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CORPORATE VENTURE CAPITAL AND TARGET COMPANIES PROFILING IN BIOPHARMA INDUSTRY

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Abstract **- Corporate venture capitals world has changed in the last few years and it keeps evolving over and over. The biotech and pharmaceuticals sectors are probably two of the main industries that experienced drastic alterations, and this is reflected in the companies that corporate venture capitals target as possible investments. Based on a sample of almost 400 deals occurred in over a decade, it has been possible to identify an ideal investment target with a higher probability of attracting venture funding. The results from the ten years dataset are meaningful, and they support the hypothesis that CVC's risk profile is becoming more risk-averse. CVCs indeed prefer to invest in target firms that are young even though no more startups, listed, that develop moderately risky molecules but that are in early-stage, and horizontally integrated with other biotech companies. The simple technique and the unique and innovative dataset built provide a scalable and reproducible analysis that could be extended to other sectors or time frames.**

Keywords**: Corporate Venture Capital, profiling, biopharmaceutical industry, stepwise regression, risk.**

I. INTRODUCTION AND LITERATURE REVIEW

Investing in biotech industry has always been a high profitable but complicated business characterized by a radical continuous innovation (Rothaermel, 2001). Indeed, if from one hand large pharmaceuticals companies were used to invest in early-stage biotech firms to fund their R&D pipeline, from the other hand they started moving their capitals toward what they are able to do better, i.e., obtaining the regulatory approval and launching the new product on the market. In the last two years, according to BMO Capital Markets, in the biotech and pharmaceuticals sectors more than 120 different IPOs have been completed, and in addition to that in 2011 more than 25% of the US biopharmaceuticals deals were supported by corporate venture capitals (CVC) with respect to the 15% of the previous year (PriceWaterHouseCoopers, 2012). All these probably represent symptoms of how the funding structure in the industry is mutating. The renewed research interest in the CVC is anyway not as recent as these events, but came back to almost a decade ago (Dushnitsky, 2006). Previously, it was already well known how CVC investing was crucial for technology-related industries (Dushnitsky and Lenox, 2005a, 2005b; Zahra, 1996; Zahra and Covin, 1995; Keil, 2002, 2004; Schildt et al., 2005), while more recent works analyzed different portfolio strategies for the CVC investing (Baldi et al., 2015). Furthermore, CVC has been also analyzed from a real options perspective (Trigeorgis, 1996; Vassolo et al., 2004) as a generator of growth options and innovation opportunities (Srivastava and Gnyawali, 2011; Faems et al. 2010; Ozcan and Eisenhardt, 2009), and as a performance driver (Mouri et al., 2012; Park and Steensma, 2013). Tong and Li (2011) suggested instead that to a higher degree of exploration of new opportunities correspond both a higher level of uncertainty of the investments, but also a greater valuation capability. On the same wave, Maula et al. (2003) showed that the activity of investing in early-stage biotech boosts the recognition ability of the CVC regarding interesting and unexploited investment opportunities.

However, to our knowledge, even though an extensive literature exists about the CVCs both in general and with a specific focus on the biotech and pharmaceuticals sectors, it seems that no one so far has tried to identify the perfect target profile for CVCs to invest in. The underlying assumption that drives the work is that CVC funds look for some common traits in potential target investment firms, and the intent of this work is therefore to extrapolate from the data the information more relevant to an investor.

The rest of the article is structured as follows: next section will deal with the data and methodology used, while Section 3 will discuss the empirical findings. The last section will indeed conclude and sum up the study, providing insights of the risk profile and target preference for CVC in the healthcare industry.

