. Again, the economic magnitude of the effects varies across databases. The magnitude of the interaction of technological advance and strategic priority in CVsource is more than tenfold that in ITjuzi and ThomsonOne.

In sum, the results suggest that each database has different coverage; not only in terms of the industries it covers but also with regard to the level of information on corporate investors. In particular, CVsource and PEdata are among the longest-standing Chinese VC/PE databases and focused initially on non-technology firms, such as those in the domestic appliance and automobile sectors. In contrast, ITjuzi was launched in 2013 with a focus on Internet-based industries. The fact that the databases focus on different industries may explain the different results. ThomsonOne and CapitalIQ are prominent international databases. These databases seem to focus on tracking the activities of international corporate investors (e.g., Baidu, Alibaba, and Tencent). Hence, analysis based on a single database may yield a partial picture of Chinese CVC. Our integrated dataset facilitates a comprehensive analysis of CVC activities in China.

6.2. Analysis based on the integrated dataset

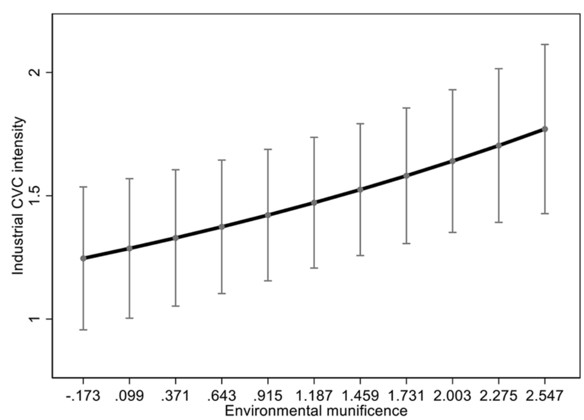
Table 10 reports Tobit panel data analyses based on the integrated CVC dataset. Model 1 is the baseline model using only control variables and the main effects of the moderators. Consistent with previous work (Basu et al., 2011; Schilling and Steensma, 2011; Tong and Li, 2011), the control variables slack resources, average firm size, heterogeneity of demand, and competition are significantly positive. Interestingly, the main effect of industry R&D intensity is not significant. This stands in contrast to previous CVC studies based on the U.S. context (e.g., Dushnitsky and Lenox, 2005a; Sahaym et al., 2010). A closer comparison with prior studies points to a difference in CVC patterns between China and the U.S. Previous U.S.-based studies suggested that R&D-intensive industries, such as the computer, telecom, semiconductor, and pharmaceutical industries, see the highest levels of CVC activity (see Fig. 1 in

Panel A: Effects of technology advance on industrial CVC intensity



Confidence intervals at 95% level.

Panel B: Effects of munificence on industrial CVC intensity



Confidence intervals at 95% level.

Panel C: Interaction effects between munificence and strategic priority on industrial CVC intensity

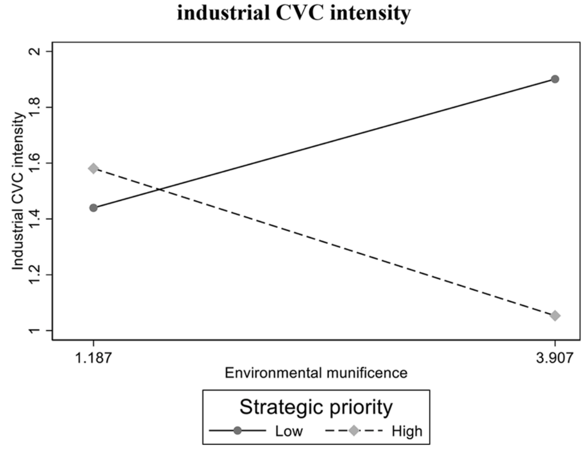


Fig. 2. Panel A: Effects of technology advance on industrial CVC intensity
Confidence intervals at 95% level.
Fig. 2. Panel B: Effects of munificence on industrial CVC intensity
Confidence intervals at 95% level.
Fig. 2. Panel C: Interaction effects between munificence and strategic priority on industrial CVC intensity

Dushnitsky and Lenox (2005a)). In contrast, our Chinese sample records top CVC intensity in online retailing, computer programing, publishing, toys, and educational services, where R&D intensity is moderate (Table 4).

