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Strategic effects of corporate venture capital investments

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ABSTRACT

This paper analyzes the strategic effects of corporate venture capital investments. Specifically, by studying the deals of 163 corporations over a four-year period, it documents the effects of driving, emerging, enabling, and passive investments on the pool of innovative opportunities available to incumbents and the scale efficiency gains they experience as a result of these investments. The study suggests that by making driving and enabling investments, incumbents position themselves in the industry to take advantage of increased pools of innovative opportunities and improve scale efficiency yields. At the same time, emerging and passive investments are detrimental for both of the strategic goals considered in this paper.

1. Introduction

Strategic objectives incumbents pursue via corporate venture capital programs are abundant. Excepting the proverbial window on technology, strategic objectives include a set of goals such as accessing new markets and stimulating demand for products/services that improve sales and—if done correctly—may bring about scale efficiency gains (Dushnitsky and Lenox, 2005; Ernst and Young, 2002; Gompers and Lerner, 1998). Unexplainably, these other strategic goals of corporate venture capital (CVC) investments remain in empirical research limbo; existing work is conspicuously silent with respect to the alternative outcomes of CVC activity (Anokhin, 2006; Benson and Ziedonis, 2009; Cox et al., 2013; Riyanto and Schwienbacher, 2005). Moreover, although conceptually the literature (Chesbrough, 2002) distinguishes among four types of CVC investments (driving, emerging, enabling, and passive), the unique impact each has on the strategic outcomes of interest (with exception of patenting) has not been scrutinized empirically. Given that incumbents are likely to make CVC investments of different types, this lack of scholarly attention to their effects is startling. The present paper documents early insights into the effects of the four types of CVC investments.

2. Capturing strategic benefits of CVC investments

Under the resource-based view (RBV) of the firm, obtaining strategic outcomes can be attributed to the improved use of

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the firm's resources when more is achieved with a comparable resource bundle.[1] Improving the deployment of resources occurs in two ways: by creating a new way to combine resources (that is, advancing technology or innovating) and by increasing efficiency of resource use under existing technologies without innovation per se (through, for example, scale efficiency gains) (Fare et al., 1994; Penrose, 1959; Thursby and Thursby, 2002). The former corresponds to the proclaimed CVC strategic goal of obtaining a window on technology (Anokhin, 2006). By investing in startups, incumbents try to position themselves to increase the pool of innovative opportunities available to them. As patenting-based CVC research shows, firms then take advantage of the opportunities presented. The latter strategy reflects attempts to secure demand for the corporation's products, tap into foreign markets, and so on with the help of the CVC. This may lead to better use of available resources without novel technological advancements.

A technique exists that allows inferring total factor productivity change from publicly available secondary data and decomposing it into technical change that shows an increase in the innovative opportunities pool for incumbents, and efficiency change, from which the firm may further distill scale efficiency gains. The technique is rather involved computationally but has had a long history of use in operations research (Malmquist, 1953). The technique has also recently made its way into the literatures of economics (Fare et al., 1994), innovation (Thursby and Thursby, 2002), strategy (Durand and Vargas, 2003), and entrepreneurship (Anokhin et al., 2011).

The idea behind the technique is as follows. Corporations that belong to the same industry combine homogenous inputs (such as labor and capital) in different ways to produce comparable outputs (represented by sales). Some corporations use less labor than others, some use less capital, whereas yet others use relatively large quantities of labor and capital to produce the same amount of sales. Companies with the best combinations of inputs and outputs define the best available technology at the time; they are said to determine the production frontier (Anokhin, 2006).[2] Over time, as technology advances, the frontier shifts.

The technique, known as Malmquist Productivity Index decomposition, tracks the relative positions of different companies from year to year and captures the movement of less effective companies toward the frontier. Such shifts do not require grand innovation and suggest that firms are simply becoming more efficient at something they already know how to do (Anokhin, 2006). It also captures shifts of the relevant segment of the frontier itself, which are caused by technical advancement or by some companies introducing in year t by technologies that are superior to those employed in year $(t-1)$. The former component—efficiency change—can be decomposed into scale efficiency change and pure efficiency change. The latter—technical advancement—represents the pool of innovative opportunities available to the incumbent (Anokhin et al., 2011).

3. Data sources

Following the CVC research tradition, two sources are used to construct the pattern of CVC investments by incumbents: VentureXpert by Venture Economics and Corporate Venturing Directory & Yearbook (hereafter, the Yearbook) by Asset Alternatives. Each data source has information on deals that the other database does not provide. By matching the data carefully, we are able to obtain the most accurate information on the corporations' CVC disbursements. We only consider investments committed during 1998–2001, because this period is best covered by both databases. The U.S. Census Bureau's NAICS and Bureau of Economic Analysis' 1998–2004 Annual Input-Output tables are used to classify CVC investments into the four types—driving, emerging, enabling and passive.