II. DATA AND METHODOLOGY

In order to understand which characteristics are more relevant to CVC funds, a dataset has been built in two phases using Medtrack as primary source of information: first of all, data on all the CVC deals have been gathered, similarly to Baldi et al. (2015). There has been eliminated all the deals with undisclosed investors, and selected only the ones operated by the major CVC funds. The choice of those top 30 funds (plus some other well-know selected CVC) provided by Global Corporate Venturing (2010) is provided in the following table:

Rank	CVC name
1	Novartis
2	Johnson & Johnson
3	Wellcome Trust
4	Novo
5	GlaxoSmithKline
6	F. Hoffmann-La Roche
7	Pfizer
9	Eli Lilly
11	Dow Chemical
12	Mitsubishi Tanabe Pharma + Mitsubishi Chemical
13	Takeda Pharmaceutical
14	AstraZeneca
16	Boehringer Ingelheim
18	Amgen
20	Biogen Idec
22	Astellas Pharma
23	Siemens
24	Clarian Health
25	Kaiser Permanente
27	Cleveland Clinic
29	Sanofi-Aventis
30	Daiichi Sankyo
37	Novo Nordisk
38	Merck KGaA
54	Bristol-Myers Squibb
60	Abbott Medical Optics

Table 1. List of top CVC funds in the dataset (Global Corporate Venturing, June 2010), selected according to Baldi et al. (2015).

The deals have been then skimmed taking into consideration only the ones in the decade from 2003 to 2013, so that from an initial amount of more than 5,000 deals announced and/or completed, it was possible to achieve a consistent number of 260 meaningful investments to be used for our analysis.

The second part of the dataset creation pertains to firms in the same period that did not receive any venture funding. Deals concerning the largest pharmaceuticals companies have been taken out, to eventually have a dataset made by 126 companies. This ranking was based on the publicly released classification of currentpartnering.com, (2013), and pharmaboardroom.com (2012), and following the list already proposed in Baldi et al. (2015).

The database so built gives us a lot of different preliminary information. The Figure 1 shows the degree of intensity of the CVC activity for the period 2003-2013, exhibiting at the same time the number of CVC deals completed, as well as the average amount of capital invested with respect to the round of financing the firm was facing.

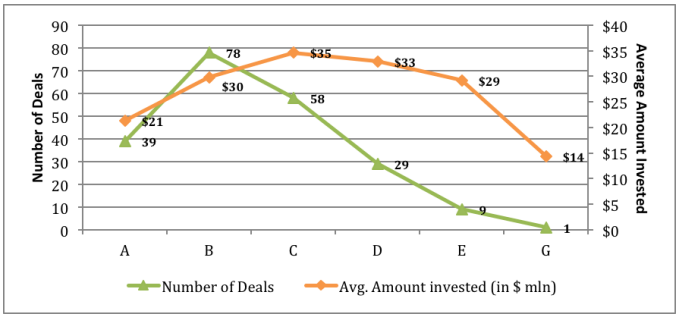

Figure 1. Relationship between the amount of capital invested and the number of deals per investment stage (number of rounds of financing). For 46 deals it was not possible to identify the round of financing associated, so they have been excluded from the figure. Anyway, the average amount for those deals was slightly more than $23 million.

According to Gompers and Lerners (1999) and Baldi et al. (2015), CVCs invest mainly in two-three subsequent rounds (i.e., A, B, C), and since round B is the mode of the distribution, it can be assumed that a CVC tends to follow-up with additional capital at least once more. Moreover, it seems that to lower rounds are associated lower amount of invested capital, while for later rounds the investment proportionally increases, with a peak in the round C.

Figure 2 shows instead the number of molecules funded by CVC. It may look like counterintuitive how the number of early stage molecules (Pre-Clinic and Phase I) is much lower than advanced molecules (from Phase II onwards), although this prove that CVC's risk preferences are changing toward safer opportunities, as already explained in Lo and Naraharisetti (2013).

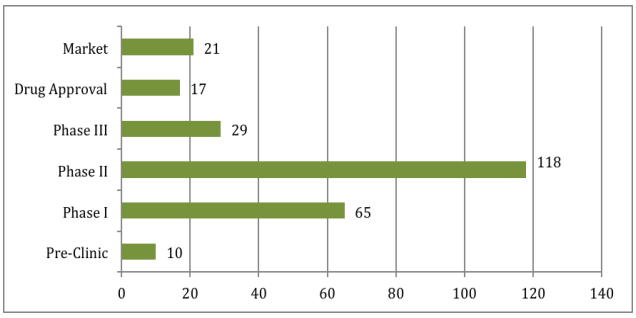

Figure 2. Molecules per R&D stage financed.