In Model 2 we introduce the main independent variables technological advance and environmental munificence. We find positive effects for both technological advance ($p<0.1$) and environmental munificence ($p<0.01$). While the positive effect of technological advance is in line with previous studies of the U.S. context (Sahaym et al., 2010; Basu et al., 2011), the persistent effect of environmental munificence is a new finding compared to prior work (Sahaym et al., 2010). The finding suggests that incumbents in an emerging market such as China are more

Table 11
Robustness check (1): Excluding industries with less than three firms

Dependent variable	Annual CVC activity [total CVC investments rounds/total firm number]						
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Technological advance		13.666*	9.488	18.055*	13.315*	15.329**	14.528†
		-5.87	-7.937	-7.357	-5.856	-5.775	-7.802
Environmental munificence		0.829*	0.829*	0.829*	0.409	1.380***	0.404
		-0.331	-0.331	-0.33	-0.495	-0.358	-0.508
Technological advance × R&D intensity			207.287				391.07
			-263.999				-346.884
Technological advance × Strategic priority				-21.107			-35.674
				-21.495			-27.509
Environmental munificence × R&D intensity					22.117		62.378**
					-19.324		-22.864
Environmental munificence × Strategic priority						-5.764***	-7.854***
						-1.57	-1.721
R&D intensity	2.358	3.376	-202.201	3.132	-19.234	2.718	-449.409
	-3.097	-3.012	-261.848	-3.009	-19.991	-2.959	-336.81
Strategic priority	0.305	0.241	0.161	21.433	0.075	7.128***	44.815
	-0.714	-0.677	-0.679	-21.586	-0.689	-1.974	-27.353
Slack resource	0.534*	0.401†	0.397†	0.400†	0.375	0.427†	0.353
	-0.235	-0.229	-0.229	-0.229	-0.229	-0.227	-0.221
Industry standard	-0.764	-0.696	-0.676	-0.696	-0.628	-0.814†	-0.63
	-0.502	-0.476	-0.472	-0.477	-0.477	-0.47	-0.453
Average firm size	0.748***	0.692***	0.668***	0.711***	0.676***	0.659***	0.581**
	-0.21	-0.2	-0.201	-0.201	-0.199	-0.197	-0.191
Industry size	0.047***	0.042***	0.042***	0.042***	0.041***	0.043***	0.038***
	-0.013	-0.012	-0.012	-0.012	-0.012	-0.012	-0.011
Heterogeneity of demand	3.147†	2.861†	2.853†	2.878†	2.840†	2.911†	2.764†
	-1.626	-1.525	-1.506	-1.531	-1.515	-1.52	-1.442
Heterogeneity of input	1.347	1.373	1.316	1.35	1.328	1.242	0.904
	-2.089	-1.965	-1.949	-1.97	-1.957	-1.944	-1.869
SOE ratio	1.293	1.23	1.14	1.256†	1.151	1.029	0.612
	-0.794	-0.757	-0.759	-0.76	-0.755	-0.744	-0.724
Competition	-0.531	-0.109	-0.157	-0.046	-0.195	0.06	-0.143
	-0.771	-0.751	-0.751	-0.755	-0.75	-0.75	-0.731
Constant	-9.34***	-23.63***	-19.26*	-28.12***	-22.60***	-25.76***	-22.85**
	-2.741	-6.423	-8.485	-7.89	-6.452	-6.346	-8.236
Number of observations	979	979	979	979	979	979	979
Log likelihood	-537.386	-531.07	-530.77	-530.585	-530.431	-524.015	-517.927
Chi-square	42.565	58.071	59.039	58.929	59.679	71.354	85.953

† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

sensitive to growth opportunities associated with economic expansion. Holding all other variables at their mean, one standard deviation increase of technology advance (from its mean) is associated with a 2.39% increase in CVC activity. One standard deviation increase of environmental munificence (from its mean) is associated with a larger (3.6%) increase in CVC activity. Fig. 2 (Panels A and B) plots the direct effects.