After matching the data on CVC deals reported by VentureXpert and the Yearbook, we merge our database with the annual firm-level accounting and financial data from Standard & Poor's Compustat. Because the data reported in Compustat relate to a financial and not a calendar year of the corporation, we do not use annual aggregates reported by VentureXpert directly, but rather look at the exact dates of particular deals to match them to appropriate financial years (Anokhin, 2006). The merger of VentureXpert, the Yearbook, and Compustat yields a sample of 163 corporations that engaged in corporate venture capital investments during years 1998–2001.

4. Measuring strategic benefits of CVC with Compustat data

Data envelopment analysis compares sets of inputs and outputs for different corporations within their subindustries in consecutive time periods. The Malmquist Productivity Index technique infers productivity change from this total factor productivity change. By decomposing it, the technique allows us to estimate changes in the pool of innovative opportunities

[1] The notion of comparability does not imply that resources are truly homogenous. In fact, some heterogeneity always exists. “Comparable” here refers to markets' homogenous pricing of heterogeneous inputs and outputs.

[2] In the present paper, we work with the piecewise frontier obtained with the help of Data Envelopment Analysis. This ensures that the firms are assessed against the portion of the frontier that is most suitable for their resource endowments and combinations. This way, if CVC investments enable the corporation to position itself such that more innovative opportunities fall within its grasp, the technique will capture such repositioning. For computational details and Data Envelopment Analysis (DEA) and Malmquist productivity index software recommendations, see Fare et al. (1994), Coelli (1996), and Hollingsworth (2004).

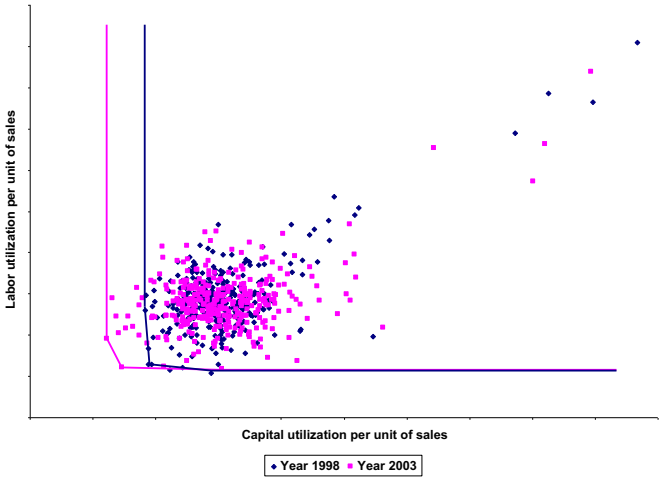

Fig. 1. Production Frontier Shift in Computer and Electronic Product Manufacturing Industry, 1998–2003. (colored dots represent companies, solid lines reflect the frontier). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

(technical advancement) and scale efficiency gains. Mathematically, the technique is explained in Fare et al. (1994). The programming algorithm is realized in DEAP software (Coelli, 1996). Overall, we analyze more than 12,000 firm-year observations to arrive at estimates of technical advancement and scale efficiency change.[3] We run the analyses separately for 20 subindustries to ensure comparability of the firms and meaningfulness of the frontier in each run. Fig. 1 illustrates the dynamics of the frontier based on the data for the computer and electronic product manufacturing industry for years 1998–2003 (Anokhin, 2006). We use the estimate of technical advancement as our measure of changes in the *innovative opportunities pool*. The estimate of scale efficiency change is our measure of *scale efficiency gains*. Compustat is employed to collect information about labor (employee count), corporate assets, and corporate sales.[4]

5. Defining driving, enabling, emerging, and passive investments

Corporate venture capital investments differ along two dimensions (Chesbrough, 2002). First is *technology fit*, defined as the degree to which companies in the investment portfolio are linked to the investing company's current operational capabilities (resources and processes) (Anokhin, 2006). Second is *market fit*, defined as the degree to which investments of the corporate parent constitute strategic benefits for the corporate parent. Combined, these two dimensions allow differentiating among four different types of CVC investments: driving, enabling, emerging, and passive. *Driving* CVC investments are characterized by a tight link between the new venture and the technology/operational capability of the corporation, as well as high market development potential. *Enabling* investments have high market development potential but are only loosely linked to the corporation's operational capability. *Emerging* investments do not provide market development potential, although they have tight links to the corporate parents' operational capabilities. Finally, *passive* investments match neither operational capabilities of the corporation nor are they capable of extending the firm's market presence (Anokhin, 2006). They are believed to be committed primarily for financial reasons and are most similar to the investments independent venture capital firms make (Chesbrough, 2002). Chesbrough's (2002) discussion of "fit" and "strategy" in the CVC context and their link to outcomes have never been tested in an empirical study.