Once gathered the data, some relevant variables have been created for the sake of the analysis. It has been decided to consider the following variables: i) the country where the firm is incorporated, and it may have only value 0, 1 or 2, respectively for companies based in European-Middle East, American or Asian area; ii) whether the firm was a startup or not. If a firm has been established less than four years from the deal, it is classified as startup according to Maurer and Ebers (2006) and Oliver (2001), and the variable assumes a value of 1. The insight behind is that corporate venture capital should look for companies in their early stage, but in practice they do not; iii) the age, meaning the years of activity from the incorporation date, used as a countercheck for the Startup variable. Data about companies' incorporation, where missing, have been filled through company websites (~25), Crunchbase (~150), and Bioscentury (~85); iv) IPO, i.e., whether the company was listed - the dummy assumed value 1 if so, 0 otherwise. This variable has been built extracting the information from Datastream (~162) and Bioscan (~98); v) risk class, which is a variable built considering the portfolio of products of the target company. Indeed, the phases of the molecules involved in the financing deal have been extracted and classified into six groups: molecules in a Pre-clinic phase, molecules in Phase I, II or III, molecules waiting for US Food & Drug Administration (FDA) approval, and eventually molecules ready to be launched on the market (as in Baldi et al., 2015). It has decided to attribute to each molecule a value inversely related to the risk of financing it, from 1 to 6. For example, since a product ready to be launched is less risky, it will then get assigned a value of 1. On the other hand, a molecule in a Pre-clinic stage is supposed to be highly risky, and thus it gets a value of 6; vi) exploration (Deeds and Hill, 1996; Rothaermel and Deeds, 2004), which is a counting variable of the portfolio products at the time of deal. So, it only counts the amount of products in Pre-clinic stage (or at a lower stage, when available or differently indicated in the official released report); vii) exploitation, i.e., exploration complementary variable, which counts all the products of the portfolio of the company in Phase I or higher; viii) whether the company pursues vertical or horizontal strategic partnerships (Pisano, 1989; Oliver, 2001). In other words, this is a ratio and it has been built as the amount of agreements standing with other biotechnological companies over the sum of agreements standing with both biotech and pharmaceutical firms. If the ratio obtained is a value between 0 and 0.5, it means that the company was more vertical oriented and developed more agreements with pharmaceuticals. For value of the ratio of 0.5, it would mean that the company is perfectly balanced between vertical and horizontal strategy and has the same number of deals standing both with other biotech and pharmaceutical firms. For a ratio higher than 0.5 and less or equal than 1, the firm is more biotech oriented, and it has more deals with other biotech companies. The deals standing with universities or other institutions have been neglected because they represent a very small portion of the entire dataset.

As dependent variable for the analysis a simple binary variable has been chosen, i.e., whether the company received or not any corporate venture capital:

$$\mathbb{1}(CVC) = \beta_1 Country + \beta_2 Risk\ Class + \beta_3 IPO + \beta_4 Exploration + \beta_5 Exploitation + \beta_6 Strategy + \beta_7 Age + \beta_8 Startup \quad (1)$$

In order to test the hypothesis and identify the main characteristics that a corporate venture capital fund would wish to find in a target company, it has been decided to run a probit regression, according to previous study (Pisano, 1989; Gerasymenko and Arthurs, 2014). This would allow to understand, with respect of companies that did not receive any form of venture funding, if some particular aspect has been taken into account into the investment decision-process of the venture capital, as well as the weight of different features in the due diligence process. Furthermore, since several variables were considered, it has been preferred to implement a variable selection model that would indicate which variable has to be included in the regression and which one it should not. It has been decided to use a stepwise regression model, and more in particular a backward stepwise model. This case assumes to estimate the full model on all the explanatory variables and, if the least-significant term is statistically insignificant, it removes that variable and reestimates the model (otherwise it stops). The process is then reiterated. Furthermore, if the most significant excluded term is statistically significant, it adds that variable and reestimates the model (otherwise it stops). The process is thus alternatively choosing the least significant

variable to drop and then reconsidering all the variables dropped to be reintroduced in the model. This allows to retain only what it matters to our model. It has been picked a significance level of 0.1 for a variable to be removed and 0.05 to be added back to the model, as commonly assumed in theory.