Models 3 through 6 introduce the moderators industry R&D intensity and strategic priority. The coefficients on the interaction of R&D intensity with technological advance and environmental munificence are not statistically significant. That is, contrary to prior work, we do not find support for the moderating effects of R&D intensity. The interaction of technological advance and strategic priority is not significant. The coefficient for the interaction of environmental munificence and strategic priority is negative and significant ($p<0.05$). This implies that strategic priority attenuates the positive relationship between industry munificence on CVC activity in that industry. Panel C of Fig. 2 plots the interaction effect between environmental munificence and strategic priority. It illustrates that the relationship between munificence and CVC intensity flips from positive to negative when strategic priority changes from low to high.

At first glance, this is a puzzling finding. One might expect more CVC activity in industries of strategic priority, where the government allocates effort to cultivating entrepreneurship and innovation. That said, recent work suggests that some of China's largest corporations do not directly leverage the government's resources and do not play a government-designated role in promoting national development (Jia and Kenney, 2021). A close look at our data yields similar insights. We find that some priority industries are growing very fast, but exhibit no CVC investment; for example, the 'hazardous waste management' industry (SIC code: 4955) and 'aircraft industry' (SIC code: 3721). Two possible reasons could explain this phenomenon. First, these industries are of strategic importance because they provide public goods (e.g., protecting the environment). To the extent that firms in these industries are expected to maximize social welfare rather than their individual profits, it is possible that firms have fewer incentives to fund external entrepreneurial ventures. A second explanation may be that firms based in 'strategic industries' are still at an early stage of development. That is, firms may emphasize growth through organic competence-building, rather than by searching for external ventures.

Finally, Model 7 reports the saturated model. The direct effect of environmental munificence and its interaction with strategic priority remains significant, while the effect of technological advance disappears. The next section investigate the effect of technological advance.

Overall, the analyses of the integrated CVC dataset infroms CVC activity in China. We find that technological advance significantly induces firms to invest in entrepreneurial ventures. Nonetheless, its effect is independent of the level of R&D intensity in the industry. Moreover, we find that environmental munificence is the key driver of CVC investments in China. Rapid industry expansion provides shared options for firms in the industry to capture future growth opportunities. The fact that a specific industry is designated a strategic priority by the Chinese government seems to impair the positive effect of munificence. These findings reflect the different character of the entrepreneurial environment in China and the U.S. The former is a context where entrepreneurs mainly leverage existing technologies to profit from demand growth; whereas the latter sees entrepreneurial efforts directed at generating