6. Measuring driving, enabling, emerging, and passive investments

To classify all CVC deals into these four groups, we employ a multistep algorithm. First, we combine information contained in both VentureXpert and the Yearbook about CVC deals committed during the specified period. Of particular interest is the startup's industry. Based on VentureXpert's classification and the Yearbook's description of the new venture and its industry, we assign NAICS codes to the new ventures. We then compare the corporate parents' NAICS code to that of the new

[3] For each run, we include all active firms with no missing values as reported by the Compustat operating in a given subindustry to obtain the most accurate estimate of the technology prevalent in that industry in each year. Due to the format of this paper, we are unable to provide a detailed description of the calculations involved in capturing the measures of interest. Instead, we refer the reader to the original sources that explained the technique in detail (e.g., Fare et al., 1994; Coelli, 1996; Hollingsworth, 2004) and to papers that demonstrate its use in the contexts similar to ours (Anokhin et al., 2011).

[4] While it was also tempting to look at more traditional measures of investment success such as the count of IPOs or trade sales, we chose to not do it in this paper. The Yearbook did not provide this information for the unique investments reported there. Besides, we tried to keep the message of the paper focused on the strategic benefits that were central here – innovation and scale efficiency gains.

venture. In the case of a match (at two- to four-digits aggregation), we assign the deal a value of 1 on the operational capabilities link (OCL) dimension and 0 otherwise. Dushnitsky (2004) used a similar approach to determine whether or not a CVC investment is likely to be a substitute to the corporate parents' line of products.

Next, we explore the Bureau of Economic Analysis' Input-Output tables. We record how much of the corporate parent industry's output is consumed by CVC investees' industries. We then classify the new ventures as having high market development potential for the corporate parent if their industries account for a certain portion of the consumption (Anokhin, 2006). Two cut-off values are used: 10% and 5% of the average consumption. The results reported in the present paper use the first threshold. Similar results are obtained, however, with the more lax cut-off value (data available from the authors). Then, we assign a CVC investment a value of 1 on the market development potential (MDP) dimension if its industry consumes at or above the cut-off value, and 0 otherwise. This indicates whether or not the corporation's investment in the new venture is likely to generate a noticeable increase in demand for the corporate's offerings. Dushnitsky (2004) employed a similar approach to determine whether or not a particular investment is likely to be complementary to the parent corporations' line of business.

Our final step—classifying CVC investments into four groups—departs from Dushnitsky (2004) approach. Unlike Dushnitsky's (2004) and similarly to Chesbrough (2002), we believe that a CVC investment may combine the two properties—operational capabilities and market development—in a meaningful way. If the deal stands high on both the OCL and MDP dimensions, it is classified as *driving*. If the value on the OCL scale is 1 and on the MDP scale is 0, it is classified as *emerging*. Investments with 0 on the OCL scale and 1 on the MDP scale are considered *enabling*. Finally, investments with 0 on both dimensions are considered *passive*. A portion of investments cannot be classified, because their industry affiliation is unclear (Anokhin, 2006).[5] We ran our analysis with and without this group of deals, which did not affect our substantive results. Here we report the results based on ventures that could be classified unambiguously.[6] For reasons explained in Anokhin et al. (2011) we look at the number of distinct investment the incumbent corporation supported in a given year in each of the categories and not at the dollar amount of investments.[7] In any case, the number of CVC investments is known to be highly correlated with the dollar amount of CVC investments (correlation coefficient of 0.85 or higher).

7. Use of control variables

We observed a need to include several control variables in our subsequent empirical tests. *Integrative capability*, the ability of the corporation to integrate knowledge across both firm and disciplinary boundaries (Henderson, 1994), may affect the rates with which the corporation integrates external knowledge and combines it with existing knowledge in a synergy-generating way. Thus, we control for the corporations' integrative capability. We operationalize it in several ways. First, we create a *composite score* that includes an external and an internal component of integrative capability. The external component is the number of distinct countries where the corporation invests its CVC money. The internal component considers whether or not the CVC team has individuals with different functional backgrounds and whether it reports to one of the corporations' top managers of the corporation (Cockburn et al., 2000; Collinson, 2001; Yeoh and Roth, 1999). Information required to create this variable is derived from the Yearbook. Second, we approximate integrative capability with the measure of *corporate venturing expertise (CVE)*, which we measure as the number of years since the corporation was first mentioned in VentureXpert as a CVC investor or co-investor. Corporations with a long history of participating in CVC activities are more likely to develop unique approaches to identifying, supporting, and assisting new ventures, as well as appropriating the fair share of the benefits based on the complementarities of the corporation–startup competencies. Third, we use a binary variable *seats*, which takes on a value of 1 if the corporation takes seats on the boards of the new ventures it supports with CVC and 0 otherwise. The idea is that if the corporate parent assigns a representative to monitor the activities of the new venture closely, it is more likely to recognize and internalize the innovative potential of the new venture's technology.