III. Empirical Findings

The stepwise regression has been useful in identifying the relevant traits that CVCs look for in a target company. In particular, as shown in Table 2, five variables turned out to be important for a CVC.

	Strategy	Risk Class	Age	IPO	Exploitation
CVC	1.631***	0.324***	-0.0922***	0.658*	-0.163**
	(4.17)	(3.93)	(-4.33)	(2.02)	(-3.05)

Table 2. Results from the stepwise regression. T-statistics in parentheses, * p<0.1, ** p<0.01, *** p<0.001.

The CVCs invest regardless the country where the companies are from, and being a startup or a firm with only very early-stage molecules do not matter for an investment purpose. Instead, it seems that there is a negative relation between the target age and the chance to get a CVC funding. Indeed, it is probably true that the older the target, the less profitable is the opportunity in terms of risk-return tradeoff. However, the variable with the highest magnitude - and so probably the most relevant one - is the strategic one: CVCs look for companies that are able to establish strong business relationships and integrations with other biotech firms, because the network favorites spillovers and unexpected discoveries, and it is source of competitive advantage in the sector. Therefore, even though the relations with other pharmaceuticals are important as well, more alliances a biotech firm has with other biotech firms, more profitable it may be the opportunity for a venture fund. On the other hand, having too many relations with other pharmaceuticals company may not be a good strategy for the target company itself, and it is not for sure a good signal for the CVC. The venture capital is indeed usually owned by a pharmaceutical, so it is natural to think they are investing in biotech companies that have no other agreements standing with their direct competitors. Furthermore, the risk class of the molecule the deal is about is also relevant, and venture capital funds still prefer riskier deals to safer ones, even though not as much as they should in theory - the magnitude of this coefficient is indeed quite low.

The IPO variable has instead a positive sign and a good magnitude. A fund may theoretically prefer to have an extra exit-strategy as an IPO, but it has also to be remembered that CVCs invest to internalize rather than capitalize. However, funds prefer to invest in safer firms that are already listed instead of non-listed ones. The biotech sector is characterized by a very high competition and a high rate of failure. Therefore, it may be not so simple to capitalize an investment and close the position positively. If everything bursts and things go really wrong, as it usually happens in the bad scenario in which the molecule does not work, it is thus impossible to exploit the IPO exit strategy. As it has been claimed above, the CVCs are shifting their risk profile. They would prefer to have more information ex-ante and during the following rounds of financing instead of having an additional exit option. Engaging with companies already listed, they are actually able to reduce both the adverse selection and the moral hazard related to the deal, as well as lowering the cost of ex-post monitoring since it is assigned to shareholders and public and private stakeholders by definition.

The exploitation variable seems to be negatively correlated with the dependent variable. Indeed, having a lot of products already in their final stages may not represent a relevant investment opportunity for the funds, because all the additional gain coming from new discoveries has probably already been exploited. In other words, their risk is not compensated by the expected return to be interested to invest in that company.

In conclusion, the optimal company profile for a CVC is to invest in listed firms that are developing moderated risky molecule and that are horizontally integrated as much as possible. Younger companies with a variegated portfolio of early stage molecules are still preferred because of the risk-return tradeoff, but it is possible to conclude that the risk preferences for the corporate venture capital funds have been changed over the last years. Indeed, they try to find well-proportionated investment opportunities, balancing the return side of the equation (young companies with risky products) with the risk side (firms horizontally integrated and listed).

IV. Conclusion

The CVC world is drastically changing year by year, and biotech sector challenges increase the degree of complexity the CVCs have to face. Identifying the right opportunity where to invest in is a cumbersome process, but many CVCs in practice look for some common traits within the potential target companies. If many years ago CVCs were more prone to invest their capital in highly risky investments, it seems that nowadays they prefer to allocate their funds in less risky opportunities, and our unique dataset of almost 400 deals spanning from 2003 to 2013 support this hypothesis. Hence,

younger and listed companies, with moderately risky molecules in early stage development phase, positioned within a strong network of alliances with their comparators, are the most likely choice to support CVCs' growth. The list of the preferred characteristics is although neither exhaustive nor complete and further studies could explore different indicators or variations of indicators.

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