Table 12
Robustness check (2): Using patents as proxy of Technological Advance

Sample	Full sample			Drop industries with less than 3 firms		
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Tech advance (patent)		0.318**	0.351**		0.238*	0.146
		(0.115)	(0.134)		(0.112)	(0.122)
Environmental munificence		1.010**	0.764		0.820*	0.239
		(0.378)	(0.613)		(0.333)	(0.528)
Tech advance (patent) × R&D intensity			1.017			0.774
			(2.087)			(2.048)
Tech advance (patent) × Strategic priority			-0.343			0.077
			(0.277)			(0.308)
Environmental munificence × R&D intensity			31.311			70.43**
			(25.251)			(23.299)
Environmental munificence × Strategic priority			-3.351*			-7.66***
			(1.607)			(1.753)
R&D intensity	2.311	1.506	-39.685	2.357	2.180	-77.409*
	(3.922)	(3.790)	(36.867)	(3.097)	(3.030)	(35.123)
Strategic priority	1.254	0.770	6.479**	0.305	-0.206	8.200**
	(0.815)	(0.808)	(2.278)	(0.714)	(0.722)	(2.783)
Slack resource	0.493*	0.402†	0.399†	0.534*	0.425†	0.402†
	(0.240)	(0.235)	(0.234)	(0.235)	(0.230)	(0.231)
Industry standard	-1.009†	-1.110†	-1.110†	-0.765	-0.860†	-0.740
	(0.582)	(0.572)	(0.574)	(0.502)	(0.488)	(0.474)
Average firm size	1.353***	1.031***	1.028***	0.748***	0.532*	0.482*
	(0.226)	(0.223)	(0.222)	(0.210)	(0.217)	(0.208)
Industry size	0.050**	0.036*	0.037*	0.047***	0.035**	0.033*
	(0.016)	(0.016)	(0.016)	(0.013)	(0.013)	(0.013)
Heterogeneity of demand	4.845*	5.425**	4.965*	3.147†	3.328*	3.138*
	(2.012)	(2.077)	(2.033)	(1.626)	(1.634)	(1.568)
Heterogeneity of input	2.930	3.109	2.889	1.347	1.553	1.207
	(2.613)	(2.582)	(2.538)	(2.089)	(2.016)	(1.933)
SOE ratio	1.262†	0.682	0.683	1.292	0.756	0.418
	(0.753)	(0.738)	(0.723)	(0.794)	(0.795)	(0.762)
Competition	1.298*	0.638	0.853	-0.531	-0.377	-0.360
	(0.647)	(0.648)	(0.656)	(0.771)	(0.758)	(0.746)
Constant	-15.71***	-17.03***	-16.38***	-9.341***	-10.59***	-8.75***
	(3.297)	(3.285)	(3.308)	(2.741)	(2.705)	(2.648)
Number of observations	1357	1357	1357	979	979	979
Log likelihood	-679.265	-670.130	-666.579	-537.387	-531.475	-521.018
Chi-square	60.684	78.424	84.514	42.559	54.920	77.391

† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

technologies that are new to the world. Thus, it appears that Chinese firms fund ventures predominantly as a strategy to 'harness economic growth.'

6.3. Additional analysis

We conduct additional analyses using alternative measures and samples. First, we check whether CVC activity in a focal industry is sensitive to one or two prominent firms. To that end, we removed industries with less than three firms. The results are consistent with our main findings (Table 11). The direct effects of technological advance and environmental munificence are positive and significant ($p<0.05$). The negative interaction between environmental munificence and industry strategic priority is significant ($p<0.001$). The results support our earlier findings.

Second, we proxy for technological advance using TFP growth, which is sensitive to the accuracy of TFP estimation. We use an alternative proxy of technological advance: the total number of patents applied by firms in an industry. We conduct two sets of analyses with this proxy. We first run the analysis based on the full sample, then drop the industries with less than three firms. The results of the two sets of analyses are displayed in Table 12. Consistent with previous results, the direct effects of technological advance and environmental munificence remain positive and significant. The interaction effect between environmental munificence and industry strategic priority holds its negative and significant coefficient.

To conclude, the robustness checks confirm that environmental munificence and technological advance are key drivers of CVC activity across Chinese industries. Industry R&D intensity has neither a direct nor a moderating effect on CVC activity; while industry strategic priority negatively moderates the effects of environmental munificence.

7. Discussion and conclusion

This study explores the antecedents to corporate venture capital using data from China, the largest developing country and home to the second-largest VC market globally. Our investigation is motivated by Clough et al. (2019), who cautioned that excessive focus on North American and Western European data might result in a myopic understanding of entrepreneurial patterns. Accordingly, we undertake a significant data effort and integrate CVC data from five leading international and Chinese databases. Our findings resonate with the insight that firms in the developing world deploy common strategies in new ways (Peng et al., 2017; Jia and Kenney, 2021). We contribute to the CVC literature in the following ways.