We also account for the internal *R&D intensity*. Following Dushnitsky (2004), we calculate this as the ratio of R&D outlays to the dollar amount of the corporation's assets rather than sales. Adjustment is made for the industry average, because it is commonplace in the strategic management literature (Anokhin, 2006; Schilling, 2002). The data is directly available from Compustat. We also control for the *organizational slack*, which is generally defined as a cushion of excess discretionary resources (Bourgeois, 1981). We operationalize organizational slack as the current ratio or the firm's ability to meet current obligations (current assets divided by current liabilities) (Singh, 1986). The data is directly available from Compustat.

Investment Risk is an important determinant of venture capital activity outcomes. In line with the venture capital

[5] Over 40% of investments in our sample were classified as passive. This raises an important issue of the importance of strategic considerations in CVC deals to corporate investors. Absent strategic benefits, the reason to invest in "passive" ventures could have been purely financial. Because financial returns were not the primary focus of this investigation, we did not explore this issue in more detail but believe that future research may uncover non-trivial insights by attending to this question.

[6] An additional set of results is available from the authors upon request.

[7] Unfortunately, the Yearbook does not report the dollar amount invested. While we could have estimated this amount based on the VentureXpert data, it would not have introduced new information into our models. Besides, as explained in Reaume (2003), strategic benefits accrue to corporate investors regardless of the amounts invested. As such, we decided to utilize the number of distinct ventures in each category that the incumbent supported in any given year, as our principle independent variable.

Table 1
Descriptive Statistics.

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Rates of corporate innovation	108.78	53.88													
2	Scale efficiency gains	108.22	45.03	−0.01												
3	Driving investments	0.65	2.47	0.10**	0.04											
4	Emerging investments	0.86	3.03	0.13***	−0.05	0.25***										
5	Enabling investments	0.16	0.96	−0.03	0.17***	−0.02	−0.00									
6	Passive investments	2.31	10.0	−0.02	0.10*	0.80***	−0.05	0.13***								
7	Unclassified investments	1.48	3.11	0.08*	0.10*	0.59***	0.21***	0.10**	0.64***							
8	Integrative capability	2.14	1.15	0.00	0.04	0.29***	0.18***	0.10*	0.33***	0.33***						
9	CVexpertise	4.41	6.70	−0.01	0.08	0.13**	0.04	0.15***	0.14***	0.11**	0.18***					
10	Seats	0.87	0.34	−0.05	−0.04	−0.31***	−0.03	−0.02	−0.25***	−0.20***	−0.00	0.18***				
11	R&D intensity	0.74	1.33	−0.02	−0.01	−0.04	−0.05	−0.03	−0.02	−0.04	−0.08	−0.07	0.10			
12	Risky	0.15	0.36	0.01	0.01	−0.02	0.05	0.01	−0.05	0.02	0.14***	−0.12**	−0.07	−0.03		
13	Organizational slack	2.25	2.20	0.00	0.00	−0.02	−0.07	−0.03	−0.02	−0.04	−0.14***	−0.20***	−0.17**	−0.02	0.01	
14	Firm size	7.51	2.19	−0.02	0.01	0.16***	0.08	0.12**	0.20***	0.20***	0.29***	0.40***	0.10	−0.08*	0.03	−0.48***

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 2
Models Summary.