First, our abductive large-N study identifies a broad set of CVC objectives. Whereas extant works predominantly view CVC as a strategy to gain a 'window on technology', we find evidence consistent with a different objective, where funding entrepreneurial ventures is a way to 'harness economic growth.' Specifically, we document that CVC activity in a focal industry is associated with the level of environmental munificence in that industry. We also observe a positive association with an industry's technological advance; yet, contrary to prior work, the association is not moderated by R&D intensity. Finally, we investigate a third objective (where CVC investment follows a 'government directive'), yet find little support for this explanation.

Second, we build on these empirical insights to inform the CVC literature. The antecedents to CVC activity we observed advance our theoretical understanding of CVC objectives. The argument in extant CVC work is based on a key assumption: entrepreneurial ventures have higher marginal innovation productivity than incumbent firms (Dushnitsky and Lenox, 2005), and therefore are the sources of novel technologies (Tushman and Anderson, 1986; Aghion and Tirole, 1994). However, this assumption may not hold in the context of emerging economies. Rather, in emerging markets, entrepreneurs often utilize existing technologies to serve their customers (Minniti and Lévesque, 2010; Bruton et al., 2018), and profit from the dramatic surge in domestic consumption (Lerner et al., 2016; Ndlwana and Botha, 2018). It follows that the practice of CVC may be prevalent in emerging economies, yet the objective for doing so differs from the one depicted in the CVC literature. Table 2 summarizes our contribution to the CVC literature, presenting the different objectives and the assumptions that underlie them. Table 3 and Fig. 1 present the empirical inferences associated with the various objectives.

Third, we discuss our China-based findings in light of similar analyses of U.S. patterns (Sahaym et al., 2010). We are mindful that extant work is calibrated on CVC patterns in the Western world. In contrast, Chinese CVC emerged in an environment characterized by growth in consumption and mobile use, weak intellectual property rights, and cutthroat competition (Jia and Kenney, 2021). The discussion helps in elucidating the discrepancies in the antecedents to CVC activity. The CVC activity in the U.S. during the late 1990s was stimulated by R&D-intensive corporations that took advantage of substantial technological advance and overall industry munificence. In contrast, we observe that CVC intensity in China centers on fast growing industries, such as online retailing, publishing, and educational services, where R&D intensity is moderate but not high (Table 4).

Our last contribution is of a methodological nature. We point to an important issue associated with data availability in the Chinese setting. We find that CVC patterns based on data from one database are often not replicated when testing a similar specification using a different database. We recognize that existing studies of the U.S. and Europe usually use a single database (e.g., VentureXpert, Zephyr); yet encourage scholars to triangulate across multiple databases when investigating CVC activity in other parts of the world. Along these lines, our abductive study is built on a comprehensive dataset integrated across five different sources (Appendix B).

Finally, we recognize that all studies have some limitations. First, we compare findings based on different databases and point to issues associated with their coverage. However, as the database providers continuously upgrade their databases, we cannot keep track of the latest data coverage. Therefore, this study does not seek to show which database is the 'best'; rather our goal is to reveal a general challenge: any single-database study should consider the data-coverage issue. Second, our analyses indicate that firms in industries of national priority are less likely to conduct CVC even under conditions of munificence. Future work might investigate whether national-priority industries are attractive to foreign investors or those from adjacent industries. Third, we recognize that firm-level studies can offer keen insights beyond the industry-level analysis presented in this study. At the same time, firm-level studies are also associated with a different focus and a complementary set of research questions. For example, within a highly munificent industry, variation in CVC activity may be driven by those who further employ an effective platform, or those enjoying greater political influence. These examples illustrate that, while it is the case that the state of the industry (i.e., high munificence) remains the underlying objective for CVC activity, both the specification and findings of firm-level analyses are geared towards addressing a complementary set of research questions. Firm-level patterns require careful interpretation because the amount of CVC each firm disburses is not only a reflection of its objectives, but also a function of the firm's attractiveness to startups (i.e., startups' willingness to solicit and accept the CVC investment). Scholars should interpret firm-level variation cautiously to avoid confounding firms' objectives with their ability to attract investees.

To conclude, our findings highlight the antecedents of CVC in China, the world's second-largest entrepreneurial ecosystem. We underscore the scale of corporate venturing in this ecosystem and construct a unique dataset to study it. Our findings call attention to a broader set of CVC objectives beyond those informed by U.S.-based studies. For scholars of innovation strategy and policy, our findings may add insights that better inform the understanding of future innovation in China (Lewin, Kenney and Murmann, 2016).

Declaration of Competing Interest

I am not aware of any conflict of interest associated with a manuscript titled, "Why Do Incumbents Fund Startups? A Study of the Antecedents of Corporate Venture Capital in China."

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Appendix A. Survey of CVC investors in China

The survey was conducted towards the end of the sample period. We first generated a comprehensive CVC investors list based on the existing dominant VC/PE databases (see detailed steps in Appendix B). The design of the survey followed existing CVC surveys (see Dushnitsky, 2012; Maula, 2007), with some adjustment to the Chinese setting. We piloted the initial survey instrument with about half a dozen CVC informants. The pilot was conducted as a face-to-face interview to facilitate feedback on the design and improve the quality of the replies. Next, we sent the survey instrument to the full list of CVC investors. To that end, we followed a snowball approach to gain access to as many investors as possible. Initially, we reached out to the CEO or chairman of each corporation, then requested them to introduce us to the CVC team. Ultimately, the process resulted in 50 complete questionnaires. The final sample covered several leading CVCs in China, such as Tencent, Baidu, and Alibaba.

The respondents provided information about the CVC's main objectives. Each objective was rated on a 5-item Likert scale where the values 1 and 5 designate 'Least Important' and 'Highly Important,' respectively. Fig. A1 plots objective, ranked by their average value. The two most important strategic objectives of Chinese CVC investors are "Build relations with industry partners" and "Find more application scenarios for current resources." These objectives are consistent with the pursuit of a 'harness economic growth' objective. Interestingly, the 'window on technology' objectives that traditionally rank at the top of the list in prior surveys of U.S. and European CVC investors are ranked lower by our China-based respondents. To conclude, Fig. A1 illustrates that market-based objectives seem to dominate technology-based objectives in the context of Chinese CVC investors.

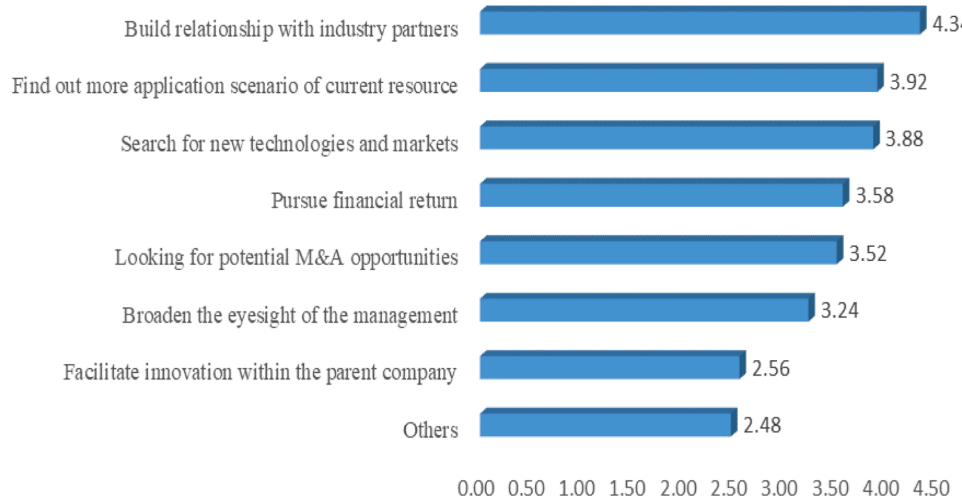

Fig. A1. Strategic objectives of CVCs in China
Responses recorded on a 5-item Likert scale.