Model Dependent variable	1 Innov.	2 Innov.	3 Innov.	4 Scale efficiency
Driving investments	4.17***	4.37***	4.19***	2.54***
	(0.77)	(0.75)	(1.17)	(0.72)
Emerging investments	−1.69***	−1.75***	−1.57*	−1.74***
	(0.48)	(0.47)	(0.69)	(0.44)
Enabling investments	1.19*	1.27*	1.44†	7.75***
	(0.52)	(0.55)	(0.74)	(0.80)
Passive investments	−0.93***	−1.00***	−0.94***	−0.65**
	(0.17)	(0.16)	(0.26)	(0.19)
Integrative capability	−0.73			
	(0.51)			
CV expertise		−0.07		
		(0.11)		
Seats			−2.40	
			(5.24)	
R&D intensity	0.33	0.34	−0.90	3.69**
	(0.44)	(0.45)	(1.37)	(1.28)
Risk	−3.39	−3.75†	−0.74	−3.41
	(2.15)	(2.17)	(4.06)	(2.16)
Organizational slack	0.76†	0.76†	−1.37	−2.51**
	(0.39)	(0.40)	(1.53)	(0.80)
Firm size	1.49**	1.35**	0.04	−8.40***
	(0.49)	(0.49)	(1.55)	(2.37)
Industry effects	Included	Included	Included	Included
Temporal effects	Included	Included	Included	Included
Intercept	76.17***	75.52***	95.83***	98.03***
	(4.99)	(2.65)	(18.12)	(1.61)
Test statistic	$\chi^2_{(14)}=522.28$***	$\chi^2_{(14)}=507.46$***	$\chi^2_{(13)}=142.19$***	$\chi^2_{(12)}=250.22$***

Standard errors in parentheses.
† $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

literature, we use the corporation's preferred investment round as a measure of risk (Ernst and Young, 2002). We dichotomize investments into relatively risky (seed and early stages) and relatively non-risky (extension, later, and balanced stages). To create the variable, we use the data from both the Yearbook and VentureXpert. Because the level of CVC activity in the industry creates pressure to innovate (Zajac et al., 1991) we control for *industry* membership. We also control for *temporal effects* (including a dummy variable for the year 2000 known for the crash of the dot.com market, which constituted a significant portion of the CVC investment portfolio) and *firm size*, operationalized as the log of sales (Anokhin, 2006). This is particularly important in light of the expected effect of some of CVC investments on corporate sales.

8. Results

Our data suggest that corporations distribute their investment funds unevenly between the deals of different type: more than 50% of the investments are passive, about 20% target emergent deals, 16% of the deals is driving, and less than 5% of investments are enabling. Table 1 documents descriptive statistics for the present study's data.

The empirical results are summarized in Table 2. In all, four models are presented.[8] Models 1 through 3 analyze the effects of CVC investments on the pool of innovative opportunities available to the corporation. They include three alternative operationalizations of integrative capabilities. Model 4 is concerned with scale efficiency gains. All models demonstrate statistical significance at $p < 0.001$ level. The results unambiguously point to the positive role of driving and enabling investments in terms of helping corporations position themselves to benefit from innovative opportunities and improve scale efficiency yields. The opposite is true for emerging and passive investments: they are detrimental in both senses, which may come as a surprise with respect to innovation—after all, they do boast technological fit with the corporation.

[8] The results were produced by feasible generalized least squares (FGLS) estimator corrected for autocorrelation. FGLS is required to address possible violation of the independence assumption by both dependent variables (Thursby and Thursby, 2002).

9. Discussion and conclusion

The present study demonstrates the need to analyze a finer-grained picture with respect to CVC activities of corporations than empirical CVC research has done previously. Rather than looking at the aggregated effects of CVC programs or dichotomizing programs into financial/strategic, significant insights can be learned from paying close attention to the kinds of deals incumbents make. Because nothing precludes corporations from making deals of different nature—which is what we see in our data—one needs to carefully consider the implications of the deals for the strategic benefits corporations are said to seek when establishing CVC programs. Only about 20% of corporate investments are beneficial in terms of either access to innovative opportunities or scale efficiency gains. The majority of deals are either detrimental or have no discernable effect on the strategic benefits corporations seek.

The implications of these findings are very straightforward. In that driving and enabling investments are clearly beneficial and emerging and passive are not, strategically minded corporations should focus on what now constitutes the minority of their contributions. Importantly, we have not studied the financial effects of these types of deals; therefore, it is possible that they may be justified in terms of the returns they provide, although we doubt this is the case. Future research should explore these issues. It appears that pull from the market is at least as important to ensure access to innovative opportunities as is push from the technological side.

The negative effect of emerging investments on access to innovative opportunities is of scholarly interest. It suggests that technology push (i.e., the surge of related technologies in the environment that the corporate parent controls) by itself does not do much in that sense. This could imply that innovation is not, in fact, sourced and internalized from elsewhere, but is internally begotten. This flies in the face of the claims the open innovation enthusiasts have made. Thus, it is our hope that these findings will stimulate scholarly discourse on the role of CVC practices in engender strategic benefits to corporations.

Our results need to be considered in the light of possible limitations. First, we did not have the information on the valuation of specific deals. It is possible that deals that are strategically important have higher valuations at the very beginning; if true, there could be an alternative way of assessing strategic benefits of investments for the incumbents.

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