Appendix B. CVC Data collection and cleaning procedures

Step 1 (Raw Data): Download all VC/PE investments between 2010-2017 from each of the five databases.

Step 2 (Obtain Investor Lists): For each of the databases, we generated a full investor list. Retain in the list all investors with three or more investment rounds in China.

Step 3 (Identify CVC Investors): We are aware that databases may differ in their labeling of CVC investors (see examples at the end of this paragraph). Therefore, we manually identified and coded investors as CVCs. To that end, we sought information about the main business and shareholders of every investor in the investor lists. An investor is identified as a CVC if it is a non-financial-industrial company or the affiliated sub-unit (e.g. a wholly owned subsidiary or a majority-owned subsidiary) of a non-financial-industrial company. To illustrate the differences in CVC labeling across databases, consider the following examples. The VC subsidiary of ZTE corporation, ZTE VC, is labeled as a "VC" in CVsource; we identified it as a Corporate VC and included it in our sample. Turning to another example, the crowdfunding platform "Angel Crunch" is labelled as "Strategic Investor" in PEdata. Yet, it does not meet our definition of a Corporate VC; hence we don't include it in our analysis. To conclude, we use our definition to consistently identify CVC investors across the five databases. In Table A1 below, for each database we list the number of CVC investors based on our definition, as well as that based on the definition in the databases.

Step 4 (a consolidated CVC investor list): Using the CVC information from the five databases, we create a single consolidated CVC list. The consolidated CVC list includes each and every CVC program across the five databases. We then identify the corresponding parent corporation for each CVC program. This process results in 357 unique CVC programs that are affiliated with 332 parent corporations. Some corporations (such as Baidu and Fosun) have two or more CVC programs. We aggregate these different names as one entity in our comprehensive CVC list. Of course, not all of the CVC-investing corporations are publicly listed. For the 173 Chinese corporations that are public (either on the Shanghai, Shenzhen, Hong Kong, or U.S. stock exchange), we proceed to collect IPO time, ticker symbol, ownership, and industry information.

Step 5 (Created an integrated CVC database): We aggregate the CVC investment information at corporate level, and create a unique ID for each corporation and venture; then we integrate the CVC investment information across the five databases and delete duplicate records (i.e., all investment records listing the same CVC investor and venture in the same month). Our focus is on approximately 3,500 investment rounds by 173 public CVC investors during the period 2013-2017.

Table A1
Number of investors or investment rounds in each step

	NO # Investors / Investment rounds	CVsource	PEdata	ITjuzi	ThomsonOne	CapitalIQ
Step 1: Raw Data	Total PE/VC Investment rounds (In China / Out of China)	28462 / 903	52228 / 7389	34986 / 8501	7990 / 67820	6656 / 64572
Step 2:	Total PE/VC Investors	8245	13510	5986	9320	24643
Investor List	Investors with 3+ deals in China	2536	3551	2203	735	676
Step 3:	CVC investors (defined by this study)	175	360	330	64	97
Define CVC	CVC investors (defined by databases) *	~36	~293	326	86	169
Step 4: Consolidated CVC List	CVC investors in our comprehensive CVC list	357 unique CVC programs (belong to 332 established firms, of which 173 are publicly listed)				
Step 5:	Nu. of publicly listed CVC investors in each database	62	138	159	16	39
The Integrated	… Nu. of CVC investment rounds	965	2092	2571	139	476
Sample	Which aggregated to a total Nu. of publicly listed CVC investors in our integrated sample	173				
	… aggregated to a total Nu. of CVC investment rounds	3571				

* (1) When we exported the VC/PE investment data from CVsource, PEdata, and ITjuzi there were no labels of "investor type", which lead to minor matching challenges across the databases. (2) We only tracked investors with three or more investment rounds.

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